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Factors Associated with Healthy Life Expectancy: An Ecological Analysis of Global Data

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Abstract: Healthy life expectancy (HALE) measures the quality of life a person expects to live. This study aims to find out the most associated factors of HALE at birth globally. The data of 212 countries came from the World Health Organization, Worldometer, World Bank, and United Nations. HALE at birth is considered as the dependent variable; and social, economic, and health factors are considered as the predictors. Descriptive statistics, Pearson's correlation analysis, and multiple linear regression models were used as the statistical tools to reach the objective. The results revealed that HALE is found lower in Central African Republic and higher in Singapore. The highest death rate due to coronavirus disease 2019 (COVID 19), alcohol consumption rate, human immunodeficiency virus (HIV) prevalence rate, and average household size are found in Nicaragua, Moldova Republic, Eswatini, and Senegal, respectively. And the lowest recovery rate from COVID 19, and universal health coverage (UHC) service index are found in Tajikistan, and Montserrat, respectively. The recovery rate from COVID 19, UHC service index, gross domestic product (GDP), current health expenditure, tuberculosis (TB) incidence, tobacco smoking, HIV prevalence rate and average household size were significantly correlated with the HALE at birth. The multiple linear regression models identified that the UHC service index, alcohol consumption rate, HIV prevalence rate and average household size are the most associate factors of HALE at birth globally. Therefore, the necessary steps should be taken to maximize the UHC service index, and to minimize the alcohol consumption rate, HIV prevalence rate and average household size for increasing the HALE at birth in the world.

INTRODUCTION

2020 is a year of pandemic due to the rapid outbreak of coronavirus disease 2019 (COVID 19) , which is an infectious disease. A newly discovered coronavirus is responsible for this disease. According to World Health

Organization (WHO) there have been 33,502,430confirmed cases of COVID-19 globally, including1,004,421deaths[1]. In this critical period, it is urgent to explore the situation of healthy life expectancy (HALE) around the whole world. HALE measures the quality of life a person expects to live. It is the expected number of remaining years of life spent in good health from a particular age, typically at birth, assuming current rates of mortality and morbidity . It is an advance measurement of life expectancy (LE), the mean number of years of life remaining at a given age[2]. At first United States Department of Health, Education and Welfare shows an improved measure of health in 1969, which is health adjusted life expectancy or HALE[3]. But in 1971, Sullivan discovered the calculating method of HALE for the first time[4].

HALE at birth is varying worldwide due to social structural, demographic, socioeconomic, regional variation and health related factors. The HALE at birth is very low(44.90 years) in Central African Republic while it was around 76.20 years in Singapore. According to WHO the global HALE at birth was about 63.30 years in 2016. In African region HALE at birth is very low (53.80 years), and in South-East Asian region it is moderate (60.40 years). On the other hand in European Region and in Western Pacific region, HALE at birth is very high (68.40 years and 68.90 years, respectively). The variation of HALE at birth is also observed by the economic status of the different countries. There was 16.00 years higher HALE at birth in the high-income countries (71.20 years) than that of in the low-income countries (54.90 years). Again in lower-middle-income countries the HALE is about four years lower than that of in the high-income countries.

There are many factors, like- death rate due to COVID 19, recovery rate from COVID 19, tuberculosis (TB) incidence (per 10000 population), universal health coverage (UHC) service index, tobacco smoking, alcohol consumption rate, human immunodeficiency virus (HIV) prevalence rate[5], average household size, gross domestic product (GDP) (current US$), and current health expenditure (percentage of GDP), which affect HALE at birth around the world. Some of these factors may be more influential in increasing HALE at birth and the rest of these factors are responsible for decreasing HALE at birth globally. But these factors vary from one geographical area to another which is needed to study. Salomon and others characterized the HALE and changes over the past two decades in 187 countries. They expressed that the HALE is affected between 1990 and 2010 due to the changes in disability[6]. The usefulness of HALE was studied and evaluated as a global indicator of variations in the health of population[7]. Siato and others have presented the idea of health expectancy, calculating procedure and showed how measures used to compute health expectancy[8]. In, Matters and others have exposed the patterns of HALE globally[9].Islam and others has tried to find out the correlates of HALE in low- and lower-middle-income countries, and they showed that mean years of schooling, TFR, freedom of the press, and achieving a level of health-related MDGs are the most influential factors in those countries[1]. In 1999 a study has conducted to explore the HALE situation in 191 WHO member countries. The authors have found that HALE increases in every country at a faster rate than the LE [5]. A huge number of studies are carried out on HALE e.g. Association between HALE at birth and consanguineous marriages in 63 countries[10]; HALE and the correlates of self-rated health in Bangladesh in 1996 and 2002 [11]; HALE and the correlates of self-rated health in an ageing population in Rajshani district of Bangladesh[12]; A comparison of self-rated health, health status, and health promotion behaviors between low and non-low-income elderly women[13]; HALE in Hong Kong Special Administrative Region of China 2003 HALE - an important indicator for health policy development in Lithuania 2004[14]; HALE in Brazil: applying the Sullivan method 2005[15]; Inequalities in HALE by Brazilian geographic regions: findings from the National Health Survey[16]; Estimating the HALE from the Health State Function of a Population in Connection to the LE at Birth ; The Influence of universal health coverage on LE at birth and HALE: A multi- country cross- sectional study [17]; Regional differences in HALE in the Netherlands [18]; Compression or expansion of morbidity? Trends in HALE in the elderly Austrian population between 1978 and 1998 [19]; Trends in healthy life expectancy in Japan: 1986–2004 HALE: comparison of OECD countries in 2001[20]; Past, present, and future of healthy life expectancy[21]. Therefore, research on HALE has been carried all around the world but none of it has inspected to find out the associated factors of HALE at birth around the whole world in past decades. Hence the aim of this present study is to find out the most associated factors of HALE at birth in the world.

MATERIALS AND METHODS

Data of 212 countries were extracted from several sources, like-WHO, Worldometer, World Bank, and United Nations. The dependent variable was the HALE at birth, and the death rate due to COVID 19, recovery rate from COVID 19, TB incidence, UHC service index, prevalence rate of tobacco smoking, alcohol consumption rate, HIV prevalence rate, average household size, GDP, and current health expenditure were considered as the independent variables. All the variables, their descriptions and sources are included in Table 1. Descriptive measurements were used to enunciate the overall

situations of the study variables in the world. Pearson's correlation analysis was executed to explore the relationships among the study variables. Before examining the effects of the independent variables on HALE at birth, the multicollinearity problem was checked by using the variance inflation factor (VIF) values. If the VIF value is less than five then it is assumed that there is no multicollinearity, and there is no multicollinearity among the independent variables of this study. Andfinally, a linear regression analysis was performed to identify the effects of the independent variables on HALE at birth.

The whole analysis of this study is completed with the statistical software Stata/MP version 13.1 and Statistical Package for Social Sciences (SPSS) to reach our objectives. Microsoft Excel is also used to complete this study. Additionally, the reference is added by using the software named 'End Note X7.4 (Bld 8818)'.

RESULTS AND DISCUSSION

Table 2 represents the descriptive statistics of HALE at birth and other related factors globally. HALE at birth was found lower in Central African Republic and higher in Singapore (Figure. 1). On the other hand the death rate due to COVID 19was low in Afghanistan, Algeria, Angola, Anguilla, Antigua and Barbuda, Australia, Bangladesh, Barbados, Benin, Bhutan, Botswana, British Virgin Islands, Brunei, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Caribbean Netherlands, Cayman Islands, Chad, China, Comoros, Congo, Cuba, Curacao, Cyprus, Dominica, Democratic Republic of Congo, Eritrea, Estonia, Ethiopia, Faeroe Islands, Falkland Islands, Fiji, French Polynesia, Gabon, Gambia, Georgia, Ghana, Gibraltar, Greece, Greenland, Grenada, Guinea, Guinea-Bissau, Haiti, Hong Kong, Iceland, Indonesia, Ivory Coast, Jamaica, Japan, Jordan, Kenya, Laos, Latvia, Liberia, Liechtenstein, Lithuania, Macao, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mongolia, Mozambique, Myanmar, Namibia, Nepal, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Philippines, Reunion, Rwanda, South Korea, Saint Kitts and Nevis, Saint Lucia, Saint Pierre Miquelon, Senegal, Seychelles, Sierra Leone, Singapore, Slovakia, Somalia, South Sudan, Sri Lanka, St. Barth, St. Vincent Grenadines, Sudan, Syria, Taiwan, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tunisia, UAE, Uganda, Uruguay, Uzbekistan, Vatican City, Venezuela, Vietnam, Western Sahara, Yemen, Zambia, and Zimbabwe, and is high in San Marino. In case of the recovery rate from COVID 19 the lowest value (0.00) is seen in Burundi, Cambodia, Fiji, Laos, Niger, Taiwan, Tanzania, Thailand, Timor-Leste, Vietnam, Western Sahara, and Yemen, and the highest value (4.35%) is seen in Qatar. TB incidence is low in Monaco and San Marino, and high in South Africa. Again, the lowest (0.00) UHC service index is found in Montserrat and highest (80.00) is found in Australia, Austria, Belgium, Brunei, Canada, Denmark, France, Iceland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Sweden, Switzerland, United Kingdom, and United States of America. Tobacco smoking has lower effect in Panama and higher effect in Indonesia. Alcohol consumption rate is found very low (0.00) in Bangladesh, Kuwait, Libya, Mauritania, and Somalia but it is high (15.20) in Moldova Republic. In case of HIV prevalence rate, the lowest value (0.10) is seen in Afghanistan, Algeria, Australia, Bangladesh, Bosnia and Herzegovina, Bulgaria, Comoros, Croatia, Denmark, Egypt, Finland, Germany, Hungary, Iceland, Iran, Japan, Jordan, Kuwait, Lebanon, Mongolia, Montenegro, Morocco, Nepal, New Zealand, North Macedonia, Norway, Pakistan, Philippines, Romania, Serbia, Slovakia, Slovenia, Somalia, Sri Lanka, Syria, Tunisia, and Yemen, and the highest value (27.30) is seen in Eswatini. Average household size is small (1.90) in Monaco and high (8.30) in Senegal. The lowest GDPis found in Sao Tome & Principe, and the highest GDP is found in United States of America. Finally, the current health expenditure is low in Venezuela (1.18) and high in United States of America (17.06).

Table 3 represents the Pearson's correlation coefficients among the selected variables. From this table it is found that the HALE at birth has a significant positive relationship with recovery rate from COVID 19 ($r = 0.32$, p 0.01), UHC service index ($r = 0.89$, p 0.01), GDP ($r = 0.52$, p 0.01) and current health expenditure ($r = 0.43$, p 0.01). On the other hand, the HALE at birth has a significant negative relationship with TB incidence ($r = -0.59$, p 0.01), tobacco smoking ($r = -0.21$, p 0.05), HIV prevalence rate ($r = -0.37$, p 0.01) and average household size ($r = -0.66$, p 0.01).

Table 4 explains the outcome of the linear regression model. It is found that the death rate due to COVID 19, recovery rate from COVID 19, TB incidence, UHC service index, tobacco smoking, alcohol consumption rate, HIV prevalence rate, average household size, GDP and current health expenditure are the associate factors of HALE at birth. Among all these associate's recovery rate from COVID 19, UHC service index, GDP and current health expenditure has positive effects on HALE at birth, and death rate due to COVID 19, TB incidence, tobacco smoking, alcohol consumption rate, HIV prevalence rate and average household size have negative effects on HALE at birth. The linear regression model (= 0.88) identifies the UHC service index, alcohol

Table 1. Descriptions and sources of study variables

Variables	Description	Sources
Healthy life expectancy at birth	Healthy life expectancy is the expected number of remaining years of life spent in good health from a particularage, typically at birth, assuming current rates of mortality and morbidity.	(WHO, 2019)
Death rate due to Coronavirus disease 2019 (COVID 19)	Number of deaths persons per 100 COVID 19 posited population	(Worldometer, 2020)
Recovery rate from COVID 19	Number of recovered persons per 100 COVID 19 posited population`	(Worldometer, 2020)
Tuberculosis incidence	Number of Tuberculosis patients per 10000 population	(WHO, 2019)
Universal Health Coverage (UHC) service index	The UHC service index comprises 16 indicators across four program areas: reproductive, maternal, newborn and child health; infectious diseases; non-communicable diseases; and health service capacity, access and health security.	(WHO, 2019)
Tobacco smoking	Age-standardized prevalence of tobacco smoking among persons aged15 years and older per 100 population.	(WHO, 2020d)
Alcohol consumption	Total alcohol per capita (>age 15 years for both sexes) consumption (liters of pure alcohol)	(WHO, 2019)
Human Immunodeficiency Virus (HIV) prevalence rate	Estimated number of HIV-positive adults aged 15-49 years per 100 population	(WB, 2020)
Average household size	Average household size is the average number of persons per household. At the aggregate national level, it is calculated by dividing the total household population by the number of households in a given country or area.	(UN, 2020)
Gross Domestic Product (GDP) (current US$)	The GDP at purchaser's prices is a financialmeasure which is the sum of market value of all thefinal goodsand services produced in a specific time period by all resident producers in the economy. It is expressed as the current U.S. dollars.	(WB, 2020)
Current health expenditure	It refers to those which are consumed to provide the healthcare goods and services for each year. It doesn't include capital health expenditures such as buildings, machinery, IT and stocks of vaccines for emergency or outbreaks. It is expressed as a percentage of GDP.	(WB, 2020)

Table 2. Descriptive statistics of the study variables

Variable	N	Mean	SE of Mean	Median	SD	Minimum Value	Country	Maximum Value	Country
X_1	169	63.54	0.53	65.4	6.88	44.90	Central African Republic	76.20	Singapore
X_2	212	0.01	0.001	0.004	0.02	0.00	†	0.12	San Marino
X_3	208	0.43	0.05	0.17	0.66	0.00	‡	4.35	Qatar
X_4	170	103.92	10.29	44	134.17	0.00	Monaco, and San Marino	567.00	South Africa
X_5	168	62.20	1.22	66	15.80	0.00	Montserrat	80.00	¶
X_6	121	33.37	1.35	30.4	14.88	8.00	Panama Bangladesh, Kuwait	82.70	Indonesia
X_7	172	6.30	0.31	6.45	4.07	0.00	Libya, Mauritania and Somalia	15.20	Moldova Republic
X_8	135	1.72	0.34	0.4	3.97	0.10	§	27.30	Eswatini
X_9	171	4.00	0.11	3.8	1.40	1.90	Monaco	8.30	Senegal
X_{10}	1761	0.77	0.161	0.64	2.16	6.05	Sao Tome and Principe	16.84	United States of America
X_{11}	170	6.40	0.19	6.22	2.53	1.18	Venezuela	17.06	United States of America

Notes: 'Healthy life expectancy at birth, X_1', Death rate due to Coronavirus Disease 2019, X_2 'Recovery rate from Coronavirus Disease 2019, X_3', 'Tuberculosis incidence, X_4', 'Universal Health Coverage service index, X_5', 'Prevalence of tobacco smoking, X_6', 'Alcohol consumption rate, X_7', 'Human Immunodeficiency Virus prevalence rate, X_8', 'Average household size, X_9', 'Gross Domestic Products, X_{10}', 'Current health expenditure, X_{11}, 'N, Number of countries', 'SE of Mean, Standard Error of Mean', 'SD, Standard deviation';

'†, Afghanistan, Algeria, Angola, Anguilla, Antigua and Barbuda, Australia, Bangladesh, Barbados, Benin, Bhutan, Botswana, British Virgin Islands, Brunei, Burkina Faso, Burundi, Cambodia, Cameroon, CAR, Caribbean Netherlands, Cayman Islands, Chad, China, Comoros, Congo, Cuba, Curacao, Cyprus, Dominica, DRC, Eritrea, Estonia, Ethiopia, Faeroe Islands, Falkland Islands, Fiji, French Polynesia, Gabon, Gambia, Georgia, Ghana, Gibraltar, Greece, Greenland, Grenada, Guinea, Guinea-Bissau, Haiti, Hong Kong, Iceland, Indonesia, Ivory Coast, Jamaica, Japan, Jordan, Kenya, Laos, Latvia, Liberia, Liechtenstein, Lithuania, Macao, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mongolia, Mozambique, Myanmar, Namibia, Nepal, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Philippines, Reunion, Rwanda, S. Korea, Saint Kitts and Nevis, Saint Lucia, Saint Pierre Miquelon, Senegal, Seychelles, Sierra Leone, Singapore, Slovakia, Somalia, South Sudan, Sri Lanka, St. Barth, St. Vincent Grenadines, Sudan, Syria, Taiwan, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tunisia, UAE, Uganda, Uruguay, Uzbekistan, Vatican City, Venezuela, Vietnam, Western Sahara, Yemen, Zambia, and Zimbabwe';

'‡, Burundi, Cambodia, Fiji, Laos, Niger, Taiwan, Tanzania, Thailand, Timor-Leste, Vietnam, Western Sahara, and Yemen';

'§, Afghanistan, Algeria, Australia, Bangladesh, Bosnia and Herzegovina, Bulgaria, Comoros, Croatia, Denmark, Egypt, Finland, Germany, Hungary, Iceland, Iran, Japan, Jordan, Kuwait, Lebanon, Mongolia, Montenegro, Morocco, Nepal, New Zealand, North Macedonia, Norway, Pakistan, Philippines, Romania, Serbia, Slovakia, Slovenia, Somalia, Sri Lanka, Syria, Tunisia, and Yemen';

'¶, Australia, Austria, Belgium, Brunei, Canada, Denmark, France, Iceland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Sweden, Switzerland, United Kingdom, and United States of America'

Table 3. Pearson's correlation coefficients among the selected variables

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
X	$_1$1								
X_2	0.32**	1							
X_3	-0.59**	-0.23**	1						
X_4	0.89**	0.33*	-0.52**	1					
X_5	-0.21*	-0.05	0.18	-0.25**	1				
X_6	-0.37**	-0.07	0.48**	-0.15	-0.10	1			
X_7	-0.66**	-0.03	0.30**	-0.58**	0.20*	0.03	1		
X_8	0.52**	0.16*	-0.18*	0.50**	-0.17	-0.18*	-0.36**	1	
X_9	0.43**	0.10	-0.35**	0.40**	-0.26**	-0.05	-0.39**	0.31**	1

Notes: 'Healthy life expectancy at birth, X_1', 'Recovery rate from Coronavirus Disease 2019, X_2', 'Tuberculosis incidence, X_3', 'Universal Health Coverage service index, X_4', 'Prevalence of tobacco smoking, X_5', 'Human Immunodeficiency Virus prevalence rate, X_6', 'Average household size, X_7', 'Gross Domestic Products, X_8', 'Current health expenditure, X_9, '**, Correlation is significant at the 0.01 level (2-tailed)', '*, Correlation is significant at the 0.05 level (2-tailed)'

Table 4. Linear regression model explaining the healthy life expectancy

Explanatory Variables	Regression coefficient, β	Standard Error of β	95% CI of β		p-values
			Minimum	Maximum	
Death rate due to COVID 19	-23.63	21.06	-65.58	18.31	0.27
Recovery rate from COVID 19	0.84	0.76	-0.67	2.35	0.27
Tuberculosis incidence	0.00	0.00	-0.01	0.00	0.40
UHC service index	0.30	0.03	0.23	0.36	0.00
Tobacco smoking	-0.01	0.02	-0.05	0.03	0.60
Alcohol consumption rate	-0.25	0.09	-0.42	-0.08	0.01
HIV prevalence rate	-0.51	0.10	-0.71	-0.32	0.00
Average household size	-1.18	0.34	-1.86	-0.51	0.00
GDP	0.25	0.19	-0.13	0.64	0.19
Current health expenditure	0.20	0.15	-0.08	0.49	0.16
R^2_a		0.88			

Notes: 'COVID 19, Coronavirus Disease 2019', 'UHC, Universal Health Coverage', 'HIV, Human Immunodeficiency Virus', 'GDP, Gross Domestic Products', 'CI, Confidence Interval'

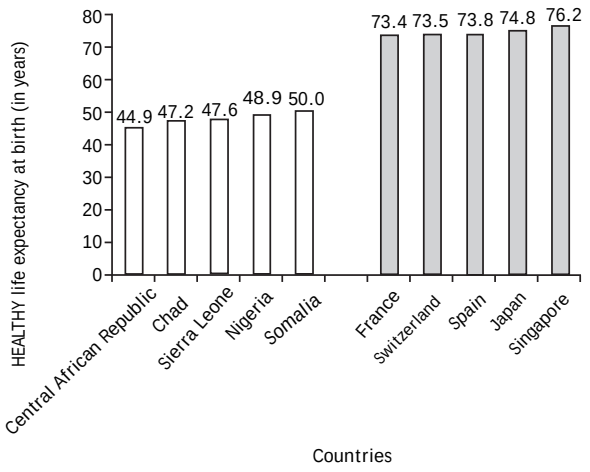

Fig. 1: Healthy Life Expectancy at birth in lowest five countries and in highest five countries respectively

consumption rate, HIV prevalence rate and average household size as the most significant factors which are responsible for the variation in HALE at birth worldwide. So, we may conclude that the UHC service index, alcohol consumption rate, HIV prevalence rate and average household size are the most associate factors of HALE at birth in the world. The HALE at birth is fluctuating from one country to another due to some factors, and this study has tried to express the most associated factors of HALE at birth globally. From this symbolic work it is found that the UHC service index, alcohol consumption rate, HIV prevalence rate, and average household size are the statistically significant factors of HALE at birth. According to this study, the HALE at birth is fluctuating due to these factors worldwide. Also, the study has conveyed that the low death rate due to COVID 19, high recovery rate from COVID 19, GDP, and current health expenditure have the great impact on HALE at birth globally.

The associated factor of HALE at birth around the world is the UHC service index, which includes 16 indicators under the four programs viz. (i) reproductive, maternal, newborn and child health, (ii) infectious diseases, (iii) non-communicable diseases, and (iv) health service capacity, access & health security. The UHC service index ranges from 0 to100. The highest score in UHC service index refers the sound situation in terms of universal health. In 2015, the WHO Region of the Americas had the highest score (78 out of 100). Again the low-income countries had the lowest score (40out of 100), and high-income countries had the highest score (80out of 100) in case of UHC service index. The UHC service indexes are different in different countries and regions. In

2015 the regional average of UHC service index was 56.00%, which was 12.00% higher than that of in 2010. This indicates the significant improvement in UHC service index since 2010. And the global HALE at birth is observed very low in the WHO African region, and in low-income countries, where the UHC service index is very poor. The UHC service index is highly significant with HALE and has the great impacts on HALE at birth around the world. Thus, it is hypothesized that a poor UHC service index means the low global HALE at birth. So, we need to increase the UHC service index for the sake of higher HALE at birth in the globe.

Alcohol consumption rate is an important factor of HALE at birth which is obviously related to HALE globally. It is the total amount of alcohol which is consumed per person aged 15 years and older over a calendar year, in liters of pure alcohol. As the alcohol is a drug and world's largest risk factors for a number of health conditions and potential mortality cases, it has negative effects on the heart, liver, including high blood pressure, stroke, arrhythmias, and cardiomyopathy. Also it is linked to head and neck cancer, esophageal cancer, liver cancer, breast cancer, and colorectal cancer. Each year the world has observed three million (5.30% of all deaths) deaths due to the harmful use of alcohol. Approximately 13.50% of the total deaths have occurred in the age group 20–39. So it is needed to reduce the alcohol consumption rate for improving the health condition of the populations. Alcohol consumption rate varies greatly from country to country due to laws, culture, and other characteristics of each country. Moldova consumes the most alcohol in the world of 15.20 liters per person per year. On the other hand United States consumes 8.70 liters of pure alcohol . WHO European Region had the highest alcohol consumption rate and the Eastern Mediterranean Region had the lowest rate. Also the alcohol consumption rate has shown an increasing trend with the increase of national income of the countries The long-living country's lowest levels of alcohol consumption rate indicate the highest average LE at birth. This finding is also supported by [22].Hence it is concluded that if the rate of alcohol consumption decreases, the global HALE at birth will increase.

HIV prevalence rate is a heavy influential factor of HALE at birth. In many developing countries, especially in Africa and in low-income countries, HIV prevalence rate is one of the most dangerous public health and developmental threats[23]. People living with HIV face the rapid loss of immunity and, 9-11 years living without treating the infection results shortness of lifespan[24]. In 2017, the WHO reported that approximately 36.90 million individuals were living with HIV and 1.80 million individuals becoming newly infected globally[25]. Among that 25.70 million people were living in the WHO African Region which is the maximum affected region in the world. In the case of HIV infections, more than two-thirds of HIV infected people in the world live in African region[25]. If the present trend persists, AIDS will be responsible for too many deaths than any other diseases by 2020 in the world's history[26]. As the life expectancy (LE) is decreasing due to the HIV prevalence rate, so the HALE at birth also decreases. Mathers and others also support this and stated that HIV prevalence rate is a responsible factor of lowering[5]. Therefore, we need to minimize the HIV prevalence rate for the increased at birth around the whole world.

Another associated factor of the global HALE is average household size, which indicates the average number of persons per household. At the aggregate national level, it is calculated by dividing the total household population by the number of households in a given country or area. Globally, there are two types of average household size, viz. i) small average household size, which includes fewer than three persons per household, and ii) large average household size, which includes five or more persons per household. The small average household sizes are concentrated in Europe and Northern America, and the large average household sizes are observed across much of Africa and the Middle East. Burch (1970) has stated that the average household size has a positive correlation with fertility, life expectancy, and average age at marriage. He has also said that the residents of large households lead a complex life than the residents of small households[27]. Some other studies stated that the residents of small households get a large facilities e.g. nutritional foods, medical care, healthy environment, etc. than the residents of large households[28].Therefore, we may say that the HALE at birth of the residents of large households will be low than the HALE at birth of the residents of small households. So, to increase the global HALE at birth, it is need to minimize the average household size around the world. Again, a large number of recovery rate from COVID 19, GDP (current US$), and current health expenditure (percentage of GDP) indicates the increase in HALE at birth. Hence, we may assume global HALE at birth will be increased if the values of these variables increase. Oppositely, if TB incidence (per 10000 populations) and tobacco smoking decrease, the global HALE at birth will increase.

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coronarius disease 2019; Fig.: Figure; GDD: Global Drinking Demographics; GDP: Gross Domestic Product; HALE: healthy life expectancy; HIV: Human Immunodeficiency Virus; LE: Life Expectancy; SPSS: Statistical Package for Social Sciences; UHC: Universal Health Coverage; UN: United Nations; USA: United States of America; VIF: Variance Inflation Factor; WB: World Bank; WHO: World Health Organization

The authors declare that they have no conflict of interest. This study is unfunded. MSI, MNIM, and PA conceived the paper: MSI and MNIM analyzed the data; MSI and PA wrote the first draft of the paper; MNIM and MRK refined the draft; all authors critically reviewed the manuscript, provided feedback and approved the final submission.

There is no requisition of ethical approval for this study since the required data has come from a secondary source. Contact to the corresponding author for the additional materials related to this research.

CONCLUSIONS

The present study was aimed to find out the most associated factors of HALE at birth among the death rate due to COVID 19, recovery rate from COVID 19, TB incidence, UHC service index, tobacco smoking, alcohol consumption rate, HIV prevalence rate, average household size, GDP, and current health expenditure. This study identified that the UHC service index, alcohol consumption rate, HIV prevalence rate and average household size are the most associate factors of HALE at birth in the world. Therefore, the necessary steps should be taken to maximize the UHC service index, and to minimize the alcohol consumption rate, HIV prevalence rate and average household size for increasing the HALE at birth in the world.

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