

Towards a Framework for Impact Pathways between NCDs, Human Capital and Healthy Longevity, Economic and Wellbeing Outcomes

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INTRODUCTION

This chapter aims to outline a framework for examining the impact pathways between non-communicable diseases (NCDs), human capital (HC), and end outcomes - primarily healthy longevity, inclusive growth, and well-being. It supports the discussion of the various dimensions and their interactions with evidence from a selection of low- and middle-income countries and summarizes policies which may influence those pathways. While the pathways and their linkages with policy are complex, the framework aims to be as simple as possible, but sufficiently open to accommodate multiple factors.

The emphasis to date of the Human Capital Project (HCP) and Index (HCI) has been largely on the years up to age 18. The Healthy Longevity Initiative (HLI) complements this work by taking a whole life course approach, with an emphasis on adulthood and, particularly, later years of life. The HLI also aims to complement the HCP by developing the links between human capital and a wider definition of wellbeing above and beyond the health and work domains. As such, the HLI can be considered in part an effort to extend the HCP across the life course, something the HCP itself is aiming for as it evolves.¹

In that context, the role of NCDs as important influencers of human capital outcomes in adult life becomes more prominent than a sharp focus only on the earlier years of life.

While already an important social policy priority, the need for raising the profile of the healthy longevity agenda has been made more pressing by the disproportionate and ongoing impacts of the COVID-19 pandemic on people living with NCDs. Indeed, not only do those with NCDs such as diabetes, hypertension, and cardiovascular diseases, and Chronic Obstructive Pulmonary Disease (COPD) have greater risks of morbidity and mortality from COVID-19, but they are also impacted by disruptions in health service delivery and ongoing care. Further, public health and social measures, while necessary to mitigate transmission of the virus, may disadvantage or exacerbate inequities for those with NCDs or older age groups. For example, physical distancing or 'shielding' of older adults or those with NCDs has

implications for their well-being, productivity, and human capital trajectories (De Pue et al. 2021).

The structure of the chapter is as follows. First, it outlines the major factors which would need to be considered in any framework, including defining key concepts and highlighting some cross-cutting themes. It then outlines a trajectory of human capital across the life course, before briefly summarizing literature on human capital and growth. It then discusses the relationship between human capital and both growth and country wealth before a more detailed consideration of the key channels through which NCDs may impact inclusive growth. A discussion of distributional and gender considerations follows. It then briefly discusses the impacts of health, and more specifically NCDs, on wellbeing, emphasizing the intrinsic importance of good health above and beyond its instrumental value. In the final section, there is a summary of policies and interventions that are likely to help minimize and manage NCDs and their impact on HC accumulation, deployment, and protection, and thus positively influence the end outcomes of concern. The chapter does not aim to go into depth in specific subject areas, which are covered thoroughly in the background research on HLI presented in this compendium, including on economic burden of NCDs, whole-of-government and whole-of-society approaches to NCD prevention and management, gender, and behavioral aspects of NCD policy, and labor market policies to promote longer productive working lives.

¹ The HCP has recently introduced Human Capital Complementary Indicators (HCCI) which are a wider set of HD indicators beyond the HCI components that take greater account of adult outcomes. HCCI vary by country but typically include labor force participation rates by gender, youth unemployment/NEET rates, and life expectancy at birth. <https://www.worldbank.org/en/publication/human-capital>.

FACTORS IN DEVELOPING A FRAMEWORK, SOME DEFINITIONS, AND CROSS-CUTTING THEMES

*In thinking about impacts of NCDs and human capital on the end outcomes of healthy longevity, inclusive growth and wellbeing, the discussion aims to incorporate several dimensions. These include structural factors, which may relate to levels of development, stage of demographic transition, and cultural and social norms. Overlaid on those big picture contextual factors is the policy and institutional environment which will play an important role in shaping the accumulation, deployment and protection of human capital, the extent to which NCDs may compromise human capital, and how human capital feeds through to healthy longevity, inclusive growth, and wellbeing. Behavioral factors also play an important intermediating role between structural and policy factors and end outcomes. In addition, as important as the link between NCDs and HC is, the channels of influence of NCDs on the end outcomes considered in this chapter are not only through HC (see Figure 2.2). For the individual, the life course perspective on how these dimensions come together over time (and across generations) is also an important element of the discussion. In considering these factors, it is useful first to define a few terms. The **core concepts and their definitions** for the purposes of our research are:*

- **Healthy longevity** is produced across the life course and means avoiding death and serious disability in middle age, enabling a high level of mental and social functioning through middle and older ages, and includes a socially connected and reasonably pain-free, short period of time before death.
- **For NCDs**, we focus primarily on cardiovascular disease and diabetes, respiratory diseases, cancers, and mental health.
- **Human capital** as understood within the HCP is, “...the knowledge, skills, and health that people accumulate throughout their lives, enabling them to realize their potential as productive members of society.”² The education/skills element of HC (often called knowledge capital) is usually proxied by years of schooling (quantity), or where data are available educational outcomes (quality) represented usually by test scores, and skills by years of work experience to proxy on-the-job skill acquisition. Increasingly, some quality-adjusted measure which captures actual learning is preferred (e.g., Hanushek and Woessman 2020), reflected for example in the HCP use of quality-adjusted years of schooling based on harmonized international test scores (Angrist et al. 2021) and other measures such as “learning poverty”³. The health element of human capital is commonly analyzed through life expectancy, or by some combination of mortality and morbidity indicators. In terms of measuring returns to human capital, present value of future earnings is the most commonly used measure. This means that the standard measure of returns will have in-built bias towards men in the large majority of developing societies due to lower female participation in market work and gender wage gaps.
- **Wellbeing** as used in the chapter is a subjective concept from psychology with three distinct dimensions: evaluative wellbeing (or life satisfaction), hedonic - or affective - wellbeing (feelings such as anger, happiness, sadness etc.), and eudemonic wellbeing (sense of meaning or purpose) (Steptoe, Deaton, and Stone 2015). It is a key end goal of good health and human capital, as it is of growth and the overall development process.

While the HCP, like many other sources and consistent with the foundational work of Gary Becker, includes health within the definition of human capital, this is not universally the case. The OECD for example defines human capital as “...the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and

2 Health is both an element of human capital as well as an input to producing other forms of human capital (Bleakley 2010), and the same is true for education and skills as influencers of the health element of human capital (Grossman 2015; Heckman et al. 2016).

3 This is a recent concept from the World Bank and UNESCO Institute for Statistics. “Learning poverty means being unable to read and understand a simple text by age 10. The indicator brings together schooling and learning indicators: it begins with the share of children who have not achieved minimum reading proficiency (as measured in schools) and is adjusted by the proportion of children who are out of school (and are assumed not to be able to read proficiently).” <https://www.worldbank.org/en/topic/education/brief/what-is-learning-poverty>.

economic well-being” (OECD 2019).⁴ While health could be included in “attributes”, it is at best hidden in such a definition, which is more akin to knowledge capital. Beyond the definitional, a considerable amount of literature speaks to only the knowledge and skills dimension of human capital when discussing the concept and its economic implications, effectively eliding knowledge capital with human capital.

Cross-cutting themes: In the discussion that follows, there are several cross-cutting themes which recur and are useful to highlight at the outset:

- First, that there are *multi-directional relationships* between NCDs and HC, and between them and healthy longevity, inclusive growth, and wellbeing. Crudely, HC and NCDs have a two-way impact on each other, and human capital elements may be affected by levels and rates of growth, healthy longevity, and wellbeing. Given these complex relationships, there has been sustained debate on the extent to which relationships between these variables are causal or only correlates, though progress has been made on clarifying some dimensions of the question.
- A second insight is that, in addition to the individual trajectory of human capital and NCDs, there are important *inter-generational dimensions*. The interactions between the NCD and human capital profiles of parents and their children are significant. This applies not just in transmission of HC and direct well-being effects of health from parents to children when the latter are young. It also applies as parents age and their co-morbidities and disability require increased care from adult children, impacting the returns to their human capital, and their mental health and self-reported quality of life (Lambert et al. 2017; Yiengprugsawan et al. 2022).
- A third important consideration is *distributional*. Within countries, there are clear socioeconomic gradients for incidence of NCDs, with their impact on both HC and directly on well-being.

This is separable from the well-known socio-economic gradients for HC overall. Poorer people on average have higher incidence of most common NCDs (Dalstra et al. 2005; Oshio and Kan 2019), lower educational attainment and on-job skills acquisition, and returns to human capital that diverge further from their peers over their shorter life cycle (Deaton and Paxson 1998). While most evidence on socioeconomic status (SES) gradients is from developed countries, increased evidence from developing countries suggests that sharp socioeconomic gradients can also be seen for both prevalence and risk factors in developing countries. In fact, both income and education gradients for NCDs have been found to be even more pronounced in low-income countries than in middle-income countries (Hosseinpoor et al. 2012; Malta et al. 2013; Williams et al. 2018; Allen et al. 2017; Sommer et al. 2015). Apart from SES, an important dimension of inequality when considering NCDs, human capital and healthy longevity is gender (see section on inequality).

- A fourth insight is that the economic impacts of improved health will vary by the *stage of demographic transition*, which in turn is closely related to the level of economic development. Reductions in NCD prevalence will help improve longevity in all countries, but there are variations across stages of demographic transition and levels of development at what stage that translates to lower fertility, increased HC investment in children, and other factors. The differential impacts across stages of demographic transition are observed in overall growth, savings rate effects, and other factors.⁵
- Finally, the *structural and institutional environment* of countries matters for the scale (and even direction) of the relationships between human capital, NCDs, healthy longevity, growth, and wellbeing. This includes institutional factors of a more foundational nature, such as culture and attitudes, but also underlying institutions such as legal systems or protection of property rights (Ac-

4 Measurement of all these attributes will be incomplete, especially when looking at a wide range of developing countries. As a result, as OECD notes, “...there is no comparable and consistent measure across countries reflecting all these elements available.” (OECD 2019).

5 The stages of demographic transition used are from the Global Monitoring Report 2015 of World Bank. They are: (i) pre-dividend countries with high-fertility (all LICs); (ii) early-dividend countries where fertility rates have started to fall and changing age structures are conducive to growth (a mixture of LICs and LMICs); (iii) late-dividend countries which have had rapid fertility decline and working age population share will shrink over coming decades (mostly UMICs); and (iv) post-dividend countries with high elderly shares and fertility rates below replacement for several decades (mostly HICs).

emoglu, Gallego, and Robinson 2014). These are examples of the structural and social factors in the outer circle of Figure 2.1. But it also includes more proximate policies and institutions such as social security systems and labor market policies and institutions, which have differing impacts on the returns to human capital across and within countries and the degree of protection provided to a given stock of human capital. Another is the built environment and the extent to which that facilitates or constrains labor force and social participation for those with functional limitations. It may also include wider issues not traditionally considered in the social sectors such as climate change. Apart from the aggregate influence of structural factors, they also play a role in promoting and sustaining inequalities and discrimination in accumulation, deployment, and protection of human capital, e.g., along gender or racial lines.

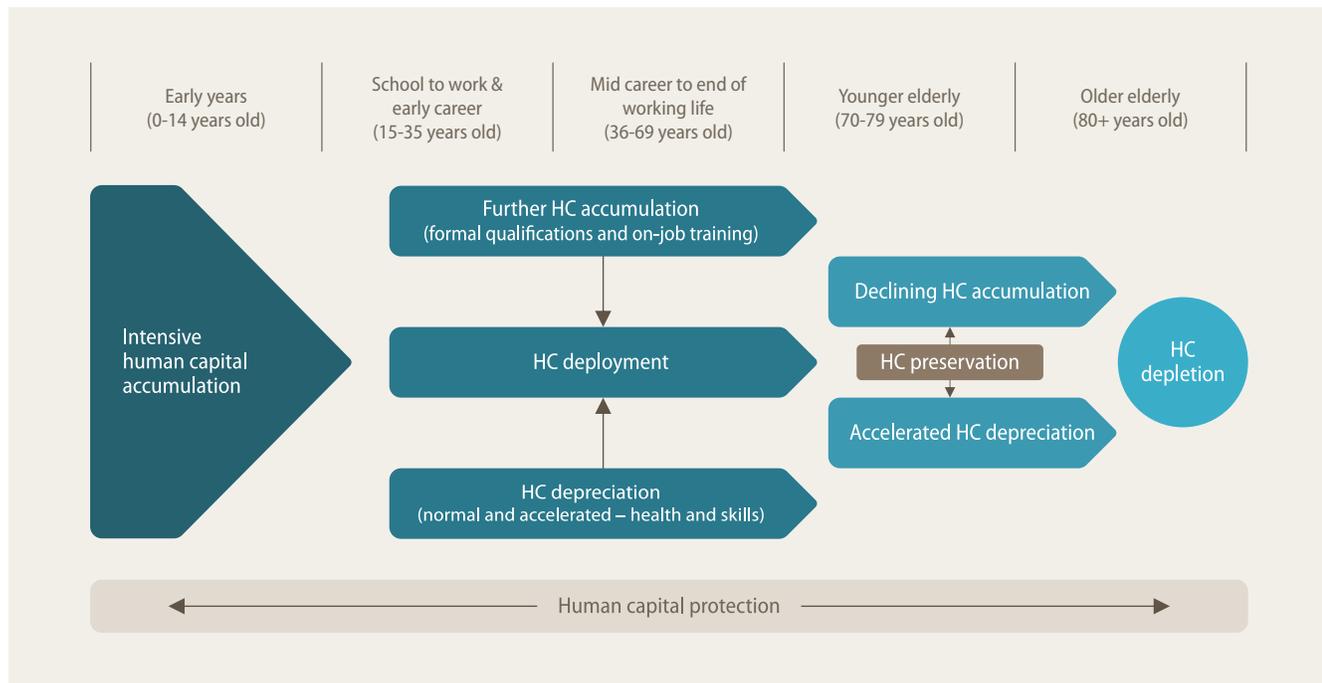
- A final important point is that there are significant *wellbeing benefits* from investments in health capital which do not show up in standard measures of returns to HC, which rely primarily on labor earnings. Such non-pecuniary benefits, starting with the intrinsic value of being alive and in good health, have direct bearing on individual and societal wellbeing which are independent outcomes of concern. These have received less attention in the literature, though this is changing in recent years (Steptoe 2019). A starting point of the HLI and this chapter is that health at the individual level, and the (increasingly NCD-driven) burden of disease at societal level, are themselves important measures of wellbeing, over and above their impacts on other outcomes such as productivity and growth. While a good deal of the discussion that follows looks at evidence on the economic impacts of NCDs, this fundamental point

on human wellbeing should not be lost sight of. Indeed, wellbeing is a key underlying objective of the development, including economic growth, process. The wellbeing impacts of health are discussed later in this chapter.

The life course trajectory of human capital

Given the life course emphasis of the HLI, it is useful to think of a “normal” human capital trajectory across the life course (Figure 2.1). The broad dimensions of the HC trajectory are formation (also called accumulation), deployment (which in this chapter refers both to utilization of HC and extending the years over which HC is deployed), and protection. Like other forms of capital, HC is also subject to depreciation, a process which may be accelerated by NCDs or structural factors such as rapid technological change. The formation of human capital is most intensive during childhood and adolescence, but also includes ongoing accumulation of HC in adulthood (for example through on-job skill acquisition). Deployment is considered here first as realizing returns to HC but extending the period of deployment – for example through minimizing NCDs, or policies to extend productive working lives – is also important. Protecting HC may take various forms, the most pertinent for the HLI being preventing or reducing the burden of NCDs, but also including policies such as social protection programs which facilitate HC formation or prevent and mitigate the depreciation of HC. Protective policies may also permit a longer period of deployment of human capital, with resultant economic and other benefits. The final stage of the life cycle is one of declining HC accumulation, and more rapid depreciation of human capital, though even at that stage interventions to delay rapid depreciation have an important role to play.

FIGURE 2.1 Human capital life course trajectory



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Good health, and particularly reducing the incidence and consequences of NCDs, will be a key driver of slowing human capital depreciation across this cycle. Economic benefits include both standard returns to human capital, which focus on earnings, and the non-market contributions of older people, including their indirect contributions through facilitating the accumulation and deployment of human capital by other family members, e.g., through provision of care to grandchildren.

The human capital life course trajectory is more commonly thought of with respect to knowledge capital, with poor health impacting its accumulation, deployment, and depreciation. However, economists also describe health capital in similar terms, with health as a form of investment of labor and commodities in healthcare with returns in the labor market and beyond (Mushkin 1964; Becker 1964) and viewed as “a durable capital stock that produces an output of healthy time” (Grossman 1972; Arrow, Dasgupta, and Mumford 2014). It depreciates with age, either with natural decline or on a more accel-

erated basis due to illness and mortality over the life course.⁶ Recent work aims to calculate dollar values of national health capital, finding that health capital per capita has increased faster than GDP per capita globally (Arcand and Rinaldo 2019).

Whether looking at human capital narrowly as knowledge capital, or more broadly also to include health dimensions, NCDs can negatively impact human capital at all stages of the trajectory. Conversely their prevention, early detection and effective management can help maximize the accumulation and deployment of HC and avoid or delay its depreciation. The impact channels and evidence on them are discussed in the following sections of the chapter. In short, NCDs in childhood and adolescence (both NCDs of children themselves and the NCDs of parents impacting their children) will negatively impact human capital formation, with consequent negative impacts on its deployment in adult life. NCDs that manifest in adulthood will not impact initial HC formation (or “HC stock at entry” to the labor market), but may impact HC deployment,

⁶ Health is also viewed as interacting with other forms of capital. One dimension is the role of social capital (or social connectedness) as an important determinant of health (Turner 2003), and another strand of research focuses on the role of cultural capital in shaping the interactions of people with the healthcare system (Shim 2010).

may compromise its further accumulation during working life, and will accelerate its depreciation. During working age, the NCDs of older parents may also negatively impact HC deployment of working age adult children through care responsibilities that lessen labor market participation and opportunities for on-job skill acquisition. NCDs of working age parents may also have additional negative effects on HC accumulation for partners, children, and grandchildren. They will also compromise the ability of older parents to provide care to others. And later in life, NCDs are likely increasingly to accelerate health (and knowledge) capital depreciation. This depreciation may in turn be delayed or mitigated through a range of medical/technological interventions, good nutrition, social connectedness, and other factors, so that human capital preservation is a further important dimension to consider as life progresses.⁷ The various impacts of NCDs across the life course will ultimately compromise economic growth, through the human capital channel and macro and fiscal channels. They will also compromise individual wellbeing, both directly and indirectly.

The stylized trajectory of Figure 2.1 comes with a number of caveats, some relevant to comparisons across countries and others to groups of people within countries. First, in developing economies the “normal” life course may be considerably shorter, with the stages of younger and older old age absent or more truncated. Global life expectancy at birth was just over 73 years in 2019 and had risen by six years in the first two decades of the century (WHO 2019) but in many countries it is considerably lower – as low as the early-mid 50s for some LICs. At the same time, global life expectancy at 60 was 83 years in 2019 – a highly relevant complementary indicator when discussing longevity – and healthy years of life expectancy have grown steadily over much of the world (Salomon et al. 2012). A second caveat which

distinguishes developed and developing countries is that under-development and/or under-coverage of public pension systems in poorer countries will usually result in a period of HC deployment which extends till much closer to death, as people are obliged to work until they lack the capacity to do so. This is the case even though the physical environments and labor policies that developed countries offer for people with NCD-related conditions and disabilities may allow for longer *productive* working lives than are possible in less enabling environments. A third caveat is that the characterization of older age as largely a period of decline is overly simplistic, increasingly so as healthy years of life expectancy rise and people at any given older age tend to have better average cognitive performance over time, as healthy longevity rises.⁸ A growing body of evidence also finds that frailty and cognitive decline are more malleable at older ages than historically assumed. In addition, a facilitating external environment can contribute to higher functioning at any given level of morbidity. Related to this point, a fourth qualification is that most estimates of HC returns fail to value non-market contributions, which will truncate or dilute the HC deployment period, failing to value activities such as informal care provision, volunteer work, etc. A final point, related to the fourth, is that this “normal” pattern has a gender bias to the extent that women are unable to engage fully in market activities during their adult lives. This last bias shows up in most estimates of human capital wealth, with World Bank for example estimating that women account for less than 40 percent of global human capital wealth due to lower labor force participation, lower hours of work when participating, and gender wage gaps (World Bank 2018). Gender aspects are discussed in section on inequality.

7 There is also growing frontier research into not only human capital preservation but active reversal of the ageing processes which contribute to health and cognitive decline (e.g., stem cell and methylation research). While important work, it is not considered here due to the likely lack of current relevance for the developing world.

8 The US National Academies of Medicine’s Global Roadmap for Healthy Longevity has a useful summary on the evolution of health and cognitive performance at older ages (NAM 2022).

HUMAN CAPITAL, GROWTH, AND COUNTRY WEALTH

There is a huge literature on the determinants of economic growth and the role of human capital in the growth process. Within this, there is ongoing debate between those who view human capital – largely with a focus on the skills dimension – as foundational for economic growth and those who view it as proximate (North and Thomas 1973). While some authors argue that human capital itself is foundational in the growth process (Easterlin 1981; Glaeser et al. 2004; Gennaili et al. 2013), others argue that the foundations of growth are institutional (or found in other structural factors such as geography or culture), and that human capital is a proximate determinant of growth which is determined by institutions (e.g., Acemoglu, Gallego and Robinson, 2014).⁹ Estimates of the level of human capital's contribution to growth vary significantly between the two approaches, with those arguing that human capital is a proximate cause finding much lower returns to human capital (and at levels which are aligned with findings from microeconomic studies).¹⁰ Nonetheless, both approaches find significant impacts of higher human capital on growth. It is also important to emphasize the limitations of focusing solely on growth in country income or wealth, which neglect wider dimensions of wellbeing which are important in considering the benefits of good health and education.

Related to the large literature on human capital and growth is research on the cross-country shares of factors of production in country *wealth*. This is a useful complement to a focus on economic growth by looking at changes in the underlying asset bases of countries, including accumulation, investment, depreciation, and depletion of different elements of national wealth. As a result, it focuses squarely on the sustainability of growth, and also has a relationship to other work under HLI on the economic burden of disease. A recent example of the research on the role of human capital in country wealth is the *Changing Wealth of Nations* (CWON) from the World Bank (Lange, Wodon, and Carey 2018, and World Bank 2021).¹¹ The importance of human capital in the wealth of countries is striking and rises sharply across levels of development. Globally in 2014, human capital accounted for 64 percent of global wealth. In addition, the correlation of life expectancy to the per capita growth in human capital is stronger than any other factor (Lange, Wodon, and Carey 2018).¹² But the variation across levels of development is striking, with the human capital share of wealth for LICs, LMICs, UMICs and HICs at 41, 51, 58, and 70 percent respectively, emphasizing the increasing importance of human capital in national wealth as countries grow richer. At the same time, the contribution of human capital to *growth* in national

wealth between 1990 and 2014 was highest in LICs and UMICs, at around 80 percent in LICs as against 60 percent or lower in other income groupings.

The World Bank estimate of human capital in national wealth is consistent with other global estimates which seek to look beyond economic growth alone. One example is the estimates in the various Inclusive Wealth Reports (IWR) from UNEP which also aim to look at all sources of wealth in an economy, including inter-generational dimensions. Not dissimilar to the CWON estimates, the 2018 IWR estimates that human capital accounted for 59 percent of average national wealth over the period 1990-2014. Of that total, 33 percent was estimated to be education-induced capital and 26 percent to be health-induced capital.

A final important point to note before getting into the discussion of human capital, NCDs, healthy longevity and growth is that there will be significant wellbeing benefits from investments in knowledge and health capital which do not show up in standard measures of returns to HC which rely primarily on labor earnings. These will have direct bearing on individual and societal wellbeing which is an end outcome of concern. The wellbeing impacts are discussed in the section on welfare effects.

The following sections review the literature first on the relationship between NCDs, longevity and growth, and then between education and skills and

9 The debate helps clarify that human capital, like many other things, has important underlying institutional determinants. And those institutional determinants at a given point in time have their own determinants, including lagged human capital, as e.g., the effect of education on political institutions that affect future human capital. This is the societal counterpart of the intra-family inter-generational above.

10 Acemoglu et al. argue that the much higher estimates on returns to human capital in studies which treat it as foundational are driven by omitted variable bias, with the human capital variable reflecting some of the effect of institutions or proxying some unknown variables.

11 The components of national wealth used in the report are produced capital and urban land, natural capital, human capital, and net foreign assets.

12 The other factors modelled include schooling levels, labor force share and growth rate, population growth, government spending, public investment, trade, and inflation.

growth. The channels for NCD impacts on growth are then discussed, notably the savings channel, fiscal channel, and HC channel. The following section then summarizes evidence of the reverse impact of education and work on health and health behaviors, bringing out the bidirectional influences of NCDs and HC.

The relationship of NCDs, longevity and growth

There is a substantial literature on the impacts of health on levels and rates of growth, using macroeconomic, growth accounting, and microeconomic approaches (Jack and Lewis 2009). Two caveats to bear in mind in assessing the literature on the relationship between NCDs and growth are, first, that much of the work has been done on overall health rather than NCDs per se, and second that a good deal of the research does not control thoroughly for underlying non-health determinants of growth (the latter applying similarly on the relationships between preventable mortality or several disability and growth). While the first is a clear limitation, the indicator most often used in macro-level work is life expectancy. While rising longevity is driven by a combination of prevention and control of communicable and non-communicable diseases, increasingly the burden of mortality is NCD-dominated, so that the gap between the economic impact of *overall* health status and *NCD-only* health impacts is falling rapidly over time and is already low in MICs and above. The other point to note is that the relationship may be bidirectional. On the second caveat of failure to control for non-health determinants of growth, important examples would be institutional or structural determinants (see above re Easterly and Acemoglu critiques), failure to control for is likely to upwardly bias estimates of the contribution of health to growth.

In work taking a macroeconomic approach, there has been considerable debate on the direction of causality between better health and higher country income, and to what extent health causes growth (Lewis and Jack (2009) have a useful summary of the diverse strands of literature in this debate). There are real challenges in demonstrating the channels and strength of the health to country income relationship, with technical challenges and variation in identification strategies, and differences in the scale and even direction of estimated impacts of health on growth. Nonetheless, a summary of the literature by Bloom, Kunh, and Prettner (2018) concludes that “...the bulk of research identifies a positive, if often weak, causal link...” between health

and growth. At the same time, cross-country work by Kotschy and Bloom (2023) points to the negative impacts of societal ageing on growth rates as the demographic transition progresses.

There is growing evidence that the impact of improved societal health (proxied by increased longevity) on human capital accumulation and ultimately growth differs according to what stage countries are in the demographic transition to lower fertility rates, and again post-transition according to whether they have reached a very high level of longevity (Cervellati and Sunde 2009, 2015; Bhargava et al. 2001; Hansen 2013; Desbordes 2011). The relationship between life expectancy and GDP per capita exhibits an inverse U-shape and countries tend to follow that curve over time. Bloom, Kunh, and Prettner (2018) summarizes the intuition of this literature as follows: “In pre-transition economies, greater longevity is not associated with greater educational attainment or a reduction in the birth rate. As such, increased survival rates translate into a higher net rate of reproduction”, which tends to be a drag on growth. In contrast, “... in post-transition economies, greater longevity is associated with increases in various measures of education and consequently reductions in fertility”. However, at very high levels of life expectancy, the relationship to growth seems to become negative again, as large amounts are spent “unproductively” in economic growth terms using expensive medical technology on people beyond working years.

A second approach to exploring the causal nexus between health and growth has been growth accounting, which informs the macro approach with microeconomic estimates of the impact of health on individual productivity and may provide a firmer methodological foundation for understanding the impacts of improved health on growth. The work of Weil (2005) and others (Ashraf, Lester, and Weil 2009; Hsieh and Klenow 2010) find positive, but considerably lower, impacts of health on growth than some of the macro work such as Bloom and others. The HCI builds on the literature on the relationship between health and productivity through incorporation of the adult survival rate from age 15 to 60 as one of its components and estimates that a 10 percent increase in adult survival to age 60 results in a 6.5 percent increase in labor productivity (Kraay, 2018).

The third approach of microeconomic studies looks at household level health factors and their effects on income. This is based on a clear relationship between individual health and incomes but does not capture externalities or general equilibrium effects. Microeconomic studies find positive effects of good

health and nutrition on growth, most notably in early childhood with high economic rates of return on investments. Nonetheless, microeconomic estimates find impacts are “1-2 orders of magnitude smaller than cross-country studies” (Bleakley 2010).

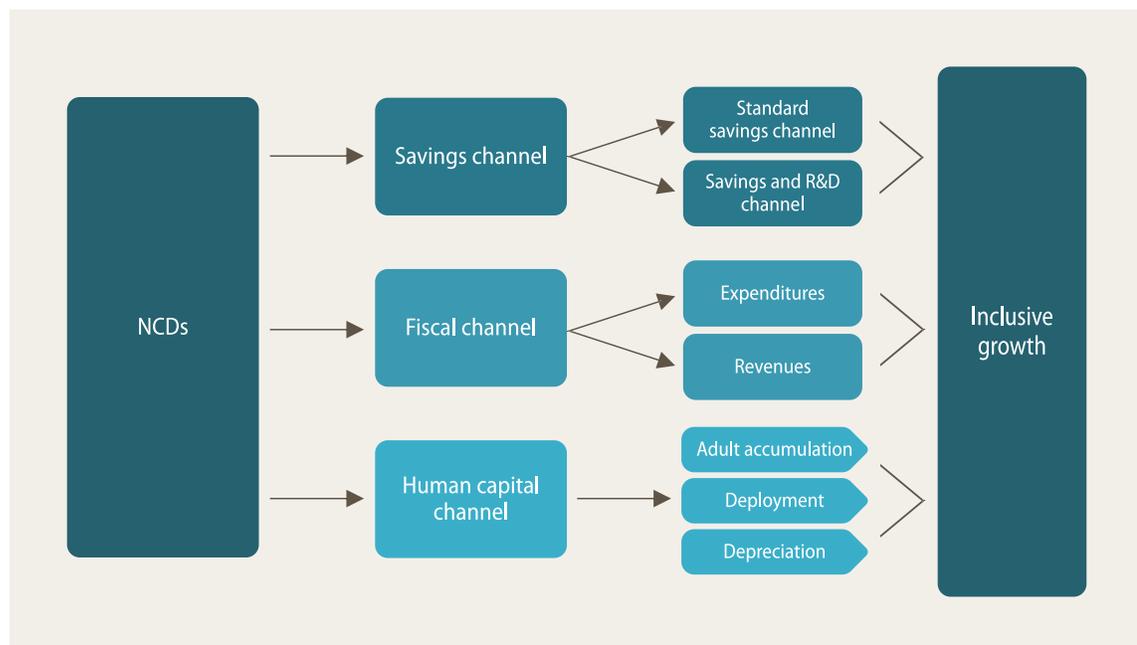
More directly, analyses on the macro-level impacts of NCDs support a negative relationship between NCD prevalence and economic growth. A 2010 study by Stuckler et al. calculating gaps in Millennium Development Goals (MDG) achievement estimated that each 10 percent increase in NCD-related death in a population was associated with a 0.5 percent reduction in annual economic growth. Put in a positive light, Han et al. (2019) in a study of 10 LIC and LMIC countries that a basic package of NCD interventions for the “big four” plus mental health would result in GDP being 0.5 percent higher annually (or 0.7 percent higher per capita) over a five-year time horizon. Looking at specific NCD categories, in HICs, Suhreke and Urban (2010) and Hyclak, Skeels, and Taylor (2016) find a negative causal effect of cardiovascular disease on subsequent economic growth for 1960–2000 and 2000–2012 respectively. Bloom, et al. (2014) project substantial negative impacts on output in China and India from five major NCDs, primarily through negative effects on labor supply and capital accumulation. Similarly, research from Singapore has projected that the growing prevalence and increasingly early onset of type 2 diabetes amongst the working-age population will have signif-

icant impacts on overall economic growth and employment through negative effects on labor force participation (Png et al. 2016). Global studies of diabetes also point to negative impacts on growth; however, the drivers of these vary between HICs where negative effects on labor force participation drive impact, as compared to MICs and LICs where premature mortality from diabetes drives the negative effects on growth (Bommer et al. 2017). Studies of the impact of cancer on growth have similarly shown a negative effect through impacts on workforce participation and productivity (Beaglehole et al. 2011). Estimating the impact of common mental illness on growth is challenging particularly in LMICs, in large part due to a paucity of data. However, there is growing evidence of the negative effect of mental illness on work force participation and productivity, and in turn GDP (Knapp and Wong 2020; Kilian and Becker 2007).

Impact channels between NCDs, human capital and inclusive growth

Looking beyond the overall NCD to growth relationship above, this section reviews in more depth the evidence on the diverse impact channels of NCDs on productivity and growth. It starts with the savings and fiscal channels, then looks in depth at the NCD-HC-productivity and growth linkages across the life course. Figure 2.2 illustrates these channels and their constituent elements.

FIGURE 2.2 Impact channels between NCDs and inclusive growth



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i. The savings and investment channel

NCDs may impact savings behavior, which in turn will impact investments in physical capital, a key contributor to economic growth. The net impact on savings of increased longevity comes down to whether behavioral or compositional effects dominate. The behavioral effect is that increased longevity encourages higher savings at all ages as people anticipate longer post-work lives and hence periods of dissaving (Bloom, Canning, and Graham 2003; Kinugasa and Mason 2007; Lee, Mason, and Miller 2000; Doshi 1994).¹³ This beneficial impact on savings will be compounded in the earlier stages of demographic transition by favorable dependency ratios. On the other hand, as the population stabilizes with a higher share of elderly people, the positive behavioral effect of people saving more across the life cycle may be offset - and eventually dominated - by the higher share of people in the overall population who are dissaving at older ages (the compositional effect). Apart from these general effects, there may also be more specific effects of NCDs on household savings behavior. Intuitively, if lower prevalence of NCDs increases productive working years, and working years are ones of positive net savings, this effect may itself contribute to higher aggregate savings. In contrast, there is evidence of the dissaving and financial stress impact of smoking (Greenhalgh et al. 2022), but also that smoking in LMICs lowers household level investments in human capital, on average across studies lowering education spending by around 8 percent (Do and Bautista 2015).

For pre-demographic dividend developing countries, the net positive savings effects of increased longevity can be substantial and can persist for 50 years or more, as the experience of East Asia demonstrates (Horioka and Terada-Hagiwara 2012; Li, Zhang, and Zhang 2007).¹⁴ The empirical analysis of Bloom, Canning and Graham (2003) suggests that the positive effect on savings of increased longevity dominates the deterioration in the dependency ra-

tio for a group of 69 largely developing countries, though how different institutional and policy factors mediate impacts is not well understood.¹⁵ In terms of net effects on growth, any potential negative effect on savings from increased societal longevity could be offset by increased labor supply, extending the pay-off period for earlier investments in human capital and reducing the period of dissaving.¹⁶

An additional - though less direct and more speculative - channel is the impact of increased longevity on technological progress, which has increasingly been recognized as an important source of growth since the work of Romer and others (Romer 1990; Aghion and Howitt 1998). In such models, increased longevity positively impacts technological progress (and ultimately long-run growth) through higher savings which in turn drive down equilibrium interest rates and increase incentives to invest in R&D. An additional way of looking at the impact on R&D investment, linked to how addressing NCDs increases human capital, is that parents who invest more in the education and health of their children help create a deeper human capital stock which is ultimately a key input to the R&D sector (Baldanzi, Bucci, and Prettnner 2017).

ii. The fiscal channel

While much of the discussion on the impact of health and education on growth and productivity focuses on individual or household level effects, NCDs may also have fiscal impacts, both on the expenditure and revenue sides. Higher NCD incidence is likely most obviously to increase the need for public spending on healthcare services, and also aged care services in countries where those are financed in part by governments. How much healthcare spending on NCDs increases relative to outcomes will be a function of the efficiency of that spending (on which there has been major efforts to refine “best buys” and cost-effectiveness of interventions by WHO and others). Those cost-effective

13 Though Bloom, Canning, and Graham (2003) find that the increased savings effect may be non-linear across the life cycle and was most pronounced up to age 65 in the early 2000s, suggesting that the positive impact of increased longevity on savings rates will be more pronounced in countries with initially lower life expectancy. The life cycle hypothesis underlying this effect may also be diluted where there are adequate and high coverage public retirement income systems.

14 Though the caveat on non-health determinants of growth and savings probably applies unusually strongly to East Asia.

15 There is also a gender dimension to this given the disproportionate burden on women for care of older frail parents and/or children with NCDs. To the extent this compromises their ability to undertake market work, it would result in lower income and ultimately savings.

16 This effect may be constrained in more formalized economies by mandated retirement ages or other incentives for retirement at particular ages.

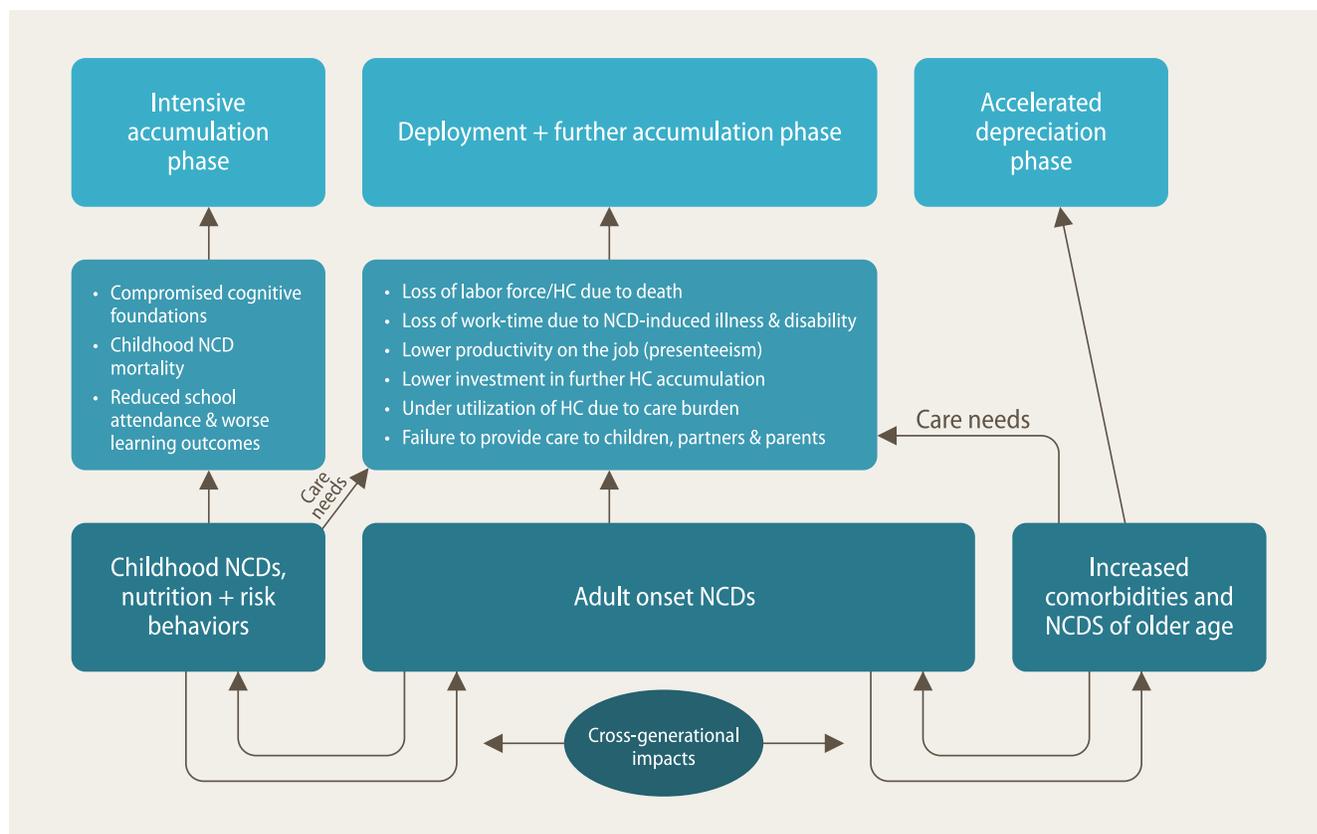
interventions, in particular to take steps from early in the life cycle to reduce the incidence of NCDs, represent an important effort to bend the cost curve downward. To the extent that NCDs nonetheless increase public expenditure and budget deficits, that results in increases in public debt and requires higher interest payments to those purchasing the government bonds that finance the deficit (i.e., higher bond yields). It may also lead to crowding-out of private sector investment. While fiscal deficits need not be negative for growth if debt finances productivity-enhancing investments in physical or human capital (and are a standard part of a Keynesian arsenal), the experience of 2022 has demonstrated that persistent rapid increases in fiscal deficits and resultant public debt may have serious consequences for growth, inflation, and capital markets.

The other fiscal channel is on the revenue side. The budgetary impact of a package of NCD prevention programs can be significantly mitigated by including taxes on tobacco products, alcohol, and sugar-sweetened beverages (SSB), which produce revenues as well as longer term contributions to health and to productivity and growth (Summan et al. 2020). As discussed in more detail below, tobacco taxes, in particular, have been shown to be highly effective in reducing smoking, so reducing illness and death from a range of respiratory and cardiac diseases and cancers. There is also increasingly strong evidence for the revenue and health benefits of taxing alcohol and SSB (The Task Force on Fiscal Policy for Health 2019). For the longer term, to the extent that NCDs compromise workforce participation, that will reduce revenues from labor income, either entirely where people fail to enter or withdraw prematurely from the labor force, or at the margin where they are working fewer hours over time. To the extent that NCDs compromise productivity while at work rather than participation or hours worked, the negative revenue impact is likely to come through the firm profits and corporate tax channel rather than labor taxes.

iii. The human capital channel

There has long been an intuition that greater longevity leads to investment in more years of schooling in the anticipation of a longer dividend period on the initial years of educational investment – the so-called “horizon effect” (Ben-Porath 1967). Increased longevity is of course driven by a combination of communicable and non-communicable diseases, but increasingly the burden of disease is NCD-dominated. While micro-level analysis has found a robust causal relationship between increased life expectancy and higher human capital (e.g., Jayachandran and Lleras-Muney 2009), macro analysis differs between those who confirmed a similar positive causal relationship at the macro-level (Lorentzen, McMillan and Wacziarg 2008; Bloom, Canning and Sevilla 2004) and those who argue that increased population growth in response to increased longevity results in a negative causal relationship once changes in *per capita* income levels are taken into account (Acemoglu and Johnson 2007). In any event, global life expectancy has been on a steady increase for decades, from around 51 years at birth in 1960 to 73 years by 2019 (with a small drop due to the COVID-19 pandemic after that). It is instructive to look at the impact of NCDs on human capital across the life course. This allows us to understand how NCDs impact different aspects of the human capital trajectory (formation/accumulation, deployment, depreciation, and depletion, with protection a common element across the life course) and with differing intensity. Annex Table 2A.1 is a stylized mapping of life course stages, human capital trajectory, NCD patterns and impacts of NCD patterns on human capital across the life course.

The following sections discuss these relationships across the life cycle in more detail. They are summarized below in Figure 2.3 across the NCD and human capital life trajectories. Two important points to note are: (i) there are important interactions of NCD status and HC outcomes across generations in addition to the direct impacts of NCD on the human capital of individuals; and (ii) there is often a two-way relationship between NCDs and human capital which can make causal channels hard to determine with confidence.

FIGURE 2.3 Impact channels between NCDs and human capital across the life cycle

Source: Original figure for this publication

a. Gestation, early years, and childhood (Conception - 14 years)

For both NCDs and human capital formation and its trajectory over the life course, pregnancy and early years of life are critical, both in the short-term and the long-term. While for most people NCDs only manifest in adulthood, pregnancy and infancy crucially influence the risks of NCDs in childhood and adult life, with attendant impacts on human capital accumulation deployment and depreciation (Heidari-Beni 2019; Shrimpton and Rokx 2012).

Starting prior to birth, inter-uterine growth restriction (IUGR) affects 10–15 percent of all pregnancies worldwide, and may be of maternal, placental, or fetal origin. Whatever the causes of IUGR, it is increasingly clear that it makes affected infants more susceptible to a host of NCDs later in life, in-

cluding cardiovascular and renal diseases, metabolic disorders including non-alcoholic fatty liver disease, metabolic syndrome and type 2 diabetes and chronic lung disease in adulthood (Armengaud et al. 2021; Kruger and Levitt 2017). Distinct from IUGR, low birthweight is associated with an increased risk of NCDs in childhood and in adult life, including for the latter diabetes, hypertension, cardiovascular disease, and neurological disorders.¹⁷ In addition, “... the associations between low birthweight and NCDs can be transmitted across generations, even in the absence of further adverse exposures, such as maternal malnutrition” (Nyirenda and Byass 2019).

In the early years after birth (particularly up to age 3 but for this discussion 0-5 years old), NCDs and HC exhibit a mixture of short- and longer-term impacts and inter-relationships. The first short-term issue is the incidence of childhood NCDs. This is a

17 The relationship between low birthweight and diseases in adulthood is known as the Developmental Origins of Health and Disease (DOHaD) hypothesis (Hanson and Gluckman 2014).

significant and growing health burden in itself, with around 20 percent of childhood deaths and around 42 percent of DALYs due to NCDs (WHO 2016; Proimos and Klein 2012; Gore et al. 2011; Patterson et al. 2019 re childhood and adolescent diabetes; Chatenoud et al. 2010 and Bertuccio et al. 2020 re childhood cancers; McCoy et al. 2005 re asthma). This represents an enormous loss of human potential globally.

Childhood under-nutrition has major well-documented impacts on both NCDs across the life course and human capital formation and deployment. Over the long-term, early under-nutrition significantly increases susceptibility to NCDs in adulthood, including CVD, type 2 diabetes, obesity, and hypertension (Karakochuk et al. 2018; Shrimpton and Rockx 2012; Black et al. 2013; Victora et al. 2008). It also has strong negative impacts on neurological development and cognitive performance, compromising the foundations for learning in childhood and potentially over the life course (Nyaradi et al. 2013).

Increasingly, interventions for promoting better childhood nutrition need to focus on the double burden of malnutrition, i.e., not only undernutrition but also childhood overweight and obesity which has become a growing epidemic in developing countries due to changes in food systems, lifestyles, and other factors (Abdullah 2015; Popkin et al. 2020). Childhood obesity is a direct cause of childhood NCDs and co-morbidities which usually manifest in adulthood (Pizzi and Vroman 2013; Finkelstein, Graham, and Malhotra 2014). It may also contribute to poor socialization and poor learning. Like under-nutrition, it is also a strong predictor of both obesity and a range of NCDs in adulthood, with associated health costs and lost productivity. Finally, there are inter-generational effects with parental obesity linked to obesity of children (WHO 2015 for a summary of evidence).

As children move into school years (around 5-14 years old for this discussion), the interactions between nutritional status and the educational dimension of human capital formation become more evident and are well documented. The literature on childhood NCDs and educational performance is thinner but shows clear negative effects. Work for this project finds that in India and the UK NCDs are correlated with lower school enrolment, for some countries attendance, and strongly impact educational attainment, the key human capital outcome.

Children with NCDs were also found to be less likely to be employed as adults and to work less when they are employed, thus influencing future earnings and on-job human capital accumulation. This echoes work on negative impacts on educational indicators for specific NCDs such as diabetes, asthma and epilepsy (Wodrich and Cunningham 2008; Meng et al. 2013), and of mental health conditions such as ADHD (Currie and Stabile 2006).

Apart from the health and nutritional status of children themselves, there are important associations between parental health and HC status and the health, cognitive and educational outcomes of children. There is an important gender dimension of improved adult health in women and strong inter-generational spillover effects on children's health, as well as an interaction of child health with education (Bhalotra and Rawlins 2011; Field et al. 2013). There is a well-developed literature on the correlations between overall maternal health and various child development outcomes, including birth weight, survival, cognitive development, schooling performance, adult health, and productivity (Bloom, Kuhn and Pretzner 2015). While the impacts of paternal health on children's outcomes are less studied, there are obvious channels such as loss of household income on children's dietary diversity and nutrition, as well as documented negative impacts on children's health from paternal risk factors such as smoking (Oldereid et al. 2018).

While the literature on the impact of NCDs specifically on child health and human development outcomes is somewhat thinner, available studies on parental NCDs and child outcomes are consistent in finding negative impacts of maternal NCDs on child health and human capital development (see Onarheim et al. 2016 for a systematic review). Jayachandran and Lleras-Muney (2009) also provide evidence from Sri Lanka that increases in female adult survival rates led to differential increases in the education of girls over boys. The picture on mental health is somewhat more mixed, though meta-analysis of studies from developing countries finds that maternal depression is associated with early childhood underweight and stunting in early years – and thus with NCD likelihood in adult life (Surkan et al. 2011), and in high income countries has negative effects for offspring health, behavior, and psychosocial functioning (Propper, Rigg, and Burgess 2007).¹⁸ For more

18 Paternal mental health during pregnancy, early years and adolescence also appears to affect the development of children, but contextual mediators strongly affect the strength of the association (Sweeney and Macbeth, 2016).

acute mental illnesses, the negative effects on child mortality and morbidity are clear (Webb et al. 2005). There is also a longer-run macro channel of impact through fertility and education, with the transition from a low equilibrium “poverty trap” of high fertility and low educational investment in pre-dividend countries to a new situation of declining fertility and increased educational investments in early dividend countries and beyond (Bloom, Kuhn and Prettnner 2015; Onarheim et al. 2016; Vitoria et al. 2008).

In the formative years of life, the role of social assistance in both promoting human capital accumulation and protecting it has increased markedly in the developing world over recent decades. In terms of promoting human capital accumulation, there is solid and growing evidence of the positive impacts of social assistance transfer programs (both food and increasingly cash) on a range of human development/capital outcomes. This includes vaccination, use of maternal and child health services, child and maternal dietary diversity and other nutritional outcomes, and school attendance (Bastagli, Hagen-Zanker, and Sturge 2016; O’Keefe et al. 2022).¹⁹ These beneficial impacts have been found in both unconditional and conditional transfer programs.²⁰ Given that such programs are often targeted on the basis of need, the benefits in most cases accrue in a progressive manner, though exclusion errors in targeting often limit programs having as widespread an impact as intended. In terms of protecting human capital, transfer programs have similarly helped to reduce negative coping mechanisms such as school drop-out and child labor.

b. Impacts of NCDs during school-to-work transition and working ages (15 – 65 or 69 years)

In addition to the evidence on childhood NCDs and their impacts, NCDs which manifest in adulthood negatively impact labor force participation (and

thus returns on a given stock of human capital), as well as further human capital accumulation during working life. Reductions in NCD-related mortality and morbidity in adulthood will thus raise the returns to the productivity of educational investments (Mushkin 1964; Bleakley 2010; Bouncekine, de la Croix and Licandro 2002). NCDs in adulthood may also accelerate depreciation of human capital in different ways. Some of these impacts are fairly self-evident and others less so. Mushkin categorizes the three impacts of poor health on labor product as due to death (resulting in loss of workers altogether), disability (lost work time) and debility (loss of productive capacity at work). The relative likelihood and intensity of different impacts will vary over the life course for the individual and over time for the society as the average age of workforces increases. Figure 3 summarizes some of the key channels in which NCDs may negatively impact accumulation, deployment, and depreciation of knowledge capital across the HC trajectory. These are discussed in turn in this section. Annex 2.1 provides a more detailed mapping of the human capital trajectory and its interactions with NCDs across the life cycle.

This is also a domain where structural factors and labor market policies and institutions will matter a great deal. For example, a health condition which may be completely disabling so far as ability to work and earn in one society may have more limited or even negligible impacts in societies which have accommodative workplaces and labor practices, or in occupations which are less physically demanding. To the extent that NCDs impact physical capacity, their impacts may for example be expected to be more acute in low-income countries with greater prevalence of manual labor in agriculture.

- The most obvious impact is the ***labor supply and human capital loss from premature mortality due to NCDs***.²¹ Given that over 40 percent of

19 See also Handa et al. (2018), Baird et al. (2014), García and Saavedra (2017), Petrosino et al. (2014), Snilstveit et al. (2016) for cash transfers.

20 There is long-running debate on the pros and cons of conditioning transfer programs. While there is evidence that conditioning has in some countries resulted in somewhat better human development outcomes than UCTs, in many developing countries there are issues of supply side availability of services, administrative capacity to monitor compliance with co-responsibilities and other factors which caution against strict enforcement of compliance. These supply-side challenges have led to increased interest in “cash-plus” transfer programs where the transfer is accompanied by social and behavioral change programs and other complementary interventions, but where participation of beneficiaries is nudged rather than strictly enforced.

21 WHO estimates around 42 percent of NCD deaths occur before 70 years old, an age at which substantial shares of the labor force continue to work in low-income countries in particular. Of these, an estimated 1.7 million (4 percent of NCD deaths) occurred in people younger than 30 years of age, and 15.2 million (38 percent) in people aged between 30 years and 70 years (Bennett et al. 2018). For the EU, OECD estimates that premature death due to NCDs corresponds to a rate of about 200 per 100,000 population in the age group 15-64 (OECD, 2016). See also Sweeney et al. (2015) for estimates of the economic cost of premature NCD mortality for 12 largely developing countries.

NCD deaths occur before age 70, they represent a major loss in total labor supply and thus human capital globally. The relative importance of this impact channel is increasing over time as the average age of labor forces rises. The economic impact of premature mortality is also projected to increase more quickly over time relative to impacts from morbidity (Sweeny, Rasmussen, and Sheehan 2015). The value of that lost labor output (HC deployment) will vary according to labor force participation rates and un- and under-employment rates (with significant gender differentials also) but is an obvious drag on productive potential and a reduction in returns to the human capital of workers who die prematurely from NCDs. There is also an economic impact of not being able to provide care for children, partners, and older parents.

- The next channel is *reduced returns to human capital from NCD-based morbidity and disability* resulting in reduced labor input and/or worker productivity. Available estimates suggest that this is a notably higher economic impact than premature mortality from NCDs, though this is less likely to be the case in some of the poorest countries with the highest premature mortality rates and lower productivity workforces (e.g., Sweeny, Rasmussen, and Sheehan 2015). Reduced returns to HC may take the form of complete non-participation in the labor force (or early withdrawal), unemployment, lower hours worked, absenteeism and “presenteeism” (being at work but less productive due to NCDs), delayed return to work, and, for formal sector workers, sick leave. These impacts may be measured in terms of DALY totals or shares lost, or monetized output losses. While evidence is largely from developed countries, the economic losses through this channel appear to be substantial.²² There also appear to be gender differences in how specific NCDs impact labor market outcomes, with for example high BMI having more negative impact on women’s labor market outcomes than for men, and diabetes having higher negative impacts for men (Chakraborty, Wu, and Jha 2024). Focusing first on non-participation and unemployment, perhaps the best documented NCD group is mental health and sub-

stance abuse, with strong relationships between poor mental health and unemployment. Across the OECD, people with mild to moderate mental illness, such as anxiety or depression, are twice as likely to be unemployed, and that can rise to as high as seven times with severe mental illnesses. The stigma around mental health has been shown to impact hiring and job loss, and to involve a self-stigma element which constrains job search (Brouwters 2020). Substance abuse both increases the chances of being unemployed and is more likely to occur among those who are unemployed, creating a vicious cycle (Henkel 2011). Apart from mental health and substance abuse, the limited number of studies from developing countries also show negative labor market impacts of specific NCDs such as diabetes (e.g., in Mexico, there was a 7.7 and 6.3 percent reduction in probability of being employed for men and women respectively for those with self-reported diabetes, though no significant impact on hours worked or wages, Seuring et al. 2019).

Variations in approach and accounting make rigorous comparison or aggregation challenging, and the limited developing country evidence points to significant diversity in the impacts of different NCDs on labor force productivity across countries. The economic impacts of presenteeism in particular have proven difficult to measure and compare, with differing methodologies, variable impacts according to welfare regimes and other factors leading to highly variable estimates of impacts (Mattke et al. 2007; Cancelliere et al. 2011).²³ A literature review concludes that “the biggest problem remains the lack of an established and validated method to derive monetary estimates of the cost of lost productivity” (Garrow 2016), and Schultz et al. 2009 caution against assigning dollar amounts to presenteeism losses. Accepting these substantial caveats, one study for 12 mostly developing countries finds the economic impacts of NCDs due to absenteeism and presenteeism in 2020 to be between 0.9 and 1.6 percent of GDP annually for absenteeism, and between 2.6 and 3.7 percent of GDP annually for presenteeism (Sweeny, Rasmussen, and Sheehan 2015).

The gender dimension of these impacts is also

22 One systematic review found that less than 4 percent of studies from developing countries (Chaker et al. 2015).

23 Mattke et al. (2007) describe three broad approaches to measuring presenteeism: assessment of perceived impairment by employees; comparative productivity, performance, and efficiency measures; and estimates of unproductive time while at work.

important to note. Globally in developing countries, labor force participation rates of women are significantly lower in paid employment than those of men. The participation gap is exacerbated by the gender wage gap. One accounting effect of this is that reduction in measured returns to human capital from NCDs among women overall will be systematically lower than for men. At the same time, Bloom et al. 2015 show that healthier women are more likely to be in formal sector employment, with higher earnings and productivity than either informal work or no market work. An important second order effect is that women in formal employment tend to have fewer and better-educated children, so the economic and social benefits of averting NCDs are inter-generational. The gender inequalities in different dimensions of human capital are discussed in detail in section on inequality below.

- A third channel is the **reduction in further accumulation of human capital** during working life from both the *direct* impact of NCDs on labor input and quality of labor input (and hence work experience and on-the-job learning), and the *indirect* behavioral impacts on subsequent effort to accumulate human capital and changes to saving and other behaviors (Capatina et al. 2020; Smith 2004; Hokayem and Ziliak 2014). Firstly, with respect to the direct impact, substantial human capital accumulation occurs on the job, through learning-by-doing and/or structured training and skill upgrading (see Program for International Assessment of Adult Competencies (PIACC) publications of various years²⁴; Ma, Nakab, and Vidart 2022). Secondly, the indirect effect on further human capital accumulation has been less studied but appears to be substantial. The logic is that those experiencing poor health or significant health shocks will anticipate reduced future labor supply and thus lower future returns to their current human capital investments, disincentivizing such investments. The extent to which health shocks from NCDs impact earnings over the life course is also likely to vary according to the chronicity and the unpredictability of symptoms of different NCDs (Heckman and MaCurdy 1980). Estimates for the US show that around 40 percent of the loss in remaining lifetime earnings from a major per-

sistent health shock is due to the indirect effects of reduced human capital accumulation after the shock (Capatina et al. 2020). Just as interestingly, the same analysis finds that two thirds of the impact of health shocks on inequality of subsequent lifetime earnings is due to the behavioral effects rather than the direct impact of the health shock itself.²⁵ Both direct and indirect impacts would be expected to have a compounded effect where NCDs induce multiple health shocks over time.

- NCDs can also contribute to accelerated **depreciation of human capital**. This may be primary/direct, where NCDs in the working age person result in long spells of unemployment or withdrawal from the labor force. While not easy to measure, carefully done work finds evidence of skill depreciation from periods out of work (Dinerstein, Megalokonomou, and Yannelis et al. 2020; Laureys 2021). With respect to health capital, the impact of NCDs and poor health is obvious. Alternatively, the impact may be secondary/indirect, whereby absenteeism and presenteeism accelerate the normal depreciation in human capital that has been observed to happen over time for healthy workers.
- Depending on the severity of NCDs during normal working age, there may be negative **spillover effects on other adult family members and children**. For children, this is discussed above, and there are clear negative spillovers of parental NCDs on children's human capital development. For prime age adults reducing work or withdrawing from the labor force due to NCDs, the net impacts are less clear. There may be an added worker effect where other adult(s) in the household who were not in the labor force prior to the NCD shock take on market work to offset the loss of income from the withdrawal of the breadwinner (Lundberg 1985) but this depends on care needs and options.

c. *Later life (66 or 70 years – death)*

The later stages of life present a quite distinct trajectory of both NCDs and HC, and their inter-relationships. From the NCD perspective, prevalence increases, and co-morbidities are more frequent. ADL/IADLs are increasingly compromised for

24 Full database of publications available at: <https://www.oecd.org/skills/piaac/publications/>

25 Though the analysis factors in access to social insurance in the US, which may have differential impacts on low skill workers than high skilled.

many and may become disabling conditions beyond a certain point. The risk of age-related NCDs such as dementia also increases sharply, as well as depression related to social isolation. From the human capital perspective, the educational/skills element of human capital accumulation decelerates (and eventually stops) and depreciation accelerates, while returns on human capital according to standard measures diminish or cease with withdrawal from the labor force (though this reflects the limitations of standard measures of returns to human capital rather than implying that older people outside the workforce make no contribution to their households or society).²⁶ Protection of the health dimension of HC becomes ever more important, aiming for compression of morbidity.

The inequality dimension is also on average more acute, as the cumulative deficits of a lifetime for those at lower ends of the socio-economic gradient come home to roost in the shape of higher co-morbidities and shorter life expectancy and lower incomes (Deaton and Paxson 1998; OECD 2017), but also commonly having to “work till one drops” out of financial necessity, lack of old age financial protection from formal pension schemes and inadequacy of social assistance benefits, and lack of affordable formal aged care or other unpaid care options. In poorer countries, a positive factor is high multi-generational co-residence, which facilitates mutual caregiving across generations, though tends to decline steadily as countries get richer (Evans and Palacios 2015).

The inter-generational element of the human capital and NCD interaction is crucial at this life stage. The most common negative impact of advancing NCDs is diversion of adult children/children-in-law from market work in order to provide care. The obligation for care falls disproportionately on women and has diverse impacts on their labor market participation depending on prior status and the extent to which care demands have major impacts on capacity for market work or are more modest and manageable (Moreira da Silva 2019). But there

is significant potential for lower returns to the existing stock of human capital of adult family members and stalled accumulation of further human capital. The impacts can be direct (care needs and time for the older parent) and/or indirect (older parents no longer able to care for grandchildren and the care responsibility falling again to the “sandwich generation” parent). These social dynamics are well understood anecdotally, but for developing countries have only in recent years been better researched with the spread of HRS-style household surveys which quantify time and opportunity costs and benefits of informal care provision (e.g., CHARLS in China, SAGE surveys²⁷ in India and other countries).²⁸ The gender dimensions of care burden and the resulting under-utilization of women’s human capital is discussed more in section on inequality below.

Impacts of human capital and work on NCDs, overall health and health behaviors

There is more debate about the extent of causality in the other direction – from human capital (accumulation, deployment and depreciation) to NCDs. There is less evidence on the effects of education on NCDs specifically in developing countries, but more evidence of education gradients and impacts on general health and NCD-related risk behaviors. The excellent summary by Grossman (2015) concludes, “...many studies suggest that years of formal schooling completed is the most important correlate of good health. There is much less consensus as to whether this correlation reflects causality from more schooling to better health” (Heckman and Karapakula (2019); Heckman, Humphries and Veramendi (2016); Conti, Heckman and Urzua (2010); Cutler and Llera-Muney (2006). He reviews the literature which addresses these challenges in various ways: by introducing omitted variables; by examining environmental factors (in twin studies); and through use of instrumental variables. As a starting point, there are consistent education gradients with respect

26 The standard measures of economic output have well-known limitations in this regard, with non-market contributions of older people (such as caring for grandchildren or volunteering) not being valued either directly or implicitly in terms of their positive impacts on the labor force participation of adult children. The HLI program will examine this in the context of women’s non-market work and its valuation. The insights from this will also be relevant to the non-market contributions of older persons.

27 WHO Study on Global Ageing and Adult Health (SAGE). <https://www.who.int/data/data-collection-tools/study-on-global-ageing-and-adult-health>.

28 ILO estimates that on average women around the world perform 4 hours and 25 minutes of unpaid care work every day compared with 1 hour and 23 minutes for men (Pozzan and Cattaneo 2020).

to NCD risk behaviors such as smoking, including in developing countries such as China and Kenya (Jin et al. 2022; Donfouet et al. 2021). Inclusion of omitted variables does not significantly reduce the size of impacts of schooling on self-reported health and NCD risk behaviors such as smoking (e.g., Conti and Heckman 2010; Conti et al. 2010; Conti and Hansmann 2013; Van der Pol 2011; Savelyev 2014). Twin studies have mixed findings, while instrumental variable analysis for developing countries also has mixed findings on a causal relationship but with variation across different measures of health and health behaviors and for some studies gender (Clark and Royer, 2013; Braakmann 2011; Fabrice and Jones 2011; Buckles et al. 2013; Atella and Kopinska 2014). To take the important example of smoking, it would be hard to argue that less smoking causes more education rather than the other way around. For conditions such as obesity, the relationship in developing countries may be more complex.

There is also a literature on how income, wealth, and employment shocks (all elements of returns to human capital) affect adult health, primarily NCD conditions (Capatina et al. 2020). The literature finds that job losses result in negative impacts on health in the longer run, including worse health behaviors, self-reported health and mental health, and mortality (Smith 1999 and 2004; Black et al. 2015; Eliason and Storrie 2009; Adda, Banks, and von Gaudecker 2009). Looking at NCD risk factors, a systematic review of low and lower-middle income countries found that in most studies low SES groups had higher tobacco and alcohol use, and consumed less fruit, vegetables, fish, and fiber than high SES groups (Allen et al. 2017). Reviews of health literature finds similarly strong relationships between unemployment and various indicators of mental health (mixed symptoms of distress, depression, anxiety, psychosomatic symptoms, subjective well-being, and self-esteem), as well as general and physical health (McKee-Ryan et al. 2005; Paul et al. 2009; Norström et al. 2014), with the effects appearing to be causal.²⁹ Those who are unemployed are also more likely to engage in NCD risk behaviors such as over-consumption of alcohol, tobacco consumption and substance abuse (Henkel 2011). Conversely, being in work, or returning to work, appears to have a protective effect for depression, general

mental health, and self-rated health (Schuring et al. 2012; Van der Noordt 2014; Modini et al. 2016).

Finally, there is an expanding literature – largely from richer countries – on the health effects of retirement or continued work. The findings across studies are not definitive (Van der Heide et al. 2013), but on balance meta-analysis finds positive effects on mortality, cognition, and some other health conditions of extending working lives beyond normal retirement ages (Sewdas et al. 2020; Rohwedder and Willis 2010), confirming country level studies (e.g., Wu et al. 2016; Kachan et al. 2015). Other studies have linked working past retirement age with a reduced risk of dementia and heart attack. Studies are not unanimous, though. Meta-analysis suggests that retirement may result in improvements in mental health, though was contradictory on impacts on general and physical health (Van der Heide et al. 2013). The review also found little analysis of potentially variable impacts across types of work (white versus blue-collar) or on variation according to whether retirement was voluntary or not. Yet again, two-way causality is likely to be a factor: those who work longer may be healthier; but those who are healthier have both the capacity and desire to work more (for income and non-income reasons).

Protecting human capital

As shown in Figure 2, in addition to the life course impacts of NCDs on human capital accumulation, deployment and depreciation, a further important aspect of the human capital trajectory is *protection* of human capital across the life cycle. This will primarily be in the face of various types of shocks, including idiosyncratic and covariate health shocks, external shocks such as weather-related or economic crises, or employment-related shocks such as job loss. It also includes consumption smoothing across the life course into older age through pension or social assistance systems. The main focus of discussion below is on health shocks, in particular NCD-induced health shocks, and financial protection in the face of them.

While the range of measures of catastrophic health expenditure (CHE) and the non-health elements included (or often not included) in their calculation makes cross-study comparisons challeng-

29 As with other areas, there may also be reverse causality.

ing, nearly all studies show worryingly high levels of CHE.³⁰ In many developing countries, illness and death is one of the most common drivers of poverty (McIntyre et al. 2006), and health and weather-related shocks are recurrent and their impacts cumulative across the life course (e.g., for Africa, see Nikoloski, Christiaensen, and Hill 2018). One study by Wagstaff et al. (2018) using spending data from 133 countries found that over 800 million people in 2010 incurred CHE, and that the share of total households incurring spending of at least 10 percent of household consumption rose steadily to almost 12 percent in 2010, and approached 15 percent in Latin America and the Caribbean (LAC) region.³¹ At the individual country level, there was a wide range in incidence of CHE, from under one percent in some richer countries to over 40 percent. Alternative estimates for developing countries using a different measure of CHE (40 percent of capacity to pay) find that the incidence of CHE was 30 percent of households in LMICs, 17 percent in UMICs and 15 percent in LICs (Haakenstad et al. 2022).³²

While the literature on the household financial burden of seeking and receiving NCD care in developing countries is expanding steadily, it remains more limited for LICs and for specific conditions such as COPD (Jaspers et al. 2015; Eze et al. 2022; Kankeu et al. 2013; Jan et al. 2018, Essue et al. 2017). Nonetheless, the evidence is consistent that the negative financial impacts on households from NCDs are substantial across the developing world, with major deficits in financial protection. Recent work from developing countries, which carefully distinguishes CHE from NCDs and communicable diseases, finds that CHE from NCDs tends to increase with the share of NCDs in the overall burden of disease, though with major exceptions such as China and South Africa, mediated by the health system. NCD CHE rates were also consistently higher in lower wealth quintiles within countries (Haakenstad et al. 2022). There

is also evidence that risk factors such as smoking can be significant contributors to CHE and driving families into poverty (Verguet et al. 2015; Global Tobacco Economics Consortium 2018). Where systems are built around insurance, those who are uninsured are 2-7 time more likely to experience CHE (Jan et al. 2018), though similar differences might also be expected where systems are general revenue financed but fail to cover segments of the population.

The figures above are also likely to underestimate the impacts of NCDs on human capital, as many households may avoid or delay seeking care due to the financial burden, or services may simply not be available. In addition, lost labor income from time spent accessing care may not be properly accounted for, nor in many studies costs such as transport for accessing care (e.g., see Jan et al. 2018 on studies which include transport costs, which in India for example is the major cost item of seeking care).

In terms of financial protection against CHE, the push towards universal health coverage (UHC) across the developing world has been a crucial development of recent years. However, the realization of UHC continues to encounter challenges, in terms of the proportion of population covered by services, the share of health expenditures which are prepaid, and the range of NCD-related health services included in UHC packages (Wagstaff and Neelsen 2020; Watkins et al. 2017). Even where people are in principle covered by SHI or entitled to services under general revenues financed systems, financial protection is often shallow due to limited service packages, co-payment requirements and/or informal payments, or other factors such as costs of accessing health services. Comparative analysis of a UHC index combining service coverage and degree of financial protection finds a mixed picture across developing countries with respect to financial protection. Some countries (e.g., Ghana, Indonesia, and Viet Nam) have increased both financial protection

30 Catastrophic health spending is defined as a proportion of total household expenditure - usually between 10 and 40 percent of total consumption - or 40 percent of non-food consumption. Impoverishing health spending is defined as taking a household below a defined poverty threshold. Jan et al. (2018) provide a useful comparison of studies on CHE shares using a range of measures.

31 For sub-Saharan Africa, Eze et al. (2022) find that the incidence of CHE continued to rise from 2010-20. These measures are not for NCD-related health expenditures specifically. Haakenstad et al. 2020 find that across 39 countries around 45 percent of CHE cases could not be linked to a specific cause.

32 The result for LICs appears counter-intuitive, given the greater likelihood of households being poor in the first place. While the authors do not speculate, it may be that those in the poorest countries are more likely to forego health treatment and spending altogether due to income and supply side constraints. Somewhat distinct from these results, Wagstaff and Neelsen found that GDP per capita was positively and significantly associated with CHE, and higher inequality had a positive association with CHE at all country income levels (Wagstaff and Neelsen 2020, noting that low service coverage in LICs may drive the former finding).

and service coverage, while financial protection in others has declined (Wagstaff and Neelsen 2020).

The impacts of health spending by households on human capital are both direct and indirect (Jan et al. 2018). The most direct negative effect will be on household non-health consumption. This may impact human capital in various ways, including reduced nutrition (impacting human capital formation early in life and its preservation later in life); negative coping strategies such as withdrawal of children from school due to household budget constraints and increased participation in child labor; and selling assets and/or running down savings (both likely to have impacts on productivity, and hence reduce returns to human capital). When an adult female in the household has an NCD which compromises her capacity for unpaid work/care responsibilities, this is also more likely to be redistributed to other females in the household, often girls. Reduced household income from health spending may also result in failure to seek care when needed subsequently, directly impacting the health dimension of human capital. At the same time, there is evidence from a number of developing countries that illness of one family member often induces increased work effort from others to mitigate the income shock, including migration (Nikoloski, Christiaensen, and Hill (2018) for Africa, for example). Estimates of the scale of the so-called added worker effect tend to focus on participation of non-ill adults rather than net income impacts. A study from Korea for example found onset of chronic illness of a husband reduced the probability of the wife exiting the labor force by 9.2 percentage points, and the effect was more pronounced for chronic than acute conditions (Kim et al. 2018). This is consistent with work from

Brazil on informal worker household which finds a significant added worker effect from health-induced work absence (Reis 2007). Work from Chile has found more nuanced impacts, with the added worker effect observed for some chronic conditions (e.g., arthritis) but not others (hypertension and asthma), and variable according to the age of the ill and well spouses (Acuna et al. 2019). The studies highlight the importance of considering the specific health condition and its implications for whether spouses are able to work or need to focus on providing care.

Apart from social health insurance, unemployment, disability, and work injury insurance programs can play important roles in providing financial protection and protecting human capital. Like SHI, to the extent that these other forms of social insurance protect incomes in the face of shocks, they should mitigate both direct consumption impacts on human capital and negative coping mechanisms which compromise it. However, unlike SHI where subsidized approaches have become increasingly popular in developing countries, coverage of these programs tends to be confined to formal sector workers who are often a minority of the labor force. These major coverage gaps were highlighted during the COVID-19 pandemic. Coverage of non-health forms of social insurance is also much more likely to exhibit income and gender bias due to coverage being focused on the individual rather than the household. The exception to this coverage deficit in many developing countries is disability transfers under social assistance programs which are targeted on the basis of severity of disability and in some countries also according to poverty/vulnerability (World Bank 2018), though adequacy is often modest.

INEQUALITY AND GENDER DIMENSIONS OF NCD AND HUMAN CAPITAL PATHWAYS

In thinking through the pathways discussed in previous sections, it is vital to consider distributional aspects. Inequalities may have several layers, from differentials in NCD incidence by different characteristics, to differences in human capital deployment/returns in the labor market, to differences in access to and provision of care, to financial protection. There are also likely to be important intersections between different dimensions of inequality, e.g., between gender and poverty. This section focuses on two important sources of inequality and their relationship to NCDs and human capital: socio-economic status (SES) and gender.

With respect to SES, the first clear inequality is between income and life expectancy, both across countries and across households within countries. Across

countries, there is a strong relationship between GDP per capita (PPP) and life expectancy.³³ While there are outliers on the up- and downsides, and consid-

33 Clio Infra Project. Life Expectancy at Birth (total). Available at: <https://clio-infra.eu/Indicators/LifeExpectancyatBirthTotal.html>

erable improvements in developing country life expectancy over time, the overall pattern of rising life expectancy with country income is strong. Similarly, the likelihood of death from specific NCDs remains substantially higher in lower income countries versus richer ones (e.g., a woman in a LMIC has around twice the annual likelihood of dying from CVD than her peer in a HIC, Yusuf et al. 2014).

Within countries, the income gradient of life expectancy across individuals has been shown in a number of developed countries (e.g., Chetty 2016; Galama et al. 2018; Lleras-Murney 2022; Mortensen et al. 2016). The evidence from developing countries is thinner, but available multi-country studies show a clear relationship between lower income, especially very low income, and higher mortality, though the direction of causation between health status and income is less clear (Banerjee and Duflo 2010). Interestingly, one study of China, Costa Rica, Indonesia, Mexico, South Africa, and South Korea found more nuanced relationships between education levels and adult mortality than in richer countries, with the exception of a consistent advantage for the tertiary educated (Sudharsanan et al. 2020).

As in richer countries, the available evidence from developing countries shows clear socio-economic inequalities in incidence of both NCDs and risk factors, though evidence remains incomplete and the quality of studies on the issue mixed (Hosseinpoor et al. 2012; Williams et al. 2018; Allen et al. 2017; Sommer et al. 2015). The simplistic notion that NCD are rich people's diseases in developing countries thus appears not to be borne out by the evidence and suggests that inequalities in prevalence and risk factors should be taken into account in policy. For example, a majority of studies in one systematic review found higher incidence of cancer, CVD and multiple NCDs for low SES households, while obesity in contrast was higher among the better off (Williams et al. 2018). However, for all conditions examined, the results were not uniform across countries (and in some cases also within larger countries like India) and studies in terms of SES and NCD incidence, suggesting a need for further research. In an earlier review, angina, arthritis, asthma, depression and NCD comorbidity were associated with lower SES and education within countries, while for diabetes the association was in the opposite direction (Hosseinpoor et al. 2012). Looking across developing countries, all these inequalities were more pronounced in LICs relative to MICs. A review of systematic reviews across LICs, MICs and

HICs also found on balance an association between SES and NCD incidence (Sommer et al. 2015).

Looking at NCD risk factors in developing countries, a systematic review of low and lower-middle income countries found that in most country studies low SES groups had significantly higher prevalence of tobacco and alcohol use, and consumed less fruit, vegetables, fish, and fibre than high SES groups (Allen et al. 2017). At the same time, high SES groups were less physically active and consumed more fats, salt, and processed foods. The Sommer et al. review also found an association between SES and NCD risk factors, with low SES increasing the risk of developing CVD, lung and gastric cancer, type 2 diabetes, and COPD.

Apart from incidence and risk factors, other aspects which may impact human capital often exhibit SES inequality. One as noted above is coverage of social insurance. Those in the informal sector and with lower SES status are more likely either to lack SHI coverage, or – where SHI participation is subsidized for poor households or those outside the formal sector – to have SHI packages which may be more limited than those in formal sector or civil service schemes or more rationed in terms of service access. In almost all developing countries, low SES informal workers (and those outside the labor force altogether) are highly likely to be outside unemployment, disability, work injury and other social insurance programs, except to the extent that those risks have some protection under social assistance systems (though even then, the adequacy of cover will be less than in social insurance systems). The risks of uninsured income shocks from these sources and negative coping strategies that may compromise human capital are accordingly higher.

With respect to gender, there are multiple layers of gendered differences with respect to NCDs and human capital which are important to consider (Bonita and Beaglehole 2014; Knaul et al. 2021; Langer et al. 2015). There are several underlying differences in NCD incidence and risk factors, but also a range of other inequalities which may also impact human capital accumulation, deployment and protection. With respect to NCD incidence and risk factors, NCDs dominate the disease burden globally for both genders (and for women account for around two thirds of deaths annually), but there are some differences in the gender-specific patterns of NCD incidence and risk factors. For example, male smoking rates (and lung cancer deaths) are substantially higher than women globally, and

harmful alcohol consumption tends to be lower among women, while obesity is higher for women than men in most countries, and women disproportionately suffer and die from Alzheimer's and other dementias (WHO 2022). Of particular note is the widespread prevalence globally of gender-based violence as a risk factor which drives higher incidence of mental health disorders, other conditions such as head trauma and consequent cognitive impacts, and higher rates of behavioral risk factors for NCDs (Devries et al. (2013) estimate around one third of women globally experience intimate partner violence). The combination of lower age-specific death rates for women from NCDs and their greater longevity means that around 88 percent as many women as men die annually from NCDs (WHO 2022).

A second source of inequality relates to the gender patterns of unpaid care provision. While NCDs represent a major health burden for all genders, the burden of informal care falls disproportionately on women. Globally, around 76 percent of all unpaid care work (including household work, direct personal care, and volunteer work) is undertaken by women, though is not typically valued in national accounts nor in most estimates of returns to human capital.³⁴ That share can run to over 90 percent in some countries (e.g., India, Pakistan, Cambodia, and Mali). The gender differentials in unpaid care work are in all regions and at all levels of income, though they are higher in LICs and MICs than HICs on average. Almost half of women outside the labor market in MICs and over a third in LICs cite unpaid care duties - broadly defined - as the main reason (ILO 2018; Charmes 2019; Folbre 2015). Thus, there is a massive underutilization of women's human capital due to caring duties using standard valuations to returns to human capital. Based on data from 53 countries across income levels, ILO estimates that women's unpaid care work would amount to 6.6 percent of global GDP. Using a more focused definition of the value of women's contribution to health work globally, Langer et al. (for the Lancet Commission on Women and Health) estimate unpaid health-related care work of women at between 1.1 and 3.1 percent of GDP globally, depending on the valuation method used, and with the GDP share in

LICs and LMICS around 50 percent higher than in UMICs and HICs. In addition to unpaid care work, there is a strong gender dimension to paid health-care work also, with women over-represented in health sector workforces across the world, though often in lower skilled and lower paid jobs (or not paid at all, as with community health volunteers in many developing countries). Whether paid or unpaid, the dual role of women as both consumers of healthcare and aged care and providers is notably more pronounced than for men (Langer et al. 2015).

A related but less obvious gender dimension in terms of health outcomes is the disproportionate burden on women of household tasks which are not directly care-related. A number of the most time-intensive tasks of women in households such as cooking, cleaning, and fetching water (often called elements of "reproductive labor") have very direct health and nutritional benefits for households, lowering their likelihood of both communicable and non-communicable diseases. The wellbeing and economic benefits of this labor are almost never measured but are likely to be substantial. One such analysis for Mexico is instructive, suggesting that proper accounting for the health benefits of mixed household work which also promotes better health in the household would significantly multiply the economic contribution of women's direct unpaid care work. For Mexico, the total value of women's unpaid contribution to health increased from 0.5 percent of GDP to 2 percent once the health-promoting value of mixed work was accounted for, valuing time at minimum wage (Langer et al. 2015).

Broader but related to the points above, a major source of gender difference relates to measurement of deployment and returns to human capital. The lower labor force participation rates of women in market work and the common failure to value their non-market work results in a major downward bias in returns to women's human capital. To the extent that NCDs compromise labor force outcomes, these factors will also result in major under-estimation of the negative impacts of NCDs on the human capital of women and societies and on growth. Even where women are working in the labor market, the gender wage gap will also contribute to lower estimated impacts of a given

34 ILO estimates that the bulk of unpaid care work is household duties other than direct personal care, though acknowledged that multi-tasking across regular household duties and care specifically makes precise estimates of shares of type of unpaid care difficult to unpick even with time use surveys. As noted by Langer et al. (2015) "...four methods are typically used [to value unpaid care], each with advantages and disadvantages: opportunity cost; proxy good; contingent valuation; and conjoint analysis".

burden of NCDs for women relative to men.

A further source of gender inequality with respect to NCDs relates to access to healthcare and patterns of care provided. This is an area with a thinner evidence based in developing countries. Overall, there appear to be gendered patterns of access to care, and the nature and quality of care provided if accessed, shaped by social determinants including gender inequality, poverty and cultural factors (Langer et al. 2015). The first source of gender difference relates to women's lack of control of household resources in many developing countries and the likelihood of this impacting their access to care relative to men. This may reflect either higher poverty rates of female-headed households, or within male-headed households lack of prioritization of women in whatever is spent on healthcare. While extending and deepening financial protection for health will benefit all people, lower financial barriers are thus likely to benefit women disproportionately (and those benefits to be outsized for poorer women). Another factor with respect to access is social and cultural factors which limit women's access to care where there are strong norms around women being treated by men and there are insufficient female providers as evidence from Afghanistan has shown for example (Save the Children 2008).

Apart from failure to access care when available, there may be gender biases or gaps in the definition of publicly financed basic packages of care. For example, it has been common in basic packages to prioritize sexual and reproductive health interventions for women, which may come at the cost of NCD-focused interventions for prevention or management (Bonita and Beaglehole 2014). An example would be failure to include mammography in basic packages in some countries. While such neglect may not be intentional, it may be reflective of lack of prioritization of research on women's NCD incidence and risk factors to strengthen the evidence base upon which disease control priorities are formulated at global and national levels.

Similar issues arise relating to care received when care is accessed. First, even where women do seek care, this may be more likely to be delayed and timeliness of care compromised (see for example, Liakos and Parikh (2018) for the US). While the evidence is largely from developed countries, there appear to be gender differences in diagnosis and management by doctors, with women being asked fewer diagnostic questions, and given fewer diagnostic tests, though unpicking how differences may be driven by biolog-

ical differences, provider bias or other factors is not easy and evidence from developing countries is very thin (Chang et al. 2007). To the extent such differential treatment exists, it may, as noted, reflect in part an ongoing prioritization of sexual and reproductive health as the dominant concern in women's health (Langer et al. 2015; Bonita and Beaglehole, 2014).

As in many areas of social policy, the gender inequalities in NCD incidence, access to care and NCD management, financial protection and other factors often co-exist with other sources of deprivation, and the various factors are likely to be reinforcing. This may include race or ethnicity, language, illiteracy, disability status, poverty, sexual orientation, and other factors. This inter-sectionality of deficits or risks applies to all population groups but are likely to be more pronounced for women.

As with NCD and health-related issues noted above, there are clear gender differentials in both education and labor market participation and outcomes, though the picture on education has become somewhat more nuanced in recent decades (Evans, Akmal, and Jakiela 2020; Saavedra et al. 2021). Historically, gender gaps in girls' school enrollment were observed in nearly all developing countries and remain in many. The positive news is that the median gender gap in enrollment reduced globally between 1960 and 2010 from 1.2 years to 0.8 years, and that around two thirds of all countries have achieved gender parity in primary enrollment. At the same time, the Barro-Lee data set for 146 countries finds that while 104 countries reduced their gender gap in that period, it increased in 42 countries (Evans, Akmal, and Jakiela 2020). While a significant number of those are fragile states, India is one which saw an increase.

Looking below high-level averages, the picture remains concerning, however. In countries affected by fragility, conflict and violence girls remain 2.5 times more likely to be out of school than boys. Also, in low-income countries the school completion rates of girls at both primary and secondary levels remain below that of boys (63 percent for girls against 67 percent for boys at primary level, and 36 percent versus 44 percent at secondary level – Saavedra et al. 2021). These deficits are more pronounced in economic terms, given that the average rate of return to an additional year of schooling is higher for girls, at around 12 percent against 10 percent for boys. Across developing countries girls who have multiple disadvantages such as coming from poor households, living with disabilities, or coming from minorities or rural areas are furthest behind. Inter-

estingly though, the learning poverty rates of girls in low- and middle-income countries are on average actually lower than for boys (55 versus 59 percent), and in many developing countries tertiary enrollment rates are slightly higher for young women than young men.³⁵ At the same time, there remain strong gendered patterns in subject mix and more general biases in schools and classrooms which often reinforce more limited expectations for girls (e.g., the substantial under-representation of girls in STEM subjects). While the situation has therefore improved in many developing countries over time and become more nuanced, the averages also conceal significant regional and other variations, and gender equality in education remains an unrealized goal for significant numbers of developing countries and for significant shares of girls within countries.

When considering deployment of human capital, there remain often substantial gender gaps in labor force participation in much of the developing world, and the gaps are particularly pronounced in South Asia (SAR) and Middle East and North Africa (MENA). Globally, female labor force participation is around 20 percentage points lower than for men overall, and over 40 percentage points lower in MENA and SAR regions. Even in the developing regions with the highest labor force participation such as EAP, there remains a participation gap between women and men in terms of market work, which increases for higher skilled and upper level and leadership positions, including in the health sector (Knaul et al. 2021). As a result, the gender gaps at the intensive human capital accumulation phase in

many countries are exacerbated during the deployment and further accumulation stages. In terms of returns to human capital, the participation gap is exacerbated by the gender pay gap in all countries, and the gap is sharply higher for women with children (Terada-Hagiwara et al. 2018; Si et al. 2021).³⁶

Gender differentials in terms of labor force participation and wages are in turn reflected in differential gender coverage and adequacy of contributory pension, unemployment, disability, and work injury social insurances. While SHI tends to be provided on a household basis, the other social insurances attach to the individual worker and overwhelmingly in developing countries to workers in the formal sector. To the extent that women have lower overall labor force participation and higher rates of informal sector employment when they are doing market work, they have lesser financial protection against these non-health risks and in old age. Even where they are working in employment where non-health insurances are provided, they are likely to have shallower coverage of protection during working life (due to vesting periods and breaks in work history due to child rearing for many women), lower contribution densities across their working lives for pensions, resulting in often significantly lower pensions in later life, and lower adequacy of non-health insurances in general reflecting the gender wage gap. Where women do not work but their spouses do, the prevalence and adequacy of survivor pensions for female spouses is also mixed across the developing world (Chłoń-Domińczak 2015).

35 Learning poverty is a concept popularized by the World Bank which focuses on the ability of children aged ten to read and comprehend a simple paragraph, as well as shares of children out of school altogether.

36 In response, Target 8.5 of the 2030 Sustainable Development Goals calls for “equal pay for work of equal value.”

WELLBEING EFFECTS OF ADDRESSING NCDs

While the bulk of literature discussed above is on the links between economic growth or productivity and health, longevity and education/skills, it is important also to take account of the direct impacts of health, and NCDs more specifically, on non-economic measures of wellbeing at the individual and societal levels. This is a rapidly growing area of research, with different measures of life satisfaction used, including life satisfaction, quality of life, health-related quality of life, and happiness.³⁷ In economist speak, good health has consumption value in terms of improved quality of life, over and above its contribution to individual and societal welfare through its investment value and impacts on productivity, growth, and individual earnings. Alternatively, one can look at health (and education) as functions which contribute directly to capabilities which are the basis for the wellbeing, freedom and dignity of people, over and above their narrow human capital contribution to production (Sen 1997; Nussbaum 2011). They are both the result of capabilities and prerequisites for capabilities.³⁸ In recent years, the literature on the relationship between health status and different measures of wellbeing has been growing (Deaton 2008; Steptoe et al. 2015; Steptoe 2019).³⁹ As noted earlier, wellbeing has different dimensions: evaluative wellbeing (or life satisfaction), hedonic - or affective - wellbeing (feelings such as anger, happiness, sadness etc.), and eudemonic wellbeing (sense of meaning or purpose). Interestingly, measures of wellbeing across the life course vary across regions, with richer English-speaking countries exhibiting a U-shaped pattern of lowest life satisfaction around mid-40s, while former Soviet and LAC countries see a steady increase in dissatisfaction with age, and Africa shows no strong age pattern (Steptoe et al. 2015, using Gallup data from 160 countries).

Evidence is growing that subjective measures of wellbeing matter for health, and that health – and specifically NCD status – impacts subjective measures of wellbeing in a bidirectional relationship. Poor health has been shown to reduce subjective wellbeing (and conversely, positive health behaviors such as physical activity positively affect wellbeing), and lower subjective wellbeing increases the risks of premature mortality and a range of NCDs, including coronary heart disease, diabetes, and other chronic conditions (Chida and Steptoe 2008; Windle et al. 2010; Steptoe et al. 2015, Steptoe 2006). Just as interestingly, newer research suggests that positive subjective wellbeing may be a *protective* factor for health and is associated with longer lives and lower morbidity. A brief summary of the literature from prospective epidemiological studies, retrospective

assessments of eudemonic wellbeing, and momentary hedonic measures is in Steptoe et al. 2015.⁴⁰ A growing body of literature suggests that being happier (often measured by absence of depression or distress) is good for health. A major meta-analysis finds that it reduces all-cause mortality (Martin Maria et al. 2017). And a range of studies find similar positive impacts on specific NCD conditions (Davidson, Mostofsky, and Whang 2010; Boehm and Kubzansky 2012), including coronary heart disease (Carney and Freedland 2017), stroke (Li et al. 2015) and type 2 diabetes (Hackett and Steptoe 2017). Depression also predicts increased mortality among people with COPD, diabetes, CHD, stroke, and some cancers (studies summarized in Steptoe 2019). For NCDs specifically, studies also show increases in depression after diagnoses of various conditions, including

37 While the focus here is primarily on the WHO Quality of Life and happiness measures, there has been a proliferation of initiatives which aim to go beyond GDP as the dominant measure of human wellbeing, including the OECD's Better Life Initiative, and the work of the Stiglitz/Sen/Fitoussi Commission which is informing quality of life measures by the EU. The UN Human Development Index inspired by Sen has a similar motivation.

38 Nussbaum also contrasts *internal* capabilities (which are personal), and *combined* capabilities that are "defined as internal capabilities together with the social/political/economic conditions in which functioning can actually be chosen". Combined capability "combines internal preparedness with external opportunity in a complicated way, so that measurement is likely to be no easy task." (Nussbaum 2011).

39 While not the focus of this chapter, this is also true for the studies on the wellbeing effects of education, which look at both direct impacts on wellbeing (for which findings are inconsistent across studies, and weaker than for health when positive) and impacts on non-pecuniary factors which are associated with better quality of life, within the labor market (e.g., job satisfaction, positive mental health impacts of lower unemployment probability, or social status), and outside it (e.g., better health behaviours, marriage market outcomes, children's educational performance, fertility behaviour for women, parenting behaviour, and variables such as levels of trust and social capital. See Oreopoulos and Slavanes 2011; Grossman 2006; Vila 2000; Helliwell and Putnam 1999; Powdthavee et al. 2015; Blackstone and Van Rensselaer 2019).

40 While more evidence is available from prospective studies to date, with their potential shortcomings including confounding factors and reverse causality, retrospective work points to similar conclusions.

diabetes, coronary heart disease, some cancers, and chronic kidney disease (Satin et al. 2009; Hedayati et al. 2010; Meijer et al. 2011). Even more interestingly, studies have found that the association between happiness, mortality and specific conditions seems to hold even after controlling for negative emotions (Tilvis et al. 2012; Steptoe and Wardle 2012).

Broader measures of quality of life and its linkage to health have also been a growing focus of WHO. The WHO Quality of Life (WHOQOL) method aims to measure an individual's "perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns", aiming for a composite (and decomposable) measure which provides a measure of quality of life that goes well beyond traditional measures of health and self-perceived health (WHO 2012). The WHOQOL instrument was developed across 15 centers globally (including in some developing countries) in an effort to reflect culturally diverse perceptions of quality of life and asks 100 questions across a range of domains of wellbeing (physical, psychological, level of independence, social relations, environment, spirituality/religion, and personal beliefs), as well as an overall measure of wellbeing and health. The instrument has also been adapted to the WHOQOL-BREF, which is a shortened form of the instrument better suited to inclusion in surveys which may be measuring multiple things beyond quality of life.

The research from developing countries which relates NCD incidence to WHOQOL measures is relatively nascent but growing. Studies from middle-income and lower-income countries have found negative associations between a range of specific NCDs and lower QOL using the QOL-BREF measure (Lee et al. 2015; Arokiasamy et al. 2015), and cross-country work on middle-income countries has also analyzed how multi-morbidity NCD dyads negatively impact QOL (Sum et al. 2019, for example finding that diabetes, stroke and depression had the largest negative impacts on mean QOL scores, while depres-

sion in combination with other NCDs had particularly strong negative effects). A study from Brazil also found that the negative impacts of NCDs on QOL scores were more pronounced for older people, and those with low income levels, low education, and Black people, suggesting that the socioeconomic differentials which are apparent for NCDs themselves may be exacerbated when considering wider measures of life quality (Höfelmann et al. 2017).

Using a simpler measure of wellbeing, several rounds of the World Happiness Report find that better health is strongly associated with happiness. A range of factors are positively associated with higher life satisfaction, including income (notably relative income) and employment, education and family life, and mental and physical health (Helliwell, Layard, and Sachs 2017; Clark et al. 2017). However, mental health has a particularly strong impact, in Western countries studied more than income, employment or physical illness, and second only to income in the developing country analyzed (Indonesia). There is a similar ranking when one focuses on the drivers of misery rather than satisfaction, with elimination of depressive and anxiety disorders the single most impactful intervention in simulations (and the most cost-effective). Childhood factors such as emotional health and conduct are also strong predictors of adult happiness (Layard et al. 2014), and children's emotional health is in turn impacted by parental health, particularly the mental health of the mother (Helliwell, Layard, and Sachs 2017). The findings are consistent with country-specific studies, which also point to the importance of the health measures used, with conditions which affect daily functioning more closely associated with impacts on happiness (e.g., Angner et al. 2013). Looked at from a health capital perspective, Arrow et al. (2014) estimate that the direct well-being impact of better health (that is not mediated through production of good and services as measured in GDP) is likely larger than their indirect effects through production.

POLICIES AND INTERVENTIONS FOR NCDs AND HEALTHY LONGEVITY

A wide range of policies can impact human capital across the life course, as well as the likelihood of developing NCDs which negatively impact healthy longevity. This section looks at policies that have the greatest potential to impact NCDs and healthy longevity across the life course. These can contribute to achieving the UN SDG Target 3.4 of reducing premature mortality from NCDs by a third between 2015 and 2030. Across the life course we focus on policies and interventions to improve NCD outcomes and support healthy longevity, including for nutrition, NCD prevention and management, as well as interventions for long-term care, the built environment and tax, air pollution and traffic accident reduction. The policies and interventions considered here are those with the most direct impacts on NCDs: the full spectrum of policy areas includes education, labor, and social protection, to name a few (which are summarized in Annex Tables 2A.2 and 2A.3). This is a menu, and countries would need to choose judiciously what combination of policies and interventions were cost-effective and consistent with financial and capacity constraints. Evidence to guide these choices is provided in several of the chapters on HLI research presented in this compendium, in particular on the economic burden of NCDs and cost-effectiveness of different interventions. Within a number of these areas, tax and fiscal policies can play a useful role. There is also a common need for better data and measurement tools, as well as research to inform policy development and evaluate outcomes.

i. Nutrition

Nutrition policies are the most foundational for human capital, NCDs and healthy longevity given their important short and long-term impacts. The policy menu of nutritional interventions focuses primarily on women of child-bearing age and young children and combines both direct nutritional interventions and multi-sectoral policies which address the underlying determinants of poor nutrition (Bhutta et al. 2008 for a meta-review of studies on different interventions for maternal and child nutrition and their effectiveness; Von Salmuth et al. 2021; IFPRI 2016; Shekar et al. 2017). The direct nutritional interventions include strengthening supply-side interventions, including micro-nutrient supplementation (e.g., Vitamin A, zinc and iron for children and folate for pregnant women); pre-school and school feeding programs (Verguet et al. 2020); social and behavioral change and parenting programs, including breastfeeding and complementary feeding education; and management of severe acute malnutrition following WHO guidelines. World Bank costing of a core package of nutrition-specific interventions in 2017 suggested a cost of around US\$ 70 billion over a decade to address childhood stunting and wasting, maternal anemia and promotion of exclusive breastfeeding. Apart from averting an estimated 3.7 million child deaths annually, the economic returns per dollar invested were between \$4 and \$35, “making investing

in early nutrition one of the best value-for-money development actions” (Shekar et al. 2017).

There have also been considerable investments in complementary interventions, including agricultural programs to promote more diverse food cultivation and adoption, food systems, WASH interventions, women’s empowerment programs, and increasingly conditional or “cash-plus” cash transfers which help address the demand side and income constraints to better nutrition.⁴¹ While more research is needed to understand the cost-effectiveness and interactions of these interventions, there is emerging consensus on a core set of maternal and child nutrition interventions which will impact childhood and particularly adult NCDs and provide the cognitive foundations for better learning and human capital acquisition and deployment. There is also growing attention to obesity in childhood, both as an NCD itself and as a pre-disposing condition for many NCDs later in life.

While most attention in development literature is understandably focused on young people, the importance of nutrition for good physical and mental functioning of older people has received increasing attention in recent years. Poor diet and associated micronutrient deficiencies have been linked to increased morbidity, hospitalization, and mortality in older people, including to a range of NCDs, includ-

41 For example, Manley et al. (2020) in a systematic review and meta-analysis of the impact of cash transfers on child nutrition find transfers programs had significant positive impacts on dietary diversity, animal-sourced food consumption, linear growth and stunting reduction, though program design matters for the degree of impact.

ing heart disease, cancer, osteoporosis and weak immune systems in general (Kaur et al. 2015). There is a host of reasons for inadequate nutrition in older people, from affordability to loss of enjoyment in eating, physical difficulties in eating for physical or cognitive reasons, mobility constraints in acquiring food, and motivation and depression.⁴² Studies in developing countries have found rates of malnutrition among older people which often rival those of children, with one cross-country synthesis for Africa for example finding malnutrition rates between 10 and 36 percent and 13.1 and 27 percent for men and women respectively (Charlton and Rose 2001). In terms of interventions to address poor nutrition at older ages, there are direct measures such as supplementation to address common deficiencies (e.g., calcium, amino acids, iron, zinc and vitamin B), but also addressing the access, mobility and other social causes of poor nutrition is at least as important (Roberts et al. 2019).

In addition to nutritional interventions for *under*-nutrition at different ages, a growing concern in the developing world is the double burden of malnutrition with the rapid increase in obesity (Popkin et al. 2020). This has two dimensions. First is the direct prevalence of obesity itself and associated NCD risks, including increasingly in childhood. According to WHO, in 2016, more than 1.9 billion adults were overweight, and of these, over 650 million were obese, or 13 percent of the global adult population. Obesity is associated with a range of NCDs, including cardiovascular diseases, diabetes, some cancers (endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon) and musculoskeletal disorders. In addition, over 340 million children and adolescents were overweight or obese in 2020. Most of the world's population now lives in countries where overweight and obesity kills more people than under-nutrition (WHO 2021). The levels and rates of increase in childhood obesity in developing countries are particularly alarming, and associated with a range of NCDs, including type 2 diabetes, the early-onset metabolic syndrome, sub-clinical inflammation, dyslipidemia, coronary artery diseases, and adulthood obesity (Gupta et al. 2012). Second is growing evidence on the increased likelihood of adult obesity as a result of under-nutrition in childhood (Heidari-Beni 2019). For the second dimension, the interventions for pregnant women and children are common to those noted

above. For the explosion of obesity at all ages, but particularly childhood, the main areas for attention relate to diet and lack of physical activity, both at the individual level - including limiting consumption of fats and sugars, increasing intake of fruits, vegetables, legumes, whole grains and nuts, and increasing physical activity - and at industry and societal levels reducing the fat, sugar and salt content of processed foods, increasing availability and affordability of health foods, better regulating marketing of obesity-inducing food and taxing them more (see below), and promoting regular physical activity at the societal and workplace level.

ii. Preventing, delaying, and managing NCDs across the life course

There has been intensive work on the package of policies and interventions that can best address the NCD epidemic, including how to do so as cost effectively as possible. These are thoroughly summarized in Disease Control Priorities (DCP), including mental and neurological disorders (DCP 3rd edition, 2017; Lancet 2017) and WHO “best buys” for addressing the risk factors for NCDs (tobacco and alcohol use, unhealthy diets, and physical inactivity) and managing the “big four” NCD categories (CVD, diabetes, cancers, and chronic respiratory diseases (WHO 2017). While already crucial, there has also been increased attention to NCDs as pre-disposing for severe impacts from COVID-19 (Nikoloski et al. 2021), as was also seen in the SARS and MERS outbreaks (Chan et al. 2003; Arabi et al. 2017).

Broadly, effective policies to reduce exposure and incidence of and manage NCDs stretch across a range of areas, many within the health sector, but also quite a number beyond it. They include:

- Strategies to reduce exposure to NCD risk factors, including taxes and other interventions to control tobacco, alcohol, sugar, trans-fat and salt intake use (see below); nutritional and dietary policies (see above); vaccinations to reduce risks of hepatitis B and liver cancer; and measures to reduce indoor and outdoor air pollution.
- Strategies to manage key NCD risks such as screening and management for cholesterol and BP, diabetes, and cancers; promotion of self-man-

42 www.mayoclinic.org/healthy-lifestyle/caregivers/in-depth/senior-health/art-20044699.

agement through education and support services, including promoting medication adherence; and widespread availability of palliative care.

- Development or refinement of layered strategies for mental, neurological, and substance use including community-level interventions in life-skills and building social and emotional competencies; promoting self-management; strengthening primary care and outreach services; and strengthening general and specialist care for severe and emergency cases and integration with other health care channels.
- Building an effective coordinate care strategy which is built on a central role for primary care with affordable access to care and availability of essential medications.
- Strategies to get better value from health systems, including moving from line item and fee-for-service payments to combination of capitation for primary care and global budgets with case mix-adjusted for hospitals; strategic pharma purchasing with reference pricing; transparent and evidence-based processes for prioritizing medical interventions and technology; and building strategic purchasing capacity.
- Strategies within the health system to slow functional decline among older people, including for weakening eyesight, hearing and bones/joints.
- Strategies outside the health system to prepare for and mitigate functional decline in old age, including access to affordable assistive devices, access to social participation, recreation and public spaces, workplace health promotion programs, and improvement/adaptation in workplaces environments (see below).

The Lancet 2017 summaries of the DCP (3rd edition) spell out in more detail the priority interventions for different groups of NCDs, with a model list of 21 interventions (the Lancet papers on DCP3; Bundy et al. 2017 for childhood and adolescent conditions; Black et al. 2013 for reproductive, maternal, newborn and childhood interventions; and Debas et al. 2015 for essential surgeries).⁴³ The interventions all aim to: (i)

provide good value for money; (ii) be feasible to implement in low- and middle-income countries; and (iii) address a significant disease burden, drawing on systematic reviews of economic evaluations, epidemiological data, clinical effectiveness studies, and expert judgment. The key priorities identified were:

- For *cancer control and management*, a range of interventions for prevention, detection, diagnosis, surgery, other treatments, and palliative care (Gelband et al. 2015). These include “prevention of tobacco-related cancer and virus-related liver and cervical cancers (including vaccinations), diagnosis and treatment of early breast cancer, cervical cancer, and selected childhood cancers; and widespread availability of palliative care, including opioids”.
- For *cardiovascular, respiratory, and related disorders*, Prabhakaran et al. 2017 provide a costed essential package of interventions to reduce risk of and manage CVRDs, including tobacco taxation, salt reduction interventions, bans on trans-fats, availability of essential medications, and strengthening of primary care.
- For *mental, neurological and substance abuse (MNS) disorders*, “a variety of interventions, including drugs, psychological treatments, and social interventions, can prevent and treat MNS disorders. At the population-level, best practices include legislative measures to restrict access to means of self-harm or suicide and to reduce the availability of and demand for alcohol. At the community-level, best practices include life-skills training in schools to build social and emotional competencies. For healthcare, three channels are identified: self-management, primary care, and community outreach; hospital care, including both specialist services and first-level hospitals for those with severe, refractory, or emergency presentations; and promoting the integration of mental healthcare in other channels of healthcare (Patel and Chatterji 2015).

In addition to the looking at the cost-effectiveness of policies and interventions to address NCDs, chapter 15 by Watkins et al. in this compendium incorporates additional factors to take into account

43 <https://www.thelancet.com/disease-control-priorities-3>

as countries at different levels of development prioritize their essential health packages. These include the degree of financial protection and equity considerations, features of health system performance, and fiscal space. They also provide a costed set of priority interventions which allows for variation in the Incremental Cost-Effectiveness Ratio (ICER) of specific interventions across regions.⁴⁴ Overall, the authors note that UHC approaches to date have often emphasized high coverage with low OOP spending and low cost, an approach which may not accommodate well within essential health packages the broad nature of NCDs and may fail to exploit the synergies of shared platforms. At the same time, they find that a package of high priority NCD interventions can be implemented across developing regions at a reasonable incremental cost with major gains in deaths and DALYS averted.

Apart from condition-specific interventions, global and national attention is needed for global public goods which are necessary for preventing and managing NCDs. In particular, promoting an R&D structure for relevant drugs, diagnostics, vaccines, and related products which balances legal protections and financial incentives for research and production with health needs and global equity is an ongoing challenge.

In addition to the general interventions for NCDs across the life course (and where the higher rates of NCDs and co-morbidities of older people make interventions especially pertinent for older people), there is a range of interventions which target older people and have the potential to prolong life and compress morbidity at older ages. Some of these will be focused on individuals and some ideally take a population-focused approach. These have been framed around the “4Ps”: predictive, preventive, personalized and participatory. This would include population-based public health interventions such as education on self-management of health, including maintaining proper nutrition and exercise at older ages (Izquierdo et al. 2021). It also includes enhanced screening of the evolving capacity of older people based on a biopsychosocial assessment, which would include not only general NCDs, but frailty, social isolation, dementia, and other factors that are most pronounced at older ages (Stuck et al. 1993). While there will be a growing need for specialized geriatric care skills as societies age, inevitably – and especial-

ly in developing countries – frontline care will fall to non-specialists and non-medical people, making the integration of basic preventive and management geriatric care into GP, nursing, social work and related disciplines particularly important.

There have also been rapid advances in dementia risk reduction and care, reflected in the 2019 WHO guidelines for risk reduction of cognitive decline and dementia and evidence that “multidomain approaches targeting simultaneously multiple risk factors and tailored at both individual and population level, are likely to be most effective and feasible in dementia risk reduction” (Stephen et al. 2021). Apart from dementia specifically, there has been a proliferation in recent years of research on delaying, and even reversing, normal cognitive decline in healthy older adults – so-called cognitive aging – through combinations of exercise, diet, sleep, mental stimulation, and social interaction (Blazer et al. 2015; Dumas 2017). Similarly, palliative care in both residential and outpatient settings, and using digital technologies, has led to improvements in patients’ and caregivers’ wellbeing at end-of-life and often cost-effective (Naoum et al. 2021; WHO 2020). Despite that, WHO estimates that only around 14 percent of those needing palliative care globally each year (most of them in developing countries and almost 90 percent of them suffering from one or more of the “big four” NCDs) have access to such care (WHO 2020).

iii. Long-term care

Closely related to aspects of healthcare, long-term care is an area which has gained growing attention from policymakers in recent years and where there are direct and indirect impacts on health, human capital, wellbeing, and productivity. In developing (and, to a significant extent, developed) countries, this continues to be an area dominated by informal provision of care to frail elderly people by families and other private arrangements. However, the economic and social cases for expanded public sector involvement are compelling. In direct terms, extending the period in which older people can live safely in their own homes through access to decent quality home- and community-based care improves wellbeing of care recipients (who consistently prefer those forms of care to residential care), increases the return on earlier investments in the health capital

44 The geographic disaggregation is China; Eurasia and Mediterranean; India; LAC; and Sub-Saharan Africa.

of both cared and carers, and is likely to be more cost-effective through delaying costly residential care (Low et al. 2011; You et al. 2012). Long-term care has also been seen to be a significant and growing source of employment across the world given the major shortages in care workers in both developing and most developed countries. Realizing the employment effects also often requires attention to migration policies, with immigration of care workers from younger and poorer countries a win-win for sending and receiving countries (OECD 2020).⁴⁵ In indirect terms, there are demonstrated positive impacts on the wellbeing of informal carers from formal care interventions which supplement informal care, and potential for extending the working lives and/or intensity of market work of adult children and in-laws (particularly women).

While these benefits for health, human capital, budgets, and output are clear, long-term care is a sector where there remains enormous diversity in terms of institutional boundaries between health and social care services, in the mix of services, levels of public spending, and public/private roles even in developed countries. In developing countries, formal care systems remain largely in their infancy, though a growing number are in the initial stages of developing them (see Glinskaya et al. 2018 for discussion of China), with particular challenges in working through the appropriate institutional arrangements and financing models. For most developing countries, the starting point is likely to be developing a national long term care strategy which delineates the roles of state, market, communities, and households and is built around an “ageing in place” approach which also promotes a continuum of care across home, community-based and health facility settings. For countries which are further along in development of their long-term care sectors, there is a range of issues which need to be addressed as the formal LTC sector matures, including institutional mandates, defining packages of public-

ly-financed LTC and who is eligible for them, financing, contracting and provider payment mechanisms, and human resources (Yiengprugsawan and Piggott (2022) and O’Keefe and Yiengprugsawan (2023) on the experience of emerging Asia for example).

iv. The built and community environment

While much of the literature on NCDs tends to focus on the underlying diseases, it is vital also to think about how NCDs play out in terms of *functional* capacity. As WHO has emphasized in its World Report on Ageing and Health in 2015 (summarized in Beard et al. 2016), functional capacity is an outcome of the interaction of intrinsic capacity (“the composite of all the physical and mental capacities of an individual”) and the external environment within which people live. That external environment has many dimensions, but a crucial one is the built environment within which people live.⁴⁶ As noted, a common underlying disease or condition may have very different impacts on a person’s functioning depending on whether their built environment is accommodative or hindering. This social model of disability is highly relevant to the impact of NCDs on people’s ability to live a full and satisfying life. For the built environment, promoting universal design for buildings and public spaces, appropriate housing, multi-generational spaces, more accessible and inclusive public transport systems, effective spatial planning to facilitate access, and other features of the physical environment is crucial to maximizing the potential of people with NCDs as producers, satisfied citizens, and contributing family members (Das et al. 2022).⁴⁷ While this will likely involve retrofitting on the stock of such infrastructure (which may benefit from financial incentives beyond the public sector), it will be far more cost-effective to build in universal design at the design stage, requiring incorporation in planning and approval processes.

45 At the same time, the relatively low productivity of the sector makes it important to assess the net increase in output and returns to care worker human capital, which will also have a strong gender dimension given the preponderance of female workers.

46 Built environment has varying definitions but at a basic level covers the man-made or modified structures and spaces that provide people with living, working, services and recreational spaces, including man-made parks and green spaces and utilities and transport systems which provide the supporting infrastructure to utilize it. See for example US EPA: <https://www.epa.gov/smm/basic-information-about-built-environment>.

47 Universal design is built on seven guiding principles: Equitable Use; Flexibility in Use; Simple and Intuitive Use; Perceptible Information; Tolerance for Error; Low Physical Effort; Size and Space for Approach and Use. The original principles have been supplemented by 8 goals of universal design, namely: Body Fit, Comfort, Awareness, Understanding, Wellness, Social Integration, Personalization, Cultural Appropriateness. <https://universaldesign.ie/What-is-Universal-Design>.

Beyond the level of individual infrastructure or specific systems such as public transport, the focus in more advanced policy settings is on whole-of-community approaches to creating environments which are accommodative of people with functional limitations. The focus is often elderly people, but such initiatives are beneficial for anyone with functional limitations. This can be seen in planning and areas-based approach in countries such as Singapore and Japan, usually in the context of building age-friendly communities.

v. *Cross-cutting policies directly impacting NCDs and their management*

While many cross-sectoral policies influence NCDs and human capital more broadly, four are worth highlighting as especially salient. The first is ***taxation policy and tax treatment of tobacco, alcohol, and sweetened beverages (SSBs)***. While the political economy of increases taxes on all three is always challenging (Elliott et al. 2020, the benefits in reducing risk behaviors and ultimately NCDs are very well documented (Jha et al. 2014). The impact in terms of mortality and morbidity, costs to households and reduction in other beneficial forms of consumption, costs to health systems in treating tobacco-related disease are enormous. WHO estimates over 8 million deaths globally per year from tobacco, of whom around 1.2 million are non-smokers, and that around 80 percent of the world's 1.3 million tobacco users are in LICs and MICs.⁴⁸ The Asian Development Bank (ADB) estimates for Asia also suggest that productivity losses from tobacco and alcohol use combined run to around 2 percent of GDP annually (Lane (2022) for ADB). At the same time, taxes on tobacco in most developing countries average less than half of the price of products, as against around two thirds or higher in many HICs (Verguet et al. 2015; Lane 2022). WHO estimates that an increase in tobacco prices by 10 percent decreases consumption by about 5 percent in low- and middle-income countries. In addition, despite assumptions to the contrary, raising taxes appears to benefit the poor more due to their price elasticities, so is equitable as well (see Verguet et al. 2015 for China). Similarly, evidence from countries such as

Mexico, South Africa, and Chile shows the positive health impacts of raising taxes on sugar-sweetened beverages (SSBs) (Basto-Abro et al. 2019; Stacey et al. 2021). The case for raising tobacco, alcohol and SSB taxes in most LICs and MICs is therefore clear, despite the arguments of industry that illicit trade increases. This has been happening in developing countries, most commonly through increases in excise taxes. A CGD study (Lane, Glassman, and Smitham 2021) found 124 policy commitments in 43 countries in IMF and World Bank programs on the taxation of alcohol, tobacco, and SSBs, with more than half relating to tobacco products and one third to alcoholic beverages.

Of course, taxes are not the only instrument in seeking to modify these risk factors, albeit they are the most effective in the case of tobacco. For example, the *WHO Framework Convention on Tobacco Control* recommends a multi-prong approach labelled “MPOWER” i.e., **Monitor** tobacco use and prevention policies; **Protect** people from tobacco use (particularly through smoke-free indoor public places); **Offer** help to quit tobacco use; **Warn** about the dangers of tobacco; **Enforce** bans on tobacco advertising, promotion, and sponsorship; and **Raise** taxes on tobacco. Ekpu and Brown (2015) provide an excellent summary of interventions to reduce smoking and their economic cost and benefits. Similar mixes of policies are relevant for alcohol and SSBs.

A second area of direct relevance to NCDs is ***policies to reduce air pollution***. According to WHO's World Global Ambient Air Quality Database nine in 10 people globally breathe highly polluted air, and in 2019, 99 percent of the world's population was living in places where the WHO air quality guidelines levels were not met.⁴⁹ The health impacts of outdoor air pollution are exacerbated by household air pollution from burning fuel inside houses, notably for women. The combined impacts of outdoor and household air pollution are about 7 million premature deaths each year from NCDs (almost 90 percent of them in developing countries) including from heart disease, chronic obstructive pulmonary disease, lung cancer, acute respiratory infections, and stroke.⁵⁰ Exposure also has an equity dimension, with people in developing countries more exposed to both types of pollution, and poor and marginal-

48 <https://www.who.int/news-room/fact-sheets/detail/tobacco>.

49 <https://www.who.int/publications/m/item/who-air-quality-database-2022>.

50 <https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/exposure-air-pollution>.

ized communities within those countries more exposed than their better-off fellow citizens. WHO also notes the specific impacts on women and children, with air pollution increasing low birth weight, pre-term birth and small for gestational age births, and evidence suggesting that air pollution may affect diabetes and neurological development in children. The policy responses to limit air pollution are multiple, and include efforts on clean household fuel and energy, clean energy technologies, clean use of technology in industry, urban planning and transport practices that reduce pollution, taxes, and market mechanisms to incentivize green technologies, and reforming waste management practices.⁵¹

The third is **expanding coverage of social insurance**. This applies first and foremost to social health insurance, where more rapid progression toward UHC, and inclusion of cost-effective NCD interventions in essential health packages, has the potential to impact NCD prevalence and management in several ways. But it also applies to other forms of social insurance such as sickness, workplace injury, disability, and unemployment insurance. For example, sickness cover can be protective of human cap-

ital, reducing further deterioration of health conditions by allowing recovery time, but also protection of fellow workers from infectious conditions. In addition, unemployment benefits may help to mitigate the negative mental health effects that have been shown to accompany job loss and unemployment (McKee-Ryan et al. 2005; Paul et al. 2009). See Annex Table 2A.3 for examples of social insurance and other social protection policies which are relevant to NCDs and HC across the life cycle.

The fourth is **interventions to improve road safety** and reduce the enormous toll of mortality and injury from traffic accidents. While not NCDs in the main sense of the HLI, road accidents claim 1.35 million lives per year (over 90 percent of them in developing countries), and up to 50 million people sustain non-fatal injuries, accounting for output losses of 7 to 22 percent of GDP over a 24-year period.⁵² Addressing the causes of traffic accidents includes policies on road and roadside design and operation, safety standards for vehicles, behavioral issues such as drunk driving and seat belt and helmet use, and improving post-crash emergency and healthcare services (WHO 2018).

CONCLUSION

NCDs are one of the major health and development challenges of our time. The preconception that NCDs are mainly conditions of rich countries is increasingly untenable, and the HLI is one of a growing set of efforts to increase the urgency of policy response across the world. An operational framework is imperative to address the impact of the rising toll of NCDs on the lives and wellbeing of people in low and middle-income countries. NCDs reduce the possibility of healthy longevity and their negative impact on human capital and productivity is complemented by their effect on wellbeing, itself an intrinsic outcome of development. This chapter has attempted to unbundle the intricate web of relationships between NCDs, human capital, and the end outcomes of healthy longevity, inclusive growth, and wellbeing.

The three main channels through which NCDs may impact end outcomes are the macroeconomic/savings channel, the fiscal channel, and the human capital channel. On the first channel, there has been much debate on the impact of population health on economic growth, and an inherent challenge is how to account for non-health factors such as institutions and geography. But a growing body of empirical work, including from developing countries, supports a negative relationship between

NCD prevalence and economic growth, though the causal nature of the relationship remains a subject of debate. NCDs also have clear fiscal impacts on the expenditure and revenue sides, increasing public spending on healthcare and aged care, and reducing revenues from both workers and firms. At the same time, taxes on tobacco, alcohol and sugar-sweetened beverages are crucial instruments for prevention of NCDs, increasing longevity, and promoting future productivity.

51 [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health).

52 <https://www.worldbank.org/en/news/feature/2019/05/09/how-can-you-help-save-lives-on-the-road>.

In terms of the human capital channel, a life course perspective is vital, and the discussion has attempted to unbundle how NCDs impact HC from conception through to old age, and also across generations. NCDs compromise the entire trajectory of HC, from its formation to deployment to protection and preservation. The immediate and long-term impacts of NCDs and risk behaviors play out in the labor market in multiple ways, compromising individual welfare, and productivity and growth at the societal level. The relationships between NCDs and HC, and between them and end outcomes, are also multi-directional. NCDs and HC have a two-way impact on each other, and NCDs and HC are themselves affected by levels of economic development and wellbeing. While the tangled nature of the relationships makes attribution of causality challenging, the expanding literature from rich and developing countries increasingly suggests a causal link between NCDs, human capital and end outcomes.

Apart from the aggregate impacts of NCDs, the chapter has highlighted the importance of distributional implications. In terms of socio-economic status, most NCDs and risk factors disproportionately affect poorer and more vulnerable people within countries, both in terms of their incidence and in terms of lower financial protection offered by public programs. These disparities appear to be even more pronounced within LICs. There are also important gender inequality considerations, both in terms of the NCDs of women themselves and how they are managed by health systems, and in terms of the disproportionate burden on women of caring for NCD-affected family members.

NCDs also have crucial effects on human wellbeing itself, over and above their impact on human capital, productivity, and growth. That intrinsic benefit is a fundamental motivation for addressing the rising toll of NCDs in developing countries. Research on the relationships between NCDs and wellbeing

consistently demonstrates that NCDs compromise quality of life across various wellbeing measures, and that the relationship is also bidirectional: subjective measures of wellbeing matter for health (including appearing to be a protective factor), and NCDs impact subjective measures of wellbeing.

Just as NCDs impact HC and end outcomes across the life course, policy responses to prevent and control them are needed from before birth to the end of life. The chapter has outlined some of the major policy areas, with detailed consideration of specific policy domains in various areas of HLI research. The most direct are the areas of nutrition, public health, and healthcare services, where the economic and social returns to investments are high, and affordable packages of essential NCD interventions are available. While cost-effectiveness is a key consideration for developing countries in prioritizing limited budgets, it is also important to integrate equity and financial protection considerations, as well as feasibility of implementation. Beyond the health sector, there are improvements needed in taxation policies to shift risk behaviors (and raise revenue), and policies and interventions to reduce air pollution, improve road safety, adapt the built environment, and expand coverage of social security systems.

Finally, while some of the channels through which NCDs influence the end outcomes of interest are becoming better understood, there remains a huge outstanding research agenda, especially for developing countries. The knowledge base on NCDs and their socioeconomic and wellbeing impacts in developing countries is growing rapidly, but that evidence also points to the diversity of situations across countries and within them. In particular, making the economic case for why NCDs matter for development will be crucial to persuading policymakers of the urgency of and high returns to enhancing investments in NCD prevention and management.

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ANNEX 2.1

TABLE 2A.1 Mapping the human capital trajectory and its interactions with ncds across the life cycle

Life stage	Human Capital (HC) Trajectory stage/elements	NCD Incidence and factors	Impacts of NCD on HC (and feedback)
Gestation/birth	HC "at entry"	<ul style="list-style-type: none"> IUGR as risk factor for NCD in adulthood, incl. CVD, renal, lung, and diabetes. Maternal, placental or fetal origins (10–15% of pregnancies) Health/nutrition at birth incl. birthweight, and at-birth disability. Mainly inter-generational drivers, derivative of maternal health/nutrition, risk factors/behaviour, and genetics 	<ul style="list-style-type: none"> IUGR impacts both child vulnerability to CDs and adult NCDs, with negative HC acquisition and deployment implications Low birthweight increases risks of later life NCDs, incl. diabetes, obesity, hypertension, CVD and neurological disorders. And children or low BW mothers more likely to have low BW children Compromised foundation for HC development
Early years 0-14	HC intensive formation and building stage <ul style="list-style-type: none"> Early cognitive base, learning and foundational skills built Childhood health and formation of health behaviours Childhood nutritional status as key HC life course determinant 	<ul style="list-style-type: none"> Childhood NCD onset and NCD-related mortality. incl. asthma, obesity, congenital heart, mental/behavioural health Derivative impacts of parental NCDs on children/adolescents Some risk factors and behaviours for later NCDs start. Pollution, sugar and salt intake, diet 	Short to medium run impacts: <ul style="list-style-type: none"> Short-circuit of future HC through childhood deaths Decreased education attendance and attainment Returns to HK compromised by lower attainment Decreased educational attendance and attainment from parental NCD impacts on children Long-run impacts: <ul style="list-style-type: none"> Nutritional deficits, esp. in early years, increase adult NCD risks Horizon effect of lower societal life expectancy from NCDs on investments in education
School to working age transition and early career – 15-34	HC trajectory diversifies, as HC accumulation continues, HC deployment stage starts, and potential HC depreciation stage starts for some Tracks of accumulation: <ul style="list-style-type: none"> Intensive formative stage + for those continuing education Learning-by-doing HC accumulation stage in work starts Track of deployment: <ul style="list-style-type: none"> Returns to stock+flow of HC initiated Track of depreciation: <ul style="list-style-type: none"> For some, disability or serious or recurrent NCD may prevent LM entry altogether or compromise participation, resulting in active depreciation and failure to accumulate further HC on the job 	<ul style="list-style-type: none"> Intensive period of mental health conditions onset Initiation of some NCD risk behaviours, e.g., smoking and alcohol Childhood NCD continuation and exacerbation (e.g., obesity) Earlier onset of adulthood NCDs, [with social gradient] 	<ul style="list-style-type: none"> Lower likelihood to progress in education due to lagged and current NCD impacts Failure to enter labor force or withdrawal from LF due to NCD mortality, disability or morbidity: multiple HC impact of no HC stock deployment, depreciation of HC stock (which had investment costs to build) and failure to accumulate further HC on-job. Compromised HC deployment/returns due to lower productivity within jobs from absenteeism and presenteeism HK depreciation due to work gaps/weak LM attachment Reduced accumulation of OTJ HC and reduced incentives to deepen human capital Lower HC of parents/mothers starts to impact children Correlation between education and own health outcomes, but casual link disputed and may vary according to health variable and other factors

Life stage	Human Capital (HC) Trajectory stage/elements	NCD Incidence and factors	Impacts of NCD on HC (and feedback)
Mid-career to end of "standardized" working life – 35-65/69	<p>Three track HC trajectory continues, but relative balance between tracks may shift over this life stage:</p> <ul style="list-style-type: none"> • HC accumulation through learning by doing continues, with maintenance or increase of crystallized skills and tapering of fluid abilities. • HC accumulation divergence in low and high quality jobs • Continued deployment of HC/returns, with RoR to human capital diverging over time for high/low skilled • Employer biases against older workers compromise returns to HC from around 55 • Normal depreciation of skills element of HC may be more compromised with time • Protection of human capital stock challenge increases 	<ul style="list-style-type: none"> • Increased onset of NCDs, some originating in childhood • Increase in co-morbidities • NCDs of older parents increase and rising ADL/IADL impacts 	<ul style="list-style-type: none"> • Withdrawal from LF due to NCD mortality, disability or morbidity: multiple HC impact of no HC stock deployment, depreciation of HC stock, and failure to accumulate further HC on-job • Where acute, spillover effects on partners/families as carers and secondary LM impacts, and income effects and SES association with lower HK accumulation for children • Compromised HC deployment/returns due to lower productivity within jobs from absenteeism and presenteeism • HK depreciation due to work gaps/weak LM attachment • Reduced accumulation of OTJ HC and reduced incentives to deepen human capital • Parental NCDs require LF withdrawal or reduction (or transition to informal sector) for adult children, esp. women, with low/no RoR in HK deployment
Later life: 65/70 till death	<ul style="list-style-type: none"> • LM participation divergence between formal and informal workers • Decelerated and then terminated accumulation of HC • Returns to HK decline and cease • Protection of stock of HK more crucial on health and cognitive domains 	<ul style="list-style-type: none"> • Co-morbidities increase sharply, and disabling ADL/IADL with time • Enhanced risk factor of social isolation and links to other risk factors and worse NCD status • Specific NCDs of age onset (dementia/cognitive deterioration/ higher depression rates?) 	<ul style="list-style-type: none"> • Impacts on HC of adult children, esp. women, more pronounced, both in LM/ economic terms and in terms of higher NCD likelihood for carer also • Impacts of grandparental HC decline on their care contribution and spillover to grandchild HC formation and increased demand for parental child care

TABLE 2A.2 Selected policies for human capital and ncds across the life course

Life stage	Policy and action areas	Cross life course policies
Gestation and early years 0-14	<p>Gestation and early years</p> <ul style="list-style-type: none"> • Generalized nutritional interventions for adolescent girls and women of child-bearing age pre-pregnancy • Nutritional interventions for pregnant and lactating women (PLW), including supplementation and SBCC for parental roles WRT nutrition • Ante-natal care, including growth monitoring of fetus • Early years nutritional interventions for children 0-5, with priority focus on first 1,000 days, including zinc and Vitamin A supplementation • (Un)conditional cash transfers linked to PLW and early years cohort and participation in nutrition interventions, including SBCC and parenting • Parental leave policies • Early intervention for childhood NCD prevention and management including obesity and asthma • Pre-primary education interventions, including community-based approaches • Free or subsidized childcare to facilitate parental LFP <p>School years:</p> <ul style="list-style-type: none"> • Tuition free basic education • Incentive policies to minimize school drop-out, including cash transfers, allowances for transport/uniforms, fee-free education etc. • School feeding programs • Remedial programs to address lagging learning • Health education mainstreaming in school curricula and physical activity programs • Labor regulation to prohibit harmful child labor and accompanying enforcement mechanism 	<ul style="list-style-type: none"> • Taxation policies to reduce NCD risks at individual and societal levels, including public bads such as pollution, tobacco, alcohol and sugars • Accessible and affordable health care/ UHC with enhanced NCD emphasis in basic package, including mental health (aligned with WHO best buys and DCP3) • Governments engaging with private sector to control NCD risk factors, promote healthy lifestyles, and manage impacts, using sticks and carrots (e.g., pharma, food, sports and fitness, insurance, banking, advertising, entertainment, transport, and infrastructure). Consider Public-private partnerships with appropriate statutory and regulatory frameworks + managing conflicts of interest • Fiscal systems built on regular demographic projections and stress testing

Life stage	Policy and action areas	Cross life course policies
Youth, education-to-work transition and early career, 15-35	<ul style="list-style-type: none"> • Free or subsidized post-secondary education, with targeted financial incentives for low-income and vulnerable groups • Adult/life-long learning programs to promote regular skills upgrading/refreshing • Tax/financial incentives to employers to invest in workforce training • Incorporation of experiential learning in National Qualifications Frameworks • Social security programs for sickness, disability and work injury (non-contributory for informal sector) and financial subsidies to promote pension scheme participation by workers • Unemployment allowances and/or generalized social assistance and ALMP to promote workforce re-entry and skills building 	<ul style="list-style-type: none"> • Deepening research on key aspects of healthy longevity, NCDs, human capital and their interactions and economic, distributional and gender impacts, and evaluation of public interventions to assess cost-effectiveness • Promotion of universal design through planning and approval processes to promote accessibility to the built environment, transport and other services for those with functional impairment
Mid-career to end of “normal” working age, 36-69	<ul style="list-style-type: none"> • Adult/life-long learning programs to promote regular skills upgrading/refreshing across working life, adapted/targeted to meet particular needs and learning strengths of late-career workers • Tax/financial incentives to employers to invest in workforce training • Revised labor regulations to facilitate flexible work arrangements • Financial incentives to firms to retain or hire older workers • Public information/awareness campaigns to address older worker discrimination/biases • Financial incentives to adapt workplaces to minimize work injury and maximize participation and productivity of people with health conditions and disabilities • Social security programs for sickness, disability and work injury (non-contributory for informal sector) and financial subsidies to promote pension scheme participation by workers • Unemployment allowances and/or generalized social assistance and ALMP to promote workforce re-entry and skills building • Reform of pension systems to incentivize longer working lives in formal sector and align male and female retirement ages • Option of carer allowances for care of older parents 	
Young elderly stage, 70-79	<ul style="list-style-type: none"> • Adequate pensions/social pensions for elderly with wide coverage, and consider “soft” conditioning of pensions to periodic health checks • Learning and skill development interventions for those past working age, adapted for specific learning strengths/deficits of older people • Promotion of volunteer initiatives for older people to enhance community engagement and non-market contributions • Publicly subsidized aged care system with emphasis on home- and community-based care, and targeted support to most vulnerable populations (and consideration of financing model). Built on case management and age-integrated care centres • Option of carer allowances for care of older parents and enhanced care support for care-related NCDs • Community-based initiatives to address social isolation and promote social participation • Cross-sectoral mechanisms to promote coordination of care across healthcare and aged/social care systems, built around case management. • Dementia risk reduction and treatment programs • Further research and implementation of multi-mode interventions to delay or reverse cognitive decline in healthy older people • Incorporation of gerontology modules in GP, nurse and social work training • Public information/awareness campaigns to address ageism 	
Older elderly stage, 80-death	<ul style="list-style-type: none"> • As for 65-75 • Home and community-based interventions to address social isolation • Widespread and affordable availability of palliative care 	

TABLE 2A.3 Human capital promoting policies during working life for accumulation, deployment and protection of HC

Dimension of human capital	Policy/intervention
Further HC accumulation	<ul style="list-style-type: none"> • Build second chance education pathways, both towards formal qualifications and directly to the labor market, including subsidies for poor/vulnerable participants • Targeted and timebound wage subsidy program to provide work experience and improve employability for youth, women and people with disabilities • Provide tax/financial incentives for employers to enhance in- and on-job training • Consider training levy to promote formal sector firm-level training • Ensure modularity of TVET, university and other formal adult learning offerings to allow workers to upgrade skills while employed • Enhance emphasis on digital skills development for older workers, and use of technology in LLL offerings and remote access • Incorporate adult/lifelong learning into National Qualifications Frameworks • Ensure stipends or other support to ensure low-income people can access adult learning opportunities • Promote accessible public-available information on career options, skills requirements, compensation and other features • Expand skill, entrepreneurship, and financial literacy programs for informal sector workers/groups, including through partnerships with non-governmental providers and community-based approaches • Encourage inter-generational work teams to maximize diverse skill exchange • Sustain funding for agricultural extension services and increase use of technology in their provision to promote reach
HC deployment/utilization	<ul style="list-style-type: none"> • Implement Recognition of Prior Learning (RPL) system to recognize and increase returns to skills and competencies acquired through non-formal channels • Expand state subsidies for parental leave and childcare to increase LFPR, especially for women • Promote personal tax regimes that incentivize, or at minimum do not disincentivize, labor force participation by couples • Expand state support to aged care to reduce mid-late career labor force withdrawal by those providing care • Pension system reforms to incentivize longer working lives and remove mandates or financial incentives to retire prematurely • Review taxation systems to ensure that tax force to retire is minimized • Phase out wage setting practices which reward age/tenure over worker productivity • Facilitate access to credit for firms and particularly for informal sector workers/enterprises through diverse channels, including banks, MFIs, group credit schemes, etc. • Ensure non-discrimination in hiring, through labor and/or general anti-discrimination laws and their enforcement • Consider employer incentives/subsidies for retention of older workers • Adaptation of workplaces to ensure sustained productive work
HC depreciation	<ul style="list-style-type: none"> • Strengthen employment services/ALMPs to reduce human capital depreciation during unemployment and accelerate LM re-entry • Provide unemployment insurance/assistance for laid-off workers • Provide financial incentives for workplace adaptations to allow for longer working lives with lower physical stress on workers • Provide incentives in pension systems for longer working lives to realized health benefits of longer working lives • Promote and incentivize volunteerism for benefit of volunteers and recipients of services
HC protection	<ul style="list-style-type: none"> • Enforcement of legislation outlawing harmful child labor • Expand social security coverage of HI, sickness/disability, and pension social insurance, with full/partial subsidization of premiums for informal sector workers • Strengthen workplace occupational health and safety compliance and provide incentives for workplace health promotion/wellness programs • Labor regulations on unfair dismissal and workplace discrimination, with grievance redress mechanisms • General social assistance in event of need/poverty