Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 6 Issue 4 April 2022

Review Article

A Global "Tug of War": Increased Longevity Versus Obesity. What to do about it

Alfredo L Fort*

***Corresponding Author:** Alfredo L Fort, Adjunct Associate Professor, Gillings School of Public Health, University of North Carolina, US, and Independent Consultant, United States.

DOI: 10.31080/ASNH.2022.06.1023

Received: February 21, 2022

Published: April 01, 2022

Abstract

After reviewing the accomplishments of the International Conference on Population and Development (ICPD) and of the Millennium Development Goals (MDG) on key global health and development aspects, we embark on a demographic and epidemiological comparative analysis of trends on the aging of populations versus the continued rise of obesity and diabetes. We present data spanning 30 to 50 years that unmistakably confirm how progress on medical and living standards in the world have extended life expectancy, including at older ages. However, data also demonstrate how physical inactivity and sedentarism, coupled with inadequate dieting, are eroding such gains, producing the new phenomena of overweight and obesity, which is occurring at all ages and in all regions of the world. Obesity and diabetes are increasingly associated with cancer and cardiovascular disease, risk factors for premature mortality and critical components in the rise of the burden of Non-Communicable Diseases (NCD). We end the discussion proposing a few recommendations, from addressing the issues globally as part of health and well-being in the new Sustainable Development Goals (SDG), to countries enacting policies to educate their population on proper dieting and exercise, create gyms and sport centers in urban areas, and legislation for workplaces to allow physical activity among workers, while restricting and taxing sugary and processed drinks and foods. These timely actions should release the current tug-of-war between Longevity and Obesity, and align future modern lifestyle with quality of life in older ages.

Teaser key message: Overweight and obesity due to sedentarism and inappropriate dieting are eroding gains in population longevity and well-being.

Key messages: The manuscript presents global data from demographic and epidemiological statistics showing,

- how increased life expectancy is being eroded by a rise in overweight and obesity, which in turn are a consequence of sedentarism and inappropriate dieting of individuals.
- These negative lifestyle situations are also expressing themselves in the appearance and increase of diabetes, cancer and cardiovascular disorders, which are producing disability and premature mortality.
- These phenomena are occurring in all regions of the world, on all genders, and in urban and rural areas alike.
- The study has immediate implications for individual behavior change, plus urgent adoption of universal conventions and national legislation and policies.

Keywords: Life Expectancy; Longevity; Obesity; Physical Inactivity; Poor Diet; Sedentarism

Introduction

From September 5 to 13, 1994, the acclaimed International Conference on Population and Development (ICPD) was held in Cairo, Egypt [1]. At the time, 179 countries addressed for the first time the complex interrelationships between population growth, economic growth, gender equality, reproductive and child rights and health, migration, and development, plus the needs for research, national action, international cooperation and "non-governmental" partnerships to achieve a better world. The resolutions and Programme of Action adopted inspired wide enactments of public policies and legislation that vastly transformed the way economies, health, education and development services were delivered in many countries.

Recently, from November 12 to 14, 2019, the world celebrated in Nairobi, Kenya, 25 years of ICPD, reviewing progress and challenges in respect to the commitments adopted. ICPD+25 expanded its promises to include sustainable funding, demographic diversity, gender equality, timely and disaggregated data, inclusivity, and assistance in humanitarian and fragile contexts [2].

The other global initiative that attracted universal attention was the Millennium Development Goals (MDGs) [3], which were established by the United Nations in the year 2000. These were 8 goals adopted to halve extreme poverty, halt the spread of HIV/AIDS and reduce malaria and Tuberculosis (TB) infections, improve maternal health and reduce child mortality, promote gender equality, ensure environmental sustainability and global partnerships for development, and achieve universal primary education by the next 15 years (2015). Of the 14 numerical targets, 3 and a half were achieved (halving extreme poverty, reducing education gender disparity, reducing new malaria and TB infections, and increasing access to safe drinking water-though not to sanitation [4].

This was followed in 2015 by the ambitious 17 Sustainable Development Goals (SDGs) for the next 15 years which, as known, encompasses a much larger number of sectors and topics, with 169 targets set on health, education, gender, water and sanitation, energy, industry, economy, climate, land and water lives, peace, justice and partnerships for development, among many areas [5].

As we follow these global commitments and their results, for this article we will concentrate on a couple of trends of contrasting significance: Life expectancy and Aging versus Sedentarism and Obesity, and their implications for "…healthy lives and…well-being for all at all ages" (SDG Goal # 3). As we will see, each side pulls its own weight, with foreseeable consequences. In this "tug of war", which side will win?

Life expectancy and aging

Life Expectancy

Much of our data comes from the United Nations, to ensure maximum objectivity. For example, the latest "World Population Prospects 2019" provides important trends and statistics for our discussion [6]. Life Expectancy is an indicator that summarizes human survival, after applying mortality rates at each age from birth to death. In the last 50 years, Life Expectancy worldwide has increased more than a third, or by nearly 17 years (55.4 years between 1965-1970 to 72.3 years between 2015-2020). Similarly, for somebody at 65 years of age their additional life expectation has risen by 4 years, from nearly 13 additional years in 1965-1970 to 17 years by 2015-2020. The contrasts are, of course, more pronounced if the indicators are disaggregated by whether figures are for the "more developed" or "less developed" regions of the world (according to a UN classification). For example, Life Expectancy had nearly 19 years of difference in the 1965-70 period between the two regions (70.3 vs 51.5) and is nearly 9 years lower (79.2 vs 70.7) for less developed than for more developed countries between 2015-2020 (see Table 1).

Aging (Ageing)

Population Aging is regarded as one of the four global demographic "megatrends" of the last decades (together with population

Indicator/period	Region*	1965-1970	1985-1990	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Life expectancy at birth (years)	World	55.4	63.7	65.6	67.1	68.9	70.9	72.3
	More D	70.3	74.0	74.8	75.6	76.9	78.4	79.2
	Less D	51.5	61.4	63.7	65.3	67.1	69.1	70.7
Life expectancy at age 65 (years)	World	12.9	14.4	15.0	15.4	15.9	16.5	17.0
	More D	14.3	16.1	16.8	17.4	18.2	19.0	19.6
	Less D	11.6	13.2	13.9	14.3	14.7	15.2	15.8

Table 1: Life Expectancy at birth and at age 65 for the World, More, and Less Developed Countries, by Time Periods between 1965 and 2020.

Source: Extracted from United Nations [6].

*Regions: More D: More Developed (Europe, Northern America, Australia, New Zealand and Japan). Less D: Less Developed (the remainder).

growth, international migration and urbanization). It has occurred as a combination of reduced fertility plus increased longevity, the latter benefitting greatly from huge advances in medical diagnosis, care and treatment. The population aged 65 or more has increased in absolute and relative terms [7]. Numerically, the total population has increased from 3.7 billion in 1970 to nearly 7.8 billion in 2020 (2.1 times), while the population aged 65+ increased disproportionally more, from 196 million to 727 million (3.7 times) in the same period, passing from being 5 percent to more than 9 percent of the total population!

Again, these aggregate numbers do not reveal the larger variation between high- and low-income economies. In the more developed world, the population aged 65 and over increased 2.5 times, while in the less developed world it increased twice this rate. However, in relative terms to their total populations, it is interesting to note that, although nearly doubling their percentage to the total population from 3.6 in 1965-1970 to 7.4 percent in 2015-2020, such relativity in the less developed world is nearly 3 times lower than the 2015-2020 percentage of the more developed nations (19.3% vs 7.4%) see Table 2.

Indicator/ period	Region*	1965-1970	1985-1990	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Population aged 65+ (thousands)	World	196,215	328,211	422,209	474,872	526,688	607,548	727,606
	More D	100,031	143,681	170,068	184,834	197,736	220,834	245,648
	Less D	96,183	184,530	252,141	290,038	328,953	386,714	481,959
Percentage of population aged 65+	World	5.3	6.2	6.9	7.3	7.6	8.2	9.3
	More D	9.9	12.5	14.3	15.3	16.0	17.6	19.3
	Less D	3.6	4.4	5.1	5.4	5.8	6.3	7.4

Table 2: Population aged 65 or more and its Percentage of the total Population, for the World, More, and Less Developed Countries, by Time Periods between 1965 and 2020.

Source: Extracted from United Nations [6].

* Regions: More D: More Developed (Europe, Northern America, Australia, New Zealand and Japan). Less D: Less Developed (the remainder).

This has been known for decades, how the more advanced economies had a long history of lower fertility plus higher survival rates of their populations, given their access to higher standards of living, healthcare and socio-economic support for vulnerable populations. In lower income countries, fertility reductions plus increased childhood survival rates and improved healthcare have occurred more recently, creating a larger share of populations of working ages (i.e., 15-64) in the typical "population pyramid," weighing heavily in the age structure to produce "younger" average populations than in the higher income countries. This "Demographic Dividend" is the opportunity a country has to grow its economy from having a larger working-age population due to lower fertility (thus fewer dependent children) and higher survival rates into adulthood. It is an opportunity but can also create challenges for this large population [8] - see Figure 1. The pyramid also shows the increased proportions of the population over 65 in 2020.

However, it is also important to recognize that aging is a worldwide phenomenon that - if anything- will continue to expand in the future. It is expected that the number cited above for the population aged 65 and over will double by 2050, to become 16 percent of the total population worldwide. Clearly, a big challenge for the sustainability of economies.

Immediate health implications of population aging

The World Health Organization (WHO) is recently getting more concerned about the connotations of aging and health implications. A common narrative is to associate older age with "hearing loss, cataracts and refractive errors, back and neck pain and osteoarthritis, chronic obstructive pulmonary disease, diabetes, depression, dementia." [9] However, less attention has been given to other Non-Communicable Diseases (NCDs) highly associated with older populations, such as Cardiovascular Disease (CVD) and cancer.

Aging and CVD

CVD is known to increase with age, including the prevalence of atherosclerosis, stroke and myocardial infarction [10]. Interestingly, among the most important risk factors associated with this disease are hypertension, diabetes and obesity [11] which, themselves, are intrinsically correlated [12].

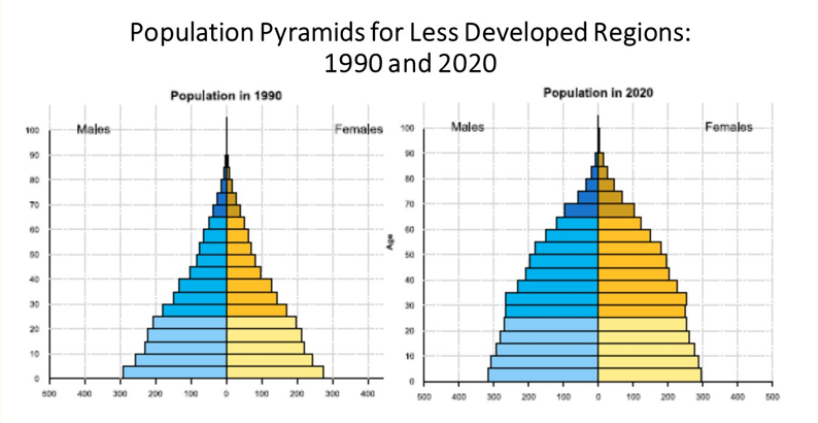

Figure 1: Population pyramids for less developed regions: 1990 and 2020.

Source: Extracted from United Nations [6].

Aging and cancer

It is widely known that the incidence of cancer increases with age. For example, in the US it increases from less than 25 cases per 100,000 in populations under 20 years, to about 350 per 100,000 among those 45-49 years, and to more than 1,000 per 100,000 among those 60 years and older [13] see figure 2.

Increasingly, cancer is seen through a "life course approach", where genetic plus epigenetic forces need to be addressed, in an effort to combat the disease. Epigenetics is the study of how our behaviors and the environment can change, not our DNA, but the way our genes work and express [14]. For example, excess body weight and the presence of three or more of these conditions: abdominal obesity, high triglycerides, low High-Density Lipoprotein

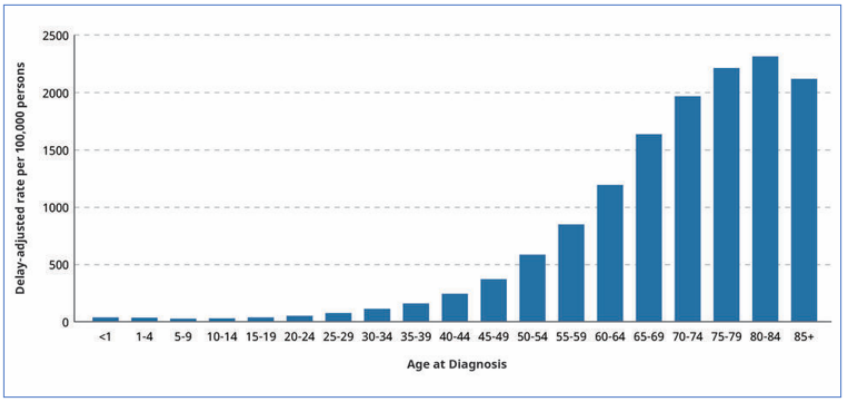

Figure 2: Incidence rates of cancer (all types) by age.

Source: SEER 21: 2013-2017. National Cancer Institute [13].

(HDL) cholesterol, high blood pressure, or hyperglycemia (known as metabolic syndrome), have been linked to higher risk of cancer of breast (post-menopausal), endometrium, colon and rectum, pancreas, kidney, thyroid, gallbladder and esophagus. Similarly, type 2 diabetes is associated with cancer of the breast (post-menopausal), colon and pancreas [15].

The rise of obesity and diabetes

After examining how conditions such as cancer and CVD increase with people's age, we are also finding how they are highly correlated with being obese or having type 2 diabetes. This is particularly troubling, because they are precisely two conditions that are also more prevalent in our world.

Obesity and Overweight

The prominence of obesity and overweight cannot be over-emphasized in our current global situation. They are measured based on the Body Mass Index (BMI), or relationship between Weight in Kilograms and the square of Height in meters. Overweight is a BMI greater or equal to 25 Kg/m^2 and Obesity is a BMI greater or equal to 30 Kg/m^2 [16]. Obesity worldwide has tripled since 1975 and, in 2016, more than 1.9 billion adults were overweight (of which more than a third, or 650 million, were obese). These conditions exist in all age groups, including among children and adolescents (340 million aged 5-19 overweight or obese in 2016). Also, overweight and obesity are no longer only affecting high-income countries. In Africa, there has been a nearly 24% increase in overweight children since 2000, and almost half of the children under 5 overweight or obese in 2019 lived in Asia. It has also affected both boys and girls.

The most important concept about these conditions is that they are preventable. Their cause is an imbalance between calories consumed and expended. The causes have been an increased consumption of high-energy foods (fats and sugars), and less physical activity related to sedentary living, transportation and urbanization.

Poor dieting that contains large amounts of food with high levels of fat or sugar is one of the major contributors of overweight and obesity. A 1990-2017 Global Burden of Disease (GBD) modelling study across 195 countries found that 11 million deaths could have been avoided in 2017 had "dietary risk factors" not been present, among them a high intake of sodium and low intake of whole grains, nuts and seeds, vegetables and fruits. This amounted to the prevention of "one in every five deaths globally". Additionally, there was only 16% of optimal consumption of milk, far higher per day consumption of sugar-sweetened beverages (49 gm) -especially among young adults of 25-49 years, 90% greater consumption of processed meat than optimal, and 86% greater consumption of sodium than optimal. Overall, the study found that suboptimal diet is responsible for more deaths than "any other risks globally, including tobacco smoking." [17] Given the amount of information on the components of good dieting, there are many sources detailing the types and amounts of food people should consume to control and manage weight [18]. See Figure 3. On the positive side, a just released study using a model based on the GBD estimates that an optimal diet with whole grains, legumes, fish, fruits, vegetables and less red and processed meats and sugary drinks from age 20 would increase life expectancy (LE) in a US population by more than a decade, and if making the change from age 60 it would still increase LE by 8 to 9 years (Fadnes., *et al*. 2022) [19].

Figure 3: Two Contrasting Foods (processed meats and high fat/carbohydrates versus vegetables and soybean).

From: Harvard T.H. Chan School of Public Health [18].

Diabetes

Similarly to obesity, diabetes has risen spectacularly in the world, 4 times since 1980 (from 108 million to 422 million in 2014). Unfortunately, it has been rising faster in low- and middle-income countries than in high-income countries. Aside from the associations with cancer, obesity and CVD, diabetes is also a cause of blindness, kidney failure, and lower limb amputations, and is directly linked to premature mortality. In 2016, it was the 7th leading

cause of death in the world. Unfortunately, type 2 diabetes is rising so steeply in many parts of the world that, contrastingly to the past, it is also being more and more diagnosed in children [20]. And, in a 1990-2019 modelling of the Global Burden of 369 Diseases and injuries (GBD) in 204 countries and territories, despite the steady improvement of global health in the last 30 years, they found such burden remaining rather stable. This was due to two forces in the opposite direction. On the one hand, the greatest annualized rate of decline of the burden (measured as disability-adjusted life-years, or DALYs) had occurred among children below 10 years of age. However, in the age groups of 50-74 years and 75 years and older, diabetes (and chronic kidney disease) had increased the age-standardized DALY rates, and appeared as one of the top ten causes of GBD for both age groups [21].

An aggravating phenomenon: Sedentarism

The increased presence of these NCDs that are threatening to counteract many advances made in public health and the well-being of the population, including healthy aging of older people, is compounded by the surge of a post-modern phenomenon: Sedentarism.

Sedentarism, or the persistence of physical inactivity in a population, is now recognized by WHO as a "global public health problem" [22] and the fourth leading risk factor responsible for more than 5 million people dying per year [23]. It is associated with all the conditions reviewed above [24], as well as with mental health and dementia, and threatening overall well-being. One model estimated that physical inactivity was responsible for 6% of the burden of CVD, 7% of type 2 diabetes, 10% of breast cancer, and 10% of colon cancer, as well as for 9% of premature mortality that occurred in 2008 [25]. WHO estimates that a quarter of adults and 81% of adolescents (11-17 years) do not meet their global recommendations on physical activity for health. For example, WHO recommends 150 minutes weekly of moderate intensity aerobic activity for adults over 18 years, plus several other recommendations for different age groups [26].

Low levels of physical activity have been related to massive urbanization occurring in the world, which has increased the use of motor vehicles, more intellectual and technological work with less physical demand, and environmental aspects such as traffic, pollution, street violence, and shortage of parks and recreational facilities.

The special case of COVID-19

In the year that has elapsed between the declaration of the COVID-19 pandemic and the writing of this article, the social and educational lockdowns, employment restrictions and layoffs, have created a new reality in people's homes. It has amplified the two main phenomena discussed here: Sedentarism [27] and Poor Dieting, [18] but has also influenced unfavorably over obesity [28]. As suspected, the pandemic has also added a component that is inherently related to the other three conditions: Mental Health. Although not a new disorder in our societies, early studies are confirming the increased psychological distress of healthcare staff and an increased prevalence in the general population of anxiety, moods, depression, suicidal ideation and actions, and violence (including domestic violence) during this pandemic [29]. If anything, COVID-19 has exacerbated and showcased situations already existing in our society. Policies and actions enacted in the future will also have to take into account how they will affect our populations in the event of another pandemic.

In conclusion: Aging and Sedentarism-Obesity, a "tug of war" or a lifeline?

As the reader can gather, we have used a combination of the disciplines of Demography, Epidemiology and Nutritional Health to arrive at this juncture. We are also adopting a comprehensive view of health as per WHO's definition: "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." [30] This means it is not enough to achieve a positive trend in the longevity of human beings in this earth (i.e., the numerical aspect), but to ensure those additional years of life are lived in "good health" (i.e., the quality aspect), without the infirmity of cardiovascular and diabetic symptoms, plus the burden of frequent laboratory exams and medical appointments, and taking countless medications.

We also do not want to address these statistics through a curative or reparative approach, but through a smarter and more sustainable preventive medicine/global health lens. On this consideration, it is striking to find that, of the 17 SDG goals, 169 targets and 231 indicators, there is only one indicator (2.2.2) within Goal 2 ("End hunger, achieve food security and improved nutrition and promote sustainable agriculture") that speaks about ending "…all forms of malnutrition…by type", where the terms "wasting and overweight" are included in parenthesis at the end. And on

Goal 3 ("Ensure healthy lives and promote well-being for all at all ages"), there is only one target (3.4) on reducing premature mortality from NCDs which will measure mortality rates "…attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease." However, throughout the framework there is no mention about appropriate diets, or prevention of sedentarism through neighborhood and school policies promoting exercise/physical activity at all ages. Even Goal 11, which seeks to make cities and human settlements "inclusive, safe, resilient and sustainable" only includes an indicator (11.7.1) that will look for the "Average share of the built-up area of cities that is open space for public use for all", but without explicitly mentioning its use for physical activity. Only a few initiatives have come up with indicators on "…sport, physical education and physical activity" as potential contributors to the SDGs. For example, "% of population who participate once a week in sports and exercise", "% of i) adult and ii) adolescent population sufficiently physically active." [31].

From our review of global population and health statistics we can quickly realize that there are two key extreme trends pulling in opposite directions: increasing longevity versus obesity due to sedentarism and poor dieting. If we do not acknowledge the potential of the latter to erode accomplishments made by science and quality standards of living on the former, we may end up cutting years of healthy living, plus allowing an augmenting expression of disease and disability in the elder population, which in turn will increase the economic and social burden of disease, diagnosis, medication, healthcare and ultimately, disability. We may end up making a reality of the 2008 animated movie "WALL-E", where people -clearly depicted as obese- are lying all day in floating flying chairs, watching videos on holograms, and being fed sodas and sugary foods, while robots come to brush their teeth and massage their bodies (see Figure 4). Will the contrast be a "tug of war" or a lifeline?

Figure 4: Image of people in flying chairs, from the 2008 WALL-E animated film.

How to turn the tug of war into a lifeline

After reviewing these contrasting figures, we can conclude that they are all a consequence of "modernity", which has brought on progress but also new challenges. We need to develop a view and framework that help children and adults continue benefitting from early global health interventions into a healthy lifestyle that includes self-satisfaction and esteem, positive relationships with other persons, sufficient but not excessive foods of high quality and composition, and physical activity in its many varied formats (e.g., sports, exercise, recreation).

Without attempting to be comprehensive and exhaustive, it is clear that, after recognizing these antagonist forces working against each other, we can lay out policies to align them so that they work reinforcing and helping each other. These policies, in no particular order, should consider

- The reform of urbanization planning to include not only spaces for parks and recreation, bicycle lanes, but also the construction of public gyms and sport centers.
- Ensure that all education curricula, starting at Early Childhood Education and Development (ECED), schooling and higher education include content and subjects related to healthy foods and proper diets, the risk of overweight and obesity, and the dangers of sedentarism/physical inactivity. Continue with and expand, free and subsidized healthy school meals.
- Enact policies and legislation to dictate that every workplace includes a gymnastic facility or partnership with a lobal gym, as well as sets aside a fraction of weekly working hours for minimum exercise periods for its adult workers; similarly, public and private entities should hold weekly seminars on appropriate dieting using locally produced foods.
- Governments, in public-private partnerships (PPP), should use extensively all modern means of mass communication to advocate and promote healthy lifestyles that combine appropriate foods and exercise.

- As with the tobacco legislation, convene UN/WHO global conferences for the universal caution, taxation and restriction of sugary drinks and foods. Advocate for the diminution of consumption of processed and fried meats and carbohydrates, while promoting and championing the regular consumption of fruits and vegetables (food-based rather than nutrient-based guidelines). Include related indicators in the SDGs.

If these and other similar individual and collective actions are taken around the world, we can ensure the remaining time of the 21st century, and beyond, will see even longer longevity, but moreover, a healthy, active and satisfying life for the ever-increasing older populations. Combat any potential tug-of-war by aligning global achievements with the promotion of health and well-being. Obviously, these actions should go hand-in-hand with other logical and humanistic ones such as poverty eradication, equality, tolerance and global peace. So be it.

Bibliography

1. United Nations. "Report of the International Conference on Population and Development - Cairo, 5 (1995).
2. Nairobi Summit. "Nairobi Statement on ICPD25: Accelerating the Promise" (2021).
3. United Nations. We can End Poverty. "Millenium Development Goals and Beyond" (2015).
4. Ritchie H and Roser M. "Now it is possible to take stock - did the world achieve the Millennium Development Goals?" (2018).
5. United Nations. Department of Economic and Social Affairs. "Sustainable Development" - the 17 Goals (2021).
6. United Nations. World Population Prospects 2019, Volume II: Demographic Profiles. UN Department of Economic and Social Affairs. Population Division. New York (2019).
7. United Nations. World Population Ageing 2019: Highlights. UN Department of Economic and Social Affairs. Population Division. New York (2019).
8. Johns Hopkins. "Demographic Dividend: Investing in Human Capital" (2021).
9. World Health Organization. Ageing and Health (2018).
10. Yazdanyar A and Newman AB. "The burden of cardiovascular disease in the elderly: morbidity, mortality, and costs". *Clinical Geriatric Medicine* 25.4 (2009): 563-577.
11. Lu Y., *et al*. "Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration (BMI Mediated Effects)". *The Lancet* 383.9921 (2014): 970-983.
12. Lloyd-Sherlock P., *et al*. "Hypertension among older adults in low- and middle-income countries: prevalence, awareness and control". *International Journal of Epidemiology* 43.1 (2014): 116-128.
13. National Cancer Institute. Undated. Age and Cancer Risk.
14. National Cancer Institute. Surveillance, Epidemiology, and End Results Program. All Cancer Sites Combined SEER Incidence Rates by Age at Diagnosis, 2013-2017.
15. Centers for Disease Control and Prevention - CDC. "What is Epigenetics?" *Genomics and Precision Health* (2020).
16. White MC., *et al*. "Age and Cancer Risk". *American Journal of Preventive Medicine* 46.301 (2014): S7-15.
17. World Health Organization. Obesity and overweight (2020).
18. GBD 2017 Diet Collaborators. "Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017". *The Lancet* 393. 10184 (2019): 1958-1972.
19. Harvard TH. Chan School of Public Health. Undated. "Obesity Prevention Source". Obesity Causes. Food and Diet.
20. Fadnes LT., *et al*. "Estimating impact of food choices on life expectancy: A modeling study". *PLoS Medicine* 19.2 (2002): e1003889.
21. World Health Organization. "Diabetes" (2020).
22. GBD 2019 Diseases and Injuries Collaborators. "Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019". *The Lancet. Global Health Metrics* 396.10258 (2020): 1204-1222.

23. World Health Organization. Noncommunicable diseases and their risk factors - "Physical Inactivity": a global public health problem.

24. NCD Alliance. "The 4th leading risk factor for death worldwide: physical inactivity is an urgent public health priority" (2016).

25. González K., *et al.* "Physical Inactivity, Sedentary Behavior and Chronic Diseases". *Korean Journal of Family Medicine* 38.3 (2017): 111-115.

26. Lee IM., *et al.* "For the Lancet Physical Activity Series Working Group. Impact of Physical Inactivity on the World's Major Non-Communicable Diseases". *The Lancet* 380.9838 (2012): 219-229.

27. World Health Organization. "Physical activity" (2020).

28. Zheng C., *et al.* "COVID-19 Pandemic Brings a Sedentary Lifestyle in Young Adults: A Cross-Sectional and Longitudinal Study". *International Journal of Environmental and Public Health* 17.17 (2020): 6035.

29. Kompaniyets L., *et al.* "Body Mass Index and Risk of COVID-19-Related Hospitalization, Intensive Care Unit Admission, Invasive Mechanical Ventilation, and Death - United States, March-December 2020". 70.10 (2021): 355-361.

30. Kola L., *et al.* "COVID-19 mental health impact and responses in low-income and middle-income countries: reimagining global mental health". *Review in The Lancet Psychiatry* (2021).

31. World Health Organization. What is the WHO definition of health? Frequently asked questions.

32. The Commonwealth. Sport and SDG Indicators: Category 1 Indicators. Sport for Development and Peace Team. Economic Youth and Sustainable Development Directorate. Commonwealth Secretariat. London, UK (2020).