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A STUDY ON DEVELOPING A HEALTH INDEX FOR INTERNATIONAL COMPARISONS[1]

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ABSTRACT

The Health Index is instrumental in determining the status of a country's healthcare sector and assists regulatory authorities in evaluating the effectiveness of health policies. Additionally, it can be used to compare and improve health conditions between countries. The aim of this research is to develop a health index and ascertain its applicability in international comparisons. In this context, 51 different health indicators from 32 countries were classified under health determinants for the years 2000-2020, and sub-dimensions of the desired index were identified. By aggregating the standardized indicator values in each sub-dimension, health index scores were obtained, and findings regarding each sub-dimension and the overall health index for the countries were presented in detail. The research concluded that the developed index model was significant based on the findings of panel data analysis; however, it was determined that the variables within the environmental dimension need to be re-evaluated. The constructed health index model contributes to the literature by serving as a measure that can be used in international health comparisons, lays a foundation for future research, and suggests that a more comprehensive index could be developed if the contributions of the sub-dimensions are determined using advanced statistical methods.

Keywords: Health Index, Measurement of Health, International Health Comparisons.

1. INTRODUCTION

Indexes, typically created by combining multiple factors, produce a score or value based on the relationships between these factors. For instance, an economic index can be used to assess a country's economic condition and may include factors such as growth rate, unemployment rate, and inflation. While indexes are predominantly used in the field of economics, they also serve as comparative indicators in various other domains, including education, arts, psychology, and health (Bayramoglu and Petekkaya, 2010).

The concept of health, due to its multidimensional and complex nature, is challenging to measure. To compare the health levels of populations in different countries, a standardized health measurement tool is required. In this context, a health index can be developed to comprehensively and standardized measure the health of a population. Health indexes are composite measures that combine various health-related indicators into a single score or value. They can be used to compare the health status of populations both within a country and between countries.

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Consequently, health indexes can identify health inequalities and serve as a reference point in the formulation of public health policies.

Creating a health index for international comparisons is a complex process that brings several challenges. The first challenge is the selection of indicators. While many health-related indicators exist, not all are suitable for international comparisons. The indicators must be comparable across countries. Another challenge is the weighting of these indicators. The weighting process is subjective, and achieving consensus among experts can be difficult. This process needs to be transparent and aligned with the objectives of the index. Calculating the index is also a highly complex task. Various methods can be used to calculate the index, but these methods can yield different results. The choice of method should depend on the characteristics of the indicators and the purposes of the index.

Currently, the Human Development Index (HDI) is considered a measure for identifying health inequalities and differences between regions on an international scale. The HDI is an index used to measure a country's socio-economic development. Its components are education, living standards, and health (Sagar and Najam, 1998; UNDP, 1990). However, the use of life expectancy at birth as the sole indicator for the health component of the HDI is criticized for being inadequate in international health comparisons. This underscores the need for a more comprehensive evaluation of health indicators (Klugman, Rodriguez and Choi, 2011).

2. CONCEPTUAL FRAMEWORK

The concept of the index, derived from the French word "index," is a proportional measure calculated to show the changes occurring within a spatial or temporal dimension in the values taken by a specific collective event (Atlas, 2013: 165). An index is a measure that expresses the proportional change occurring in the movements of one or more variables (Özbek et al., 2019: 29).

Initially, indexes were used solely for the proportional measurement of prices, but over time they have become the most important tool for tracking changes in purchasing power and general price levels. Today, the application of indexes has significantly expanded. Various indexes have been developed for the analysis and interpretation of various socio-economic indicators, especially in production, consumption, imports, exports, wages, price movements, commercial activities, development, and health. These include consumer price indexes used to measure inflation, industrial production indexes for assessing production volume, real exchange rate indexes for tracking exchange rate changes, consumer confidence indexes for analyzing consumer confidence and expectations, and the GINI coefficient and Human Development Index for evaluating development and levels of prosperity (Bayramoglu and Petekkaya, 2010: 201).

Indexes are classified into three different categories based on the factor causing variability: temporal and spatial indexes; based on the number of variables they contain: simple and composite indexes; and based on the variability of the examined factors: fixed-base and variable-base indexes (Mazmanoğlu, 2012: 9-13). Temporal indexes express the proportional change in the values considered over a specific time period, while spatial indexes pertain to the change ratio occurring between different locations (Hamilton, 2020: 25). A simple index is used to calculate the change ratio in the value of a single factor over a specific time period, whereas a composite index is necessary when multiple factors are involved to determine the change ratio (Chakrabartty, 2017: 26-27). In fixed-base indexes, a base value is selected from the time series, and the change

ratios in the remaining values are interpreted based on this base value. When the base value varies for each index calculation, the type of index used to express the change ratio is called a variable-base (chain) index (Dou et al., 2022: 4-5).

To minimize the margin of error and obtain more reliable results during the index creation process, the following considerations must be taken into account (BIST, 2013):

- Accurately determining the purpose of the index and the variables it will include,
- Ensuring that the data used is consistent and comparable,
- Selecting samples to be included in the index that are appropriate and accurately representative of the index's objectives,
- Correctly determining the base period,
- Adjusting or fixing the weights assigned to the variables in the index according to changing conditions,
- Selecting and applying the appropriate calculation method.

The Human Development Index (HDI) was first prepared in 1990 by the United Nations Development Programme (UNDP). This index evaluates living conditions worldwide and recommends actions to improve people's living standards. The concept of human development emphasizes the level of access to basic human needs and the role of humans in the development process, considering human values such as freedom and personality. The HDI operates on the understanding that poverty cannot be measured by a single criterion and thus uses composite index methods in poverty measurements. While these methods can change over time, the HDI is widely accepted as the most representative indicator of human development (Sagar and Najam, 1998: 1-2). The HDI is a summary measure of fundamental human development dimensions, emphasizing that the primary criterion for determining a country's level of welfare should be people and their capabilities, rather than economic development alone (UNDP, 2024).

The HDI consists of three fundamental components: health, education, and living standards. The sub-dimensions for these fundamental components are life expectancy at birth, average and expected years of schooling, and gross national income (GNI) per capita (Hidalgo, 2010: 15). As stated in the 1990 Human Development Report, life expectancy at birth is used as an indicator of long and healthy life, which is considered the first component of the HDI. This approach highlights the belief that a long and healthy life is valuable for all people and emphasizes that adequate nutrition and health can enhance the quality of life. Additionally, due to the lack of detailed information on people's health and nutritional status, life expectancy has been accepted as an important component of human development (UNDP, 1990: 11-12).

To measure progress in education, statistics on the average schooling years and expected years of schooling are used. The expected years of schooling indicate the total duration of education that a school-age child is expected to complete, while the average schooling years reflect the average duration of education for individuals aged 25 and above in the society (Zor, 2020: 43-44).

In the living standards component, real GNI per capita is used. A country's control over short-term economic activities and its success in growing its economy in the long term can be measured by GNI. An increase in per capita income can significantly raise the HDI score. This increase can lead to improved purchasing power, and subsequently, improvements in the quality of education

and health. However, a high rate of economic growth in a country does not necessarily mean that all citizens' incomes are rising or that income distribution is improving. Therefore, to accurately measure the living standards dimension, other economic parameters must also be considered (Arisman, 2018: 114).

The Human Development Index (HDI) is calculated by equally combining the scores of all its components: health, education, and living standards, each with an equal weight of one-third. When calculating the scores for these components, they are standardized to fall between 0 and 1 using the following formula (UNDP, 2022: 2):

$$component\ value = \frac{actual\ value - minimum\ value}{maximum\ value - minimum\ value}$$

For the health component, a minimum value of 20 years and a maximum value of 85 years are set, as there were no countries with a life expectancy below 20 years in the 20th century, and life expectancy at birth exceeds 85 years in countries like Monaco and Hong Kong, China. For the education component, the minimum value is 0 and the maximum value is 18 years for expected years of schooling, and 0 to 15 years for mean years of schooling. After standardizing the values for the two different education indicators, the average of the two standardized values is taken to obtain the education component score. For the living standards component, unlike the other components, the logarithmic function is used during the standardization process. For the GNI per capita adjusted for purchasing power parity, the minimum value is set at $100 and the maximum value at $75,000. After obtaining the scores for all components, the geometric mean of the components is calculated using the following formula to obtain the HDI score (UNDP, 2022: 2-5):

$$HDI\ Score = \sqrt[3]{I_H + I_E + I_{LS}}$$

As the HDI score approaches 1, the level of development increases, while it decreases as the score approaches 0. Based on the HDI score, countries are classified into four different levels of development: low human development for scores between 0 and 0.479, medium human development for scores between 0.480 and 0.670, high human development for scores between 0.671 and 0.780, and very high human development for scores above 0.780 (Ünal, 2013: 274).

There are serious criticisms in the literature regarding the acceptance of the Human Development Index (HDI) as a measure for evaluating human development. Davies (2009) emphasizes that an increase in Gross Domestic Product (GDP) does not always positively impact human development. While an increase in GDP may raise the HDI score, countries with high GDP often exhibit high levels of poverty and income inequality. According to Vega and Urrutia (2001), environmental factors directly influence human development. Countries with high HDI scores may face issues such as high levels of air and water pollution, deforestation, and inadequate sanitation services. However, the HDI does not include these environmental factors. Klugman, Rodriguez, and Choi (2011) argue that a long life expectancy does not necessarily mean a high quality of life, and a high level of education does not provide information about the quality of education received. Criticisms of the HDI suggest that it primarily measures economic growth and does not adequately consider a country's social, cultural, and ecological development. Moreover, it is criticized for being suitable mainly for developed countries and not fully reflecting the true situation in developing countries, potentially leading to misleading comparisons between countries. Therefore, instead of using the HDI as the sole criterion for measuring human

development, considering different indicators in line with these criticisms could lead to more comprehensive and comparable results.

3. RESEARCH METHODOLOGY

3.1. Aim and Significance of the Study

The aim of this research is to develop a comprehensive health index that can be used for international comparisons. Existing international indices such as the Human Development Index, Gini Index, Democracy Index, and Economic Complexity Index are commonly used to compare countries based on factors like economic status, educational opportunities, and social policies. However, there is currently no comprehensive health index available for comparing countries' health levels. This study contributes significantly to the literature by presenting a model for a health index that can be utilized in international comparisons. It also serves as a prototype for creating more comprehensive and advanced health index models in the field.

3.2. Data Set and Scope of the Study

The data set used in the research includes indicators related to health, education, and economy for countries spanning the years 2000-2020. Data were obtained from the World Bank Open Data, Food and Agriculture Organization (FAO), and Organisation for Economic Co-Operation and Development (OECD) databases. Instead of imputing missing data using statistical estimation methods, only actual data were used, resulting in a dataset that is free of missing values. The dataset was reorganized by excluding specific countries, years, or indicators as needed to ensure completeness. As a result, the research dataset comprises data from 51 different health indicators across 32 countries within the 2000-2020 timeframe.

In developing the health index model based on the Human Development Index, the following steps were followed: data related to health indicators were classified within the framework of determinant models of health, normalized to ensure consistency, corrected for any negative data identified, and sub-index scores were created. These sub-index scores were then aggregated to derive the overall health index scores. Following the derivation of health index scores and presentation of findings, panel regression analysis was conducted to determine the significance of the model created for the index and to assess the extent to which dimensions affect health index scores.

3.3. Classification of Indicators

The obtained data were classified based on Dahlgren and Whitehead's (1991) Rainbow Model to determine the sub-dimensions of the health index. This model was developed to assess and improve health status in health and social service fields.

Figure 1. Dahlgren and Whitehead's Rainbow Model

Source: Dahlgren and Whitehead (1991). Policies and strategies to promote social.

The Rainbow Model defines factors that determine people's health status as physical, psychological, social, and environmental, examining interactions among these factors. Physical factors relate to physical health and bodily functions; psychological factors involve emotional and mental health; social factors encompass social relationships and support; and environmental factors refer to the quality of the living environment and healthy living conditions.

Health indicators data have been classified into seven different groups for the purpose of creating the sub-dimensions of the health index: health outcomes, health services, environmental factors, social factors, education, economic factors, and habits-behaviors.

Table 1. Classification of Indicators-1 (Health Outcomes, Health Services, Social Factors, Enviromental Factors)

Health Outcomes	**Health Services**
• Crude death rate (per 1,000 population) • Immunization, DPT (% of children aged 12-23 months) • Immunization, measles (% of children aged 12-23 months) • Tuberculosis incidence rate (per 100,000 population) • Life expectancy at birth, total (years) • Lifetime risk of maternal death • Probability of dying between ages 30 and 70 from cardiovascular disease, cancer, diabetes, or chronic respiratory disease (%) • Mortality rate, adult, female (per 1,000 adult females) • Mortality rate, adult, male (per 1,000 adult males) • Mortality rate, infant (per 1,000 live births) • Mortality rate, infant, female (per 1,000 live births) • Mortality rate, infant, male (per 1,000 live births) • Mortality rate, neonatal (per 1,000 live births) • Mortality rate, under-5 (per 1,000 live births) • Mortality rate, under-5, female (per 1,000 live births) • Mortality rate, under-5, male (per 1,000 live births) • Number of deaths aged 10-14 years • Prevalence of undernourishment (% of population) • Suicide mortality rate, female (per 100,000 female population) • Suicide mortality rate, male (per 100,000 male population) • Tuberculosis case detection rate (% of all forms)	• Current health expenditure (% of GDP) • Current health expenditure per capita (current US$) • Domestic general government health expenditure (% of current health expenditure) • Domestic general government health expenditure (% of GDP) • Domestic general government health expenditure (% of general government expenditure) • Domestic general government health expenditure per capita (current US$) • Domestic private health expenditure (% of current health expenditure) • Domestic private health expenditure per capita, PPP (current international $) • Out-of-pocket expenditure (% of current health expenditure) • Physicians (per 1,000 people) **Social Factors** • Crude birth rate, crude (per 1,000 people) • Catastrophic expenditure risk for surgical care (% of people at risk) • Impoverishing expenditure risk for surgicalcare (% of people at risk) **Environmental Factors** • CO2 emissions (metric tons per capita) • Forest area (% of land area) • Methane emissions (kt of CO2 equivalent) • Methane emissions in the energy sector (thousand metric tons of CO2 equivalent) • Nitrous oxide emissions (thousand metric tons of CO2 equivalent) • People using at least basic sanitation services (% of population) • People using at least basic sanitation services, rural (% of rural population) • People using at least basic sanitation services, urban (% of urban population) • People using safely managed drinking water services (% of population)

Table 2. Classification of Indicators-2 (Education, Economic Factors, Social Factors, Habits and Behaviors)

Education • Adjusted net enrollment rate, primary (% of primary school age children) **Economic Factors** • Inflation, consumer prices (annual %) • Unemployment, total (% of total labor force) • Adjusted net national income (current US$)	**Habits and Behaviors** • Intentional homicides, female (per 100,000 female population) • Intentional homicides, male (per 100,000 male population) • Current prevalence of tobacco use (adults aged 15 and older) • Obesity prevalence in adult population (18 years and older)

Health outcomes include indicators that are directly indicative of health, have correlations with multiple determinants, or are difficult to assess under a specific health determinant. It is observed that health service data are generally shaped through health expenditures. This situation enables the comparison of countries' investments in the health sector, which is one of the sub-dimensions of the health index to be created. Education, as an important indicator affecting health, has been evaluated separately as a distinct class independent of social factors. Within the education dimension of the index to be created, the enrollment rate expresses the percentage of children enrolled in school at a specific education level in a country. Under environmental factors, there are indicators related to air and water pollution. The environmental sub-dimension of the health index to be created with these variables reveals the situation of countries' levels of air pollution and sanitation services relative to each other.

3.4. Standardization of Indicators

Indicators in the dataset contain values on different scales and metrics (e.g., ratios, counts, currency). To eliminate these differences and make indicators comparable, a statistical normalization method called "min-max normalization" has been used.

The formula for min-max normalization is as follows:

$$I_v = \frac{I - \min(I)}{\max(I) - \min(I)}$$

Here, Iv represents the standardized indicator value, I represents the original value of the indicator, min(I) is the minimum value among countries, and max(I) is the maximum value among countries. After applying min-max normalization, the indicator value Iv falls within the range of (I_v) $0 \geq I_v \leq 1$.

3.5. Adjustment of Negative Indicators

Within the scope of the research, some indicator values may indicate a negative health status when they are high, while low values may indicate a positive health status. These types of indicators are referred to as "negative indicators" in the study.

In calculating the index score for negative indicators, if the calculation is done based on the current value of the indicator, the index score may be positively or negatively affected in the opposite direction of what the indicator represents. To address this issue, for all values of negative indicators, the operation "1- standardized negative indicator value" has been applied. This adjustment ensures that the indicator value contributes to the index score in the expected positive or negative direction.

Table 3. Negative Indicators

Health Outcomes	**Health Services**
• Crude death rate (per 1,000 population) • Tuberculosis incidence rate (per 100,000 population) • Lifetime risk of maternal death • Adult mortality rate, female (per 1,000 adult females) • Adult mortality rate, male (per 1,000 adult males) • Infant mortality rate (per 1,000 live births) • Infant mortality rate, female (per 1,000 live female births) • Infant mortality rate, male (per 1,000 live male births) • Neonatal mortality rate (per 1,000 live births) • Under-5 mortality rate (per 1,000 live births) • Under-5 mortality rate, female (per 1,000 live births) • Under-5 mortality rate, male (per 1,000 live births) • Number of deaths among 10-14 year olds • Prevalence of undernourishment (percentage of population) • Suicide mortality rate, female (per 100,000 female population) • Suicide mortality rate, male (per 100,000 male population)	• Out-of-pocket expenditure (percentage of current health expenditures) **Social Factors** • Risk of catastrophic expenditure for surgical care (percentage of at-risk individuals) • Risk of impoverishing expenditure for surgical care (percentage of at-risk individuals) **Enviromental Factors** • CO2 emissions (per capita in metric tons) • Methane emissions (kt CO2 equivalent) • Methane emissions in the energy sector (thousand metric tons of CO2 equivalent) • Nitrous oxide emissions (thousand metric tons of CO2 equivalent) **Economic Factors** • Unemployment, total (percentage of total labor force) **Habit and Behaviors** • Intentional homicides, female (per 100,000 female population) • Intentional homicides, male (per 100,000 male population) • Prevalence of current tobacco use (percentage of adults) • Obesity prevalence in adult population (18 years and older)

3.6. Creation of Sub-Index Scores

After categorizing indicators, standardizing their values, and correcting for negative standardized values, the data have been prepared for the creation of sub-index scores. When calculating the sub-index scores, the standardized indicator values belonging to the same year and category have been summed and divided by the number of indicators in each category. This process results in the sub-index scores for countries within their respective categories.

Mathematically, the sum of n numbers divided by n (1/n ratio) equals the arithmetic mean of those n numbers. The arithmetic mean approach is preferred in calculating sub-index scores because it provides a practical method for computations.

$$I_s = \frac{\sum I_V}{nI}$$

In the equation, I_s represents the sub-index score, $\sum I_V$ denotes the sum of indicator values, and nI indicates the number of indicators. Sub-indices prepared according to determinants of health carry the same names as these groups.

3.7. Creation Of Health Index Scores

After preparing and calculating the scores of the sub-indices, seven different indices have been obtained for each country corresponding to the respective year: health outcomes, health services, environment, social factors, education, economy, and habits and behaviors. Assuming these sub-indices equally influence the level of health, the health index score for a country in a specific year is obtained by summing all its sub-index scores, each weighted by 1/7. The formula for the health index can be expressed as follows:

$$I_{health} = \frac{1}{7}(I_{health\ outcomes} + I_{health\ services} + I_{environment} + I_{social} + I_{education} + I_{behaviors} + I_{economy})$$

With the attainment of health index scores, countries' health levels can be evaluated relative to each other. Comparisons and rankings among countries based on index scores can be made according to the health index sub-dimensions and the overall health index.

4. FINDING AND ANALYSIS

4.1. Health Index and Sub-Indices Scores

Table 4. Scores of Sub-Indices (2020)

Countries	Health Outcomes	Health Services	Environment	Social	Education	Behavior	Economy
Austria	0,80	0,49	0,91	0,76	0,46	0,78	0,55
Belgium	0,78	0,50	0,85	0,78	0,94	0,77	0,56
Canada	0,78	0,50	0,75	0,76	0,96	0,71	0,55
Chile	0,72	0,32	0,89	0,52	0,64	0,57	0,61
Costa Rica	0,70	0,35	0,88	0,60	0,80	0,66	0,49
Czechia	0,81	0,37	0,85	0,80	0,46	0,65	0,64
Denmark	0,83	0,53	0,87	0,80	0,95	**0,88**	0,64
Estonia	0,80	0,28	0,91	0,41	0,76	0,70	0,43
Finland	0,84	0,44	**0,93**	0,73	0,94	0,78	0,51
France	0,79	0,52	0,85	0,82	0,95	0,69	0,57
Germany	0,81	0,57	0,84	0,76	0,60	0,78	0,67
Greece	0,82	0,23	0,87	0,68	0,86	0,65	0,34
Holland	0,81	0,50	0,80	0,78	0,93	0,61	0,61
Hungary	0,72	0,23	0,84	0,63	0,84	0,62	0,67
Iceland	**0,91**	0,49	0,84	0,75	0,95	0,82	0,59
Ireland	0,87	0,46	0,57	0,83	0,97	0,75	0,58
Italy	0,82	0,38	0,89	0,66	0,77	0,84	0,55
Latvia	0,68	0,21	0,72	**0,09**	0,79	**0,43**	0,39
Lithuania	0,64	0,26	0,74	0,52	0,93	0,63	0,39
Luxembourg	0,89	0,41	0,78	0,79	0,93	0,69	0,49
Mexican	**0,24**	**0,15**	0,51	0,79	0,92	0,45	0,61
New Zeland	0,81	0,48	0,89	0,84	**1,00**	0,84	0,54
Norway	0,90	0,60	0,84	0,78	0,97	0,83	**0,67**
Poland	0,67	0,26	0,82	0,77	0,87	0,81	0,58
Portugal	0,83	0,34	0,90	0,69	0,72	0,79	0,49
Slovak Republic	0,71	0,30	0,85	0,80	**0,00**	0,66	0,43
Spain	0,85	0,38	0,90	0,67	0,88	0,81	0,41
Sweden	0,88	0,55	0,92	0,82	0,96	0,79	0,61
Switzerland	0,84	0,49	0,91	0,77	0,97	0,80	0,64
Türkiye	0,62	0,20	0,84	0,92	0,75	0,62	**0,20**
United Kingdom	0,80	0,50	0,84	0,80	**0,94**	0,84	0,61
United States of America	0,64	**0,75**	**0,48**	0,81	0,90	0,50	0,66

When examining the scores of sub-dimensions of the health index, it is observed that Mexico has the lowest scores in health outcomes and health services (0.24 and 0.15, respectively). Iceland has the highest score in health outcomes (0.91), while the United States leads in health services with the highest score of 0.75. Regarding environmental factors, the United States has the lowest score (0.48), while Finland has the highest score (0.93). Turkey holds the highest score in social factors (0.92), whereas Latvia has the lowest score (0.09). New Zealand ranks highest in education dimension, while Slovak Republic has the lowest score. Denmark scores highest in behavior and habits dimension (0.88), with Latvia scoring the lowest (0.43). Turkey has the lowest score in economic factors (0.20), whereas Norway has the highest score (0.67).

Table 5. Health Index Scores

Countries/Years	2000	2005	2010	2015	2020
Austria	0,66	0,64	0,63	0,66	0,68
Belgium	0,73	0,70	0,72	0,72	0,74
Canada	0,74	0,73	0,72	0,72	0,72
Chile	0,61	0,60	0,62	0,62	0,61
Costa Rica	0,64	0,63	0,65	0,65	0,64
Czechia	0,56	0,60	0,61	0,62	0,65
Denmark	0,76	0,75	0,73	0,76	0,79
Estonia	0,48	0,54	0,56	0,55	0,61
Finland	0,73	0,73	0,73	0,74	0,74
France	0,73	0,76	0,74	0,74	0,74
Germany	0,62	0,64	0,65	0,67	0,72
Greece	0,67	0,66	0,66	0,66	0,67
Holland	0,77	0,74	0,73	0,71	0,72
Hungary	0,60	0,63	0,60	0,61	0,65
Iceland	0,76	0,76	0,74	0,75	0,76
Ireland	0,71	0,73	0,73	0,72	0,72
Italy	0,75	0,76	0,76	0,72	0,70
Latvia	0,47	0,47	0,45	0,45	0,47
Lithuania	0,48	0,49	0,52	0,55	0,59
Luxembourg	0,73	0,73	0,68	0,69	0,71
Mexican	0,56	0,59	0,54	0,52	0,52
New Zeland	0,64	0,75	0,75	0,74	0,77
Norway	0,78	0,78	0,78	0,79	0,80
Poland	0,59	0,59	0,62	0,69	0,68
Portugal	0,72	0,73	0,72	0,68	0,68
Slovak Republic	0,58	0,51	0,52	0,52	0,54
Spain	0,72	0,74	0,72	0,72	0,70
Sweden	0,77	0,74	0,77	0,79	0,79
Switzerland	0,78	0,77	0,77	0,78	0,77
Türkiye	0,54	0,57	0,57	0,58	0,59
United Kingdom	0,75	0,76	0,74	0,77	0,76
United States of America	0,65	0,69	0,66	0,65	0,68

When examining the health index scores for the year 2020, which is the most recent year covered in the research, Latvia has the lowest score (0.47), while Norway has the highest score (0.80). Throughout past years, Latvia consistently has had the lowest score. Norway consistently ranks highest in scores across all years. In the year 2000, Switzerland and in 2015, Sweden achieved the same score as Norway. There is no year among the countries that involves a common change in a positive or negative direction. New Zealand showed the largest positive change (0.11) over the previous 5-year period, occurring between 2000 and 2005. The largest negative score change (-0.07) occurred during the same period in the Slovak Republic.

Table 6. Health Index Scores by Country's Health System Model

HEALTH SYSTEM MODEL	COUNTRY	2020 HEALTH INDEX SCORE
Private Enterprise	USA	**0,68**
Welfare Orianted	Germany	0,72
	Belgium	0,74
	Czechia	0,65
	Estonia	0,61
	France	0,74
	Holland	0,72
	Switzerland	0,77
	Canada	0,72
	Latvia	0,47
	Lithuania	0,59
	Luxembourg	0,71
	Hungary	0,65
	Mexican	0,52
	Portugal	0,68
	Türkiye	0,59
	Greece	0,63
	Average Score	**0,66**
Comprehensive	United Kingdom	0,76
	Denmark	0,79
	Finland	0,74
	Ireland	0,72
	Spain	0,70
	Sweden	0,79
	Italy	0,70
	Poland	0,68
	New Zeland	0,77
	Average Score	**0,74**

When examining the average health index scores of countries based on their health system models, it is observed that the inclusive health system model has the highest average score (0.74), while the welfare-oriented health system model has the lowest (0.66). The difference in average scores between the welfare-oriented health system and the private enterprise health system (0.02) is quite minimal. In the inclusive model, Denmark and Sweden have the highest health index scores (0.79), whereas Poland has the lowest score (0.68). Regarding the health index scores of countries applying the welfare-oriented health system model, Latvia is observed to have the lowest score (0.47), and Switzerland the highest (0.77).

4.2. Panel Data Analysis Findings

The data used in the research spans the period from 2000 to 2020, and the type of data is annual. The study includes 32 countries. In the research, there is one dependent variable and seven independent variables. The dependent variable of the study is the health index variable, while the independent variables are health outcomes, healthcare services, environment, social factors, education, behavior, and economic variables. The econometric models planned to be developed within the scope of the research are represented by the following equations:

$$\Delta HEINDEX_{it} = C + \sum_{j=1}^{pi} \lambda_{ij}\, \Delta HEOUTCOMEx_{i,t-j} + \sum_{j=0}^{qi} \delta_{ij}\, \Delta HESERVx_{i,t-j} + \sum_{j=0}^{qi} \varphi_{ij}\, \Delta ENV_{i,t-j} + \sum_{j=0}^{qi} \Theta_{ij}\, \Delta SOx_{i,t-j} + \sum_{j=0}^{qi} \Theta_{ij}\, \Delta EDUx_{i,t-j} + \sum_{j=0}^{qi} \Theta_{ij}\, \Delta BEHx_{i,t-j} + \sum_{j=0}^{qi} \Theta_{ij}\, \Delta ECOx_{i,t-j} + \varepsilon_{it}$$

As seen in the equation, the dependent variables used in the models within the scope of the research are on the left side of the equations. On the right side of the equations are the independent variables and control variables. The symbols on the right side of the equation represent: c for the constant term, i for the cross-sectional unit, t for the time variable, ϵ for the error term, and λ for the coefficients of the independent variables. In the developed model, to identify whether there are variables that might cause multicollinearity issues, the Variance Inflation Factor (VIF) values for each variable were calculated. The fact that all VIF values for the variables are below the critical value of "4" indicates that the variables in the model do not have multicollinearity issues.

Following the examination of the multicollinearity problem, the next step is to determine the appropriate data model for the panel. After conducting the F-test, it was found that the model to be developed is not suitable for the pooled panel approach. The Hausman test results indicated that the most suitable panel approach for the model is the random effects approach. To determine whether the model meets the panel's basic assumptions, autocorrelation tests, heteroscedasticity tests, and cross-sectional dependence tests were performed; it was found that the model has issues with autocorrelation, cross-sectional dependence, and heteroscedasticity. To address the fundamental assumption problems encountered in the models, the Driscoll and Kraay estimator was used.

Table 7. Panel Data Analysis Results of the Health Index with Driscoll-Kraay Standard Errors Model

Dependent Variable: Model 1 HEINDEKS				
Period: 2000-2020				
Cross-section: 32				
Total Number of Observations: 640				
Variable	**Coefficient**	**Driscoll/Kraay Standard Error**	**t-Statistic Value**	**Probability Value**
Environment	0.2183429	0.2381656	0.92	0.371
Economy	0.0345335	0.0164186	2.10	0.049
Health Services	0.1456909	0.0323401	4.50	0.000
Health Outcomes	0.1899426	0.0420251	4.52	0.000
Social	0.0804572	0.0404608	1.99	0.061
Education	0.1218404	0.0050573	24.09	0.000
Behaviors	0.2356344	0.0261011	9.03	0.000
C	0.4067286	0.0161919	25.12	0.000
R^2: 0.76	F-statistic: 431.30		Prob (F-Statistic): 0.000	

In the table related to panel data results, the panel regression outcomes of the model developed within the scope of the research are presented. Before reaching the regression results, the model's compliance with basic assumptions was examined. It was identified that Model 1 had issues with autocorrelation, heteroscedasticity, and cross-sectional dependence. To address these issues and ensure the accuracy of the final findings, robust estimators were used. As a result, the final outcomes are free from basic assumption problems. The F-statistic value indicates that the model is significant at the 1% significance level. Additionally, the R^2 value, which determines the explanatory power of the independent variables on the dependent variable, was found to be 76%. This indicates that the model has a high success rate in explaining the dependent variable.

When examining the findings related to the variables in the model, it is projected that a 1-unit increase in the index value of the economic dimension will increase the health index value by 0.03 units. A 1-unit increase in the index value of the healthcare services dimension is expected to lead to a 0.14 unit increase in the health index value. Each 1-unit increase in the index value of the health outcomes dimension is expected to increase the health index value by 0.18 units, while each 1-unit increase in the index value of the social indicators dimension is projected to increase the health index value by 0.08 units. Each 1-unit increase in the index value of the education dimension is expected to increase the health index value by 0.12 units, while each 1-unit increase in the index value of the behavior dimension is projected to increase the health index value by 0.23 units.

When the analysis results are examined under the assumption that the sum of the coefficients of the sub-dimensions is 100, the behavior dimension has the most significant impact on the index at 23%. The behavior dimension is followed by the environment at 21%, health outcomes at 18%, healthcare services at 14%, education at 12%, social dimension at 8%, and economy at 3%. While the overall model created for the health index is significant, it is also necessary to re-evaluate the variables that constitute the environment, one of the sub-dimensions.

5. CONCLUSION AND RECOMMENDATIONS

International health comparisons enable the analysis and comparison of health status and outcomes across different countries. These comparisons are crucial for identifying the strengths and weaknesses of health systems and determining appropriate health policies. They also play a significant role in guiding how resources can be more effectively utilized in the delivery of healthcare services, thus contributing greatly to the improvement of health inequalities.

Within the scope of the research, the developed health index includes sub-indices such as health outcomes, which generally encompass death rates based on demographic factors. Iceland achieves the highest score in these indicators, while Mexico is identified as the country with the lowest score. Death rates serve as direct health indicators, with Mexico having the highest life-threatening rate among the other countries in the index, and Iceland having the lowest. Indicators in the healthcare services sub-index are typically related to healthcare expenditures. According to 2020 data, the United States invests more in healthcare services compared to other countries, whereas this investment level is significantly lower in Mexico.

When examining the education sub-index, the country with the highest percentage of children not attending primary school is Slovakia, whereas the lowest is New Zealand. The environmental sub-index includes countries' rates of air pollution and sanitation services. In this context, the United States posed the greatest threat to human health from air and water resources in 2020,

while Finland posed the least threat. The habits and behaviors dimension encompasses the effects of individual behaviors on personal health. According to this dimension, Latvia exhibits the highest tendency to harm its own health, while Denmark exhibits the lowest.

According to the Health Index 2020 scores, Sweden has been identified as the country with the most advanced health status. Norway and Denmark have also achieved high scores. The lowest health development has been observed in countries such as Slovakia, Mexico, and Latvia. The 70% score difference between Sweden and Latvia illustrates the extent of health inequality between countries.

The research concludes that the developed health index model is significant. However, to determine the contributions of the sub-dimensions of the index, weighting is necessary. Particularly, it is suggested that environmental variables be reshaped using advanced statistical methods and expert opinions to create a more comprehensive and reliable index for international comparisons. The index developed within the research is expected to serve as a foundation for future studies in similar fields.

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