Building health throughout the

life course

Concepts, Implications, and Application in Public Health

PAHO
Pan American Health Organization
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Fostering human development in a shifting public health landscape requires a renewed public health model; one that states that our actions, or inactions, at any point in our life, determine our health trajectory, even affecting future generations. A life course approach to universal health must not only address disease, but build upon good health to reach the highest attainable human capital.

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Preface

The 2030 Agenda for Sustainable Development calls for the mobilization of efforts to end poverty. Prioritizing health is an essential step in these efforts. Goal 3 of the sustainable development goals (SDGs) entails "ensuring healthy lives and promoting well-being at all ages".[1] The concept of the life course is one of the pillars of this strategic vision of sustainable human development. Understanding the life course and its application in practice are essential to integrating health and wellbeing into the concept of development.

The World Health Organization (WHO) has therefore dedicated one of its strategic objectives to "building health throughout the life course".[2] Emphasis on this new vision of health responds to and is supported by an accumulation of evidence and scientific knowledge. In realizing these objectives, the WHO's Regional Office for the Americas, the Pan American Health Organization (PAHO), considers it essential to strengthen the understanding and conceptualization of the life course vision to bring this concept closer to public health practice and management.

In leading these efforts, PAHO and WHO have engaged in a gradual process of incorporating the life course approach (LCA) into both their conceptual models and technical cooperation strategies. The LCA was first formally adopted by WHO in 1995 with the launching of the Aging and Health Program, which drew upon the cumulative effects of health across the life course on healthy aging outcomes and the ability of older people to maintain functional ability. The Department of Aging and Life Course at the WHO and the Family, Health Promotion and Life Course Department at PAHO were later created to more fully promote the LCA across the organizations. The LCA has since been incorporated into multiple strategies and recommendations, including the *WHO Global Status Report on Non-communicable Diseases*[3], the *World Report on Ageing and Health*[4], and the *Global Strategy for Women's, Children's and Adolescents' Health (2016-2030)*[5].

This edition of *Building Health Throughout the Life Course* is addressed to all public health practitioners, health professionals, and policy-makers. The manuscript includes specialized topics and practical examples to foster the integration of the life course perspective into public health practice. It invites readers to see health through the life course lens and apply such concepts to public health strategies in the 21st century.

1 United Nations. Sustainable Development Goals Goal 3: Good Health and Well Being [Internet]. United Nations: New York, 2015 [cited 2019 April 1]. Available from: https://www.un.org/sustainabledevelopment/health/

2 World Health Organization. Promoting health through the life course [Internet]. 2017. Available from: http://www.who.int/life-course/en/

3 World Health Organization. Global status report on noncommunicable diseases. Geneva: WHO; 2014; Available from https://www.who.int/nmh/publications/ncd-status-report-2014/en/

4 World Health Organization. World report on ageing and health. Geneva: WHO; 2015.

5 United Nations. The global strategy for women's, children's and adolescents' health (2016–2030): Every woman Every child. Geneva: United Nations; 2015. Available from: https://www.everywomaneverychild.org/global-strategy/

The current demographic, social, and epidemiological transitions; rapid increase of life expectancy, recognition of social determinants of health, and the need to overcome the concept of health based only on the absence of disease, have served to create an intricate set of health and social scenarios. These scenarios have exposed different health and social needs for individuals and societies and encouraged the development of innovative interventions to meet new demands. All these elements are revealing the need for a more comprehensive vision for public health approaches.

In recent decades, society, the economy and technology have evolved at a faster pace than the life course of individuals and populations across the globe. A person who was born at the beginning of the 20th century, witnessed more changes than any other person in previous generations. Some of them were born without access to vaccines or antibiotics; others are experiencing the double impact of malnutrition (undernutrition along with overweight and obesity); it is also the first time that five generations are coexisting during the same period. Generations that faced illiteracy in their childhood have been forced to adapt to the current influence of global connectivity and to live with other generations that were born and raised in a more advanced and interconnected environment.

Building Health Throughout the Life Course is based on three solid concepts that serve to guide the manuscript and to initiate discussion on the topic of the life course approach in public health.

The first concept is what the authors have called **the longevity revolution** – this concept is based on the statement that longevity increased faster in the 20th century compared to any other time in human life; during this period life expectancy at birth increased by nearly 30 years. Despite the important events during the first centuries of human development, longevity increase was very limited. Life expectancy increased from 23 years during the Roman Empire, to 44 years at the beginning of the 20th century. During the second half of the 20th century, Latin America and the Caribbean (LAC) experienced an increase of more than twenty years in life expectancy. Today 74 percent of people born in LAC can expect to live more than 60 years; and nearly 34 percent, more than 80 years. The decline in mortality and birth rates, as well as social, economic, political, and scientific changes explain the accelerated demographic and epidemiological transitions the region is facing today.

The second concept is the **chronicity effect** – which relates to the increase in the proportion of years lived with a disease or disability; or the expansion of morbidity. The life course approach encourages readers to think beyond the traditional chronicity idea and consider chronicity as the result of epidemiological transitions. Today it is clear that many of the years gained include years lived with illness and / or in disability.

Chronicity is not only the result of the increased rates of non-communicable diseases (NCDs), it is also the result of successful public health interventions and progress in health service access and better health technologies that make possible an early diagnosis, management and adequate control of risk factors and disease, Infectious diseases such as tuberculosis, hepatitis and HIV / AIDS have evolved to a chronicity phase because even though they do not have a cure, the survival rate has improved significantly with the new available treatments. This survival increase implies new challenges for people, societies, and for health systems and services, for which we have not been prepared.

The third concept is **health for development** – this is not a new concept, but it is one that is still under discussion and in constant evolution. Fostering a more effective inclusion of health in the global sustainable development agenda as an essential resource on and for development is a task still in progress. It demands a vision that goes beyond survival as the central goal and entails health to transcend the simplistic conception of fighting disease. Among individuals and populations, a healthy life trajectory is reflected through the notions of capacity, resilience, and functional ability; all of which are an integral part to the life course approach to health. Disease prevention is important, but it is not enough. Health interventions must be largely oriented to support individuals and populations in the development of all their physical and mental capacities.

The LCA for development is of profound importance and provides the bases of how health care can be structured, financed, and delivered while placing the person at the center of its actions, and taking into account the new and complex scenarios the Region of the Americas is facing. It provides key guiding principles that are interrelated and integrated into the life course approach. Throughout the document, the reader will have the opportunity to comprehend the life course concept and to be able to translate it into the practice of public health and policy. This argument allows the reader to look ahead with a different perspective on the significance of public health practice today.

Moving forward the commitment to the field of public health will require the understanding of health through the life course lens. Using an LCA to health allows us to see and understand new individual and population needs, new challenges ahead, as well as provide more effective interventions and strategies concerning changes in society. It will require an updated know-how on practicing public health, putting into action a life course perspective that displays a new way of thinking about health, which is holistic and far from the traditional and simplistic concept of absence of disease.

Building Health Throughout the Life Course – Concepts provides a newfound understanding of the life course meaning and concepts that is essential to understanding how health develops and changes throughout the life course. Part 1 aims to translate the technical language of the life course literature to a platform used by protagonists of change in the organization of health systems. Eventual impact of the LCA depends not only on the reliability of the scientific knowledge that sustains it, but on whether it is possible to insert the LCA into governance processes involved in the development and implementation of public health practice.

Global and regional strategies and recommendations based on the life course must be translated into local action to achieve the desired outcome of improved health and wellbeing for all. Recognizing the uniqueness of each country and community, this document serves as a tool to operationalize theory according to local contexts. This requires an unpacking of the life course theory and understanding of its implications on public health practice.

Building Health Throughout the Life Course – Implications describes those inferences for public health practice, including implications for epidemiology, policy and investment, health equity, health systems, and monitoring and evaluation.

Lastly, **Building Health Throughout the Life Course – Application** describes how the life course model allows us to address health disparities by generating mechanisms to improve health and well-being through the promotion and generation of skills throughout the life course. The world has committed to using people-centered, multisectoral approaches to achieving health for all through the sustainable development goals (SDGs). A life course approach provides high-impact, evidence- and rights-based strategies to do so using a perspective that understands health in today's context and prioritizes the health of those that were once left behind.

Public health and health professionals observe and make decisions about individuals, who are situated at different times in their life course and in which health will determine their life trajectories. These decisions do not only imply an action and / or a temporary reaction, but they can determine an important modulation of their lives. For centuries we have been taught, and we have learned the importance of the trajectories and the course of diseases but we have not walked the same path to learn about the trajectories and the life course of individuals and populations. We hope this document provides another perspective on public health.

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PART 1

Concepts

I

The Meaning of Life Course

The "life course" offers a unique and in-depth perspective on the trajectories of life, taking into account the changes of individuals and populations in relation to their changing environments, and evaluating their implications for development.

Alwin DF. Life course, life cycle, life history, life span and life stage. In: Runehov ALC, Oviedo L, editors. Encyclopedia of sciences and religions. Dordrecht: Springer; 2013.

The life course is a multidisciplinary model that allows for the dynamic study of the life of people and populations within their structural and social contexts. Its focus is on the connection between individual lives and the historical and socioeconomic context in which they are developed that impact health. Giele and Elder [1] define life course as "a sequence of events and roles that an individual performs over time" and highlight the importance of time, context, process, and meaning in human development.

The life course definition has evolved over time, and the work of many has contributed to the definition proposed by Giele and Elder. During the 1950s, the concept of life course depended on the rationalization of experiences in structural, cultural, and social contexts, yet this concept did not yet include the notion of time. In the 1990s, the continuity and change of human lives in relation to these contexts were explored, and life trajectories across multiple stages of life were examined[2]. For example, in 1993 Bengston and Allen [3] suggested the notion of family within a context of social macro dynamics or as they defined it, "a group of individuals who share a story

where they interact in social contexts in constant change over time and in a continually longer period". With a wide range of application to various sciences, standardizing the meaning of life course has proven challenging.

Alwin's research across disciplines reveals the different uses of the term "life course" to relate to

A: time or age;

B: life stages;

C: life events, transitions, and trajectories;

D: life span;

E: life influences on later adult outcomes [1].

These terms are used interchangeably or as synonyms, making their understanding difficult. Alwin therefore proposes the integration of concepts to create a more comprehensive yet clear life course definition. He defines the life course as an "integrated perspective for studying the causes and consequences of life course events and transitions and understanding the manner by which life events and the role transitions they signify influence the life-span development of outcomes of interest across stages of the life cycle" [4].

Life course vs. life cycle

While the life course definition is far-reaching, it is important to distinguish life course from life cycle. Used specifically in biology, the term "life cycle" refers to the continuous sequence of changes undergone by organisms in their development over time, with reproduction as a key feature. The concept of life cycle has also been used in sociology and economics, where it refers to a series of stages that are socially constructed and characterize the course of an individual's existence or a social or economic structure.

The "life course," on the other hand, does not contradict the cycle or stages of life, but rather enriches the concept. It offers a unique and in-depth perspective on the trajectories of life, taking into account the changes of individuals and populations in relation to their changing environments, and evaluating their implications for development [5]. The life cycle has a more limited definition focusing on specific changes. Given its direct relation to development over time, the term life course is more appropriate for use in public health.

II

Vision of the Life Course in Contemporary Public Health

The 21st century has been characterized by complex scenarios that generated new needs and opportunities in public health.

For years, the life course concept has been studied in biology, psychology, demography, and social sciences, and more recently in the health sciences [9]. Still evolving, the concept is applicable not only to the life of an individual but also to the life trajectories of populations, and regards human development as a dynamic process that begins before conception and continues throughout life [7-9].

The 21st century has been characterized by complex scenarios that generated new needs and opportunities in public health. Alongside a rapid increase in life expectancy and the demographic, social, and epidemiological transitions, the value of public health was further recognized, and public health efforts evolved from being disease-centered to including the social determinants of health. This evolution of public health necessitated a renovation of health programs and policies with an integrated life course vision [10]. In public health, the life course concept has been applied to identify and interpret trends in the health outcomes of the population, but its use has been irregular, and its application has been limited due to the lack of consensus on the terms and concepts. The increasing generation of data and evidence, including longitudinal research, and a better articulation of theoretical and methodological proposals, is reinforcing the scientific basis that allows for the integration of this essential approach into public health today [10, 11]. The knowledge gained from these advances allows us to not only retrospectively analyze what happened, but to also influence the health trajectories of people and populations using a prospective approach.

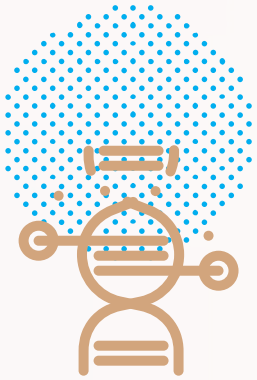
Some researchers, such as Halfon and colleagues [12], propose that this life course perspective could signify the beginning of a “third era of health”

in which the sciences that explain the development and origins of health, including disease patterns, reveal how environmental exposures and social experiences, especially during sensitive periods in life, are integrated into biological and behavioral systems. This still-evolving theory is based on biopsychosocial and genomic models according to which health is considered its own process of complex systems [12]. Furthermore, under the life course vision, health is understood through an expanded meaning of causality that refines the interpretation of determinants of health and risk factors, deepening their interrelation and reciprocal influence. To better understand health, the life course approach explores its origin, transmission, long-term effects, and mechanisms of perpetuation [13].

The life course approach therefore offers an improved interpretation of the dynamic health needs of people and populations and a model of care consistent with the vision of universal health. It provides a better understanding of the process of health generation, and of the ways to materialize this process through more efficient and sustainable social and health interventions and policies. Furthermore, the life course approach provides a solid rationale to invest in individual and population health by generating capacities in people, families, communities, and health systems.

III

Evolution of the Concept of the Life Course in Health



From the epidemiological point of view the life course perspective was proposed to study the physical and social risks present during the different stages of life (gestation, childhood, adolescence, young adulthood, and mature age) that contribute to the contraction of chronic disease and modulate the trajectories that lead to health outcomes in the later stages of life.

Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epidemiol. 2002;31(2):285–93.

Various theoretical and methodological platforms have explained how health is conceived as a dynamic entity, with historical events and economic, demographic, social, and cultural changes influencing it [13]. For example, the Industrial Revolution was characterized by profound changes in the organization of social and economic structures, which had a great impact on the lives of people and populations. In 1845, Engels examined how socioeconomic position across place and time affected health, giving new insights into the etiology of disease and mortality [14].

While the model of health continued to be dependent on illness for quite some time, the first research seeking to elucidate the biological, behavioral, and psychosocial processes that operate throughout the life of an individual or throughout generations was conducted in the 20th century [15, 16]. This new perspective gave birth to the search for an early causal role (from the prenatal stage) of some factors related to chronic disease, and development of the "theory of the fetal origin of chronic disease in adults". The appearance of cohort studies showed the persistence of classic risk factors from childhood to adulthood [17, 18], and indications of intergenerational transmission of risk further supported the idea that risk for chronic conditions can be tied to the prenatal stage [19-21].

Epidemiological evidence also related environmental factors in early stages of life with alterations of the individual genome and with patterns of health and disease. These adaptive reactions to exposures in sensitive periods of growth generated persistent structural and functional changes in organisms in response to stress and other environmental pressures [22, 23]. Many clinical studies also suggest the association between environmental influences in utero or during the initial stages of postnatal life, and the appearance of chronic diseases throughout the life course.

These findings open the door to a new understanding of causality and suggest that many diseases could have their origin in structural or metabolic adjustments or adaptations that are established very early in life [24]. This "theory of the fetal origins of disease in adults" tried to explain how adverse influences during intrauterine growth induce adaptive changes, both functional and structural, that make individuals more apt to resist said influences, but that persist in time and also make them more vulnerable to other subsequent conditions that generate risk [25, 26].

In the 1960s, Neel published his "thrifty gene" hypothesis that found susceptibility to insulin resistance in populations that historically evolved to be efficient at food storage and utilization. While humans developed genetically through natural selection to survive cycles of feast and famine, the transition to an overabundance of food and limited physical activity created a situation where previously advantageous "thrifty genes" increase susceptibility to obesity and diabetes [27]. Building off the work of Neel, Ravelli and colleagues later demonstrated how critical periods existed in which deprivation would have greater repercussions. This study showed that in a population of approximately 300,000 male adults whose mothers had been exposed to a period of severe food shortages during the German blockade of Holland at the end of World War II, the incidence of obesity was lower among those exposed to food shortages during the last trimester as opposed to the first six months of pregnancy [28].

Despite strong arguments supporting the theory of fetal origins and the thrifty gene hypothesis, objections to both were raised. The major objections to the theory of fetal origins have been of a methodological nature, due to the existence of potential confounders, such as social determinants, that persist over time and can be simultaneous cause of the deprivations that give rise to insufficient growth, and of the risk factors of diseases in later stages of life. Furthermore, the thrifty gene hypothesis has since been repudiated seeing that these purely genetic and evolutionary considerations could not have such biological consequences [13].

Given these drawbacks to such approaches, at the end of the 20th century, the more pragmatic model of "lifestyles and chronic disease" was studied. This model focused almost exclusively on the risk factors of adulthood and was based on the success of cohort studies that confirmed, for example, that smoking and high cholesterol levels are high risk factors for several chronic diseases [29].

But it did not take long for the epidemiological focus of the life course to reemerge in the debate on the origin of chronic diseases. Several cohort studies of children contributed to this, in which it was observed that the risk of many noncommunicable diseases, such as cardiovascular disease or diabetes, was not only linked to the risk factors in middle age adults, but it also started in adolescence, childhood, or even fetal development. There is a growing consensus that chronic diseases are due, at least in part, to the cumulative effect of adverse experiences in the early stages of life [30].

Giele and Elder [1] have since defined the concept of life course as a succession of socially defined events and roles through which a person transitions through time. From the epidemiological point of view, the life course perspective was proposed to study the physical and social risks present during the different stages of life (gestation, childhood, adolescence, young adulthood and mature age) that contribute to the contraction of chronic disease and modulate the trajectories that lead to health outcomes in the later stages of life [10]. This new logic constructs the biomedical and biopsychosocial models of causality, highlighting social epidemiology, with attention to the social and behavioral determinants of health.

A new paradigm of the life course, known as "developmental origins of health and disease," transcends the dichotomy between the traditional "adult lifestyle" and "early origins" models of chronic disease, both of which insufficiently explain individual risk, variations in temporary disease patterns, and the broad concept of building health in the life course [31].

The “developmental origins of health and disease” hypothesis has its underpinnings in the theory of fetal origins, and represents advanced conceptual progress in two essential aspects.

First,
the life experiences that determine the subsequent risk of diseases are not limited to the prenatal period, but include the entire period from birth to early childhood when changes in neural development are greatest.

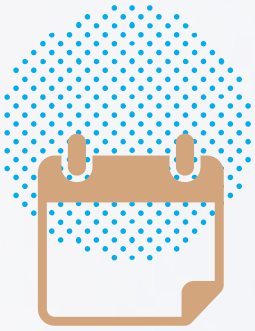
Second,
the new model emphasizes not only the implications with respect to diseases and their prevention, but also a new vision of health promotion which is of vital importance for public health [32, 33].

In recent years, Halfon and colleagues [10, 34, 35] examined and synthesized a large number of different investigations focused on the life course. They suggested that aside from understanding the mechanisms related to the “developmental origins of health and disease,” the life course approach is of profound importance in considering how health should be organized, financed, and delivered. Furthermore, Halfon and colleagues pointed out that some general principles were emerging that begin to outline a new model or framework that has been named the “life course health development” (LCHD) model. According to the model, health and development are unified in a single construct that is deployed in an adaptive way throughout life. The model examines risk factors, protective factors, and early life experiences from a developmental perspective that includes the importance of early relationships, addresses the unique aspects of different life stages, and incorporates emerging ideas from biological systems theory [10]. The development of health provides instrumental assets that allow individuals and populations to pursue the desired lived experiences [35]. The LCHD model reflects the new scientific trends that are transforming health research, health system design, and long-term investment in health development.

Recognizing that complex, multilevel, and interactive systems affect health development, the LCHD model calls for the participation of a network of highly collaborative multidisciplinary teams to further understand the relationship between biological, developmental, social, and contextual influences of health. All of these changes in the scientific approach are helping to better understand how the world today is organized, how it works, and how it contributes to the health of people and populations [34, 35].

IV

Biological, Psychosocial, and Epidemiological Bases that Support the Life Course



A better understanding of the interaction between biopsychosocial factors and epigenetic mechanisms has allowed the concept of life course to become more relevant in recent decades

Elder GH, Giele J, eds. The craft of life course research. New York: Guilford Press; 2009.

The bio-demographic models that seek to explain the classic patterns of mortality have included the heterogeneity of biological, social, and environmental variables, but they have not sufficiently described the recent transition to human longevity [36]. The increase in the maximum age at death and the exponential growth of centenarians and super-centenarians suggest that longevity will continue to increase [37].

In recent years, the scientific community has developed an improved understanding of different molecular pathways that contribute to aging. The wear caused by the stretching of DNA strands that protect chromosomes from deterioration, known as telomeres, is considered to be a major cause of aging. When telomere wear occurs, the ability of cells to divide is reduced, and risk for malfunction, suggested to be the origin of different disease stages, increases [38]. In a study conducted in the United States, several genetic factors relating to telomere length were observed.

Firstly, it was observed that the telomere length of female participants, also linked to life expectancy, was related to the length of the telomeres of their parents, particularly that of the father. Secondly, the age at which men and women become parents influences the average length of the telomeres of their children: the greater the age of the parents, the greater the telomere length of the children [39]. These findings suggest that people are also born with genetic predispositions that influence health and longevity [40].

However, current research recognizes that genetics represents only:

30%
of the total influence on health

70%
depends on the impact of positive and negative factors during the life trajectory of individuals [41].

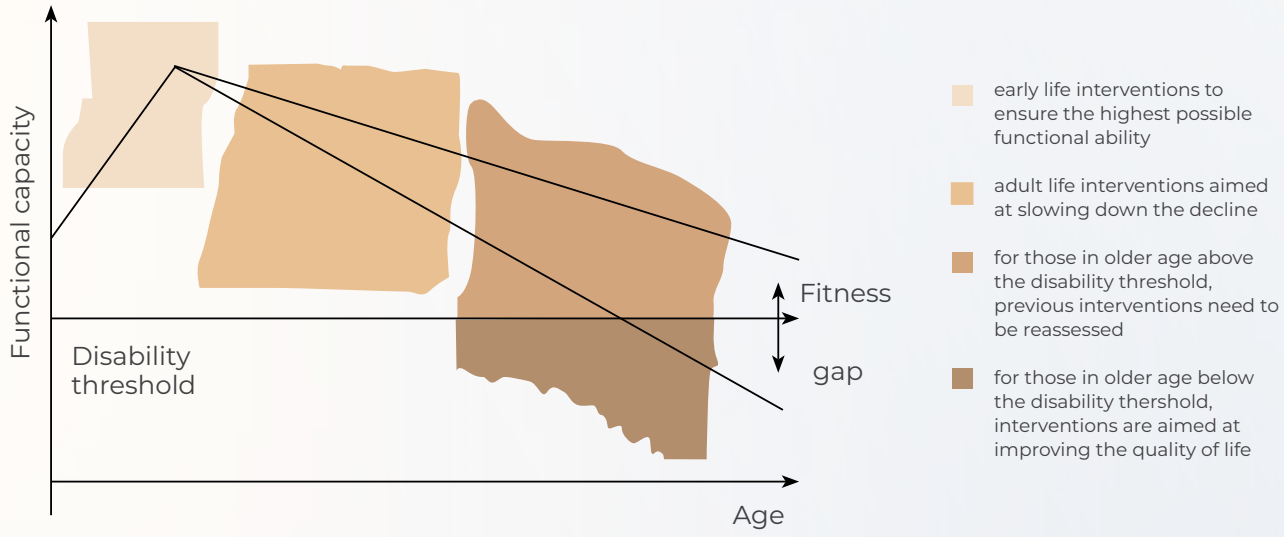
A better understanding of the interaction between biopsychosocial factors and epigenetic mechanisms has allowed the concept of life course to become more relevant in recent decades [42]. Advances in epigenetics explain how gene expression can be modified in response to environmental signals and how it can be perpetuated over several generations [43]. Research from Ellis and colleagues [44] shows how individuals have varying levels of susceptibility to environmental influence, creating a variation across individuals in sensitivity to both risk-promoting and development-enhancing environmental conditions. Accumulating evidence is demonstrating that this modification of genes sparked by environmental signals does not only occur in the early stages of life, but during other moments of the life course. This newfound understanding of gene modification throughout the life course has implications for the exercise of public health [45].

Perhaps one of the most important recent contributions to the life course perspective in public health has been the concept of intrinsic capacity, defined as the combination of all the physical and mental capacities a person has [46]. People are born with a "capital" of intrinsic capacity and during their growth and development they increase those capacities in a very close relationship with the social environment in which they operate [47]. While intrinsic capacity can be created throughout all of life, growth and development in the first part of the life course elevate the generation of this intrinsic capacity. As the life course advances and a person ages, there is an increase in the loss of this intrinsic capacity, thus decreasing an individual's ability to adapt to the environment where they develop [46]. Furthermore, intrinsic capacity, the environment, and the interaction between the two make up the functional ability of individuals, defined as the attributes related to health that allows a person to be and do what is important to them [46]. In early adulthood everyone has similar functional ability, but the subsequent rate of decline depends on lifestyle and environmental factors. As people age, the gap in functional ability across the population widens. As exemplified in **Figure 1**, people with lower peak functional ability reach the “disability threshold” at a younger age [48].

TABLE 1. DEFINING INTRINSIC CAPACITY AND OTHER ASSOCIATED CONSTRUCTS

Construct	Definition
Functional ability	Includes the attributes related to health that allow a person to be and do what is important to them. Functional ability is composed of the intrinsic capacity, the environment and the interaction between them [46].
Functional reserve	The remaining capacity of an individual's body to perform its physiological activity, which declines with age [49].
Intrinsic capacity	The combination of all the physical and mental capacities a person has [46, 47].
Environments	All of the factors of the exterior world that form the context of the life of a person [46].
Resilience	The capacity to maintain or regain well-being during or after adversity [50].
Allostatic load	The cost of chronic exposure to elevated or fluctuating levels of stress on the body [50].
Frailty	A progressive age-related decline in physiological systems that results in decreased reserves of intrinsic capacity, which confers extreme vulnerability to stressors and increases the risk of a range of adverse health outcomes [46]. Frailty can be attenuated or reversed with appropriate interventions [51].

FIGURE 1. A LIFE COURSE PERSPECTIVE TO MAINTAIN THE HIGHEST POSSIBLE LEVEL OF FUNCTIONAL ABILITY



Source: Kalache, Alexandre & Kickbusch, Ilona. (1997). A global strategy for healthy ageing. World Health, 50 (4), 4 - 5. World Health Organization. https://apps.who.int/iris/handle/10665/330616

Today, we know more about the trajectories of the intrinsic and capacities of individuals and populations during the life course. We understand the critical moments marked by gains and losses in capacity, and how these physical and mental capacities are not only defined by genetic inheritance, but also by development and aging that are affected by personal characteristics, health status, and social determinants.

A healthy life trajectory can be reflected through the notions of intrinsic capacity, resilience, and functional ability; all of which are integral to the life course concept [46]. These definitions are fluid concepts in which gains or losses can impact one's health. During the first stages of life, losses of intrinsic capacity are more related to catastrophic events, whereas in the later stages of life these losses are generally progressive and multidetermined [52, 53]. In the young, the alterations of the functional trajectories related to health are mostly affected by a single organ and in individuals with high functional reserve. Meanwhile in the elderly, the effect is usually multi-organic and with less basic functional reserve. If a life course risk model is used, one can see that most modifiable factors for prevention occur in the late and middle stages of life and not in the early stages [54].

Similarly, levels of functional ability can be determined by different combinations of intrinsic capacity and the environment. The relationship between intrinsic capacity and the environment can be a guide for the evaluation of life trajectories and the efficient design of interventions [52, 55]. For example, an elderly person with limited physical capacity can maintain the mobility they need if they use a support device and live near a means of public transport with access for people with disabilities. However, another elderly person with the same degree of limitations but who lives in unfavorable environments may find it much more difficult to maintain their functional ability.

The physiological response of an individual to the aggressions of the social environment is cumulative and is not reduced to a series of independent episodes of stress. The allostatic load refers to the cost of chronic exposure to elevated or fluctuating levels of stress on the body. As an adaptive reaction to environmental stressors, the body may undergo changes, such as fluctuations in hormone levels or initiation of inflammatory processes, that increase vulnerability to cardiovascular disease, type II diabetes, cancer, and other diseases and metabolic disorders [56-59].

As demonstrated by the interrelation of these various concepts of aging and health, the dynamic of health during the life course is not simple or linear, and the incidence of health problems in the life course is not static. As the years go by, the dynamic of health becomes even more complex as environmental factors compound genetic factors [46]. Over the years, important physiological changes occur and the risk of chronic health problems increases. No matter the contributing factors, the greatest burden of disease is related to the loss of mobility, hearing, vision, cognition related to age, and chronic noncommunicable diseases. The loss of intrinsic capacity is due to the interrelation of factors such as disease and the normal aging process. Disability is the net effect of the interrelation of intrinsic capacity and the environment [60].

V

Theoretical Models of Causality in the Life Course

A life course approach to health rests on three non-mutually exclusive basic causal models that describe the interactions of the physical and social environment with individual factors and their influence on health over the life course.

Aboderin I, Ben-Shlomo Y, Lynch J, Yajnik C, Kuh D, et al. Life course perspectives on coronary heart disease, stroke and diabetes: key issues and implications for policy and research. Geneva: World Health Organization

Kuh D, Ben-Shlomo Y, Hallqvist J, Power C. Life course epidemiology. J Epidemiol Comm Health 2003;57:778–83.

The theoretical models of causality in the life course include:

- **A:** **the critical period model,**
- **B:** **the social mobility model,**
- **C:** **the cumulative risk model.**

According to the critical period model, hardships in particularly sensitive periods of life (which include the prenatal stage and the initial periods of postnatal growth) provoke adaptive responses, both structural and functional, whose effects last and are felt in adulthood [61]. According to the social mobility model, change in social class between or within generations gives rise to differences in health and disease profiles [62]. Finally, the cumulative risk model postulates that diseases are the result of risks accumulated throughout life and particularly in its critical periods [63].

The causes of the risks can be independent, or they can have common determinants that are generated in the physical and social environment and can exert direct influences or influences mediated by other factors [13].

These life course models directly influence research development and methodology. Using a life course approach, researchers adopt dynamic, multidimensional models that better address the complex relations that contribute to health, disease, and adult well-being. Among its practical implications for the exercise of modern public health epidemiology, research driven by these models has created a better understanding of functional changes associated with disease, the impact of socioeconomic conditions on disease etiology, and the heterogeneity in responses of adults to treatment.

Understanding the background of diseases associated with aging during the life course is central to the development of optimal interventions with the greatest impact on population health [64, 65]. A life course vision does not exclude the causal effects of individual risk factors, but focuses on the long-term effects of physical and social exposure factors throughout the life course [66]. This vision guides research methodology in relation to the determinants of adult diseases and epidemiological trends among populations undergoing demographic transformation [65].

The three causal models explaining health in the life course suggest that the health of individuals and communities depends on the interaction of various protective or favorable factors and of risk throughout life. These factors are related to psychological, behavioral, biological, and environmental influences, as well as access to health services. One of the purposes of life course epidemiology is to examine the cumulative degree of damage to biological systems as the number, duration, or severity of exposures increase and determine when the body's systems become vulnerable and lose their repair capacity. In this way, the epidemiology of the life course shares with social epidemiology an interest in the risk factors that accumulate, since they are often related to the socioeconomic position of an individual or of the population.

These conceptual bases that constitute biological, psychosocial, and epidemiological paradigms of the life course form an interdisciplinary framework that provides an ecological understanding of individual lives based on time, context, social and environmental changes, and health and development trajectories.

VI

The Life Course Approach for Health

It is impossible to talk about health and development without considering a life course perspective.

The evolution to a definition of health that is more closely aligned with development becomes progressively more necessary. The definition of health presented by WHO European Region at the end of the 20th century is very clearly adapted to the language of development: "health is the measure of the capacity of an individual or a group to realize their aspirations and meet their needs, on the one hand, and to change and face the challenges of the environment. Health is conceived, therefore, as a resource of daily life and not as the goal of life; it is a positive concept that emphasizes personal and social resources, as well as physical abilities" [67].

It is impossible to talk about health and development without considering a life course perspective. A life course model for health integrates the notions of development patterns, biological and social factors, and their interrelations throughout the life of individuals and populations [9]. With an understanding that development has a role in health, and health in development, it is imperative that health science interventions evolve towards a different paradigm that applies a new epidemiological model of causality that interprets individual, family and community health as the result of biological, psychological, physical, social, and environmental influences that operate from conception to death and that have their greatest repercussions in critical periods of the life course. Interventions with a life course approach seek to create intergenerational change. Current generations, regardless of age, should have the opportunity to reach their health potential and experience a better life without compromising their future and the future of generations to come [68].

To favor its understanding and potential application in public health practice, this document defines the healthy life course approach as follows:

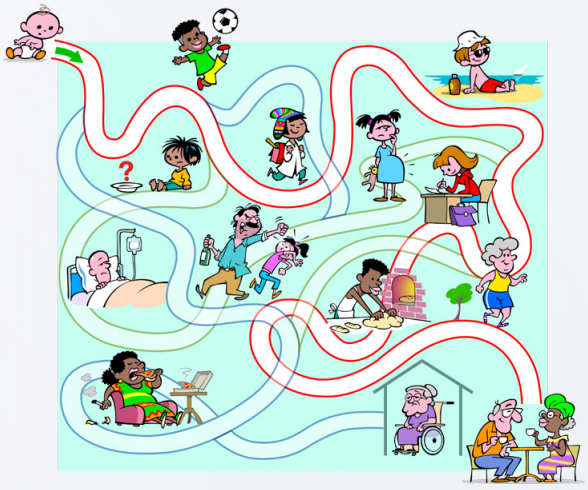
The dynamic relationship of previous exposures throughout life with the subsequent health results and the mechanisms by which positive or negative influences shape human trajectories and social development, impacting the health outcomes of the individual and the population

This concept implicitly covers the whole lifespan, recognizing that there are specific characteristics of each life stage and highlighting the value of each one in the construction of the other. Throughout these life stages, life events, continuous or cumulative, lead to adaptive changes. The conglomeration of these life stages and events constructs the life of a person, which transcends to other generations [69, 70]. The timing and sequence of these experiences influence the health and development of individuals and populations. In turn, development, in addition to health, can be enhanced, diminished, interrupted, or recovered throughout the life course [10] **(Figure 2)**.

In this context, health is conceived as an important dimension in human development. With a life course approach, the ability to analyze the influence between living conditions and health outcomes over time, the relationship of determinants andrisk factors in the evolution of individual and collective life, and how these can enhance their effect in moments of vulnerability of people and populations expands. With this approach, the fight against disease and early mortality is much more effective. More importantly, with the life course approach, public health will evolve to guarantee the achievement of health and well-being for all, in all ages, in an effective and sustainable way [71].

Although the life course approach to health is still an evolving topic and theoretical debate [72], basic principles that define the conceptual framework of a life course approach to health are well understood [73].

FIGURE 2. **LIFE STAGES AND EVENTS MAKE UP THE LIFE COURSE**



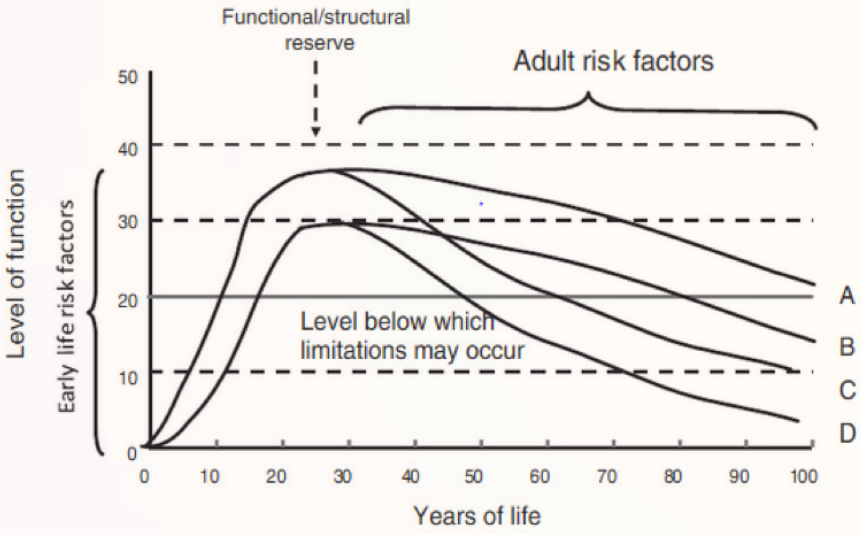
It is precisely based on these principles that today we can, in addition to holding a theoretical construct of high scientific value, develop a capacity to model contemporary public health with solutions according to present day challenges. These basic principles are described below.

Trajectories

The concept of trajectory refers to a path throughout life that can vary and change in direction, degree, and proportion. In the life course, trajectories do not imply a particular sequence or a certain speed, but rather combine periods of stability with times of change and with multiple transitions. Trajectories encompass interdependent domains such as work, school, reproductive life, migration, development and health; all of them influenced, in turn, by social, cultural, economic, and political factors. Health trajectories can reflect a decline, as in the generation of disease, or alternatively indicate an improvement, as in the development and sustainability of capacities [74]. The experiences that comprise a trajectory have a cumulative effect, and a sequence of linked exposures can increase or decrease given outcomes.

Figure 3 below demonstrates how trajectories like that for functional ability capture the natural trend of biological systems that display rapid growth and development during the prenatal stage and childhood, reaching a peak or plateau at maturity, and then decline with age.

FIGURE 3. **LIFE COURSE FUNCTIONAL TRAJECTORIES**



Source: Kuh D, Karunananthan S, Bergman H, Cooper R. (2014). A life-course approach to healthy ageing: maintaining physical capability. Proc Nutr Soc. 2014;73(2):237–48. doi: 10.1017/S0029665113003923.

As exemplified by the lines A, B, C and D, exposures in early life may affect the course of functional reserve, and exposures after the developmental period can only affect the timing of onset and rate of decline [75].

Unlike with a vertical timeline, the analysis of trajectories allows for the evaluation of the influence of favorable factors on health and development that support the capacities of individuals and populations. This analysis contributes to the identification of the critical or sensitive periods that would maximize health capacity. Trajectories are essential to identifying and predicting the "how" and "when" of health, and to designing and implementing health policies that are more efficient and better organized [76].

In the coming years, the health sciences, which for centuries have been oriented toward understanding trajectories of disease, will seek to understand the trajectories of life and, specifically, the trajectories of the health of people and populations.

Transitions

The vital trajectories of people and populations have transitions that are milestones in themselves. Transitions define moments of change in life that may be of biological, economic, psychological, social, political, and geographical origin. Their timing may not necessarily be predetermined nor predictable, as is the case of adolescence, menarche, menopause, entry to school, the beginning of working life or retirement [77]. Transitions can be changes in physiological ability or social roles, and can be linked to the gain or loss of functions depending on the beginning or end of physiological or social processes. Transitions can also occur on a population level **(Figure 4)**.

Epidemiologic transition describes changing patterns of population distributions in relation to mortality, fertility, life expectancy and leading causes of death [76, 78]. Defining any given transition is complex and even specialists do not have an agreed upon approach. For example, adolescence is perhaps the clearest example of a transition from childhood to adulthood, but even with all the accumulated knowledge, its understanding and management on an individual and population level is still very complex.

While adolescence can be considered a broader period of time with varying definitive factors, the complex components, including exploring one's identity, creating intimate relationships and navigating the physical changes of one's body and corresponding sexual desires, make defining this transition difficult [79].

There are also transitions in the life course that have been largely ignored by public health and become gray or transparent periods. Perhaps the best example is the transition between the reproductive stage and the post-reproductive stage, which is

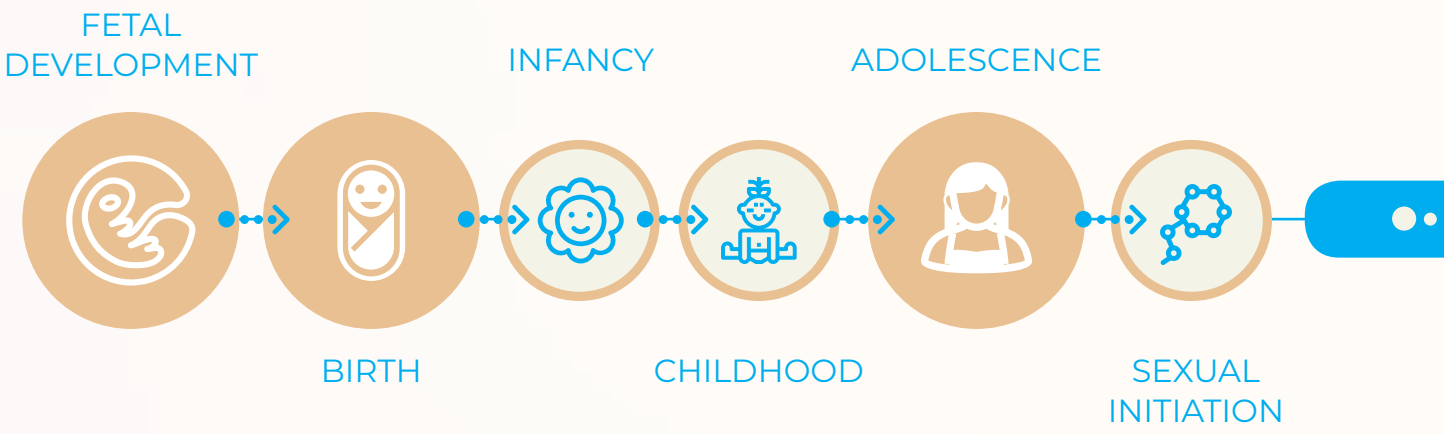
rarely studied. Enclosing the so-called "stages" of life in rigid and immovable age groups has been and is one of the main limitations to understanding and addressing this key element of transitions within the life course.

Critical and sensitive periods

A critical period is defined as a limited time window in which an exposure can have adverse or protective effects on development and subsequent disease outcomes [7]. Outside this window, there is no excess disease risk associated with the exposure. Critical periods refer to time windows of susceptibility where certain exposures can change the direction of health trajectories. These moments or periods of time can function as inflection points, modifying the biological programming [81] or the social trajectory of people and populations, and creating short- and long-term effects [61] **(Figure 5)**. A sensitive period is a time period when an exposure has a stronger effect on development, and hence disease risk, than it would at other times. For instance, in a recent study it was found that when compared with nonsmokers, current smokers had a greater reduction in age at menopause than former smokers [82]. This suggests that perimenopause is a sensitive period when the effect of smoking may be more important than smoking history in explaining an earlier onset of menopause.

Critical periods may be more evident for chronic disease risk associated with developmental mechanisms in biological subsystems, whereas sensitive periods are likely to be more common in behavioral development [35].

FIGURE 4. **TRANSITIONS FOR WOMEN**

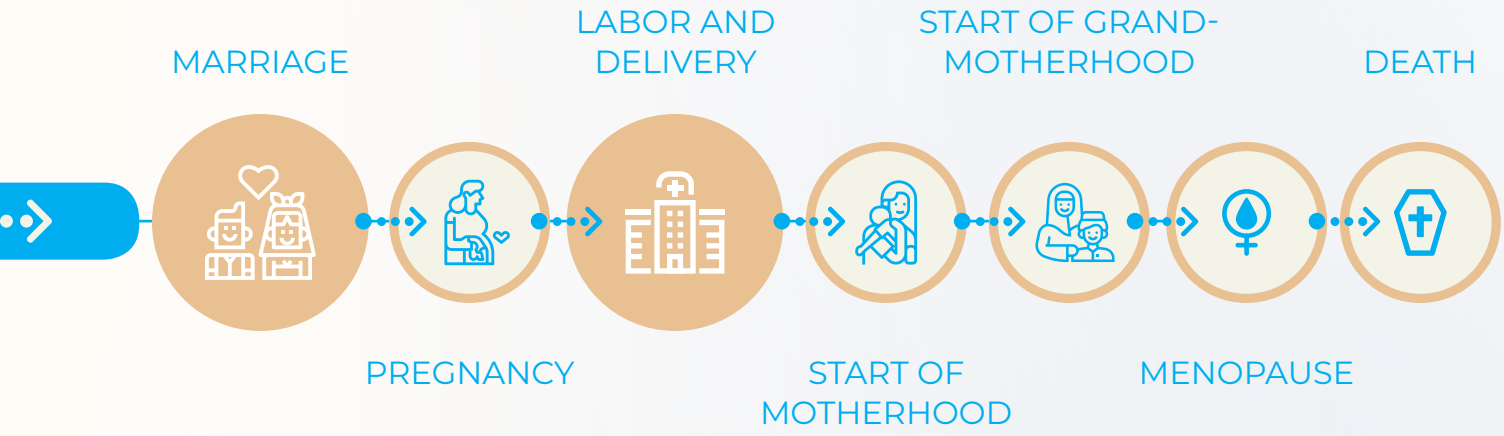


Temporality

Various aspects of time, operating on historical, social, and personal levels, are essential to the life course approach to health. The historical period in which a person lives has a profound effect on the life course, as the dimensions of daily experience vary greatly among generations and impact health trajectories. On a social level, social structures, often shaped by culture, exert normative influences over individual lives. For example, specific benchmarks like educational transitions are associated with successive age statuses that give meaning to trajectories. On a personal level, an individual's changing cognizance of time, grounded in biological rhythms as well as social clocks, contributes to one's temporal world [83].

Temporality can be applied at different levels of health and science to understand cause for disease. For example, HPV infections precede cervical precancerous lesions and cervical cancer by a substantial number of years, and the epidemiology and the dynamics of HPV infection in a population relate cervical cancer to a sexually transmitted disease [84].

The consideration of time in the life course differs from the sometimes-contrived periods of epidemiology that limit the dynamic understanding of health, disease, and population change. The life course perspective highlights temporal issues that shape age-related patterns, pointing to social, cultural, and historical factors that impact developmental processes [85].

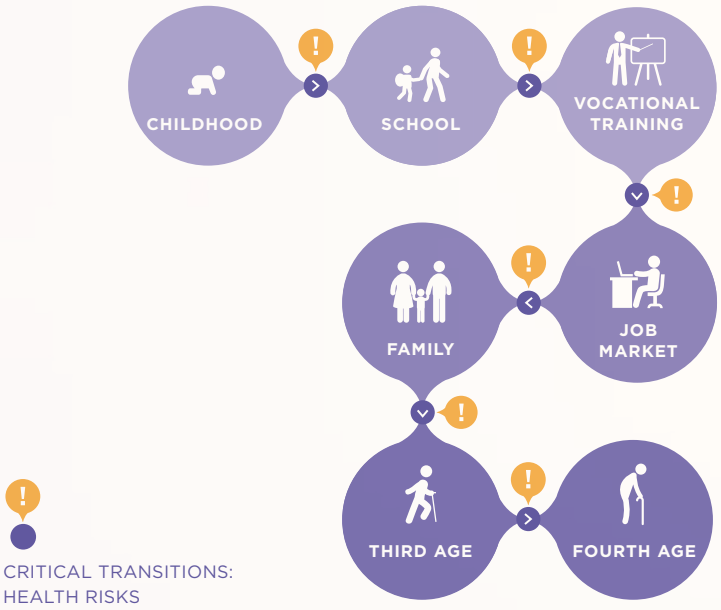


When evaluating the various impacts that a stimulus can have on an individual, it is important to consider the moment of development in which that impact occurs. This allows us to better understand why some risks or interventions do not show their effect immediately and only generate their impact after a period of latency. For example, it is known that folic acid supplementation to prevent neural tube defects has a greater impact when it is offered not only to pregnant women, but to all women of reproductive age in order to increase the biological reserve of women before conception [86]. If temporality was integrated into a health analysis and intervention proposal to increase the effect of folic acid supplementation, the impact would be greater.

Cumulative impact

The factors that optimize or decrease health or the risk of disease accumulate throughout the life course. This principle allows us to understand how the intrinsic capacity of individuals or the diseases themselves are the result of positive or negative factors that accumulate throughout life, particularly in critical periods. Cumulative impact emphasizes the chronological dimension of health as positive or negative risk factors that are compounded over time.

FIGURE 5. **TIMES OF CRITICAL LIFE TRANSITIONS POSE GREATER HEALTH RISK**



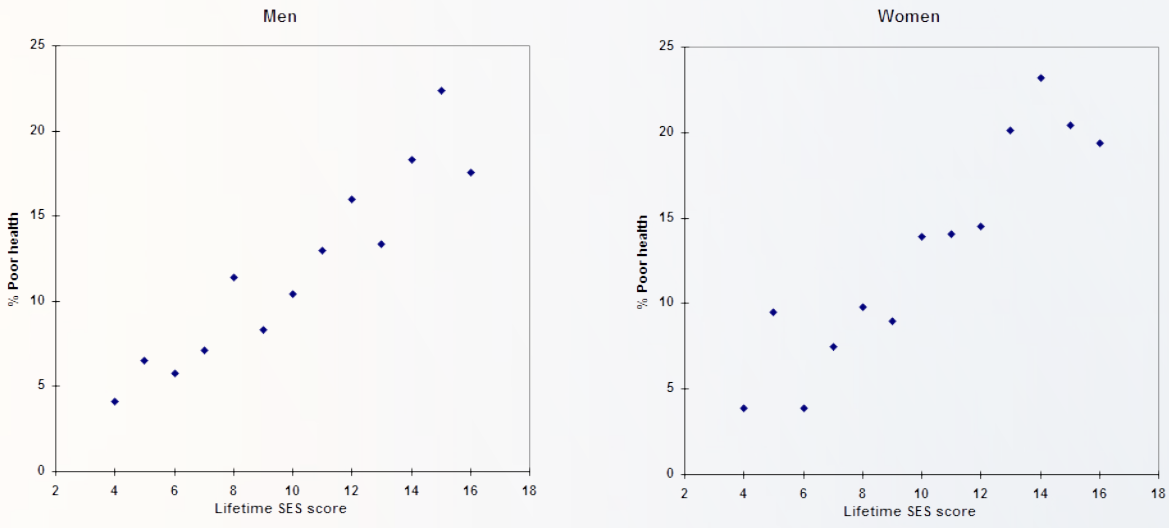
Source: Federal Office of Public Health. Government of Switzerland [Internet]; 2018. Available from: https://www.bag.admin.ch/bag/en/home/zahlen-undstatistiken/zahlen-fakten-zu-chancengleichheit.html

Cumulative impact is demonstrated in a 1958 birth cohort study that shows that the duration of exposure to particular socioeconomic circumstances has a cumulative effect on several health outcomes in adulthood.

Individuals in this study who were always in the lowest occupational class were approximately four times as likely to report poor health as those who were always in the highest. The occupational class over the lifetime is a stronger predictor of poor health than occupational class at any single point in time, indicating that duration of exposure to poor socioeconomic circumstances matters a great deal. The **Figure 6** below demonstrates how health risk increases alongside the "lifetime score," representing the cumulative duration and intensity of material/social privilege or deprivation [87].

Similar to how risk accumulates and leads to greater impact, evidence shows that interventions that appear earlier in life lead to greater impact [88, 89]. However, as the principle of temporality suggests, healthy practices that begin later in life can have a maximum beneficial impact [90]. Advances in epigenetics explain how gene expression can be modified in response to signals from the environment and how it can be perpetuated over several generations [43]. The accumulated evidence has allowed us to understand that this plasticity does not only occur in the first stages of life, but during other moments of its course, which

FIGURE 6. CUMULATIVE EFFECT OF SOCIOECONOMIC CIRCUMSTANCES



Source: C Power, O Manor, and S Matthews Department of Epidemiology and Public Health, Institute of Child Health, London, England. "The duration and timing of exposure: effects of socioeconomic environment on adult health.", American Journal of Public Health 89, no. 7 (July 1, 1999): pp. 1059-1065.

will have a great impact on medicine and public health [45, 91].

In public health, the concept of cumulative impact informs the development of comprehensive interventions that encompass multiple risk factors and/or protective factors at the same time or in a temporal sequence. The cumulative effects on health are not limited to the life of an individual, but can be transmitted to the following generations, which should be considered in the definition of opportunities for public health [88, 89].

Transfer of traits and resources

The life course approach incudes the concept that resources can be transferred between generations. The intergenerational transfer of the socioeconomic condition has been studied extensively, particularly regarding income and education. However, with regard to health, studies are scarce [13]. Health is an important component of human capital. People with better health tend to be more productive and achieve higher personal development quotas, establishing a circular and recurrent link between health and development.

When children learn from their parents' habits and behaviors that are favorable or unfavorable to health, or acquire inherited traits and material goods (or debts), positive or negative resources are being transferred. For example, in their study on childhood obesity, Davis and colleagues [92] found cross-generational patterns of obesity, with associations between child weight status and grandparental obesity. Studies such as this indicate that there is a substantial familial component to obesity, whether genetic or behavioral in origin [92].

In public health, this mechanism can be useful for the promotion of protective factors, the reduction of risk factors, and the construction of social capital at the individual, family, and community levels [93]. In addition to benefiting individuals, policies and programs aimed at families and communities promote intergenerational actions that foster coexistence, solidarity, and the efficient use of resources.

Linked lives

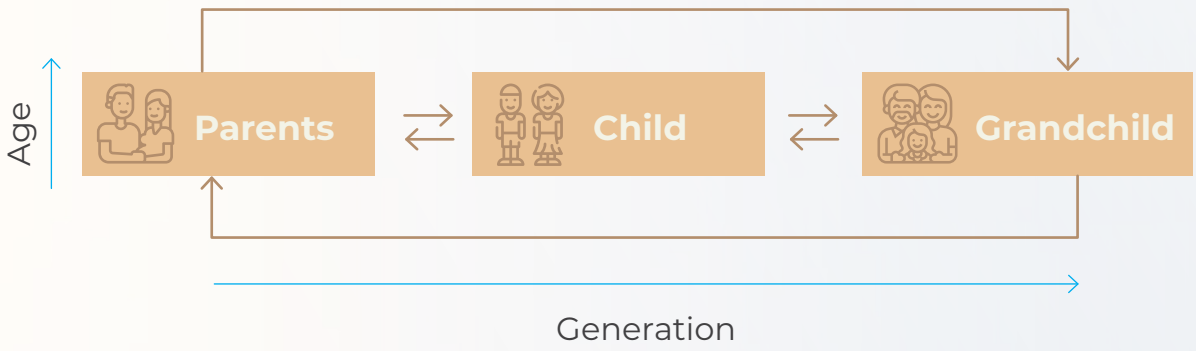
The principle of "linked lives" highlights the interdependence of a person's life course with the lives of other people in their environment. The life and health of individuals and generations are linked to their families and communities and are also influenced by the generations that preceded them. Unfavorable conditions at the family and social level limit the achievement of better welfare quotas and contribute to the intergenerational transmission of suboptimal levels of development. Much of the individual differences in risk profiles can be explained by shared genetic, environmental, and cultural factors [13].

Figure 7 depicts this model of linked lives demonstrating how multiple generations have bidirectional effects on each another. Grandparents and grandchildren can transfer traits and resources to each other indirectly via parents, and there can also be direct impacts between grandparents and grandchildren. Time dimensions of generations and age contribute to a paradigm that understands how health is further perpetuated across lifespans and multiple generations [94].

The concept of linked lives is also defined by social roles that impact the health of people. Throughout their life span, individuals transition in and out of social roles, creating changes in identify and status [95]. For example, moving from a parent's home to an independent household with a spouse signifies a change in the life stage and status of an individual.

These roles, defined by social environments as normative or non-normative, have repercussions for health and well-being. Furthermore, driven by the fact that individuals have evolutionarily developed social interactions for survival, social networks and the support they provide often shape health outcomes [96]. In this regard, studies suggest that isolation and loneliness have a similar magnitude of impact on health as risk factors such as high blood pressure, obesity, and smoking [97]. In order to understand the various health outcomes, particularly in relation to cardiovascular and cerebrovascular disease, life course models of health and development consider social roles and networks as influencers of health.

FIGURE 7. **THREE-GENERATION MODEL OF BIDIRECTIONAL EFFECTS**



Source: Gilligan M, Karraker A, Jasper A. 2018. Linked lives and cumulative inequality: a multigenerational family life course framework. J Fam Theory Rev. 2018;10(1):111–25. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/jftr.12244#jftr12244-fig-0003.

Human agency and social determinants

The term "**agency**" refers to the thoughts and actions that people take to express their individual power to think for themselves and act in ways that shape their experience and life trajectory.

In public health, it is important to understand the relationship between agency and social determinants in order to understand the realities of health beyond epidemiological associations **(Figure 8)**.

The life course perspective seeks to understand how health trajectories are shaped by understanding the dichotomy of agency and social determinants [99]. This dynamic perspective contributes to advancements in public policies and programs that generate health and capacity for people and their communities.

FIGURE 8. **SOCIAL DETERMINANTS OF HEALTH**

Economic stability	Neighborhood and physical environment	Education	Food	Community and social context	Health care system
Employment	Housing	Literacy	Hunger	Social integrations	Health provider availability
Income	Transportation	Language	Access to healthy option	Support systems	Provider linguistic and cultural competency
Expenses	Safety	Early Childhood		Community engagement	Quality of care
Dept	Parks	Education		Discrimination	
Medical Bills	Playground	Vocational training			
Support	Walkability	Higher education			

Health Outcomes
Mortality, Morbidity, Life expectancy, Health care expenditures, Health status, Functional limitations

Adapted from: https://www.healthedge.com/blog-social-determinants-health-what-are-payers-doing

VII

Using Life Course Definitions to Shape Public Health

Thinking differently, and therefore acting differently, is the premise of this document. Faced with such a complex reality, a more complex public health model is needed to effectively improve individual and population health.

The life course approach can offer a new vision to public health, which complements our knowledge about the reality of the health of individuals and populations. But to generate longer, healthier, and more active lives and to ensure that health can become a resource for development for current and future generations, the life course paradigm should be incorporated into contemporary public health action to enhance health. At the beginning of this century, WHO began to consider the need for a life course approach, particularly in relation to the promotion of healthy aging and the need to improve the preventive focus in the management of chronic diseases. In 2001, WHO convened the first meeting of experts on the life course and health.

The main objective of this meeting was to establish state-of-the-art knowledge on the influences of the life course on the risk of chronic disease (specifically heart disease, stroke, and diabetes) and, on this basis, identify their main implications for public policy and research.

Since then, the vision for the life course perspective has been pursued in WHO's work. The launch of the World Report on Health and Aging [46] in 2015 generated a huge leap in understanding. The report proposed a vision of health for the second stage of life based on the life course. The concept surpasses a basis of health grounded in disease and focuses on the intrinsic capacity

of individuals and populations in the construction of healthy aging. In addition, WHO's Global Strategy on the Health of Children, Women and Adolescents [100] is engrained in the life course approach and clearly expresses the need to understand health achievement in alignment with sustainable human development. Furthermore, the conceptual bases of several of WHO's most important strategic interventions such as early childhood development or positive development in adolescence are based on the life course vision.

In PAHO/WHO, we begin to transform a life course vision into an approach that contributes to a paradigm shift in the building of health. In an effort to increase healthy life expectancy, it is important to not only address disease, but also seek the maximum potential for health generation, understood as the development of capacities or assets that allow individuals and populations to develop according to their expectations and the demands of the environment where they live. In addition, the life course approach is important in understanding and addressing health disparities that contribute to inequities [101].

In practicing this approach, PAHO/WHO promotes the development and sustainability of maximum physical, mental, and social capacity throughout the continuum of life, preventing people from getting sick but also maintaining the maximum possible potential even in the presence of diseases or disabilities. This new paradigm is an essential component in promoting, creating, and maintaining health.

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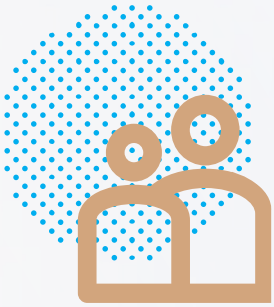
Building Health Throughout the Life Course

PART 2

Implications

Implications for Epidemiological Practice



The life course epidemiology recognizes that an individual's lifespan includes the broader genetic, psychosocial, and environmental effects that cumulatively influence health.

The LCA has had significant implications for the study and understanding of health and disease; so much so that a new epidemiological practice centered around the life course theory has been developed. Life course epidemiology is defined as "the study of long-term effects on later health or disease risk of physical or social exposures during gestation, childhood, adolescence, young adulthood and later adult life" [1]. The aim of life course epidemiology is to elucidate biological, behavioral, and psychosocial processes that operate across an individual's life course, or across generations, to influence the development of disease risk [2].

In this regard, life course epidemiology recognizes that an individual's lifespan includes the broader genetic, psychosocial, and environmental effects that cumulatively influence health. Connecting the biological, social, and environmental models of the LCA has potential to help elucidate new mechanisms of disease causation and develop measures for the maintenance and improvement of health [3]. Furthermore, when applying the LCA to epidemiology, key life course models must be considered, including the critical periods model, the social mobility model and the cumulative risk model; all of which are described in Part 1. Through the critical periods model, it is understood that deprivation has greater repercussions during certain periods of increased vulnerability. According to the social mobility model, change in social class between or within generations

give rise to differences in health and disease profiles [4]. Moreover, the cumulative risk model postulates that diseases are the result of risks accumulated throughout life and particularly in its critical periods [5].

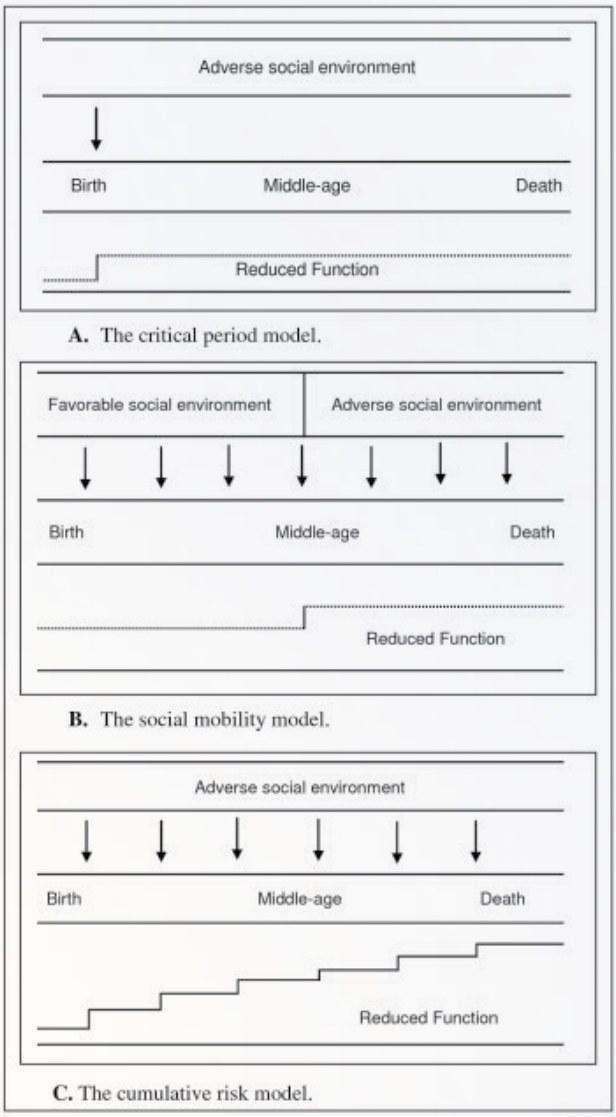
As demonstrated in **Figure 9**, these models suggest pathways linking exposures across the life course to later life health and include the temporal ordering of exposure variables, their inter-relationships, and their outcome measures [3]. These theoretical life course models must be tested in epidemiology, thus creating new implications for study design, implementation, and analysis.

It is important to consider how life course processes generate associations between risk factors and health outcomes. Longitudinal studies with time-related designs to capture certain time windows or other significant features of the life course are therefore required. Given that few researchers have access to birth cohort studies with repeat measure of biological, psychosocial, and environmental measures, obtaining adequate exposure measures across the life course can prove difficult. New, innovative techniques are needed to empirically test the models that drive the life course theory [6].

Furthermore, given that epidemiology goes beyond the study of the distribution and determinants of health-related states and includes the application of this study to the control of diseases and other health problems, life course epidemiology has implications for health systems, policy, and governance [7].

Practicing life course epidemiology is important as we project into the future the health of populations and consider priorities for current health investments.

FIGURE 9. **LIFE COURSE MODELS DEMONSTRATING RISK OF EXPOSURES ACROSS THE LIFE COURSE**



Source: Rosvall M, Chaix B, Lynch J, Lindström M, Merlo J. Similar support for three different socioeconomic models on predicting premature cardiovascular mortality and all-cause mortality. BMC Public Health 2006;6:203–19.

II

Implications for Policy and Investment

Investment in health brings considerable revenues.

Good health is not only a consequence of economic development, but also one of its main agents. Healthier people have higher productivity, better educational and work performance, and less poverty.

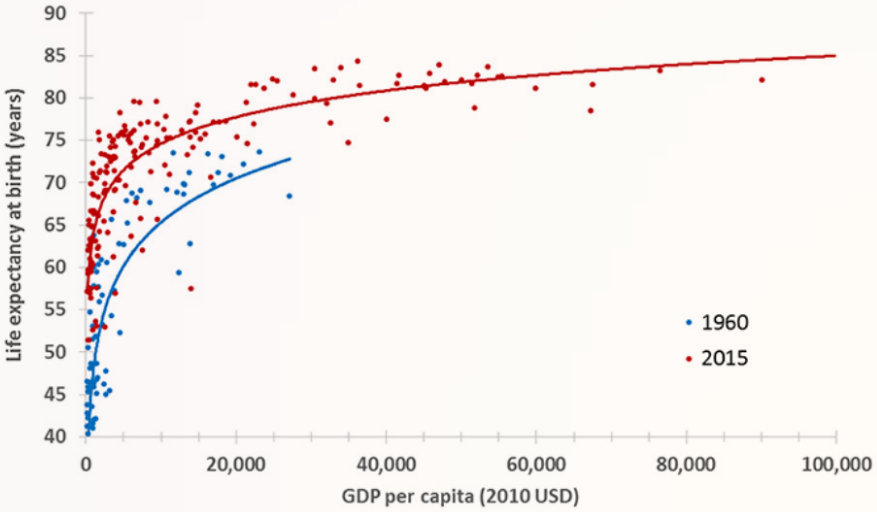
Mortality reduction represents about 11% of recent economic growth in low- and middle-income countries, and between 2000 and 2011, about 24% of total income growth in low- and middle-income countries was due to the value of the additional years of life gained [8].

On the other hand, the average life expectancy of groups with greater socioeconomic status is higher than that of groups of poorer socioeconomic status [10].

Regardless of the indicator used as a stratification criterion (education, income, occupation, etc.), the most advantageous groups are more likely to live longer across all age groups and for all causes of death [9]. This correlation between health, using life expectancy as an indicator, and economic growth is demonstrated in **Figure 10**.

The LCA brings light to this phenomenon, as it explains how socioeconomic gradients in life can manifest as different health outcomes [11]. Evidence shows that accumulation of socioeconomic risk across the life course is associated with worse health and well-being [12]. A life course perspective is essential in understanding the relationship between health and other dimensions of development.

FIGURE 10. **LIFE EXPECTANCY AND ECONOMIC GROWTH**



Source: World Bank. World development indicators. Washington, D.C.: World Bank; 2017.

Health therefore occupies a prominent place in the SDGs due to its double condition for development. The duality of health and development feeds the principle of government efficiency in terms of resource utilization; an efficient health system that promotes higher life expectancy and better quality of life also provides other collateral economic benefits. Committing resources to universal and equitable access to health protects low-income families and allows them to save more. When this benefit extends to many families, the increase in their economic activity translates into global economic development [13].

Adopting the LCA is central to effectively building health and well-being and moving towards the SDGs, and its evidence, which comes from a broad spectrum of scientific disciplines, establishes the basis for the design and implementation of life-oriented policies.

Policy and investment

The diversity of trajectories in the health of individuals and populations greatly depends on government policies that provide opportunities or barriers for health and development. Changes in policies can eliminate or minimize the unfair causes of this diversity and create the conditions for the sustainable development of health.

The translation of the LCA into consistent health policies must be based on three essential attributes:

1: early actions;

2: linkage to critical and sensitive transitions and periods of life; and,

3: conception and execution by society as a whole.

In this way, its effects reach the entire population, cover the course of life, and generate intergenerational impacts.

Despite the LCA evidence that supports early action in the prevention of disease, in 2015 the Organisation for Economic Co-operation and Development (OECD) estimated that spending on prevention had decreased since 2009 in around half of OECD countries, whereas spending on long-term, outpatient, and inpatient care continued to grow [14]. The LCA supports greater investment in the minimization of risk and enhancement of protective factors throughout the life course. Health policies with a life course focus are essentially promotion and prevention policies with an expanded time horizon: from conception to death and with an intergenerational vision [15].

Given the immense return on investment of health prevention programs, investing in prevention programs makes sense for both health and development [16].

Guided by this principle of prevention and drawing from evidence of the life course, greater focus must be given to critical and sensitive periods and transitions. Exposure to risk factors during pregnancy and the first few years of life greatly influences physical, cognitive, and emotional development in childhood and may influence health and well-being outcomes in later life. The prenatal and early childhood periods therefore provide particularly unique opportunities to influence the health trajectories of individuals and should be prioritized along with similarly critical stages and transitions in life like adolescence and aging. Studies show that investment in early childhood, child, and adolescent health and development can reduce rates of noncommunicable diseases and mental health disorders later in life, and thus yield a benefit-to-cost ratio of 10-to-1 in health, social and economic benefits [17, 18].

Similarly, a 2014 analysis demonstrates that a comprehensive package of family planning, quality-of-care improvements in pregnancy, childcare and the prevention and management of childhood illnesses would yield economic and social benefits valued greater than initial investment [19, 20].

Additionally, for older people, integrated health, social, and environmental investment can help reduce health-care costs and care dependency and promote well-being. Investment in evidence-based interventions surrounding these critical periods can also improve resilience and mitigate risks throughout life and across generations [21].

As well as early action and a focus on critical periods and transitions, operationalization of the LCA implies a more holistic, long-term approach to policy and investment [22]. Increasing life expectancy, health, happiness, and independence requires policies that go beyond simply combating disease but generate the maximum development of intrinsic capacity of individuals. Such policies focus attention on social and environmental circumstances rather than on purely individual choices and span the many different sectors that touch these circumstances.

III

Ethical Implications

...older adults represent the age stratum in which inequities are compounded. One's functional ability as they age, represented by the combined interaction of a person's intrinsic capacity and external environmental conditions, defines healthy aging.

Adler NE, Stewart J, editors. The biology of disadvantage: socioeconomic status and health. Hoboken: John Wiley & Sons; 2010.

One of the most important contributions of the LCA is the explanation of the mechanisms that generate health inequalities between population groups. The LCA is founded on evidence demonstrating that health is driven by factors that go far beyond genetics. If that were the case, health would be purely inherited and preexisting, and the range of public health responses would be limited. But decades of research demonstrate that what happens early in life and the conditions of the world that we grow up in, whether it be of socioeconomic, political, environmental, or cultural nature, influence an individual's health throughout the life course and hold significance for the health of generations that follow.

The resulting health inequalities that are outside the control of individuals result in health inequities that are unjust. These foundational theories of the LCA indicate that efforts to improve social equality will ease health inequities [23].

Certain population groups are more vulnerable to health inequities than others. Those living in poverty suffer a long history of restrictions and immobility, as there is a bidirectional correlation between social conditions and health. For example, neighborhood poverty increases health risk, but poor health also systematically sorts individuals into poorer neighborhoods [24]. Furthermore, older adults represent the age stratum in which inequities are compounded [25]. One's functional ability as they age, represented by the combined interaction of a person's intrinsic capacity and external environmental conditions, defines healthy aging. Regardless of the decreases in intrinsic capacity that are common features of old age, environmental conditions can support older people and help keep functional abilities at a decent or high level. The range in such environmental conditions surrounding various aging populations is the foundation for high inequities among older adults.

The concept of health equity is grounded in ethics and human rights and widely accepted as social values. Ethicists have distinguished health as essential to normal functioning in every part of life; it is not a commodity like designer clothing or a luxury car. Therefore, resources needed for health, including medical care and living and working conditions that greatly influence health, should be distributed according to need, not privilege [26, 27]. As supported by life course theory, health is not merely a benefit, but a universal right founded on the provision of equal opportunities to reach maximum possible level of physical and the mental health [28].

While equal access to medical care and conditions surrounding health is central to health equity, the LCA also underlines the notion of agency as an individual's right to express their individual power and react to changing social circumstances. To empower this notion of agency, information, and education, whether or not individuals use it to compose their actions, is a basic right. Instead of waiting for people to change their habits and behaviors based on the information they receive, or suffer frustrations when they decide not to translate information into practice, educators have the duty to help people make critical judgements about their priorities so they can become the person they want to be. Under the LCA, the quality of education in relation to health construction must be measured both by the effectiveness in generating favorable changes in people's habits, and by the value that they can attribute to the education and information they receive as support for their decisions to define their purposes and goals [29].

Understanding that the right to health includes not just resources for health but also agency, it is important to balance the provision of health opportunity based on science with individual and community-led decision-making. While based

on evidence, the LCA recognizes the responsibility of individuals and communities to shape their trajectories [30]. One's right to health and right in decision-making are not contradictory but rather go hand-in-hand.

Closing inequality gaps

Life course theory can be used as a tool to address health inequities. Understanding health inequities as multifaceted processes that unfold throughout the life course and across generations, opportunities lie in more strategic and complex responses.

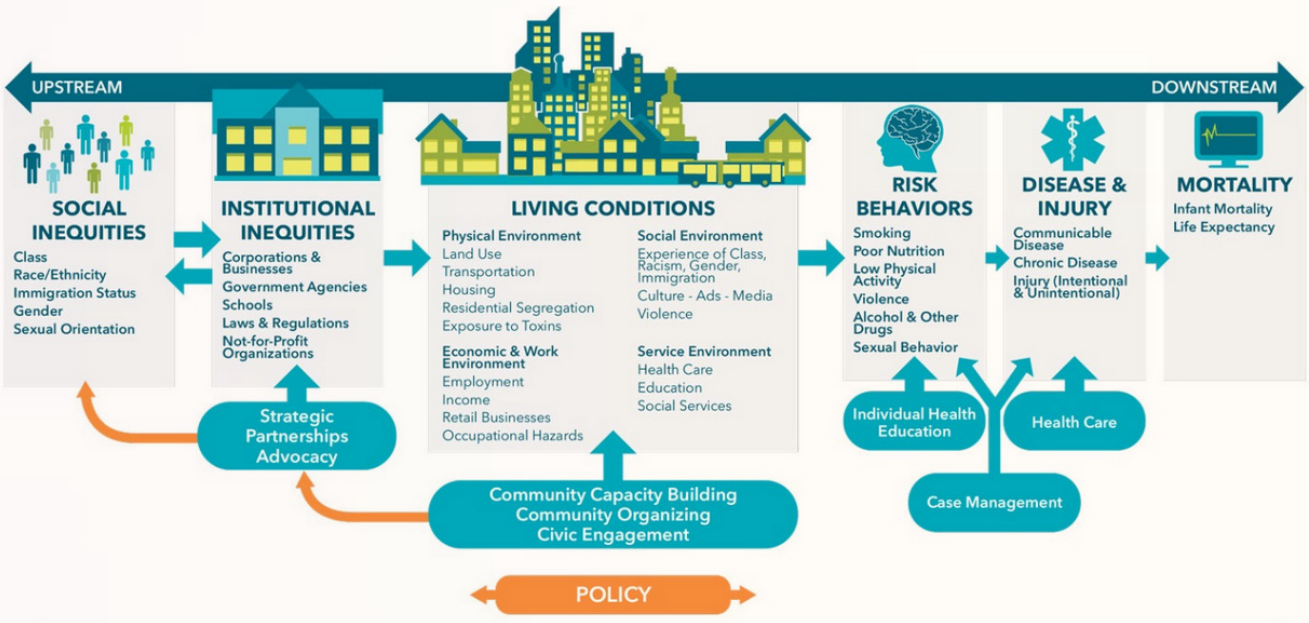
There are no one-to-one correlations between health practices and outcomes. For example, a person's efforts to eat healthy and exercise can be thwarted by economic disadvantage that can pose additional challenges to accessing healthy foods and finding a safe place to exercise. Furthermore, the explanation of factors contributing to health disparities has typically focused on downstream factors such as individual health behaviors and access to health care. But by incorporating an ecological perspective, the LCA broadens the focus of contributing factors to include more upstream determinants like social policy [31]. For example, high educational and vocational achievement can be undermined by racism that continues to have an impact on educational and career opportunity for many population groups. Broader structural forces like racism, environmental inequity, and decaying housing structures that can impact health across the life course must be understood [32]. This broad spectrum of contributors to health equity, ranging from upstream actions that address social inequities to downstream actions that improve individual risk behaviors, is illustrated in **Figure 11**. As exemplified here, addressing health inequities requires a large-scale change [36].

Large-scale change goes beyond the identification, measurement and monitoring of inequalities. It is also necessary to address their causes at the population level and take into account that policies and programs, including those that are based on evidence, can have a different impact on different population groups.
The consequent application of the LCA implies looking at health "under the lens of equity" because the same policies that have a positive result in the improvement of global indicators can contribute to increasing gaps in social inequality in health.
Future actions that successfully decrease health inequalities may therefore necessitate positive deviance from current norms and practices.
In formulating these new efforts for reducing inequalities, it is important to become familiar with history as a means of informing and understanding the present.
There exists a rich legacy of social and health movements that have successfully improved health

trajectories, and in the past 100 years, instrumental improvements in sanitation, access to health care, and nutrition have contributed to improved health equity. Life course theory and practice offer a new strategic framework for this longstanding challenge by clarifying the underlying social determinants of health over the life course. Countries that have embraced a more comprehensive vision of health through these life course principles have established a social platform for health policies and programs that provides continuous service in the course of life [34].

Taking inspiration and lessons from the past, we can use the life course to identify the right social responses to prevent and correct the direct harm that broader social conditions have on at-risk populations.

FIGURE 11. **PATHWAYS TO HEALTH EQUITY**



Source: Bay Area Regional Health Inequities Initiative https://www.barhii.org/barhii-framework

IV

Implications for Health Systems

Life course theory emphasizes the need for improved referral systems or other services linking individuals to a range of services needed. Furthermore, it emphasizes a "whole-person" approach to care that takes wellbeing into account.

As described in the previous section, the LCA explains health and disease patterns not only with respect to diseases or isolated conditions, but it points to factors of the physical-environmental and socioeconomic context as underlying causes of health.

This wide range of determinants of health that affect individuals in their homes, schools, workplaces, and communities has implications not only in the clinic but also in the design and implementation of public health programs and services. The ways to eliminate or minimize social inequalities driven by these determinants of health require integrative strategies that combine individual and population approaches and that include vertical, horizontal, longitudinal, and intergenerational integration [35].

Vertical integration links the primary, secondary, and tertiary levels of care and different disciplines and medical specialties. Our current medical system is organized by setting (i.e. primary care, emergency medicine, intensive care, specialty care, etc.). Under this system, disadvantaged groups get lost in transitions between different types of care. For example, a woman who just gave birth suffering from post-partum depression and incontinence may not receive behavioral health or physical therapy services after she leaves the maternity ward. Life course theory emphasizes the need for improved referral systems or other services linking individuals to a range of services needed. Furthermore, it emphasizes a "whole-person" approach to care that takes wellbeing into account.

In addition to integration within the health system itself, horizontal integration based on close coordination between different sectors must also become the norm rather than the exception. Health systems cannot autonomously face the influences of determinants of health and must incorporate other sectors in their work. This means developing

multisector service systems that involves the health, social and civic sectors.

Successful horizontal integration brings multiple programs and services to individuals where they spend their time, thus eliminating barriers in access to services and programs.

Longitudinal and intergenerational integration are also important in the strengthening of health systems to align with the LCA. Longitudinal integration pays special attention to transition periods, which often coincide with the critical or especially vulnerable periods identified by the LCA [35]. While critical periods such as the prenatal, postnatal, and pediatric care are particularly important, it does not imply that the transition periods and "gray zones" should be of less priority. Building upon longitudinally integrated services that span the life course, intergenerational integration implies a service focused on the family which recognizes the link between the health of family members between generations. Lifelong interventions and a whole-family approach are central to integrating services and programs under the LCA.

The focus that the LCA makes on the context implies the promotion of an integrated intersectoral service explained in **Figure 12**. Health administrations therefore have the task of redesigning health systems, both in their structure and function, to harmonize all forms of integration.

A vertically, horizontally, longitudinal, and intergenerationally integrated approach requires a culture change in medicine and its traditional disciplines segmented by age, setting, and specialty. It also requires collaboration between formal medical practice, communities, and governments and a change in structures to support an integrated approach [36, 37].

Primary health care is an ideal framework to guarantee the practice of this integrated approach that values comprehensive care and support [38].

Strategic planning under the LCA assumes a new primary health care architecture, based on integrated health service networks [39], with the objectives to improve the quality of care, the quality of life of the population, health indicators, efficiency in the use of resources and equity in health [40]. Integrated health, service networks have the same conceptual origin and foundation as the LCA, and favor comprehensive, integrated, and continuous care; family and community-oriented care; care coordination and person-centered health care—all of which cannot be operationalized in fragmented systems [41].

FIGURE 12. LIFE COURSE THEORY PARADIGM FOR INTEGRATION IN HEALTH CARE DELIVERY

Current medical systems	Life course theory concept	Life course theory paradigm for clinical care
Organized by age: Ob-gyn, pediatrics, Internal medicine, geriatrics (exceptions: family medicine, internal medicine-pediatrics)	"Emphasis on early ("upstream") determinants of health" "Lifelong development/lifelong intervention" "Whole-family approach"	Longitudinal and intergenerational Integration
Organized by level of care: Primary health care, emergency care, hospitalization, intensive care, specialty care, long term care	"Development of referral/linkage services to assure timely linkage to a range of needed services within... the health system..."	Vertical Integration across health settings
Organized by speciality organ system: Cardiology, gastroenterology, nephrology, neurology, etc.	"Whole-person" approach	Vertical Integration across health disciplines
Medical sector focus	"Whole-community systems appoach" "Developing integrated, multi-sector service systems that become lifelong "pipelines" for healthy development"	Horizontal integration across sectors influencing health
Individual focus	"Population focused and firmly rooted in social determinants and social equity models"	Individual, family, and population focus

Source: Cheng TL, Solomon BS. Translating life course theory to clinical practice to address health disparities. Maternal Child Health Journal 2014;18(2):389–95.

Universal health

Due to its emphasis on universal health access and coverage through integrated primary health care initiatives and people-centered approaches, the LCA reinforces efforts to achieve universal health (UH).

Considering the equity of all people at all life stages, the LCA truly ensures that no one is left behind, and uses UH as a common goal to translate life course theory into action. Planning for a life course approach to health directly coincides with national planning to achieve UH [22].

A strong health-care system is essential to implementing UH, and health system strengthening efforts therefore go hand-in-hand with universal health coverage and access and the LCA. It is common for health systems to suffer from a variety of weaknesses that reflect higher-level governance and market problems, like insufficient training among health care workers and poorly functioning supply chains.

WHO therefore proposes a three-tiered approach to improving health system performance to make UHC possible. This approach includes the following elements:

1: strengthening the foundations of the health system;

2: setting a coherent institutional framework;

3: supporting transformation [25]

Given that health landscapes and populations vary greatly across countries, countries themselves should ascertain how best to implement these elements to ensure high-quality and accessible services and provide financial protection that matches the unique health-care needs of their populations [21]. These needs are detailed in **Figure 13**, which shows the core UHC framework, comprising health-care needs and health services and systems, and includes consideration of life stages and the enabling environment [22].

The usefulness of the life course approach for helping countries address critical, interdependent factors affecting health and sustainable development in a holistic manner means that it fits perfectly with efforts to achieve UH. The LCA can inform country-specific planning for universal health coverage and access and bring together elements of many larger health and development strategies. While translating this approach into actions will involve overcoming numerous constraints, incremental steps toward fulfilling UH will produce a myriad of benefits for the health and wellbeing of people and populations, which will help to mobilize support and resources needed for continued future expansion of UH [22, 42].

Timing of programs and services

In addition to informing the strengthening of health systems to achieve integration and universal health coverage and access, the LCA has implications for the timing of programs and services. The LCA is the first to highlight the remote effects of early programming on adult health, and the existence of critical or especially sensitive periods, not only in terms of increased vulnerability to risks, but also the ability to respond to timely interventions and with due impact. Consequently, health systems and services must be structured to provide care to all, and especially

FIGURE 13. PLANNING UNIVERSAL HEALTH ACCESS AND COVERAGE USING A LIFE COURSE APPROACH TO HEALTH

Health at all life stages	Birth, neonatal period and infancy	Early and later childhood and adolescence	Youth and adulthood (main employment and reproductive years)	Older adulthood
Health-care needs (context specific)	Related to health issues, such as: (i) communicable and neglected tropical diseases; (ii) noncommunicable diseases and mental health; (iii) sexual and reproductive health; (iv) nutrition; (v) occupational health; and (vi) health emergencies Related to type of health-care services, such as: (i) preventative; (ii) curative; (iii) emergency; (iv) chronic diease management; (v) rehabilitative; and (vi) pallative services			
Health systems	Health service delivery platforms, such as: (i) community and cross-sectoral services; (ii) periodic outreach; (iii) first or primary level services; and (iv) referral level services Health systems strategies, such as: (i) integrated people-centered health services; (ii) the WHO health systems strengthening approach, involving strengthening foundations, a coherent institutional framework and supporting transformation; (iii) essential public health functions			
Enabling environment	Other social and environmental determinants of health such as families and communities, sociocultural norms, economics, politics, physical environments and sustainable development Principles in practice for the realization of rights, such as a human rights-based, gender-responsive, equity-driven approach to policies and programmes			

Notes: The blue boxes list considerations included in the core universal health access and coverage framework. The grey boxes list considerations intrinsic to a life-course approach to health.

Source: Kuruvilla S, Sadana R, Montesinos E, Beard J, Vasdeki J, Araujo de Carvalho I, et al. A life course approach to health: synergy with sustainable development goals. World Health Organization Bulletin 2018;96:42–50.

oriented to those periods in which the building of health is particularly impactful.

Among the first critical periods are pregnancy and the postnatal period, followed by early childhood and adolescence. To minimize health risks that originate in these stages, it is important to advance health promotion actions earlier in these time periods, as well as estimate health risks and offer early intervention services to address them and minimize their impact.

It is also important to note that, as understood through the life course lens, prioritizing prenatal development and the first years of life and taking advantage of windows of opportunities for relevant actions with long-term effects does not imply neglecting adult care. Everyone has a right to timely interventions in response to health needs, no matter the stage of life they are in. Timely prevention and treatment efforts have value at any age. For example, research on frailty shows that using simple assessments to identify individuals vulnerable to accelerated aging, timely interventions

may be able to modify trajectories and delay the emergence of frailty [43].

Appropriate timing of health interventions is emphasized by the right to health, defined by the International Covenant on Economic, Social, and Cultural Rights as: "an inclusive right, extending to timely and appropriate health care as well as to the underlying determinants of health..." [44].

Health systems driven by the LCA and committed to a rights-based approach to health must therefore work to ensure that health programs and services reach individuals at a time where there is greatest potential to impact trajectories — at all stages of life.

Training of health professionals

In addition to changes in the organization and structure of health systems and services, the LCA imposes special training needs for health professionals. The life course is rarely used as a framework within education. No matter the specialty, a curriculum adhering to the life course framework includes several key concepts, as outlined in **Figure 14** .

Professional specialties must break from their narrow focus and broaden their scope to account for the interconnected nature of the life course. Neonatology and pediatrics must anticipate health effects that go well beyond birth and the early stages of life and address the issues from which they derive. Similarly, geriatrics must not limit its diagnostic and therapeutic actions to the circumstances of the immediate and temporary environment of the elderly but think about causation and prevention. Internal medicine and clinical specialties must go far beyond clinical symptomatology and risk factors, in search of other health determinants that may not be the result of freely chosen lifestyles, but strongly influenced by constraints from the physical and social environment throughout one's life. And the general practitioner will have to include in their analysis of the patient health aspects that go far beyond the cross-sectional evaluation of problems those being practiced today.

Furthermore, public health professionals must integrate a life course perspective into their practice. These changes in the health practice are best driven by curricular changes in education for health professionals; not just in the content itself, but also in the process of curriculum delivery.

Apart from incorporating a life course framework into education curriculum, health systems must create a health workforce that meets the epidemiological profile and needs of the population.

With a growing population of aging adults, many systems are ill-equipped with geriatricians or other providers

with training in in caring of older adults. For example, in Mexico, by 2050 one in every four Mexicans will be 60 years or older, and there is currently only one geriatrician for every 22,000 older adults [46].

In line with the implications for the LCA on UH and primary health care, specialties oriented to the first level of care, in areas with the most demand should be encouraged, and incentivized [45].

FIGURE 14. CURRICULUM FRAMEWORK FOR THE LIFE COURSE IN EDUCATION

Stresses the importance of all ages and stages of life and acknowledges the intergenerational context within which individuals exist.
Recognizes the temporal dimension of health and aging, rather than just distinct episodes of illness; personalizes and humanizes ill health as part of a life process.
Offers the opportunity to focus on 'health' as well as specific disease processes; in terms of disease, it emphazises health promotion, disease prevention and cure and disease management throughout life (can assist in ensuring a balance in teaching).
Emphazises primary interventions in addition to cure or palliation.
Is interdisciplinary – offering the potential to link together current 'islands' of teaching, particularly in social and psychosocial topics.
Integrates the progression from cellular to organ-based to organism and population-level information.
Requires a multidisciplinary approach from staff that should improve overall co-ordination of teaching.
Is 'novel' – it represents an exciting area of current research and may promote an enquiry-based learning approach.

Source: Adapted from World Health Organization. The implications for training of embracing a life course approach to health. Geneva: WHO; 2000. https://www.who.int/ageing/publications/lifecourse/alc_lifecourse_training_en.pdf

V

Implications for Measurement and Evaluation of Results

Measurement and evaluation of the practice of the LCA is important in not only ensuring effectiveness of health interventions, but also demonstrating return on investment.

Without rigorous evaluation, the full value of the life course theory will not be understood. The gradual introduction of the LCA as a strategic line of action for health programs and policies implies the commitment to propose methods and procedures for its evaluation, both in terms of effects and impact. This includes indicators and technical guidelines for capturing relevant information and its calculation and interpretation.

Deciding *what* to measure

Deciding what to measure is a critical first step in evaluating programs that use the LCA. A life course indicator can measure short-, medium-, and long-term outcomes that reflect the health and wellness of an individual and/or their children, with potential for population-level impact. While life course theory operates under the understanding that health outcomes are impacted by many determinants spanning multiple sectors, programs must ensure that their evaluation outcomes are under the control of the intervention. Given the complex and longitudinal nature of life course interventions, creating a theory of change that depicts the pathways through which interventions may effect change can help to clarify the indicators to be measured.

Because life course interventions have implications for health equity, it is important to incorporate the equity criterion in evaluation designs to explore how well selected indicators reflect disparities. The social determinants of health may not be central measures of a life course program, but looking at the differences in overall health potential over the life course by determinants like race and ethnicity can provide important insight into differences in health outcomes. Anand et al. [47] describe how characteristics such as race, ethnicity, educational attainment and income may contribute to differences in seven health dimensions: risk; perception; care-seeking behavior; diagnosis; treatment; incidence of disease, disability and death; and socioeconomic consequences. Measurement across these dimensions is important in understanding the gaps in outcomes demonstrated by life course interventions.

Furthermore, it is important to consider the space where one lives, geographically and socially. Where someone lives affects daily practices and how life is experienced. Access to resources, safety and, technology, for example, vary greatly across global regions and local neighborhoods. As the sociologist Alwin indicates [48], social stratification affects levels of opportunity and agency, with those from higher status groups achieving greater social capital and advantages as they age.

Space is therefore an additional criterion in evaluation designs that should be paid attention to.

Deciding *how* to measure

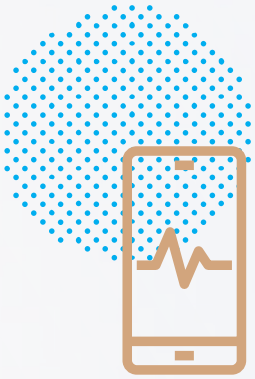
Given that life course theory underlines factors that influence health at later stages of life and even later generations, studies measuring life course indicators must expand their monitoring and evaluation goals to include longitudinal designs. While “windows of opportunity” that maximize the effect of actions are often studied, they fail to capture and control for other variables that influence long-term effects [49]. Well-designed longitudinal studies with multidisciplinary input to uncover the effects of earlier life course exposures on later health outcomes have greater potential to unravel contributors to the health and well-being of individuals and populations, particularly those most vulnerable [50]. Although important in life course evaluation, longitudinal studies demand extensive financial and analytical resources, and political will and coordination.
In addition to longitudinal designs, using participatory evaluation methods carries life course principles into evaluation practices. Life course programs intend to empower participants to change the structures and systems that contribute to disparities in health outcomes. Including participants in evaluation planning, data collection and analysis contributes to the empowerment

of individuals and communities to change these structures, while also strengthening program and evaluation plans. Participatory evaluation gives value to the expertise that individuals hold regarding their own experiences, which cannot be fully understood by outside researchers alone. Combining quantitative indicators measured longitudinally with insight on participant experiences, which is often collected qualitatively, a mixed-method approach to life course evaluation can yield comprehensive results.

Lastly, using a quasi-experimental study design with a comparison group should also be prioritized in life course evaluation, when possible. Quasi-experimental study designs greatly strengthen the power of the evaluation in attributing outcomes to life course interventions and are practically imperfect ways of measuring program outcomes. But quasi-experimental designs can be financially and logistically demanding and are oftentimes not possible in real-world contexts. Whether or not a comparison group is used, data at baseline should always be collected to measure future change, inform the program approach, and compare against endline data.

VI

Challenges and Opportunities



The LCA has implications that require wide-scale change in all areas of public health practice.

Translating the LCA to practice is met with many challenges on the one hand, but areas for opportunity on the other. With a continued emphasis on single diseases or specific age groups rather than a holistic view of health throughout life, there is a lack of shared understanding of how health and well-being are shaped by multiple factors that accumulate risk across life stages and generations [51-53]. This fragmented view of health that dominates current public health programming makes life course interventions difficult.

Despite this challenge, the LCA and its evidence offer a unique opportunity to create a larger understanding of the meaning of health and pathways to achieve it.

While life course theory is multidisciplinary in nature, life course research and practice are met with poor coordination between the various sectors of society, making multidisciplinary action challenging. The current system is organized in silos, with health being separate from housing and education and employment. These silos stem from the long-standing organization of government and programs that can be difficult to change. The LCA represents an important opportunity to restructure approaches to programs, funding, staffing structures, and policy to close gaps and improve health and wellbeing that spans multiple spectra [54].

Lastly, the large-scale changes in structures and programming needed to fully translate life course theory to practice are met by various operational constraints. Frequent shifts in political priorities and short-term policy and funding cycles make committing to change difficult [55]. And resource constraints coupled with competing priorities limits opportunities to implement life course initiatives. It is therefore important to highlight the cost-effectiveness and sustainability of life course programs and policies so that decision makers can best prioritize according to projected benefits in the longer term.

Despite the many challenges to translating life course theory to practice, the LCA offers great potential in optimizing health and achieving equity. Evidence indicates that the LCA, while complicated and demanding, is the most direct way to build health and wellness and achieve the SDGs. Acting according to this evidence will first require a shift in the way individuals think.

Understanding the mechanisms by which health develops and trajectories are formed, individuals will better grasp how life course programs directly impact health and wellbeing. With a newfound understanding of the life course by individuals, governments and organizations must lead the way in committing to life course programs and policies, through strategic planning and coordination. Rolling out this vision of the life course through action will lead to promising changes that benefit all.

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PART 3

Application

Beyond Promotion and Preservation: Building Health Throughout the Life Course

Building health means investing in generating those capacities so that people can develop according to their expectations and the demands of the environment in which they develop. It implies taking actions over a period of time that extend throughout the life course and that can have inter- and trans-generational effects.

To achieve a state of physical, mental, and social well-being, individuals and communities must be able to identify and fulfill their aspirations, satisfy their needs, and modify or face the challenges of their social and physical environment. Consequently, health becomes a resource for daily life rather than a life goal [1].

Building health goes beyond the prevention of diseases, and even beyond the promotion of health; it also suggests generating development and sustaining and improving physical, mental, and social capacities throughout the life course. Building health means investing in generating those capacities so that people can develop according to their expectations and the demands of the environment in which they develop. It implies taking actions over a period of time that extend throughout the life course and that can have inter- and transgenerational effects.

The LCA explains how the influence of determinants of health on individuals and populations is central to understanding how to respond to them. When we speak of capacity building, we understand that although these capacities have a genetic component, they are not entirely innate, but are rather actively created within a framework of stimuli and constraints of the physical and social environment. In that process of capacity development, we can modify the contextual influences and develop resources for adaptation to situations (epidemics, natural disasters, or social conflicts) or long-term challenges (disabilities, job insecurity, climate change, chronic diseases, or political turbulence) by increasing access to and quality of services and promoting human rights [2]. Therefore, determinants of health not only can lead to disease and death, but are decisive in building health. Understanding this can contribute to greater clarity about the influence of health on the model of life trajectories and on human development. The construction of health in the life course is a continuous and interactive process where life trajectories can be modified. Health is the result of the interaction of genes with the influence of the context that is manifested in experiences, exposure factors, and individual choices. It is possible, therefore, to influence the generation of protective factors and the reduction of risk factors throughout life.

The LCA has taught us that the timing of contextual modifications and the provision of resources is important in their success in developing capacities to reduce risk and adapt to situations or challenges. Through the LCA, we understand that influences of the physical and social environment may have different effects or consequences at different points in time or stages of life; a concept previously described as temporality. In particularly sensitive periods (e.g. the prenatal stage and the early stages of childhood or adolescence), contextual influences induce adaptive responses in the individual and populations and have long-term effects, either positive or negative, at other stages of life. Effects of critical moments during these shorter sensitive periods can manifest themselves in shifting trajectories that impact health and development throughout the life course. Therefore, when it comes to health interventions, timing is important.

A large amount of scientific evidence shows that, beyond the restrictions imposed by biology and genetics, trajectories in the life course depend to a large extent on the policies, environmental conditions, opportunities, and the legal framework that creates society. Changes in these policies and environmental and social conditions can create sustainable opportunities for long-term health. This is the essential meaning of the building of health [3].

Understanding the concept of building health through the lens of the LCA is key to anticipating the impact of health policies, programs, and interventions in the short, medium, and long terms.

This vision of public health provides a more realistic view of the problems we face and sharpens the focus on the priorities and needs of the population. Furthermore, it demonstrates that in health, both action and inaction have consequences [4].

II

Creating Positive Health Trajectories from the Start: Intervention in Critical Moments

Each trajectory is unique but is shared with and influenced by others. Throughout trajectories there are sensitive or critical moments in which the influences achieve a greater effect.

The trajectories of health in people and populations vary according to the various determinants of health, including individual characteristics, social networks, income, living conditions, access to services, interactions with their environment, and behaviors. That is, there are as many trajectories as people and populations.

The time-based health trajectory perspective informs public health practice, with emphasis on these sensitive and critical moments across the lifespan and across the continuum of care [5, 6].

Reproductive, maternal, newborn, and child health

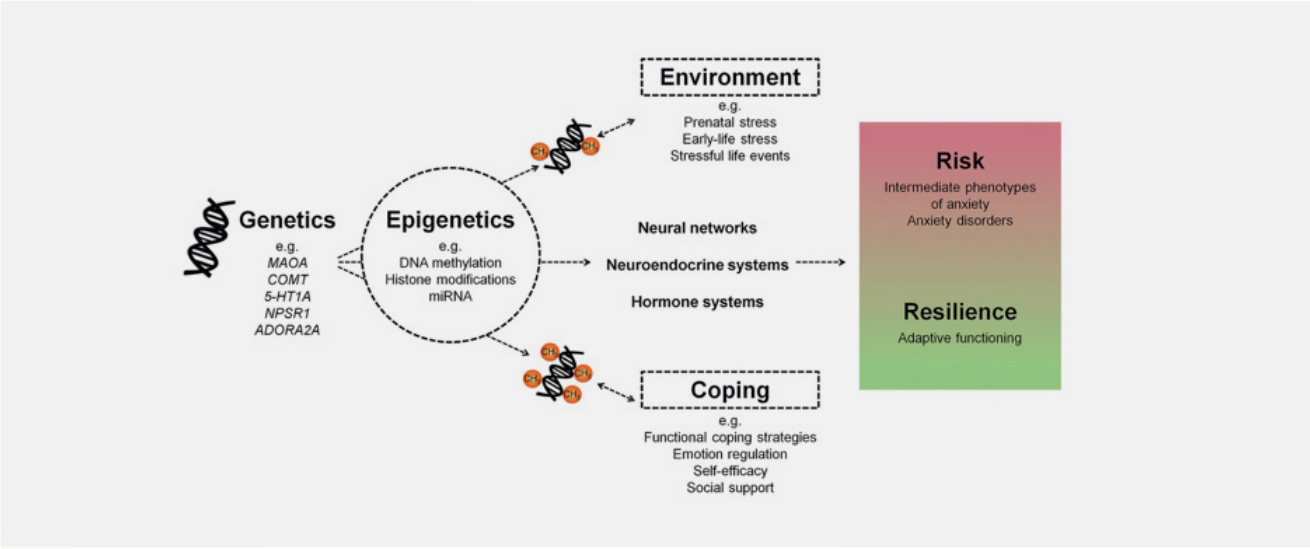
One's start in life, defined through a series of early life stages, each which impacts the next, greatly influences health trajectories. A woman's health during pregnancy affects the health of her newborn, which greatly influences the health of a child as it grows into adulthood. It is therefore impossible to silo the various areas of reproductive, maternal, newborn, and child health practice.

The prenatal period is particularly critical when it comes to influencing one's health trajectory. The sensitivity of the epigenetic system to environmental factors occurs

primarily during the prenatal period of developmental plasticity. Once a tissue or system is fully developed, while still somewhat plastic, it is less sensitive to alterations by environmental stimuli [7]. The life course perspective has therefore shown that approximately 40% of all children under five years in low- and middle-income countries are at risk of not reaching their development potential due to health and living conditions of their mothers during pregnancy and the months following birth. Low and middle-income countries have the highest prevalence of noncommunicable disease, a situation well explained by prenatal conditions that favor the emergence of risk factors for noncommunicable diseases from childhood and adolescence. The poorest populations are those that have less access to health and social services, thus perpetuating those noncommunicable diseases later in life. As health is a resource for development, the effects are manifested as low birth height and weight, diminished cognitive capacity, low school performance, teenage pregnancy, and lower income in adulthood, closing yet another circle of disadvantage [8].

Critical periods of development are also prevalent throughout early childhood, when the environment modifies and shapes the genetic map of a developing child. As shown in **Figure 15**, external experiences spark signals between neurons, which respond by producing proteins that either attract or repel enzymes that can attach them to the genes. Positive experiences such as exposure to rich learning opportunities, and negative

FIGURE 15. HOW THE ENVIRONMENT MODIFIES AND SHAPES THE GENETIC MAP



Source: Schiele MA, Domschke K. Epigenetics at the crossroads between genes, environment and resilience in anxiety disorders. Genes Brain Behav. 2018 Mar;17(3):e12423. doi: 10.1111/gbb.12423. Epub 2017 Sep 26. PMID: 28873274.

influences like malnutrition, can temporarily or permanently change the chemistry that encodes genes in brain cells. These chemical signals can be transmitted from one generation to another and interact with environmental factors that are central to development [9]. Such dynamic interactions between environment and genetics put children in different trajectories that impact their health, their cognitive potential, and their behavioral and social functioning throughout their lives.

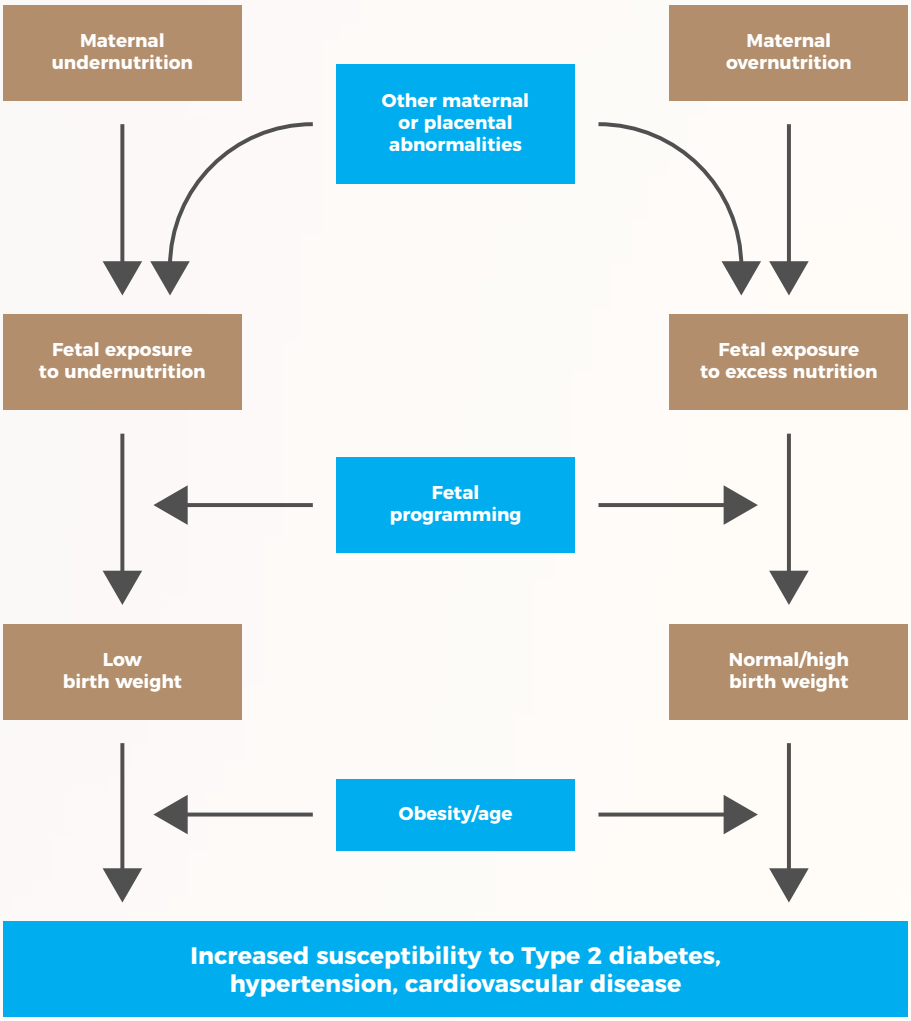
Health events (such as diseases, accidents, and disability) and access to and quality of health services and living conditions mark health trajectories. As we link these various components of health trajectories through temporality, a story of one's health unfolds. Although negative influences have a greater effect, sensitive or critical periods also represent a window of opportunity for positive influences to break the negative health cycle. To optimize these positive influences, public health areas of reproductive, maternal, newborn, and child health must be understood as a continuum with strong roots in the early stages of life that impact the health of present and future generations. In building a healthy start to life, policies, laws, and programs must not be fragmented according to disease or life stage. The life course perspective allows for the reduction of such conceptual and operational barriers by proposing a more comprehensive analysis and participation of multiple sectors involved.

The components of life course theory require public health practitioners to emphasize the linking and integration of programs by promoting integrated multisector service systems and ensuring the availability of services at critical and sensitive periods throughout the lifespan.

Nutrition

Maternal undernutrition remains a major problem in low-middle income countries, particularly since it has great potential in impacting life trajectories as it is described in **Figure 16**. Inadequate and poor-quality diets are more common among women of low income and low educational attainment, in addition to those who are food insecure [7]. Evidence shows that maternal malnutrition can have numerous implications for both the mother and the baby, and is associated with maternal morbidity, premature birth, and increased infant mortality. Furthermore, maternal undernutrition and low birth weight predispose a child to obesity, high blood pressure, heart disease, and diabetes later in life, and maternal obesity and gestational diabetes are associated with cardiovascular disease and diabetes for both the mother and her child [10, 11]. Postnatal nutrition is equally significant. In the 21st century, breastfeeding is more relevant and important for children than ever,

FIGURE 16. MATERNAL NUTRITION AND INCREASED RISK FOR NONCOMMUNICABLE DISEASES



Source: Martin-Gronert MS, Ozanne SE. Maternal nutrition during pregnancy and health of the offspring. Biochem Soc Trans. 2006;24(5):779–82. Available from: http://www.biochemsoctrans.org/content/34/5/779

regardless of whether they live in a high- or low- income country or in a rich or poor family. Its benefits transcend economic and geographical circumstances and are fundamental to the achievement of numerous sustainable development objectives, including reducing child mortality and malnutrition, improving learning, and increasing worker productivity.

Recently, it was determined that, in addition to immunological and nutritional properties, breastfeeding has components that can affect epigenetic programming at a critical moment when the child's genetic expression is being shaped for life. Exclusive breastfeeding for the first six months of a child's life is associated with higher IQ scores,

school attainment, and earnings in life [12]. Similarly, poor nutrition during this period can have irreversible consequences for the child's well-being.

While the WHO recommends exclusive breastfeeding for the first six months of life, the subsequent period of supplementary feeding, which corresponds to from 6 to 24 months of age, continues to be an important period of growth. Optimal complementary feeding not only depends on what is swallowed, but how, when, where, and from whom the infant is fed. How one feeds contributes both to good nutrition—to avoid over and under-feeding—and to development. The moments of feeding are periods of learning and love, giving the caregiver the opportunity to communicate with the infant through eye contact. Poor dietary practices and poor-quality diet can have a negative effect on a child's learning ability, economic productivity, immune response, and reproductive outcomes later in life. In addition, children who are malnourished before two years of age and then gain weight rapidly after two years are at increased risk of developing chronic diseases during adulthood [12].

The world is not yet favorable to women who want to breastfeed. The success of breastfeeding is increasingly seen not as the sole responsibility of an individual woman, but rather as a collective social responsibility. This has implications for health systems, families, and communities, and in the workplace. To be supported in breastfeeding, women need to give birth in institutions and places that are "baby-friendly" and have access to qualified personnel. To balance the demand for breastfeeding for working mothers, maternity protection is required in a consistent manner that is aligned with the recommendations of the International Labour Organization. Policies surrounding breastfeeding in the workplace must be implemented and ensured, including those that require that lactating mothers in the workplace be provided with a time and private space other than a bathroom along with a place to store breastmilk safely. Furthermore, in order to choose for themselves how to feed their baby, women need protection from breastmilk substitute companies with aggressive marketing strategies. Breastfeeding rates and adequate supplementary feeding indicators can be dramatically improved in a very short time. A package of actions that includes policies and programs to support mothers in health centers, at home, and in the workplace has a greater effect. However, the execution of these actions requires investment and political commitment.

Environmental exposures

In addition to nutrition, environmental exposures during the prenatal period greatly influence the health trajectory of a child.

While congenital malformations were long thought to be mediated by fixed genetic mutations, the perception that human development is autonomous has changed. Fetal alcohol syndrome and the impact of congenital rubella infection on genes demonstrate that stressors can result in lasting adverse effects. Similarly, it has long been known that in-utero exposures to lead and mercury lead to neurodevelopmental defects. And recent research even shows that risk of overweight in childhood is associated with the caffeine intake of the mother during pregnancy [7].

Tobacco use can also exert its negative influence during the prenatal period, and at any time during the life course. Tobacco use before and during pregnancy is associated with immediate and poor outcomes for women and their babies, including an increased risk of infertility, ectopic pregnancy, premature delivery, and low birth weight, as well as placental abruption, and intrauterine fetal death, to name a few. Exposure to tobacco in-utero can also have lifelong consequences beyond those associated with birth outcomes, and include increased susceptibility to smoking in adolescence, higher levels of nicotine dependence among adults, and an increased risk of diseases such as hypertension, diabetes, and hyperlipidemia in adulthood [13].

Toxic environmental exposures have the potential to affect not just one child, but multiple generations. The effect of either nutritional imbalance or environmental chemical exposures, depending on the dose and timing of exposures, can be transmitted to subsequent generations, thus resulting in transgenerational inheritance of increased disease risks. For example, research has found epigenetic changes in fetuses of mothers who were exposed to tobacco when their mothers were pregnant with them.

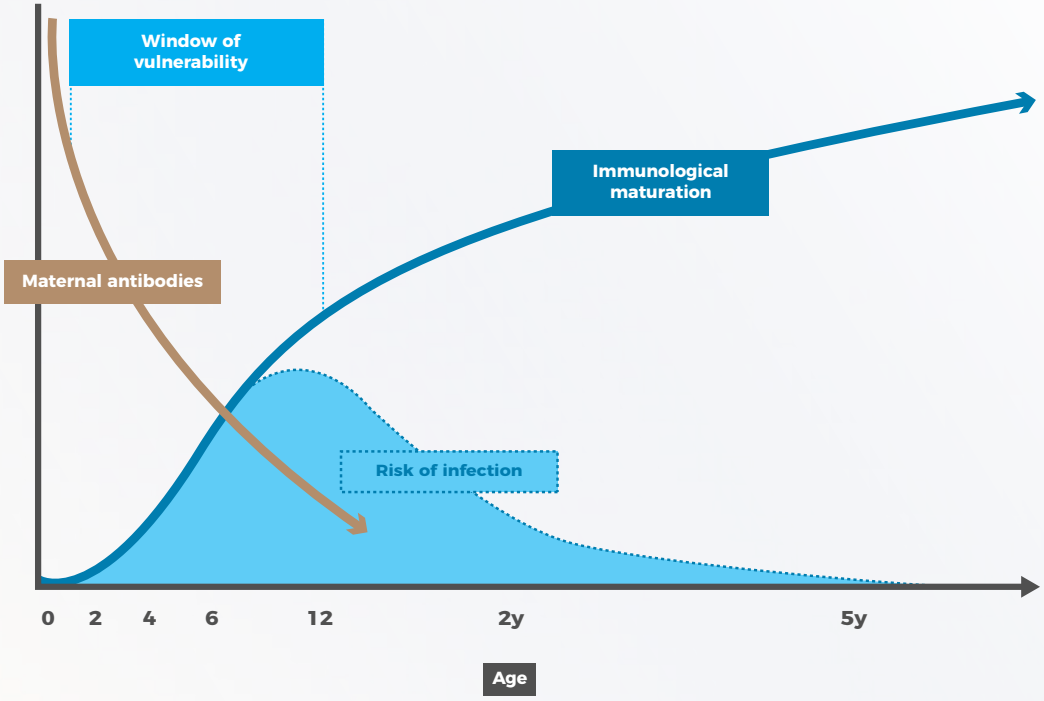
Protecting pregnant women and children from second-hand tobacco smoke and other toxins, and building safer environments, can prevent child mortality and morbidity and ultimately affect the health of generations to come. Multiple government sectors must work together to improve housing, school, and other community environments. Legislation can be created and enforced to ensure safe packaging and clear labeling, and parents and teachers can be better informed of the harms of such exposures.

Immunizations

Infectious diseases continue to be one of the leading causes of morbidity in the antenatal, postpartum, and neonatal periods that contribute to poor health later in life. The prenatal and early childhood periods are particularly critical opportunities for immunization that have great effects on one's life trajectory **(Figure 17)**.

Recent studies have demonstrated the benefits of the use of maternal vaccinations (among those who have not yet commenced or completed vaccination schedules)

FIGURE 17. INFANTS DEPEND ON MATERNAL ANTOBODIES FOR PROTECTION AGAINST INFECTIONS IN EARLY LIFE



Source: Munoz F. Immunization during pregnancy to protect infants: the case of pertussis [Internet]; Texas Children's Hospital [cited 2019 Jun 1]. Available from: https://slideplayer.com/slide/12864482

in reducing illnesses for young infants [14]. Maternally acquired antibodies are critical in protecting infants during the first months of their lives. Consequently, the immunization of pregnant women is an important strategy, not only to protect the mothers from infection but also to provide immunity to young infants [15].

Through the life course model of temporality, the importance of appropriate timing of vaccinations during childhood is also understood [16]. Incorrectly timed (early or delayed) vaccination doses often explain the persistence or resurgence of vaccine-preventable infections. For example, outbreaks of diseases such as measles can occur among populations with high vaccination rates, due to vaccine failure resulting from individuals being vaccinated outside the recommended period [17].

While recommendations on the use of vaccines during pregnancy and childhood are prevalent, ethical, policy, and educational barriers need to be addressed to improve the uptake of the currently recommended vaccines. And while the early life stages are critical moments for vaccines, vaccination strategies should not be segmented by discrete stages of life defined by age, but instead should be designed to maximize an individual's ability to achieve and maintain good health throughout their life [18, 19].

Familial and social environment

Currently, there is a sustained effort in Latin America and the Caribbean to achieve more and more economic growth and social development. Development is only possible if children reach their full potential for their healthiest life trajectory. In the Region of the Americas, it is estimated that there are some 11.9 million children under the age of five who are at risk of underdevelopment (equal to 22% of this age group)[20]. The possibility that children reach optimal health conditions at the scale of their potential depends on the opportunities offered by families and society.

Opportunities are provided through the physical and social environment in which children grow and develop, and by the macrosocial, political, and legal contexts under which parents can or cannot make the decisions that concern the well-being of their children [21]. Unfavorable conditions in any of these two planes—the familial and the social—limit the achievement of better welfare quotas and contribute to the intergenerational transmission of suboptimal levels of child development.

Parents and caregivers, both men and women, can mitigate the negative effects of disadvantage if they receive adequate parenting support to provide their children with health, nutrition, sensitive care, safety, and early learning [22].

Recent studies describe the benefits of positive parent-child relationships. Babies with very committed parents demonstrate better cognitive development compared to babies with less committed parents [23]. A study in preterm infants found that those babies with committed parents were associated with a variety of positive outcomes including better language development and a higher IQ after age three. Another study recently found that the four domains of parent engagement (cognitively stimulating activities, warmth, physical care, and caring activities) were consistently associated with greater cognitive outcomes for babies [24]. Cognitive development sets the stage for early learning and school readiness.

Apart from parent involvement, socioeconomic status in early stages of life is an indicator of the educational attainment and health throughout the life course. In addition to differences in access to health services, children at lower levels of socioeconomic status are exposed to less favorable physical and social environments at the home, school, and community levels. These environments shape the processes of physiological and psychological maturation and the acquisition of lifestyles related to health and contribute to risk for disease and dysfunction in adulthood. This explains why in many countries with an equitable distribution of access to health services, socioeconomic status at the beginning of the life course continues to be a good predictor of adult health [28].

FIGURE 18. COMPONENTS OF A NURTURING ENVIRONMENT FOR CHILDHOOD DEVELOPMENT

Source: Britto PR, Lye S, Proulx K, et al. Nurturing care: promoting early childhood development. Lancet. 2016; 389(10064):91-102. doi.org/10.1016/S0140- 6736(16)31390-3.

Adversities in the first years, even during pregnancy, can affect the trajectory of the life course, especially when multiple challenges coincide, such as poverty, nutritional deficiencies, intrafamily violence, high-crime communities, and low-quality social resources. These adversities can be influenced by public policies, social norms, and a clear action towards equity. Consequently, a commitment to promote the health and well-being of children implies support for families and caregivers, so that they can provide tender care and overcome those situations that interfere with their capacity to raise children.

Early childhood development is a call to take decisive action to ensure that employment, housing, financing and security policies consider their effects on children and their caregivers, including health, education, and protection services **(Figure 18)**.

Importance of Male Involvement in Child Development

Men make valuable and unique contributions to the cognitive development of their children. Studies examining neurological and hormonal responses to care indicate that men are natural nurturers [25, 26]. In other words, the variation between caring relationships between men and women is likely due more to sociocultural pressures than to biological capacity. In practice, research and policy, the importance of male parents and caregivers in child health throughout the life course is often not emphasized. In the same way, the importance of the father's interaction in positive upbringing in the physical and mental health of men is often unknown. The life course perspective opens the door to opportunities to understand the contributions of male caregivers to child health. Thus, this broader vision of the social conditions that have an impact on the health of children should include men as active contributors in this process of generating health and well-being [27]. In recent years, fathers have experienced a transformation in their roles, expectations, and identities. The new generation of fathers is beginning to put aside the traditional role of serving as a "breadwinner" and are dedicating themselves more to caring for their children and being parents with their partner. These changes reflect broad social progress in the empowerment of women and child development and should be explored more in public health practice.

The accumulated evidence so far identifies many factors of the physical and psychosocial context correlated with the socioeconomic conditions in the early stages of life, which would explain the long-term effects of these factors on health.

Little is known, however, of the mediating factors of these effects. The field of social epidemiology works to identify these mediating factors, together with other influencing health events not related to the socioeconomic condition, which would be a crucial step for the design and implementation of more effective and efficient interventions. As the signs that link the early stages of life with the health of the adult accumulate, it becomes more important to reveal the causal mechanisms related to socioeconomic status and strategies based on these mechanisms and their temporality to eliminate or minimize their long-term consequences. In exploring these causal mechanisms more, it is important to develop technical cooperation with countries through interagency collaboration.

III

Ensuring Healthy Transitions

Developing interventions around these transitions is important in ensuring positive life trajectories for people, no matter how young or old.

Trajectories are interspersed with transitions that are defined by changes in physiological ability or social roles and can be linked to the gain or loss of functions depending on the stage of physiological or social processes. These transitions are characterized by changing needs in health care, social support, and environments.

Positive development in adolescence

The transition from childhood to adolescence is an important time of human development. This transition is a critical moment in the change of social roles and relationships in which individuals begin to demand more autonomy and independence from adults and develop a stronger sense of who they are and what they want. This transition also implies a moment of changing experiences and great expectation as young people progress toward adulthood. At present, there is a great diversity in the sequence, time, and success of the transitions of young people to adulthood.

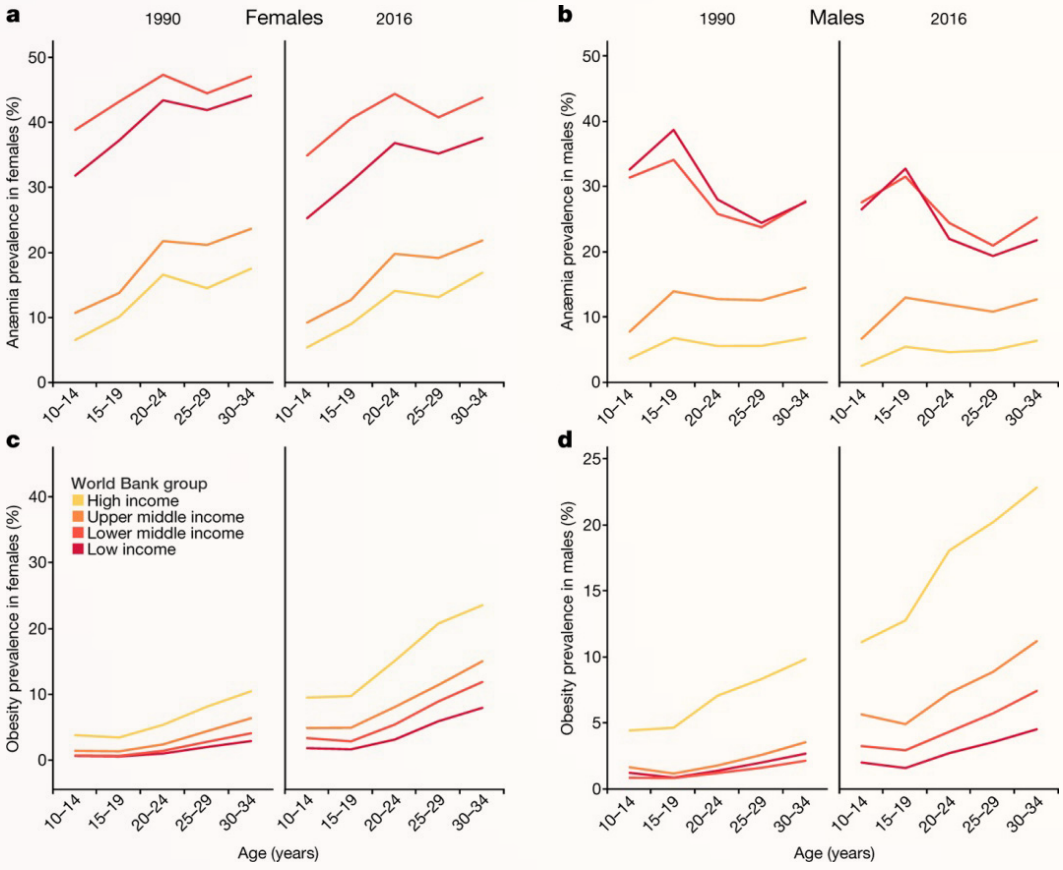
These transitions from youth to young adults are more fluid and less defined; a pattern that is more typically associated with these age groups [29]. The onset of puberty often marks the beginning of adolescence. Patton and colleagues [30] suggest that improvements in nutrition and decreases in infectious diseases during childhood have been accompanied

by a fall in the average age of onset of puberty by about four years, to 12 or 13 years of age—a fall that has been rapid in low and middle-income countries.

During this same period, there were even greater changes in the timing of parenthood; the result of extended education, changes in social norms around marriage and parenthood, and the availability of effective contraceptive methods.

Due to the earlier onset of adolescence, the continuation of the development process until age 20, delayed parenthood, and a delay in the adoption of adult roles, the proposal to establish a new range for adolescence from 10 to 24 years has emerged [30]. Adolescence is considered a sensitive period during which the quality of the physical, social, and nutritional environment can change the trajectories of health and development later in life.

FIGURE 19. LONG-TERM NUTRITIONAL RISKS OF THE FIRST BIRTH TRANSITION IN 1990 AND 2016: PREVALENCE OF ANEMIA AND OBESITY IN MEN AND WOMEN



Source: Patton et al. Adolescence and the next generation. Nature. 2018;554:458–66. doi: 10.1038/nature25759.

As described in **Figure 19**, anemia and obesity are two such examples of conditions that are more likely to arise in adolescence and affect health trajectories.

Adolescent Pregnancy

During puberty, girls who have experienced menarche gain the biological capacity to reproduce. During the following years, the female reproductive system matures little by little, and generally reaches an optimum maturity in the early twenties. Childbirth before this maturity is associated with greater risks to the mother and baby's health. Worldwide, the complications of pregnancy and childbirth are the leading cause of death in young women aged 15 to 19 years. Early maternal age is associated with lower gestational age, low birth weight, and reduced nutritional status of the child. Worldwide, perinatal deaths are 50% higher among babies born to mothers under the age of 20 than those born to mothers aged 20 to 29 years. Early unwanted conception also contributes to unsafe abortion, which contributes to mortality and health problems in the short and long term [31].

In addition to the biological significance, early motherhood has social and economic consequences for the mother and baby. New mothers have the priority of ensuring that their child's basic needs are met and that they have access to conditions to survive and thrive, including food, protection, health care, early stimulation, and education. Girls who start reproduction early are therefore more likely to interrupt their education, which contributes to a lower income capacity throughout their lives, and to a reduced ability to support themselves and their children. Children of mothers with less education are more likely to achieve less education themselves.

The prevention of adolescent pregnancy and the provision of support to adolescents to control their own fertility not only helps to save adolescents' lives, but also gives them the opportunity to complete the development of their reproductive system and increase their chances of obtaining an education, their income potential, and the possibilities for optimal health and development of the next generation.

Positive Youth Development (PYD) is an approach to working with youth that emphasizes building on the strengths of youths and providing supports and opportunities that will help them achieve goals and transition to adulthood in a productive, healthy manner [32]. Under the PYD perspective, the adolescent years are viewed as full of assets and potential rather than rife with risks to be managed and problems to be solved.

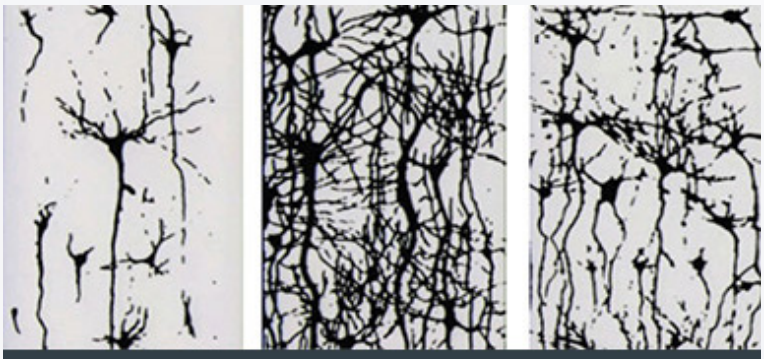
Instead of focusing on health problems and adolescent behavior such as delinquency, violence, mental health problems, risky sexual behavior and the use of substances, the PYD framework emphasizes the promotion of protective factors that mitigate risk and that are more likely to guarantee positive and sustainable results for young people [33].

The Adolescent Brain and Social and Emotional Development

Throughout life, the human brain is in continuous development, a phenomenon known as neuroplasticity. In the past, it was thought that brain development occurred only in the first years of a person's life. However, evidence in the area of neuroscience indicates that brain functions continue to develop into adulthood. Research suggests that the development of the adolescent brain is considerably different from brain development in childhood [34].

During childhood, attention is focused on synaptic growth, which allows the brain to increase in size and weight significantly. From age 10 until early adulthood, the development of the brain focuses on synaptic pruning; the process of eliminating weak synapses to achieve greater efficiency of the brain **(Figure 20)**. It is believed that synaptic pruning depends on the neuron's responses to environmental factors and external stimuli [35, 36]. Therefore, this stage of brain development is considered a critical period where the individual is excessively receptive to environmental stimuli.

FIGURE 20. **SYNAPTIC PRUNING AND THE ADOLESCENT BRAIN**



The pruning trajectory of brain synapses.
Left to right: at birth, age 6 years, age 14 years.

Source: Australian Government: Australian Early Development Census [Internet]. Melbourne, Australia: Brain Development in Children; 2019 [cited 2019 Jun 1]. Available from: https://www.aedc.gov.au/resources/resources-accessible/ brain-development-in-children

Photo: Chugani, H.T. Synaptic Density. [Drawing]. In R. Shore, Rethinking the Brain: New Insights into Early Development (p. 20). New York: Families and Work Institute, 1997.

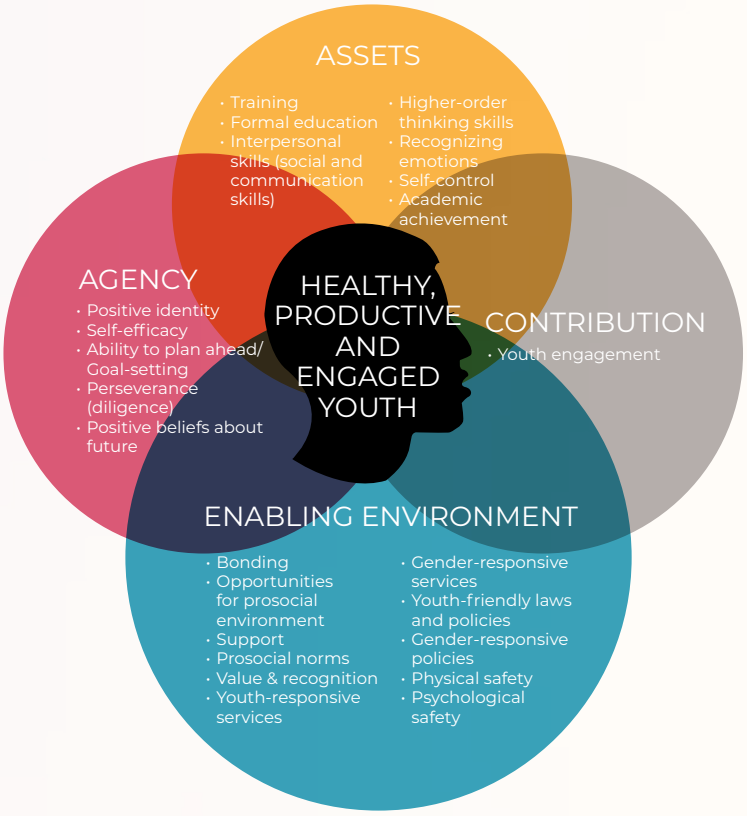
This new knowledge has enormous consequences for the neurological development of adolescents since it explains the adaptive form of learning and the rapid acquisition of interpersonal and emotional skills during adolescence. It also highlights the importance of ensuring a safe and stable social environment for adolescents in order to support the optimal development of brain functions necessary for social and emotional well-being in adulthood [37].

The PYD framework incorporates the theories of planned behavior, ecological systems, social learning, and identity development, as well as the LCA. As described in **Figure 21**, this framework identifies assets, agency, contribution, and an enabling environment as central components in the positive development of young people.

Assets refer to the resources, skills, and competencies that youth need to achieve their desired outcomes. Agency reflects the ability to employ those assets to create goals and act in ways that help them achieve those goals. Contribution refers to youth engagement for their own and their communities' positive development.

Lastly, an enabling environment develops and supports their assets, agency, access to services and opportunities, and strengthens their ability to avoid risks and stay safe and protected. These components allow youth to thrive physically, socially, and emotionally [38]. The PYD approach involves young people with their families, communities, and/or governments so that they are empowered to reach their maximum potential. It is important to incorporate PYD into youth-serving programs.

FIGURE 21. **POSITIVE YOUTH DEVELOPMENT FRAMEWORK**



Source: Youth Power. What is positive youth development? [Internet]. Washington, D.C.: Youth Power; 2019 [cited 2019 Jun 1]. Available from: https://www. youthpower.org/positive-youth-development

Following this framework, youth programs should promote supportive relationships with adults and peers, opportunities for meaningful inclusion and positive identity formation of all youth, and positive social norms. Effective youth programs provide support for youth autonomy and leadership, encouraging youth to achieve meaningful change in their community, as well as opportunities for skill-building so that they can make positive and informed decisions that affect their health, educational, and career opportunities [39, 40].

The construction of assets and skills of adolescents can result in immediate and long-term positive effects in different areas (mental health, physical health, economic development, and general well-being) for adolescents themselves, their families, and the communities in which they develop [34].

Investing in the health of young people generates a multiplied benefit: healthy youth today, healthy adults in the future, and healthy future generations. The sustainable development goals [41] and the Global Strategy for Women, Children and Adolescents (2016–2030) [42] highlight the strategic importance of young people for the success of the 2030 Agenda for Sustainable Development. It is essential to include young people in the process of transforming our future and it is our commitment to ensure that they have the necessary resources to achieve it [34].

Healthy aging

Just as adolescence brings change in physiological ability and social role, so too does the transition to late adulthood. Retirement is often one of the first changes in late adulthood and can be accompanied by reduced income and altered social roles and entitlements. Health issues in late adulthood can also impact daily life. Whether it's something chronic like arthritis or a sudden illness like a stroke, older adults may have to make significant adjustments in their lifestyle. The transition into older adulthood is not as clear as transitions in other stages of life, such as the transition from childhood to adolescence. However, these transitions are significant, and society must recognize that older adults need unique services and support.

The aging transition can also take place on a population level. Population aging is defined as the increase in the average age of the population over time. According to the publication Health in the Americas 2017 [43], between 2000 and 2050, the proportion of the world population age 60 and over will increase from 11% to 22%. By 2030, life expectancy in Latin America and the Caribbean is expected to reach 74.7 years for men and 80.7 for women. As life expectancy continues to increase, so will the problems relating to physical and mental health, as well as the economic and social well-being of the elderly. Over the next decade, aging at both the individual and population levels will be an important factor in terms of the need for health, safety, and social protection services and a challenge for the systems that will have to meet those demands [43].

Healthy aging considers factors that impact the health of the elderly, including past events and experiences that create conditions that can influence health and quality of life [44]. Healthy aging allows us to visualize a society that supports and values the contributions of the elderly and their diversity, and works to reduce

inequalities in health. Healthy aging also provides opportunities to achieve autonomy and independence, maintain quality of life, and make the right decisions in health throughout the life course.

> **Healthy aging** is a continuous process of optimizing opportunities to maintain and improve physical and mental health, independence, and quality of life throughout the life course [43].

To meet the goals of healthy aging, it is not enough to simply amplify or improve current efforts; systems will have to change and adapt to new demands. Aging will continue to be a major drawback to public health in the coming decades and its consequences will not be limited to the fact that there will be a greater proportion of people aged 60 or older. Aging also brings with it a combination of multiple chronic disorders and recurrent infectious diseases, among others [45]. It is therefore essential to educate older people on how to stay healthy and live a healthy life even with one or more chronic illness.

The WHO Framework of integrated, people-centered health services establishes a vision in which "all people have the same access to quality health services that are co-produced to meet the needs of their life course" [46]. The framework defines the concept of "health co-production" as the "care that…implies a long-term relationship between people, providers and health systems where information, decision-making and the provision of services are shared" [46]. In addition to chronic disease care, long-term care services in the home are essential during this stage of life. It is estimated that approximately 20% of people over 65 will need long-term care services and support to perform activities of daily living [46].

The health of older adults in the Region will be determined by the availability of age-friendly policies and programs that provide sustainable environments that allow older people and their families to live with

Physical Activity: A Protective Factor for Memory and Thinking

A new case of dementia is detected every four seconds worldwide. Currently, 35.6 million people suffer from dementia, and by 2050, this number will more than triple to 115.4 million [47]. Mild cognitive impairment is a recognized risk factor for dementia and may represent the initial stage of Alzheimer's disease [4]. Therefore, the social value of developing effective intervention strategies cannot be underestimated [47, 48].

Studies suggest that healthy lifestyle habits are associated with a lower risk of suffering from dementia [49], and there are significant cognitive benefits of lifestyle interventions [50, 51]. Being physically active is important to a healthy lifestyle and is actually directly related to not just the prevention of diseases like cardiovascular disease and diabetes but also dementia. Several studies show that exercise modifies the brain in a way that protects memory and cognitive or thinking skills, and regular aerobic exercise increases the size of the hippocampus; the area of the brain involved in verbal memory and learning. Exercise also reduces insulin resistance and inflammation and stimulates the release of chemicals in the brain that affect the health of brain cells, the growth of new blood vessels in the brain, and even the abundance and survival of new brain cells [52]. Studies have suggested that the parts of the brain that control thought and memory (the prefrontal cortex and the medial temporal cortex) have greater volume in people who exercise compared to people who do not. Indirectly, exercise improves mood and sleep, and reduces stress and anxiety. Problems in these areas often cause or contribute to cognitive decline [53].

In a 44-year longitudinal study conducted in 191 women between 38 and 60 years old, it was observed that high-intensity cardiovascular exercise compared with cardiovascular exercise of medium intensity during middle-age of life is associated with a decrease in the risk of suffering from dementia by 88% [54]. In another study, it was found that a low cardiovascular conditioning is associated with a smaller brain volume, which becomes visible two decades later in life [55]. The regions of the brain that are most influenced by physical activity, including the hippocampus, are those that are also vulnerable to changes related to age and early pathologies in Alzheimer's disease [56].

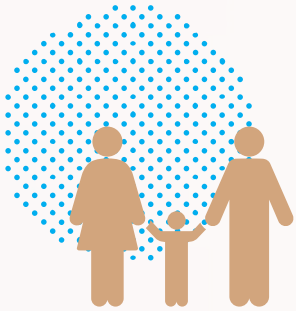
The LCA is essential to understanding the effect of a specific exposure on the risk of developing dementia. More research is needed on the long-term direct effects on brain structure to improve prevention strategies against dementia. Longitudinal studies are necessary since the effect of several of the risk factors of dementia depends largely on age [57, 58]. The exact mechanisms that link healthy lifestyles with brain health are not yet fully understood but include cardiovascular mechanisms and other physiologies.

Despite need for further research, it is clear that to change the path of cognitive impairment and loss of functional independence, aerobic exercise represents an effective opportunity in the maintenance of hippocampal volume and should be a standard recommendation for all, including older adults, regardless of their cognitive status [59].

dignity and quality of life. The oldest population of the Region today grew with privileges and disadvantages that have resulted in marked differences in life expectancy, longevity, and health. Therefore, the challenge is to invest in the necessary interventions to reduce health inequities in older adults and improve the conditions that promote healthy aging and equity by building the necessary infrastructure to address the continued growth of the older adult population [60-62]. The countries of the Region will need to strengthen their capacity to formulate and implement policies and programs that help to respond to this unprecedented reality.

IV

Identifying the Gray Zones



While the LCA emphasizes the importance of early experiences in shaping adult health, it also acknowledges agency in influencing the impact of such circumstances in adulthood.

Enclosing the so-called “stages” of life in rigid and immovable age groups has been and is one of the main limitations to understanding and addressing transitions within the life course. There are transitions that have been largely ignored by public health and become gray or transparent periods. Furthermore, the life course differs for men and women. Gender gaps exist at all stages of the life course and public health attention at all stages remains important.

Health of women of Post-reproductive age

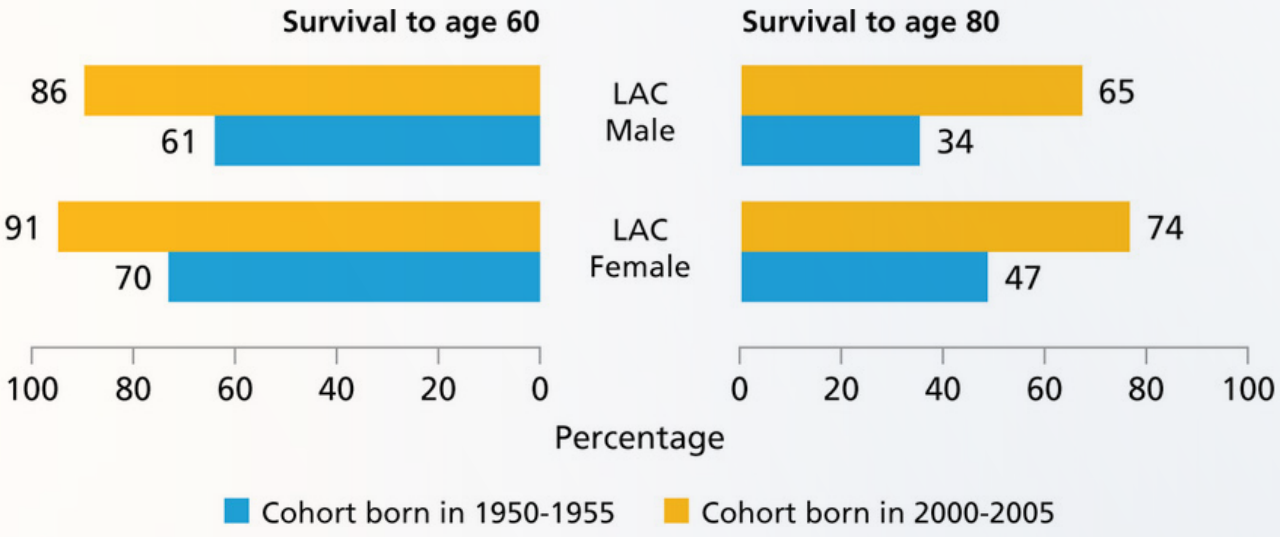
Despite considerable progress in the Region, especially in the reduction of maternal and infant mortality and the increase in life expectancy, great disparities persist between genders and across countries. The commitment to further protect the health of women is described in the sustainable development goals and the Global Strategy for the Health of Women, Children and Adolescents (2016–2030), both of which prioritize universal access to health care for women to achieve the highest possible level of physical and mental well-being. The LCA conceptualizes life trajectories and illuminates the optimal periods for the maximum effectiveness of interventions. Women’s health from a life course perspective makes visible the health challenges that women face, which are unique before, during, and after their reproductive years. These health experiences are products of a complex interaction with the social determinants that arise from multidimensional roles in society: from economic contributors to mothers and caregivers. The medical and social determinants that affect women throughout their lives include

the lack of a guarantee for a fair start for all girls, gender inequality, and health inequalities in terms of chronic disease, mental health, and sexual and reproductive health.

The consideration of health throughout the entire life course of women is necessary to understand the factors that precede and provide context to postmenopausal health. This issue has become especially relevant given population growth and increased life expectancy **(Figure 22)**; in the Americas between 1950 and 2050, the population is expected to triple, and the average life expectancy is expected to increase by 29 years. While women on average live longer than men, they are not necessarily living healthily, and there is a great disparity between life expectancies of women among nations [63].

Addressing women's right to health throughout the life course can contribute to strengthening women's health systems, rights, and health, as well as the general welfare of society [64]. Noncommunicable diseases (NCDs), such as diabetes, heart disease, and cancer, are the leading causes of death and disability among middle-aged women in the Americas. Without access to effective preventive health interventions, there is a loss of opportunity for women to continue to live healthfully into old age and increase their contributions to society. Furthermore, women are more prone to mental health problems, such as depression and anxiety.

FIGURE 22. **INCREASED PROBABILITIES OF SURVIVAL, BY SEX IN LATIN AMERICA AND THE CARIBBEAN**



Source: Pan American Health Organization. Aging and Demographic Changes. In: Health for the Americas [Internet]. Washington, D.C.: PAHO; 2017 [cites 2019 Jun 1]. Available form: https://www.paho.org/salud-en-las-americas-2017/?p=55

The factors that contribute to the exacerbation of mental health disorders are gender violence, caregiver stress, and low social status; all of which can be prevented or decreased [65-67].

Without access to adequate income, women cannot access the preventive or high-cost care necessary to effectively manage the burden of chronic diseases and mental health disorders. While the contribution of women to the development of the modern economies of the Region is extensive, women are more likely to depend economically on other people due to lack of representation in government and the formal workforce. As it is described in **Figure 23**, some 79% of employed women work in low-productivity sectors where rates of access to social protection are low, and women contribute between 71% and 86% of total unpaid work, limiting their opportunities to enter the formal labor market and to earn better salaries with pension and health insurance benefits. In addition, women in Latin America earn disproportionately less than men. In 2009, the average income of women was between 62% and 81% of their male counterparts, and women represent a higher percentage of those living in poverty compared to men. With less income, women become less autonomous in decision-making about finances and medical care [68]. The empowerment of women has serious implications for social development and demographic stability.

The Region of the Americas has the fastest aging population in the world, raising concerns about the viability of existing pension programs and the availability of health care systems. It is understood that reducing the cost of medical care through preventive medicine is part of the solution to controlling the costs of medical care. Emphasizing women's contributions to society and taking advantage of the momentum of the SDGs is the first step in addressing NCDs and promoting universal health access and coverage for women in the Region [69].

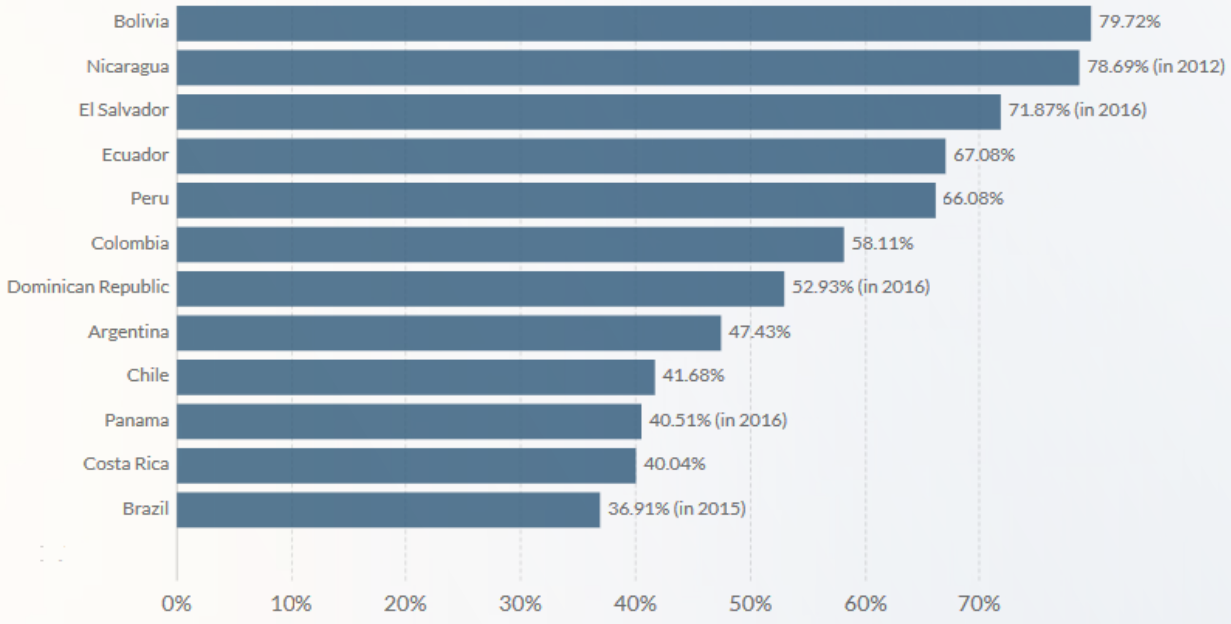
Considering the health of women of post-reproductive age in the context of the life course is key to identifying opportunities for intervention in the improvement of women's health. Supportive environments for girls that encourage positive eating habits, reinforcement of healthy behaviors, reduction of family and sexual abuse, and access to immunization and health care are necessary to optimize women's health and careers in the Americas. Continuing education, the perpetuation of beneficial physical health and dietary behaviors, access to mental health resources, protection against early marriage, and sexual education all must be provided to adolescents for a healthy transition to adulthood. Setting the stage for healthy aging with continued opportunities for health into adulthood prevents the emergence of NCDs and breaks a dangerous cycle in which women and their families cannot access quality health care.

The health of women goes beyond reproductive health and reproductive years. The factors that affect women's health are complex and should be addressed if cooperation and social cohesion are to be improved in the changing demographic and epidemiological climate. The life course perspective elucidates the opportunities for the development of policies and interventions that efficiently optimize the health trajectories of women, thus countering the proliferation of health systems with limited resources.

Men's health

In the Region, men's health has taken on increasing relevance and importance, and not only as a response to increased focus on women's health. Existing gaps in men's health have been recognized and described in scientific, social, and medical publications [70]. Throughout the life course, the stressors associated with beliefs and expectations about men's behavior, economic opportunities, and social marginalization have contributed to men being more likely to have less healthy behaviors, as well as high rates of morbidity and mortality compared to women [71].

FIGURE 23. **WOMEN IN INFORMAL EMPLOYMENT AS SHARE OF FEMALE EMPLOYMENT, 2017**



Source: Organisation for Economic Co-operation and Development. Gender, Institutions and Development Database [Internet]. Geneva: OECD; 2014 [cited 2019 Jun 1]. Available from: https://stats.oecd.org/Index.aspx?DataSetCode=GIDDB#2014

WHO data estimate that approximately 52% of all deaths caused by NCDs are among men [72]. Men younger than 70 are more likely to die earlier from NCDs compared to women, and men's life expectancy is also shorter. Compared to women, men have a four times higher mortality rate due to external causes and have a seven times higher risk of dying from homicide. The probability of men dying from ischemic heart disease is 75% higher compared to women. Moreover, 36% of all preventable deaths occur in men compared to 19% that occur in women [73].

The evidence also suggests that health behavior plays a fundamental role in the etiology and in the leading causes of death among men [75]. Men may behave in certain ways to negotiate power and social status, and these behaviors may deteriorate or promote health. The way men think and project their image responds to gender norms and pressures dictated by society, and while gender norms vary according to social and cultural contexts, they are often consistent in terms of health behaviors [76]. Societal gender norms for men are often associated with premature mortality caused by stress and unhealthy behaviors such as reckless driving, alcohol consumption, drug abuse, and high-risk sexual behaviors [77, 78].

Socioeconomic inequalities also play a role in determining how these norms affect health, and beliefs and expectations about men's behavior can become risk factors when exacerbated by a lack of economic opportunity and social marginalization [71]. Male gender norms may also contribute to the male tendency to suppress the expression of need and minimize pain, which is reflected in lower male engagement in preventive health care visits and medical routines. Men are more than twice less likely to visit a doctor than women and have lower levels of adherence to medical regimens than women [74]. These differences are pronounced for vulnerable subgroups of men, like those with low socioeconomic status. Differences in use of care and medication adherence contribute to differences in health outcomes [71].

Gender analyses in health have examined the ways in which the social constructions of gender identity affect health [79]. However, there are few systematic studies that have examined the relationship between masculinity and men's health; most studies have focused on the negative effects of gender inequalities and the negative role of masculinities on women and their health as well as the need to empower women to guarantee their right to health [80].

So far, much less attention has been paid to the relationship between the gender nature of men's identities and aspects of men's ill health.

Advancing the study and practice of men's health requires a life course perspective that explores variations in pathways through sociocultural, behavioral, psychosocial, environmental, and biological factors that create and sustain health disparities among and between men and women.

Interventions that counter gender norms that are dangerous to health at all stages of men's lives are particularly important in improving men's health throughout the life course. Increasing demand for health care among men is also central to men's health.

V

Intergenerational Transmission of Health

It is important in public health practice that we use an LCA to understand and address the intergenerational repercussions of poor health in any stage of life.

The health of parents, especially mothers, has been described as a determinant of the health of children. If a child from zero to three years of age has a mother with excellent health status, their chance of having good health increases by 27% [81]. Research shows that for health problems such as asthma, chronic headache, diabetes, and hay fever, the prevalence is greater among children with parents who reported having these health problems. Having a father with specific health problems increases the prevalence of the condition among his children by ≥100%.

For example, children of parents who have been diagnosed with asthma are 161% more likely to be diagnosed with the same problem. In addition, the strength of intergenerational transmission increases as children grow. Children whose parents were diagnosed with asthma are approximately 7% more likely to have asthma during childhood (10% prevalence vs. 3%); however, at the age of 17 the difference increases by 21 percentage points (34% vs. 13%).

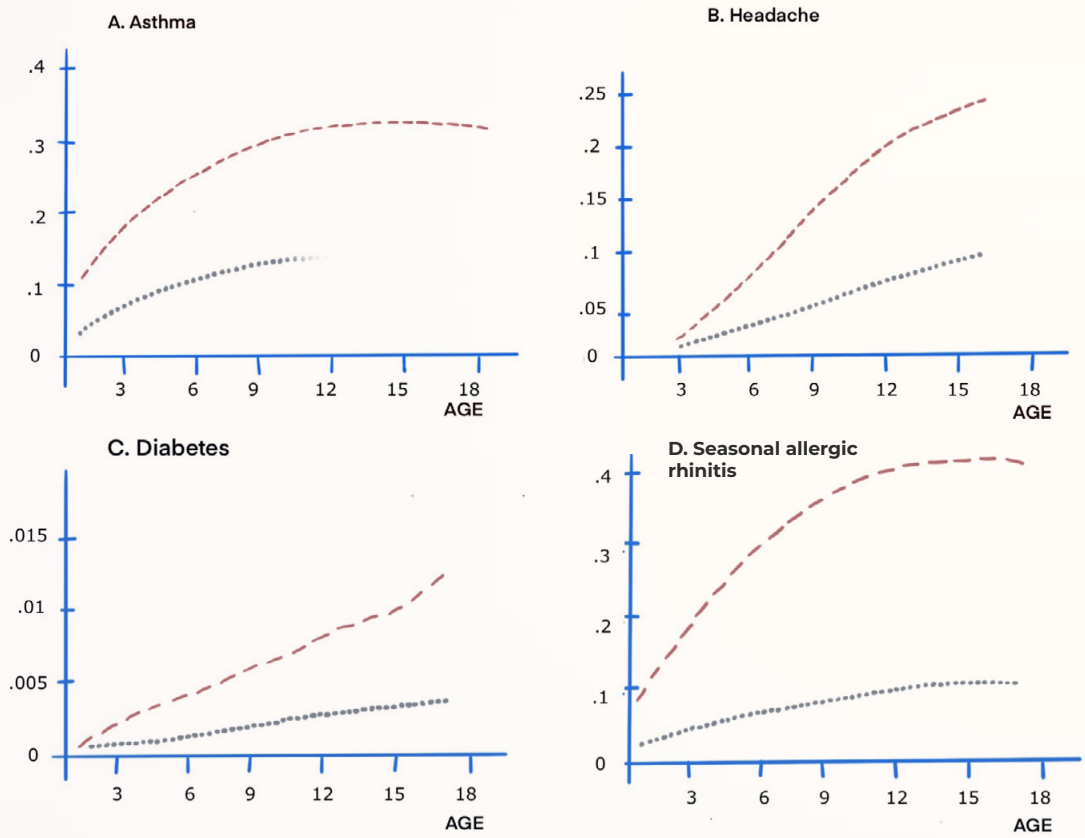
As shown in **Figure 24**, this trend has also been described in hay fever, chronic headache, and diabetes. This evidence suggests that by controlling the income, education, and family composition of parents, parents in poor health are more likely to have children in poor health. However, these studies have also shown that there are significant differences between health measures and age groups [82-84].

In developing countries, it has been observed that the correlation between the health of parents and children is weaker when parents have better incomes, levels of education, or access to public health infrastructure—all which influence health outcomes of all of which children [85].

Therefore, the circumstances of the environment shared by parents and children play a key role in the transmission of health from one generation to another.

One's socioeconomic level generates a strong influence on their children's health status from the early life stages [86, 87]. Because parents and children share the same household, both are subject to the same socioeconomic conditions that will impact their health experiences jointly (air quality, adequate nutrition, etc.). Another important factor in relation to the environment is access to health care. There is an intergenerational correlation between access to health and utilization of services, as parents decide which health services they are able to and would like to access. Health behavior represents another nongenetic factor in the intergenerational transmission of health, seeing that many habits are taught at home. Behaviors in terms of diet, exercise, alcohol and tobacco consumption, as well as personal safety are important determinants of health throughout the life course that persist through the generations [88, 89].

FIGURE 24. **TRANSMISSION OF HEALTH BY AGE OF THE CHILD**



Source: Owen T. Genetic mechanisms in the intergenerational transmission of health. J Health Econ. 2014;35(1):132–46.

Children's physical health, which may be influenced by not only their parents' health but also their environmental conditions, has a clear and lasting impact on a wide variety of outcomes later in the course of their lives. Harris et al. [90] found high correlations of health and education of parents with the health of their offspring in adulthood. Furthermore, the health of children at an early age plays a strong mediating role between the socioeconomic status of parents and that of their children when they reach adulthood. Findings such as these further suggest that there are intergenerational correlations between the health, socioeconomic status, and education of parents and their children throughout their life, beyond the covariation explained by genetic factors.

These gene-environment interactions have a physiological basis; even when the DNA sequence of an individual is fixed during conception, the genetic expression depends on the circumstances of the environment. In this context, the implication of these biological processes is that a child may have genetic characteristics that predispose them to certain health conditions, but these genetic characteristics only matter if the specific circumstances of the environment are present [91].

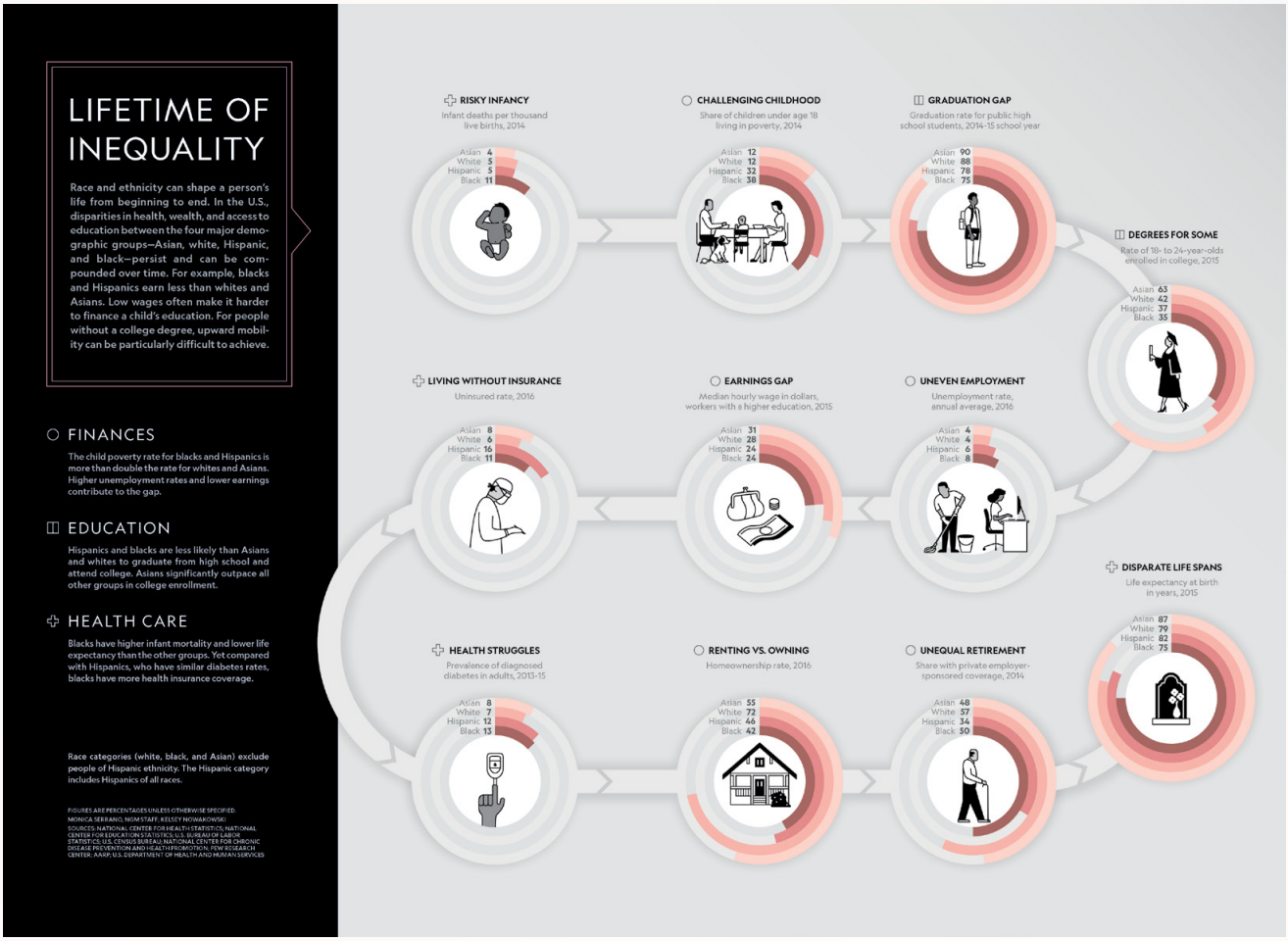
Intergenerational transmission of health inequities

Health is susceptible to inequalities on multiple levels and in different points of the life course. The LCA allows us to better understand how social inequities in health are perpetuated throughout the course of an individual's life and transmitted from generation to generation. This phenomenon indicates that greater social equity will reduce the perpetuation and transmission of social inequities in health throughout life and across generations [92, 93]. This perspective has implications for how health promotion and disease prevention should be pursued.

In the Americas, social inequity must be overcome to obtain universal health. This path to universal health cannot be severed from the LCA, which provides concrete and verifiable hypotheses about the mechanisms of inequity perpetuation, which is not limited to a particular health problem or transitory episode, but is present throughout the spectrum of health-disease balance and has effects throughout the life course.

In the Region of the Americas, inequalities are accompanied by low intergenerational mobility, which has its origin in the social differences that children must face from birth and the first stages of their lives. These differences are manifested not only in their achievements but also in their opportunities **(Figure 25)**.

FIGURE 25. **LIFETIME OF INEQUALITY**



Source: Serrano M, Nowakowski K. Lifetime of inequality. National Geographic [Internet]. 2019 [cited 2019 June 14]. Available from: www.nationalgeographic.com/magazine/2018/04/race-ethnicity-inequality-life-health-wealtheducation-%20infographic/#.W2Sl3PykzPE.email

Low Birth Weight and Intergenerational Transmission of Health Inequities

Low birth weight is predicted both by the social position of the parents of the newborn and by the results of their development [94, 95]. Babies weighing less than 2,500g at birth have lower performance in a variety of cognitive measures [96]. As found in twin studies, low birth weight has causal effects on educational attainment, therefore affecting the economic income of one's lifetime [97-99]. Figlio et al. [100] conducted the most complete study of the consequences of low birth weight in educational outcomes. Isolating the effect of birth weight from the variation of social contexts while also exploring the impact of school support, it was found that a twin born with a higher birth weight has better cognitive abilities, as determined by test scores. This effect remains constant during the first 13 years of life. In addition, they found that the greater the birthweight gap between two twins, the greater the gap in test scores. However, despite the significant effect of birth weight, social factors are more predictive of future outcomes: it is better to be the lighter child of a university mother than the heavier child of a high school graduate.

Furthermore, birth weight is more than a marker of social disadvantage; it reproduces disadvantages over generations. Low birth weight tends to reproduce existing inequalities because it is more common among parents with lower levels of education, income, or occupational status [101]. As an indicator of disadvantage, as well as a way to perpetuate inequality within and between groups across generations, birth weight is an essential starting point to examine the relationship between health and its intergenerational impact, as well as to know the processes that condition them.

How the health of a pregnant women affects the health of her child is a particularly good example of the intergenerational transmission of health inequities. The low socioeconomic status of a pregnant women, characterized by poorer access to health services, healthy foods, and education, could create greater risk for her child.

For example, low levels of vitamin D during pregnancy, related to high blood pressure and depression for the mother, is also associated with adverse birth outcomes such as preeclampsia, low birth weight, neonatal hypocalcemia, bone fragility, and increased incidence of autoimmune diseases. Undiagnosed vitamin D deficiency is an indicator of poor access to prenatal care, which

is vital in identifying and controlling vitamin deficiencies to mitigate or eliminate adverse health outcomes for both mother and baby [102].

Another example is that of women of low socioeconomic status who may experience high levels of stress. It has been shown that this stress leads to an increase in fetal cortisol that negatively affects neurological development in the offspring. Therefore, prenatal and maternal stress often experienced by women of low socioeconomic status directly affects delivery outcomes [103].

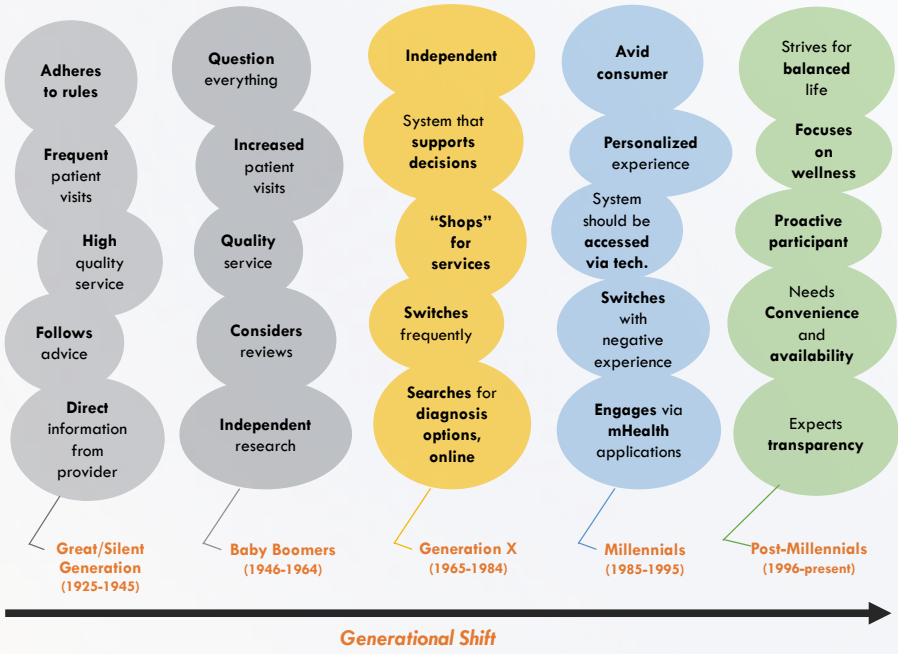
The transmission of health inequities across generations is particularly evident in cases related to teenage pregnancy. A teenager who lives in conditions of poverty, has a low educational level, or has limited or no access to quality health information and services is more likely to become pregnant compared to her richer and better educated urban counterparts. Adolescent pregnancy is also associated with poorer birth outcomes and health outcomes later in life, like NCDs.

These examples demonstrate that the health and social condition of the mother, even before having children, determines the health of future generations. Therefore, a woman with fewer resources and access to health information and services, such as women from indigenous groups or those who live in rural areas, is more likely to transmit the social inequities in health that they are experiencing to the next generation. According to the life course theory, if adolescent pregnancy prevention and prenatal health are not directed to the most vulnerable groups that experience greater health risks, social inequities in health will be transmitted from one generation to another and will allow different health outcomes to persist between the different groups.

Generational change and its impact on health

One cannot talk about health in the life course without touching on generations and their impact on health **(Figure 26)**. It is the first time in history that five generations coexist, each of them with their own trajectories and unique experiences that undoubtedly impact the generations with whom they share their daily lives as well as future generations [43]. A generation is defined as “an identifiable group of the population that shares birth years and important life events at critical moments of their development” [104]. A generational group or cohort includes those who have historical experiences or social life whose effects are relatively stable throughout their life course. These experiences tend to distinguish one generation from the other [105].

FIGURE 26. **GENERATIONAL CHANGE**



Source: Chirinos N. Características generacionales y los valores. Observatorio Laboral Revista Venezolana 2009;2(4)133-153.

As public health professionals, we must understand how these generations perceive, seek, understand, and obtain health. The differences in how different generations interact with public health have already been documented. Millennials and post-millennials prioritize options that are profitable and convenient when choosing their health care and are inclined to look for available alternatives that are aligned with technology. The silent generation born between 1925 and 1945 and the Baby Boomers adhere more to the technical opinion of traditional health authorities than to alternative health professionals. Generation X is considered the decision-making generation and have great influence on health either as caretakers of their parents and/or their children [106].

Each generation has its own unique motivations and makes decisions regarding their health in a different way. And although most generations today are familiar with technology, not all consider it their main source of information. Because of these generational differences, it can be difficult for policymakers and decision makers to use a one-size-fits-all approach. While the demand for quality health care and access to health transcends all generations, these characteristics and generational preferences should be taken into account when designing interventions, communications, and health services [106].

Creating positive intergenerational health trends through an integrated community health framework

Life course principles provide a new opportunity to identify positive or negative cumulative experiences and examine the impact of those experiences on health outcomes among different population groups and generations. By using this approach, prevention policies and interventions can be developed that identify opportunities to create ideal conditions for health and well-being at critical points throughout the life course based on trends and linkages. This requires a change in the priorities and paradigms of medical care and service delivery systems.

When developing interventions to create positive intergenerational health, it is important to use a community health framework. Community health "recognizes that people live in the context of their families, their community, and their physical and social environments, and that programs, services, and institutions must emphasize the health needs of the population as a whole" [107].

The formulation of differentiated community interventions that enable those in conditions of vulnerability to access quality, comprehensive health services and live healthy lives is central to this framework that prioritizes universal health.

To address the health needs of the whole person, family, and community, it is vital to involve that community in the establishment of priorities and the development of interventions to address social inequalities in health [108]. An important aspect of this is conducting assessments of community health needs and involving community stakeholders in efforts to improve their situation [109]. This process of involving the community goes beyond simply involving community members in decision-making processes, but also includes community mobilization and empowerment to achieve sustainable solutions to a community's most pressing challenges.

Effective community health interventions and policies to promote positive intergenerational health trends also incorporate broad cross-sector collaboration and integration of care. A relevant approach is what some refer to as "vertical, horizontal, longitudinal and holistic life course programmatic linkages" [109]. Vertical linkages refer to interventions that support and improve transitions, such as integrated primary to tertiary care. Horizontal linkages refer to interventions that foster better integration among various sectors, such as school-based health programs. Longitudinal integration refers to interventions that support critical transition points, such as new parenthood programs and improved care coordination from obstetrics to pediatrics.

While vertical integration focuses on the system of traditional health, horizontal integration implies the fusion of health services with other service sectors, including the health, social, and civil sectors. There is a need for integration of these various linkages for the creation of integrated multisector services systems that comprehensively support healthy development [107, 109].

Although many health professionals already work with professionals in other service sectors, there is a great opportunity to move from mutual awareness to a true partnership in the integration of systems. True partnership implies communication, recognition of mutual benefit, and fusion of systems. Integration must happen in an environment where people spend their time. For example, daycare or health services in schools offer the opportunity to reach children where they spend a lot of time. Programs at these sites can promote wellness and prevention at the individual and community level and these sites can even serve as medical homes or links to medical homes. Place-based strategies that focus on specific geographic areas and population approaches also have the potential to reduce barriers to care and promote health.

Horizontal integration should also foster an infrastructure of community-based support services and optimize the positive deviation that exists in a community [109].

In addition, the intergenerational integration of services when a woman becomes pregnant and a new child enters the family is also necessary with the recognition of the interdependence of the health of the members of the family through the generations [109]. Programs that facilitate transitions in care during the course of life and generations have great potential to improve people's health, the health of families, and the health of their future children. Within the family unit, the health of adults influences the health of children and vice versa. It is important to recognize the impact of interventions on individuals over time and effects on families and communities.

VI

Intrinsic Capacity and Functional Ability Throughout the Life Course

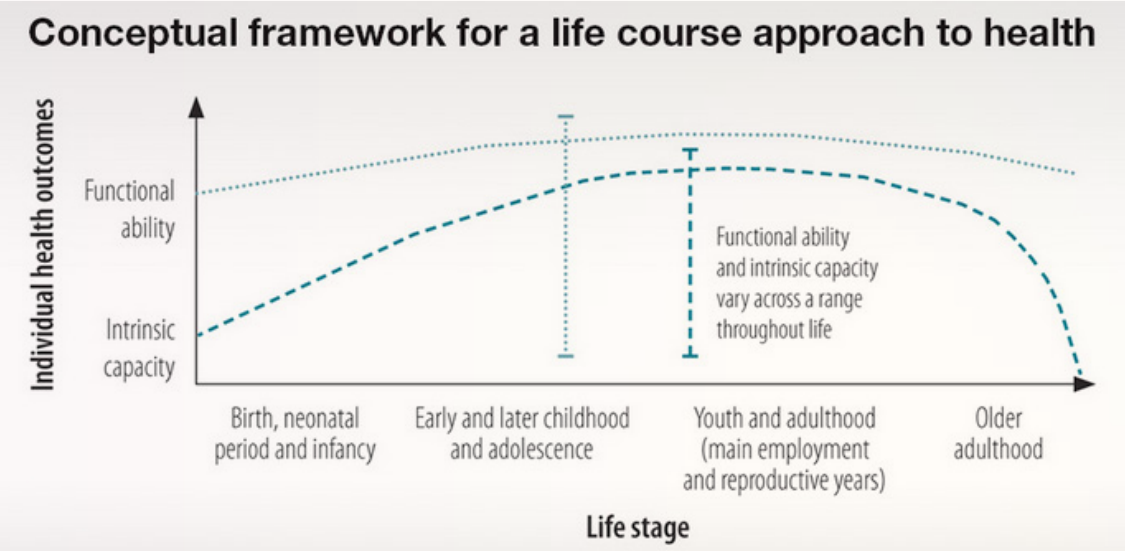
Different periods throughout the life course are characterized by different trends in intrinsic capacity and functional ability.

Intrinsic capacity grows as individuals develop during infancy and childhood, peaking in adulthood and declining in older adulthood. In contrast to the biologically determined nature of intrinsic capacity, functional ability can be optimized throughout life by a supportive environment. As displayed in **Figure 27**, intrinsic capacity and functional ability can be depicted as arcs across the life course, with variability depending on an individuals' circumstances and the critical events that influence health trajectories, as represented by the vertical bars [110].

As individuals age, there is a wider range of circumstances and life events that contribute to these health trajectories; thus contributing to a greater diversity in intrinsic capacity and functional ability. Individuals who have a similar level of physical and mental capabilities during middle-age may have very different levels of intrinsic capacity in later adulthood that are driven by variations in health trajectories. For example, some individuals may present a very low level of intrinsic capacity in their later years, driven by multiple chronic conditions or an accumulation of adverse life events. On the other hand, others may maintain physical and mental capabilities well into their 80s. This diversity of intrinsic capacity is pictured in **Figure 28**, showing how the range in intrinsic capacity widens as the life course progresses. Such trends challenge the stereotype of there being a typical older person [111].

Understanding developments and losses in intrinsic capacity and functional ability throughout the life course is important in

FIGURE 27. **LIFE COURSE FRAMEWORK: INTRINSIC CAPACITY AND FUNCTIONAL ABILITY**



Source: Kuruvilla S, Sadana R, Villar Montesinos E, Beard J, Franz Vasdeki J, Araujo de Carvalho I, et al. A life-course approach to health: synergy with sustainable development goals. World Health Organization Bulletin 2018; 96:42-50.

defining public health priorities and interventions. No matter the life stage, it is possible to intervene to increase, maintain or protect intrinsic capacity and functional ability.

Interventions to maximize intrinsic capacity and functional ability across the life course

Opportunities to increase, maintain or protect intrinsic capacity and functional ability should be available to individuals of all life stages, but trends in capacity and function described above can dictate priorities for interventions according to the life stage. During childhood we focus on developing intrinsic capacity and functional ability, and towards adulthood we shift to maintaining them [112].

Developing intrinsic capacity during childhood

While intrinsic capacity can be created throughout all of life, it is well understood that the generation of intrinsic capacity is elevated through growth and development during childhood. As the under-five mortality rate has significantly decreased in the past several decades, there has been an increase in interventions that ensure that children meet their development potential by developing the highest level of intrinsic capacity possible. This is reflected in the Global Strategy for Women's, Children's and Adolescents' Health (2016–2030), within which one of the core objectives is to ensure that all women, children, and adolescents have an equal chance to thrive (and not simply survive) [113].

FIGURE 28. THE DIVERSITY OF INTRINSIC CAPACITY INCREASES WITH AGE

Source: World Health Organization. WHO Clinical Consortium on Healthy Ageing. Topic focus: frailty and intrinsic capacity. Report of a consortium meeting. Geneva, Switzerland: WHO; 1–2 December 2016.

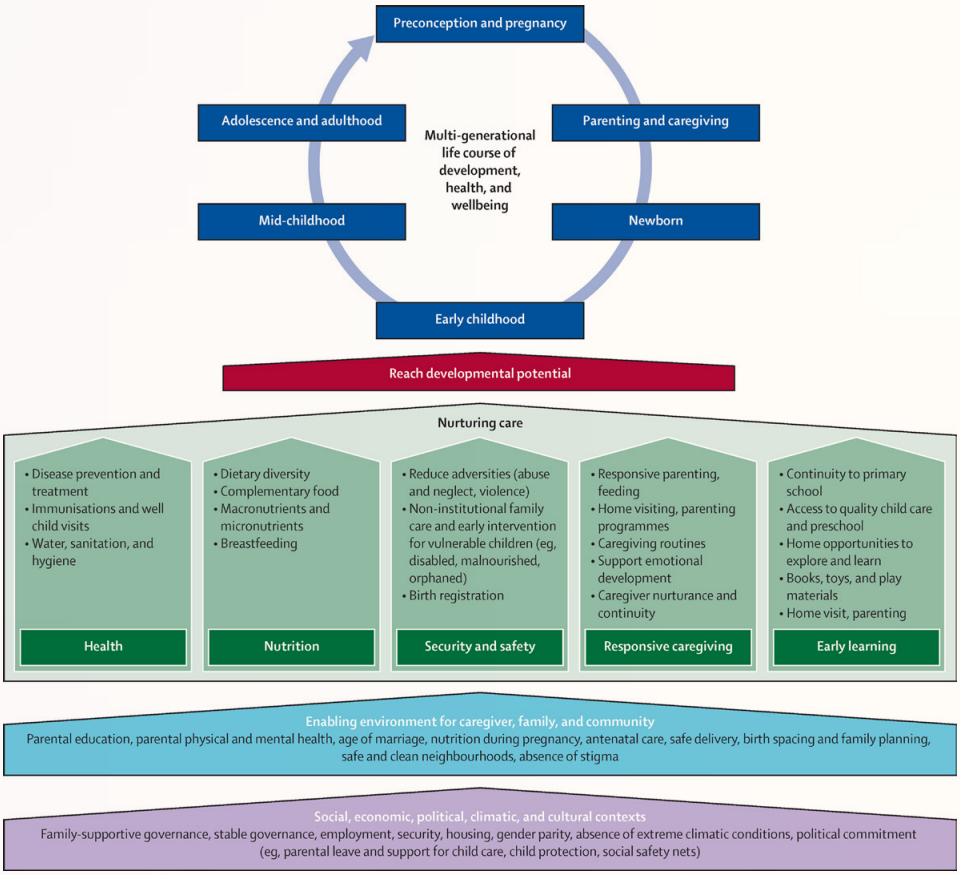
Such strategies seek to reduce the burden of risk for poor developmental outcomes that currently affects 43% of children younger than five years in low and middle-income countries [114].

Child development starts at conception, where nutrition and a mother's experiences begin to impact the capacities of a child, and continues throughout life, with greater plasticity in the first three years of life. For example, poor nutrition during pregnancy and other adversities like low levels of maternal schooling and physical maltreatment substantially raise the risks of poor development outcomes for children. Adversities after birth like poverty continue to impact physical and mental development. Research shows that nurturing interactions are important in mitigating these risks for poor development outcomes [115]. As exemplified in **Figure 29**, nurturing care is defined as "health, nutrition, security and safety, responsive caregiving and early learning—provided by parent and family interactions and supported by an environment that enables these interactions" [116].

Nurturing care is characterized by an environment that is sensitive to children's health and nutritional needs, responsive, supportive, and developmentally stimulating with opportunities for play and exploration. Spanning the many environments in which a child develops, nurturing care is provided by not just families but caregivers across various sectors like health, education and social protection [115].

The bottom of **Figure 29** shows that cross-sectoral policies and programs that equip families with the knowledge, skills, time and resources to provide nurturing care to children can spark generation of the highest levels of intrinsic capacity among children [116]. Paid parental leave, time at work for breastfeeding, and the provision of free pre-primary education, are examples of policies that enable families and communities to care for their children in a way that fosters development. Furthermore, evidence-based interventions that combine nurturing care with basic sectoral elements in health, nutrition, social protection, child care and learning, can significantly increase child outcomes. For example, breastfeeding programs combine elements of nutrition with bonding, and contribute to multiple positive outcomes beyond nutrition alone [117].

FIGURE 29. THE EFFECTS OF CONTEXTS, ENVIRONMENTS, AND NURTURING CARE THROUGH THE MULTIGENERATIONAL LIFE COURSE



Source: Black M, Walker S, Fernald L, Andersen C, DiGirolamo A, L Cu, et al. Early childhood development coming of age: science through the life course. Lancet Early Childhood Development Series Steering Committee. 2007. Available from: http://thelancet.com/series/childdevelopment-in-developingcountries

In addition, methodologically rigorous parenting programs delivered through community health worker home visits, community-based group sessions, or health center-based programs, have shown to effectively support the capacity of caregivers to support social-emotional development of children. The Care for Child Development package developed by the WHO and UNICEF, as well as the Reach Up and Learn program, are among the most effective parenting programs. Such programs use multiple behavior change techniques, including media like posters and cards describing enrichment practices, opportunities for parents to practice play and responsive talk with their child, guidance and support for changing practices, and problem-solving strategies [118]. In true life course fashion, investing in interventions that provide a nurturing environment for children creates long-lasting effects that contribute to improved life trajectories throughout the life course and across generations. Furthermore, interventions that support the physical and mental wellbeing of caregivers contributes to the development of a nurturing environment for children. The life course perspective is therefore crucial to maximizing the intrinsic capacity of individuals starting in childhood.

Strengthening intrinsic capacity of adolescents

While aspects of adolescent health are related to the cumulative effects of health during childhood, adolescence is also a time of great change, and thus great potential, with regards to strengthening intrinsic capacity.

Reach Up and Learn

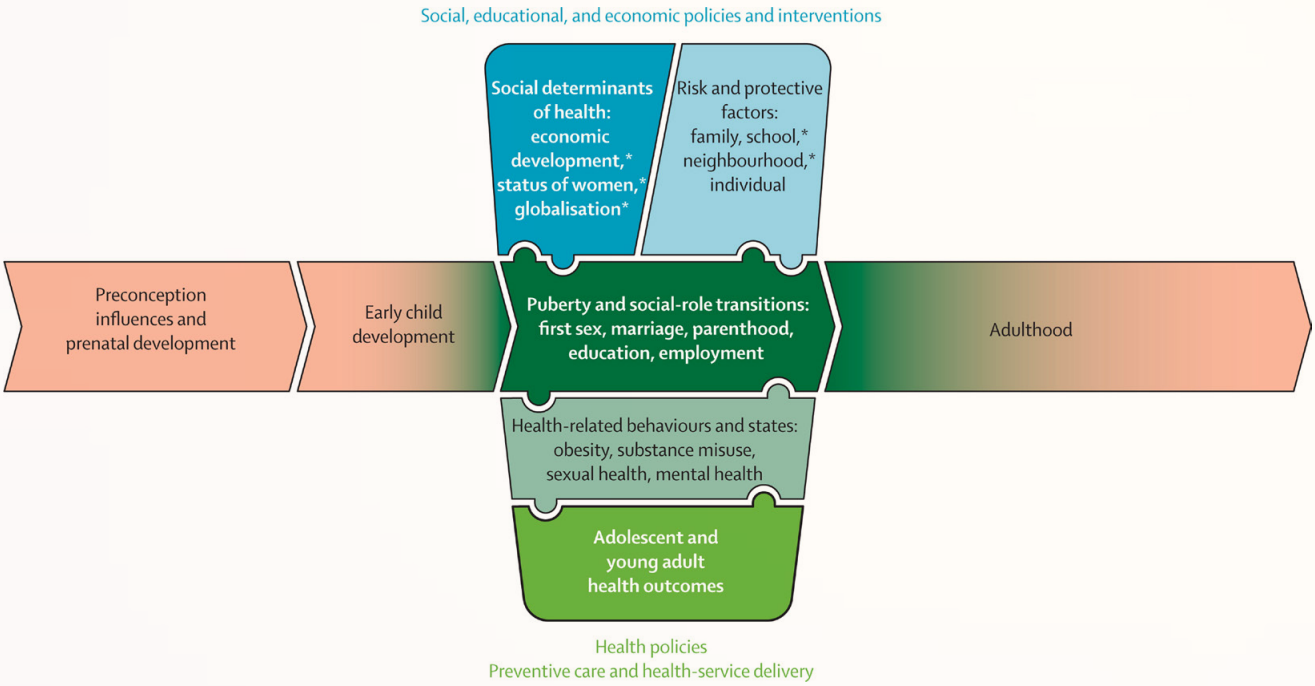
Reach Up and Learn encourages parents to engage in structured play with their children, and helps them learn how to do so effectively, and through those interactions to support their children's social-emotional and cognitive development. Home visitors use a structured curriculum to model desired actions and demonstrate activities to encourage caregivers to respond to their child's responses. The visitors promote giving praise, celebrating the child's achievements and efforts, and showing love throughout the visit.

The Reach Up and Learn program provides a comprehensive training package for trainers, supervisors, and home visitors, that is adaptable and feasible for low resource settings. Based on the Jamaica Home Visit program, the intervention has shown positive outcomes in child development and is being implemented in multiple countries including Jamaica, Colombia and Peru [119].

During adolescence, biological aspects of puberty are accompanied by key social transitions, and brain maturation affects decision making, emotional wellbeing and behavior. These physical and mental changes are accompanied by health behaviors that impact adult health. For example, tobacco, alcohol use and limited physical activity, which oftentimes begin in adolescence, contribute to increased risk for non-communicable diseases later in life. And adolescent pregnancy and sexually transmitted diseases resulting from sexual experimentation during adolescence has both immediate and long-term effects for the health, education and opportunity for both young people and future generations [120]. This life course framework for adolescent health is exemplified in **Figure 30**.

In **Figure 30**, adolescence represents an integral component of the health continuum, and there are multiple aspects of health that intersect with the unique characteristics of adolescence, including risk and protective factors and health-related behaviors. Likelihood for health-related behaviors during adolescence is impacted by risk and protective factors that operate within the individual and their family, peers, school and community. Developing an environment across these domains that promotes positive family and peer connections

FIGURE 30. CONCEPTUAL FRAMEWORK FOR ADOLESCENT HEALTH



Source: Patton G, Coffey C, Cappa C, Currie D, Riley L, Gore F, et al. Health of the world's adolescents: a synthesis of internationally comparable data. The Lancet 2012;379:1665–75.

is therefore important in attaining the best health in the transition to adulthood.

Parenting behaviors are shown to contribute to adolescent health, and adolescents who feel connected to their family are more likely to delay sexual initiation, report lower levels of drug use, and are less likely to engage in violence [121]. Adolescent health interventions should therefore focus on improving parenting and family functioning and societal factors that impact family connectedness [122]. One such example is the Strengthening Families – Love and Limits program described below.

Similar to family factors, peer modelling can serve as protective factors to adolescent health, and programs that foster positive peer influence should also be prioritized [122].

Additionally, school-based interventions that create strong engagement between students and teachers and a feeling of emotional safety result in reduced substance misuse, violence and other antisocial behaviors in adolescents [124]. Interventions across families, peers and schools that use the positive youth development approach, focusing on adolescents' internal and external assets and developmental strengths, are promising means of supporting adolescents in making healthy choices [125, 126].

Mass media and social networking have more recently influenced health behaviors among adolescents. Policies have restricted advertising of traditional tobacco products and high sugar foods to adolescents, but these industries continue to find ways to reach new young audiences.

Strengthening Families – Love and Limits

Strengthening Families – Love and Limits is an evidence-based training curriculum on life skills for families that helps caregivers learn nurturing skills that support their children while also giving youth a healthy outlook on their family and teaches them to deal with stress and peer pressure. The program is delivered in seven parent, youth, and family sessions using narrated videos portraying typical youth and parent situations with diverse families.

The Strengthening Families program has been found to significantly improve family relationships and parenting skills; decrease incidents of child maltreatment; reduce problematic behavior, delinquency, alcohol and drug abuse in adolescents; and improve school performance and social competencies in adolescents. The program has been formally adopted by national authorities across Latin America as a core national strategy for the promotion of child and adolescent health [123].

And while social media can provide a powerful voice for young people to engage with their peers and advocate for positive change, excessive or inappropriate use of such tools create new challengesfor adolescent health and development like decreased physical activity or cyber bullying. Population-focused social marketing approaches have been seen to have success in countering these challenges and producing positive health behaviors. Television series with accompanying multimedia campaigns aiming to change attitudes, behaviors and norms surrounding HIV are one such example [126]. As depicted in **Figure 30**, in addition to positive youth development programs and social marketing approaches, adolescent-friendly health services and policies are needed to adequately respond to the specific needs of young people [127, 128].

Characteristics of adolescent-friendly health services include convenient locations, flexible after-school hours, affordable fees, availability of easy-to understand health education materials, and a welcoming environment, among others. It is imperative that young people be included in decision-making processes surrounding the development and provision of adolescent health services and programs. If adolescents are given a voice by being involved in the identification of their health issues and development of appropriate solutions, adolescent health programs will be more effective and adolescents themselves will be more visible to their communities and decision-makers [128].

Maintaining intrinsic capacity and functional ability of older adults

As the life course advances, it is more likely for individuals to lose intrinsic capacity. And as intrinsic capacity decreases, so does an individual's ability to adapt to their environment, and therefore their functional ability. The WHO framework for healthy aging, pictured in **Figure 31**, describes the varying subpopulations of older adults according to levels of intrinsic capacity: those with relatively high and stable capacity, those with decreasing capacity and those who have experienced substantial losses in intrinsic capacity [3]. WHO proposes priority areas of intervention that span these subpopulations, with greater emphasis on health prevention and promotion for those with higher capacity levels, and increased focus on disease management and adaptation for those with greater loss of capacity. The main goal of health interventions targeting individuals with high or stable intrinsic capacity levels is to increase the length of time where those capacity levels are maintained. In achieving this goal, it is important that health interventions go beyond preventing death, but rather promote the maintenance of intrinsic capacity and functional ability [129].

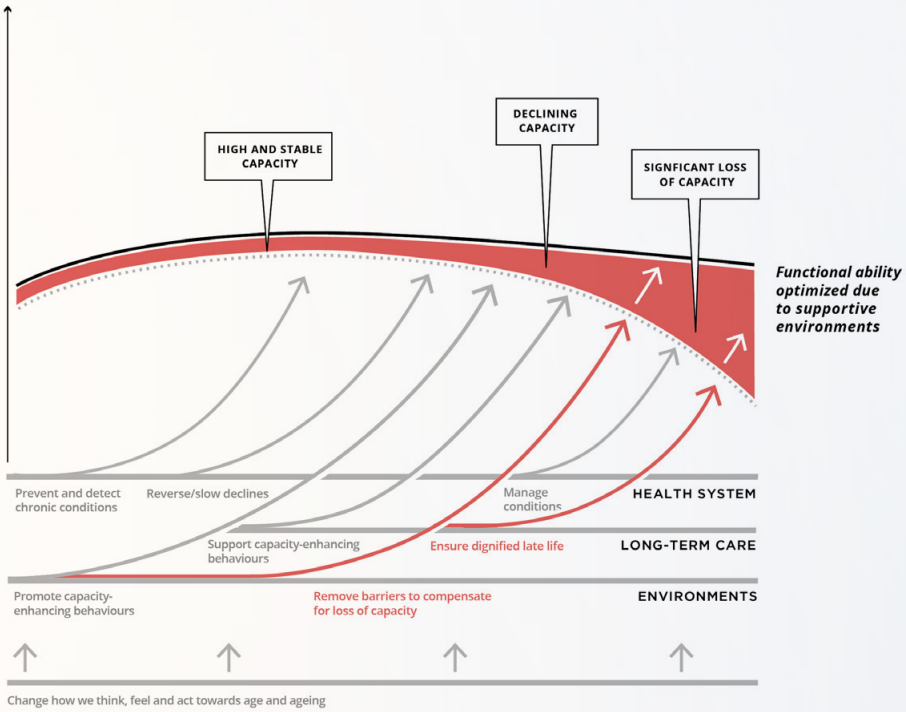
In people with high intrinsic capacity, preventing disease, and therefore disability, by lowering risk factors throughout the life course can help to maintain these levels [130-137]. For example, a straightforward intervention such as a reduction in

salt can decrease blood pressure and in turn reduce the associated outcomes of stroke and heart disease [135]. To reduce risk factors, policies and programs that empower individuals to actively manage their health, mostly through diet and exercise, should be prioritized [111]. For those with declining levels of intrinsic capacity, it is particularly important to implement interventions that prevent catastrophic reductions in intrinsic capacity that could jeopardize functional ability and independent living in the community.

With more individuals suffering from multiple chronic conditions, such interventions are more important than ever before.

The evidence-based Chronic Disease Self-Management Program, described below, is an example of a successful intervention that prevents deductions in intrinsic capacity among those with multiple chronic conditions. Furthermore, integrated, person-centered care should be implemented to monitor and prevent further decline of intrinsic capacities. The use of trained community-based health workers and volunteers to monitor older adults and facilitate use of care to ensure individuals regain capacities is one such example of an intervention with high potential. To stay responsive to the health needs of older individuals, greater investment is needed to train health workers—ranging from geriatricians

FIGURE 31. **PUBLIC HEALTH FRAMEWORK FOR HEALTHY AGING**



Source: Decade of healthy ageing: baseline report. Geneva: World Health Organization; 2020. Available in: https://www.who.int/publications/m/item/decade-of-healthy-ageing-baseline-report.

to community health workers—to address the challenges of managing many interactive disorders [136]. When individuals experience significant loss in intrinsic capacity and functional ability, interventions to compensate for these losses should be prioritized. Environmental adaptations, such as the provision of transportation for physically impaired older individuals, can significantly help individuals cope with loss of function.

Physical tools can also help to compensate for loss in functional ability. For example, adaptive eating tools like flexible or angled spoons can help those with tremors or hand mobility issues to continue to eat independently. The dynamic interactions between a person's intrinsic capacity and the environment they live in, plus the resources they are able to utilize, will thus determine the functional ability of an individual, and their ability to lead a dignified life [111]. Evidence suggests that interventions like self-management education, rehabilitative medicine, and modifications to physical living

Functional Ability

Functional ability combines the intrinsic capacity of the individual, the environment a person lives in and how people interact with their environment. The optimizing of functional ability requires inputs from multiple sectors and a whole-of-government response to population aging, with important roles and responsibilities for health-in-all-policy, each of the health system functions – e.g. stewardship, financing, resource-generation (human and physical capital), service provision – and the integration of health and social care.

Functional ability enables people to be and to do what they have reason to value. Important domains refer to people's abilities to:

1. Meet their basic needs to ensure an adequate standard of living (such as being able to afford an adequate diet, clothing, suitable housing, and healthcare and long-term-care services, including medications)
2. Learn, grow and make decisions (to strengthen the person's autonomy, dignity, integrity, freedom and independence)
3. Be mobile (for completing daily tasks and participating in activities)
4. Build and maintain relationships (with children and family, intimate partners, neighbors and others), and
5. Contribute to society (such as by assisting friends, mentoring younger people, caring for family members, volunteering, pursuing cultural activities and working).

Intrinsic Capacity

Intrinsic capacity comprises all the physical and mental capacities that a person can draw on. Important domains include a person's:

1. Locomotor capacity (physical movement)
2. Sensory capacity (such as vision and hearing)
3. Vitality (energy and balance)
4. Cognition, and
5. Psychological capacity.

Developing and maintaining a person's intrinsic capacity along the life course, with a positive connotation that builds up reserve, are additional keys to healthy ageing. This positive framing, however, recognizes that the level of intrinsic capacity is influenced by a number of factors, including the presence of diseases or injuries and psychological and age-related changes. Domains of intrinsic capacity are interrelated. Older people who experience declines require an integrated person-centred approach to assessment and management.
For example, hearing helps people to communicate, maintain autonomy, and sustain mental health and cognition. Significant declines are closely related to care dependence in older age.

Environments

Environments are where people live and conduct their lives. Environments shape what older people with a given level of intrinsic capacity can be and do. Environments include the home, community and broader society, and all the factors within them. Key domains relate to:

1. Products, equipment and technology that facilitate movement, sight, memory and daily functioning
2. The natural or built environment
3. Emotional support, assistance and relationships provided by other people and animals
4. Attitudes (as these influence behaviors both negatively and positively), and more broadly
5. Services, systems and policies that may or may not contribute to enhanced functioning at older ages.

Environments provide a range of resources or barriers that will ultimately decide whether older people are able to engage or participate in activities that matter to them. The development of enabling, age-friendly environments that optimize functional ability is another key for healthy ageing.[3]

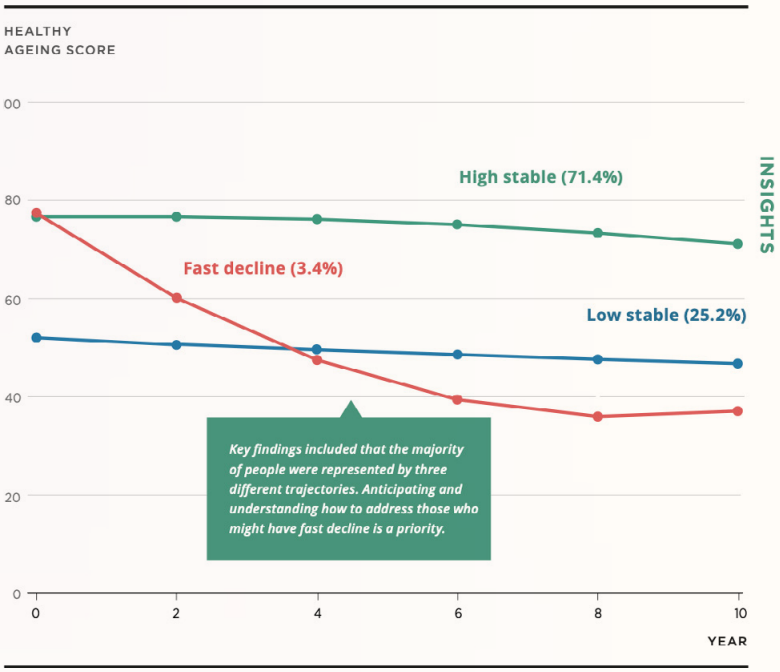
environments are decreasing loss of functioning and disability throughout the life course and especially older adulthood.

To counter the increasing rates of morbidity due to multiple chronic conditions, investments in such interventions spanning the various intrinsic capacity subpopulations in older adults should be made [138].

Framework to apply intrinsic capacity to primary health care

The intrinsic capacity model has the potential to significantly change the way in which primary health care is practiced. By shifting from a disease-centered to a function-centered approach, countries and communities can become more proactive toward achieving optimal health.

FIGURE 32. TRAJECTORIES OF HEALTHY AGING: LONGITUDINAL OPPORTUNITIES AND SYNERGIES



Source: Decade of healthy ageing: baseline report. Geneva: World Health Organization; 2020. Available in: https://www.who.int/publications/m/item/decade-of-healthy-ageing-baseline-report.

In **Figure 32** The Ageing Trajectories of Health: Longitudinal Opportunities and Synergies provides new evidence based on a measure of healthy ageing [139]. It includes up to 41 items that combined cognitive and physical capacities and ability to meet some basic needs in eight studies from Australia, England, Japan, Mexico, Republic of Korea, Spain, USA, and 19 European countries that had more than three study waves (data collection time points on the same individuals).

The figure tracks the year on the horizontal axis and healthy ageing score (0–100, with 100 being the best) on the vertical axis. This describes that the majority of people were represented by three different trajectories. 71.4% of the study participants showed a *high and stable level of healthy ageing throughout the follow-up period* (green line); 25.2% displayed a *low level of health over time* (blue); and 3.4% showed a *rapid deterioration from high to low levels of health* (red). Factors associated with each trajectory provide further insight on what might contribute to each.

Levels of education and wealth affected baseline scores of healthy ageing but had less impact on the rate of decline over the 10-year period. People with lower education and less wealth who were physically inactive and ever smokers, were more likely to be in the "low stable", or the "fast decline" trajectories, than in the "high stable" class. Women were more likely to belong to the low stable trajectories compared to the high stable class, but not more likely to be in the fast decline trajectory. [140, 141]

Translating the intrinsic capacity model into practice has various implications for primary health care. First, an integrated primary care model that goes beyond acute care will be necessary in shifting the focus from curing disease to optimizing a person's intrinsic capacity across the life course.

Such care will incorporate multidisciplinary teams that meet the full range of needs of individuals according to their age, capacity levels and environment. General practitioners must work with a network of health specialists and community health workers. Health departments must work with schools and social services. And health care and community resources must be linked to ensure that individuals are receiving sufficient support in all aspects of life. The WHO's recommendations on integrated care for older people (ICOPE) is an excellent example of evidence-based guidelines for providers that uses a person-centered and integrated approach to primary health care, developed specific to the health of older adults [142]. Guidelines like ICOPE can assist countries in enhancing primary care models and achieving universal health coverage for all.

Second, primary health care must shift from addressing to preventing loss of health, particularly function and intrinsic capacity. Programs that foster the development of intrinsic capacity at younger ages yields greater potential for building and maintaining that capacity later in life. And in later life when loss of function and intrinsic capacity is more likely, the prevention of capacity loss should be prioritized. To truly prioritize prevention, systematic assessment of a person's intrinsic capacity and functional ability must be implemented, with appropriate responses to declines in intrinsic capacity.

Chronic Disease Self-Management Program

The Chronic Disease Self-Management Program is an education workshop attended by people with a variety of chronic health conditions. It aims to build participants' confidence in managing their health and keep them active and engaged in their lives. Small-group, highly interactive workshops are six weeks long, meeting once a week for two and a half hours, and are facilitated by a pair of leaders, one or both of whom are non-health professionals with chronic diseases themselves. The workshop topics include how to deal with frustration, fatigue, pain and isolation; ways to maintain and improve strength, flexibility and endurance; managing medications; how to communicate more effectively with family, friends and health professionals; and healthy eating.

A review of nine randomized control trials that evaluated the Chronic Disease Self-Management Program showed statistically significant improvements in health outcomes (pain, disability, fatigue, depression, health distress, and self-rated health), health behavior (aerobic exercise, symptom management, and communication with health care professionals), as well as self-efficacy [137].

Detecting declines in intrinsic capacity requires a longitudinal approach that starts with the determination of normative values for intrinsic capacity. Tools and scales to measure intrinsic capacity and functional ability levels at various stages of life should be developed to facilitate decisions regarding which interventions to apply at certain times [111]. Intrinsic capacity monitoring can then be used to create comprehensive health care plans that includes multidimensional programs and treatment to maximize intrinsic capacity.

Third, seeing that intrinsic capacity includes both physical and mental capabilities, primary health care that helps build, strengthen and maintain intrinsic capacity should address not only the physical aspects, but also the psychological aspects of care. This is driven by the fact that cognitive decline is directly associated with functional loss [143].

Furthermore, mood has a direct impact on cognition, and depressive symptoms may pose as an independent risk factor for loss of capacity [144]. Evidence-based programs, including Reach Up and Learn, Strengthening Families and the Chronic Disease Self-Management Program, all include a mental health component that helps individuals overcome the mental barriers to achieving health. Mental health must be integrated into clinical and community care to address the multifaceted contributors to health.

Lastly, to shift to a function-centered approach to primary health care, investment must be made in wider dissemination of current innovations and development of new ones. Mobile clinics and telehealth services can help to overcome barriers to accessing interventions [145]. And adaptations to everyday objects can help those with capacity loss to regain function. Innovations are most often driven by those with relevant experiences; youth, caregivers and older adults must be a part of planning and development to foster health innovation.

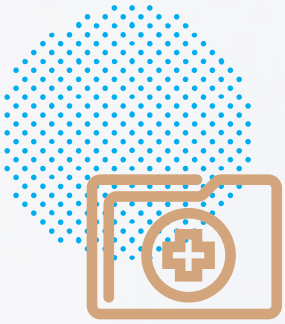
In summary, systematizing primary health care according to the intrinsic capacity model requires a comprehensive overhaul of our current systems that respond to disease. Findings from clinical and functional assessments must be met with integrative interventions that effectively improve intrinsic capacity and functional ability throughout the life course. New technologies, environmental modifications, and community support services for both physical and mental health are central to meeting the intrinsic capacity and functional ability needs of individuals and populations [146].

Integrated Care for Older People (ICOPE)

The WHO Guidelines on Integrated Care for Older People (ICOPE) propose evidence-based recommendations for health care professionals to prevent, slow, or reverse declines in the physical and mental capacities of older people. These guidelines offer evidence-based direction on: comprehensive assessment of health status in an older person; delivery of the integrated health care that will enable an older person to maintain their physical and mental capacities, and/or to slow or reverse any declines in these; and delivery of interventions to support caregivers. These recommendations require countries to place the needs and preferences of older adults at the center of coordinated community care. Important elements of integrated care at the community level include a comprehensive assessment and care plan, common care and treatment goals, community outreach and home-based interventions, support for self-management, comprehensive referral and monitoring processes, and community engagement and caregiver support. The ICOPE Guidelines were reached by the consensus of a guideline development group convened by WHO that based its decision on the synthesis of a series of systematic reviews [142].

VII

Conclusions



The application of the LCA to practice offers the opportunity to transform current thought and strategies.

Restructuring programs to align with an intergenerational perspective, seeing the individual at the center and as part of a network of relationships that intertwine within the context of the community, and focusing on building and improving health and well-being in an equitable manner, is a job that will require a lot of commitment and time.

While this may be overwhelming initially, it is time to start making this change and look with other lenses that allow us to move forward in ensuring that women, men, children, and adolescents, adults young and more mature, as well as families, can reach their full potential.

The life course perspective allows us to better understand how social inequities in health are perpetuated and transmitted, and how they can be mitigated or alleviated through the generations. Using the LCA, several prevention policies and interventions can be designed to address these social inequities in health throughout life, but particularly in critical/sensitive periods of development. Policies and interventions must consider the context in which people live, have a longitudinal focus, and integrate services. Ultimately, this requires a change in our approach to health.

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Building Health Throughout the Life Course elucidates how health develops and changes throughout the life course, and how the use of the life course approach among public health practitioners can ensure that health as a human right is achieved for all individuals. It describes the life course vision of health that focuses not only on diseases and their consequences, but rather on achieving long, healthy, active, and productive lives.

The book consists of three stand-alone parts. Part 1, “Concepts”, aims to illuminate the complexity of health through the understanding of the life course approach. It can be used to familiarize oneself with the evolution and meaning of the life course, which serves as a basis for effective public health practice. Part 2, “Implications”, identifies the implications for the operationalization of the life course approach in public health. It translates the technical language of the life course literature to understand how the application of the life course approach requires changes in health systems, policies, research, and practice. Part 3, “Application in Public Health”, identifies key opportunities to strengthen the adoption of the life course approach in public health practice. It describes concrete, evidence-based actions to improve health and well-being through the promotion and generation of skills throughout the life course.

This book aims to help decision-makers and public health professionals to understand the life course meaning and concepts, which is essential to comprehend how health develops and changes throughout the life course. The book also describes how the life course model allows us to address health disparities by generating mechanisms to improve health and well-being, and promoting the vision of health as the product of a series of experiences that contribute to or detract from health in the near and long term.

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