Viewpoint

Explaining social differences in ageing

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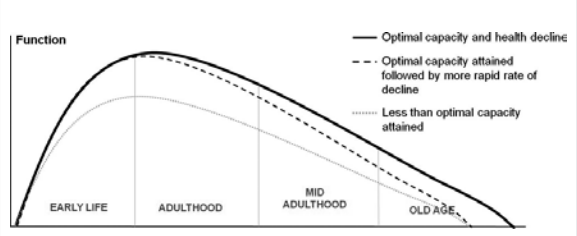
As a consequence of exposures acting from conception to old age, ageing trajectories vary between individuals, with some people ageing faster than others. Endogenous and exogenous factors acting through the life course, including genetic, environmental, psychosocial, and lifestyle factors, are accountable for the varying ageing trajectories between individuals. In the model proposed by Strachan and Sheikh (Figure 1), the life course can be divided into a "build-up" phase, characterised by a succession of developmentally and socially sensitive periods, and a "decline" phase, from maximum attained health to loss of function, overt disease, and death [1]. Exposures during the first stage influence the maximum attained level of health, while during the second stage exposures affect the rate at which function is lost. In this framework, social experiences and biopsychosocial factors accelerate the forces of damage and lessen the forces of repair that shape trajectories of healthy aging across the life course. Physical and cognitive health deteriorate more rapidly with age among individuals from lower socioeconomic groups, creating a progressively increasing health gap between social groups. For instance, a 70-year-old person from a high socioeconomic group may have average physical health comparable to that of a person from a low socioeconomic group eight years younger [2]. However, socioeconomic circumstances not only influence the rate at which functioning is lost, but also have a large impact on the maximum attained health from conception to young adulthood. Children from disadvantaged socioeconomic backgrounds are more likely to have low birth weight and shorter stature, are more frequently hospitalized, and have slower cognitive development than their more advantaged counterparts [3]. At the biological level, lower parental socioeconomic status has been related to shorter telomere length in children aged 7–13 years, and to higher serum C-Reactive protein (CRP) concentrations [4, 5]. Furthermore, it has been shown that premature babies have an accelerated senescence of cord blood endothelial progenitor cells [6], and socioeconomic factors increase the risk of preterm birth [7]. Childhood socioeconomic status and lifetime social adversity not only influence physical health but also affect structural brain development and brain ageing. The plasticity of the foetal, infant, and early childhood brain makes it particularly sensitive to the influence of psycho-socio-environmental stressors. For example, adverse socioeconomic circumstances in early life have been shown to influence the size and neuronal architecture of the amygdala, hippocampus, and prefrontal cortex, as well as to lead to functional differences in learning, memory, and executive functioning [8–10]. Although it is now established that socioeconomic circumstances exert their impact on ageing from conception (and possibly even earlier), the complex mechanisms through which they influence ageing pathways still need to be elucidated. Over the last years, research has started exploring the biological mechanisms through which socioeconomic factors are embedded and eventually "get under the skin" [11]. This new research area stems from the argument that if differences in the social environment are causally related to health, then differences in social dimensions must express themselves in terms of variations in biological factors that are linked to health. The identification of these factors might be important not only for clarifying the complex mechanisms involved in the social distribution of diseases, but also for better targeting public health interventions aimed at reducing these inequalities. Human and animal studies have identified several interrelated processes through which the social environment could be embedded, including dysregulation of the hypothalamic-pituitary-adrenal axis (HPA), inflammatory processes, neural function and structure, and, ultimately, epigenetic mechanisms [12]. In humans, low socioeconomic status across the life course has been associated with greater diurnal cortisol production [13, 14], increased inflammatory activity [15], higher circulating antibodies for several pathogens (suggesting dampened cell-mediated immune response) [16], reduction in prefrontal cortical grey matter [17], and greater amygdale reactivity to threat [18]. Evidence is accumulating for a crucial role of epigenetic modifications induced by the experience of social adversity in initiating these physiological dysregulations [19]. More specifically, human and animal studies have shown that social factors influence DNA methylation and gene expression, in particular across genomic regions regulating the immune function [20–23]. This would put individuals at increased risk of developing inflammation-related diseases and potentially of accelerated ageing. Several research questions remain to be answered in this field of research. First, whether prenatal socioeconomic conditions (and their environmental and psychosocial correlates) already put individuals onto different ageing trajectories from birth is still unclear. Few studies have assessed the association of parental socioeconomic circumstances with biological outcomes in early childhood. However, no study has so far assessed the link between prenatal

social adversity (as represented by adverse socioeconomic circumstances and their psycho-environmental correlates) and biomarkers of accelerated cell ageing and elevated inflammatory response at birth. Second, the extent to which the impact of social factors on ageing pathways is mediated through common risk factors for chronic diseases, such as lifestyle-related risk factors, remains to be determined. Studies suggest that, although a large proportion of the socioeconomic gradient in health is explained by the social patterning of lifestyle factors, socioeconomic conditions may also affect ageing trajectories via other more direct pathways such as psychosocial stress or in utero exposure to adverse conditions. However, a significant limitation of existing investigations is the lack of biological information from early life periods accompanied by a thorough assessment of socioeconomic conditions and their associated exposures, rendering it difficult to discern to what extent the experience of social adversity alters biological functioning in early life course phases. Promising research is being conducted in Switzerland and abroad to address these important questions that also have public health relevance. For example, a better understanding of the biological mechanisms involved in social differences in ageing would be particularly useful for the identification of time windows across the life course in which public health interventions are more likely to be effective.

Figure 1: The modified Strachan-Sheikh model of life course health trajectories
Adapted from: Strachan DP, Sheikh A. A life course approach to resipratory and allergic diseases. In: Kuh D, Ben Shlomo Y (eds). A Life Course Approach to Chronic Disease Epidemiology. Oxford: Oxford University Press; 2004, p. 240–259



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