

## Challenges of health and well-being in the world according to SDG indicators

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FREE THEMES

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**Abstract** *This study reviews the current state of the good health and well-being indicators included in the Sustainable Development Goals (SDG), identifying the most significant challenges faced by countries in the world and in the Americas region. The HJ-Biplot multivariate technique is used to represent variances and covariances between 16 SDG 3 indicators, reported as of 2022, based on data from 176 countries, including 31 countries of the American continent. The findings show that indicators such as life expectancy at birth, universal health coverage and satisfied demand for family planning are key characteristics of developed countries. In contrast, developing countries still face significant challenges in terms of promoting maternal health, the well-being of children and the control of communicable and chronic diseases. For this reason, in the framework of the 2030 Agenda, it is necessary to continue working on public policy actions that enable making progress in the implementation of programs to improve the health and well-being of the population, especially in lower-income countries.*

**Key words** *Sustainable development, 2030 Agenda, Health promotion, Social well-being*

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## Introduction

Good health is a key requirement for the development of any society, and for this reason countries worldwide make efforts to establish strategies aimed at ensuring healthy lives and promoting the well-being of their populations. These conditions are essential to achieve the progress of nations<sup>1</sup>. For this reason, the Sustainable Development Goals (SDGs), as a public policy strategy, enable to prioritize the needs related to healthcare at the global level, and facilitate monitoring of the SDG 3 indicators<sup>2</sup>. This SDG specifically puts health at the center of the agenda and includes other objectives such as equitable access to treatments, urban health and control of non-communicable diseases<sup>3</sup>.

The targets aimed at improving the health of millions of people incorporate several indicators, which seek, for example, to reduce child and maternal mortality, or deaths due to diseases related to malnutrition, environmental factors or other risk factors. However, when the global COVID-19 pandemic arrived, most governments prioritized resources and capabilities to address the health emergency, to the point that even today the outlook for achieving the SDG 3 targets by 2023 still looks uncertain. The fight against COVID-19 has taken center stage in recent years, and achieving the SDGs within the defined time frames has become secondary<sup>4</sup>. The pandemic has deeply affected countries in many different ways, and in many cases brought the countries' health systems to the brink of collapse<sup>5</sup>.

The 2021 Sustainability Report<sup>6</sup> indicates that COVID-19 has limited the countries' institutional and governmental capacity to continue moving forward towards achieving the proposed targets, and produced a reduction in life expectancy in several developed countries. This impact is considered particularly serious in lower-income countries, which even before the pandemic were struggling to achieve the targets due to their lower level of socioeconomic development<sup>7-9</sup>. These countries face additional challenges in their public policy models, such as corruption, which stunts sustainable and inclusive growth and worsens inequality<sup>10-11</sup>.

In view of the above, this study assesses the current outlook for the SDG indicators related to good health and well-being in the world, with the aim of identifying the most significant issues and the countries that face the greatest challenges.

## Methods

This is an ecological-type study and therefore has an exploratory and descriptive scope. It analyzes the data related to the indicators included in Table 1, as published in the Sustainable Development Report 2022<sup>12</sup>. The figures of these indicators were taken from the databases of international agencies belonging to the United Nations system, which compile information using official sources from each country. Consequently, the data might be for different years. To overcome this possible limitation, which may produce bias in interpretation, in this study we assess the information of 176 countries throughout the world that reported or provided recent estimates of all the indicators in Table 1.

The HJ-Biplot<sup>13</sup> multivariate technique was used to represent and interpret the observed variances and covariances between the SDG good health and well-being indicators. This technique has been recently used in studies related to public health<sup>14-16</sup> and for the analysis of sustainability indicators<sup>17-19</sup>.

The Biplot methods proposed by Gabriel in 1971<sup>20</sup> belong to the class of multidimensional data exploration techniques that enable the analysis of the joint distribution of several variables (columns of the SDG indicators data matrix) on a single plane of representation, according to the behavior of the observations or individuals (rows, which in this case are the countries), without assuming any relationship of interdependence between the variables.

GH-Biplot is used when the objective is to analyze the associations between variables by representing the measured characteristics as vectors. The proximity between vectors reflects a high positive association. On the contrary, if two vectors display an angle of about 180°, they are highly correlated, but negatively. When the objective is not to assess the association between variables, but rather the closeness or differences between the observations, they are represented as dots, and this type of analysis is called JK-Biplot.

In 1986, Galindo-Villardón<sup>13</sup> proposed an alternative for simultaneous representation called HJ-Biplot, which enables viewing which variables determine proximity between individuals, because they lie in the same direction as the vectors, and vice-versa when the observations lie in the opposite direction of the vectors, in which case they have low scores for the measured characteristics.

**Table 1.** Indicators under analysis.

Code	Indicator	Description
AFR	Adolescent fertility rate	The number of births per 1,000 women between the ages of 15 and 19
BHP	Births attended by skilled health personnel	Percentage of births attended with supervision and care to women during pregnancy, labor, and the postpartum period.
DCD	Age-standardized death rate due to cardiovascular disease, cancer, diabetes, or chronic respiratory disease in adults	Percentage of deaths over total adults between the ages of 30 and 70
DPA	Standardized death rate attributable to household air pollution and ambient air pollution	Total per 100,000 inhabitants
DTR	Estimated number of fatal injuries due to traffic accidents	Total per 100,000 inhabitants
LEB	Life expectancy at birth	Estimated years
M5R	Mortality rate, under-5	Total per 1,000 live births
MMR	Maternal mortality rate	Number of women between the ages of 15-49 who die from pregnancy-related causes while pregnant or within 42 days of termination of pregnancy, per 100,000 live births
NMR	Neonatal mortality rate	The number of newborn infants (neonates) who die before reaching 28 days of age, per 1,000 live births
OBS	Prevalence of obesity among adults	Percentage of the adult population with body mass index of 30 kg/m <sup>2</sup> or higher
SGC	Prevalence of stunted growth among children under 5 years old	Percentage of children under the age of 5 who have stunted growth, whose height is less than two standard deviations from the median height for their age according to WHO child growth patterns.
TUB	Incidence of tuberculosis	The estimated rate of new and relapse cases of tuberculosis in a given year, expressed per 100,000 people.
UHC	Universal health coverage	The indicator is a compound index of service coverage reported on scale of 0 (worst) to 100 (best).
VAC	Percentage of surviving infants who received vaccines	Percentage of surviving infants under the age of 12 months who received the vaccines recommended by the WHO

Source: Author based on data from the Sustainable Development Report 2022.

HJ-Biplot analysis enables interpreting the length of the vectors in terms of the importance of the variables in explaining the behavior represented in the plane, in the sense that a longer vector implies more variability, and therefore more information, and vice-versa.

It is also possible to interpret the angles between vectors and the factorial axes that result from the reduction of the dimensionality of the data: a smaller angle means a greater contribution by the studied indicators.

In terms of the observations (countries in this study), the distance between dots enables observing associations between them. Two observations

with similar values for the studied variables will appear close to each other.

## Results

The global SDG monitoring panel displayed in the map of Figure 1 summarizes the countries' scores. Those with highest achievements are displayed in green, and those with greatest opportunities are shown in red. As of 2022, none of the countries has achieved the SDG 3 targets, and only 19 countries of the global North reported substantial progress. The countries of the global

South must still make substantial efforts, especially in Africa, South Asia, Southeast Asia, the Oceania archipelagos and Latin American countries.

In view of the critical outlook reflected in the map in Figure 1, it is relevant to analyze the observed variances and covariances between the SDG indicators related to good health and well-being. To this end, we illustrate by means of a description of the behavior of the indicators UHC, AFR, OBS and DTR (see Figure 2). Afterwards we will present the calculated bivariate correlations between all the pairs of the above indicators, to then reach conclusions by means of HJ-Biplot multivariate analysis.

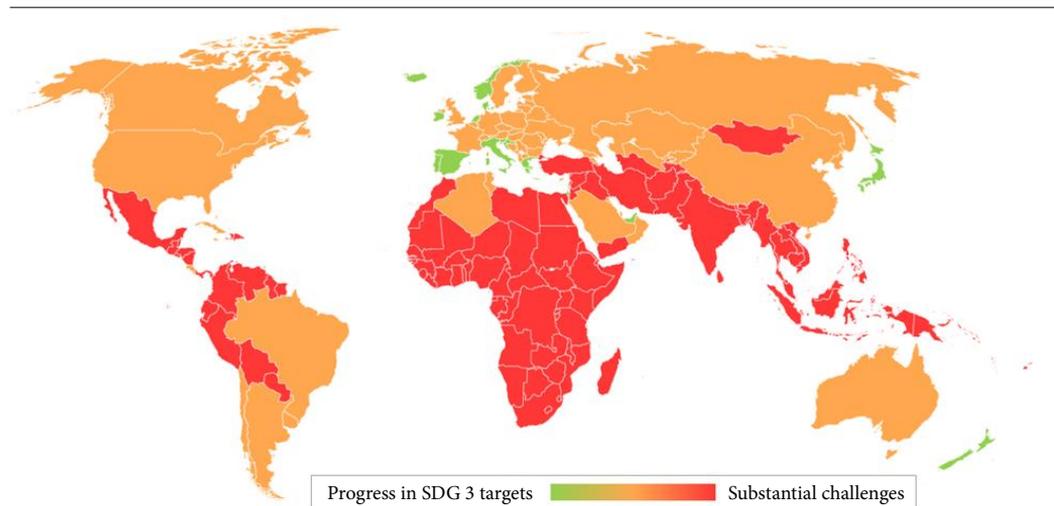
In terms of the universal health coverage indicator (UHC), Figure 2(a) highlights the contrast between the median values of Africa and Europe (45.5 compared to 79), which reflects the need to improve the primary healthcare systems of African nations. Africa also displays the highest median value in the world in terms of adolescent fertility (see Figure 2(b)), currently reporting 94 births per 1,000 women between the ages of 15 and 19, whereas European countries only report 9. Bulgaria, Romania and Slovenia stand out as atypical data in the European continent, reporting over 26 births per 1,000 adolescents between the ages of 15 and 19.

In terms of the prevalence of obesity, Figure 2(c) shows similar median values for the coun-

tries of the Americas, Europe, Asia and Oceania, where it is currently estimated that close to 21.9% of the adult population has a body mass index of 30 kg/m<sup>2</sup> or higher. In Figure 2(d) we observe that the Dominican Republic has the highest rate in terms of traffic-related deaths, reporting 64.6 deaths per 100,000 inhabitants for this reason, whereas the global average for the DTR indicator is 17.

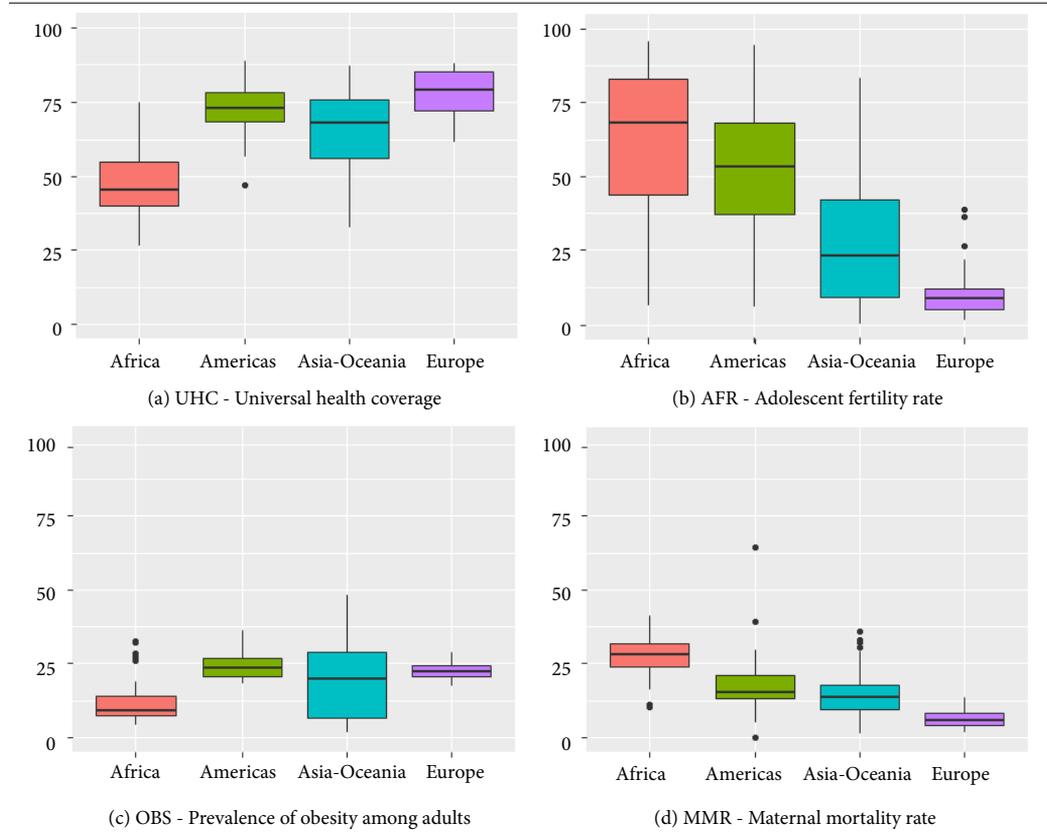
In terms of the bivariate correlation matrix between pairs of indicators, in Figure 3 the countries are color-coded in pink if they belong to the global north and in blue if they belong to the global south, based on the country classification of the United Nations Office for South-South Co-operation (UNOSSC). First, we display total correlation and then the correlations calculated with the data of each subregion.

In Figure 3 we observe high correlations between indicators, and regardless of whether such correlation is positive or negative, we find that they are all statistically significant when the data is analyzed without discriminating between countries of the global north and global south. Only when they are differentiated do we find correlations that are near to zero in the global north. For example, no significant correlation is observed between births attended by medical personnel and the maternal mortality rate or the prevalence of stunting among children under the age of 5 (BHP, MMR and SGC indicators, respec-



**Figure 1.** Current status of achievement of the SDG 3 targets in the world.

Source: Author based on data of the Sustainable Development Report 2022.



**Figure 2.** Behavior of the indicators UHC, AFR, OBS and DTR by region.

Source: Author using the R statistical program based on the Sustainable Development Report 2022.

tively). The non-significance of these associations implies that lower variability is observed among the countries of the global north in the figures reported by the countries, whereas in the global south there is greater variability among the countries, which implies greater challenges in terms of meeting the targets of the 2030 Agenda, especially for lower-income countries.

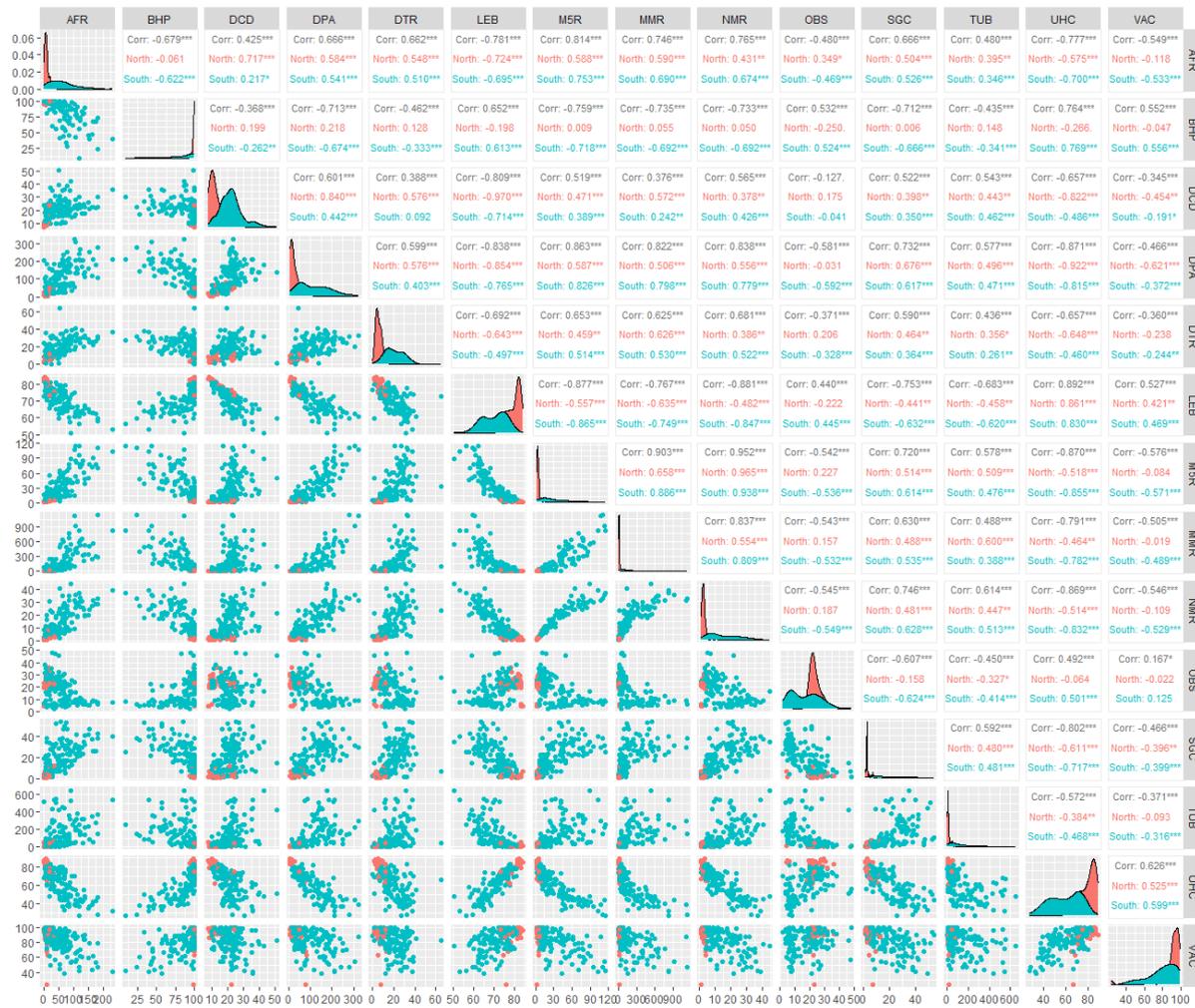
The pairs of SDG indicators are highly correlated. When such correlation is positive, it may be interpreted as conditions that jointly facilitate or limit the well-being and health of the population. When the correlation is negative, it represents offsetting between indicators that jointly cannot take on high positive or negative values. It is therefore relevant to use HJ-Biplot to analyze the existing interdependencies between the indicators and the countries.

Figure 4 presents the plain of axes 1-2 of the analysis, which summarizes 74% of all the variability that can be explained by the assessed data

matrix. The first axis reflects 66.6% of the variability and summarizes the multidimensional dimension representing the health and well-being of the world's population. The vectors located on the left represent the conditions that characterize the countries of the global north, whereas those that point towards the right characterize the developing countries.

In Figure 4 we can observe that universal health coverage, life expectancy, attention of birth by qualified medical personnel, and the vaccination of infants as recommended by the World Health Organization (WHO) (vectors UHC, LEB, BHP and VAC) are necessary conditions for sustainable development, and at present high and medium-high income countries in Europe, Asia and the Americas report substantial progress towards meeting the targets of the 2030 Agenda.

This can be observed in the relative position of the countries located at the left of the HJ-Bi-



**Figure 3.** Matrix of bivariate correlations between SDG good health and well-being indicators.

Notes: Pearson correlation coefficient between the variables are represented. The levels of significance are stated as  $\alpha = 0.1$  (.)  $\alpha = 0.05$  (\*)  $\alpha = 0.01$  (\*\*) and  $\alpha < 0.01$  (\*\*\*)

Source: Calculations using the R statistical package based on the Sustainable Development Report 2022.

plot (in quadrants II and III of the plane), which are the countries with the highest level of economic development in the world. On the other hand, the vectors located on the right (in quadrants I and IV of the plane), represent aspects that if left untended will prevent the low and medium income countries of the global south from advancing towards sustainable development and the achievement of the 2030 Agenda.

The proximity between the vectors MMR, NMR, M5R and AFR implies that countries where maternal mortality is high also have high

mortality rates for neonates and children under the age of 5, and additionally display critical levels of total teenage pregnancies. The countries that currently face the greatest challenges in controlling these four aspects are in Africa: Chad (TCD), Somalia (SOM), Central African Republic (CAF) and Nigeria (NGA). It is important to highlight that these countries and the group of vectors associated with the health of pregnant women and mothers and the well-being of infants are located on the opposite side of the vector that represents births attended by qualified

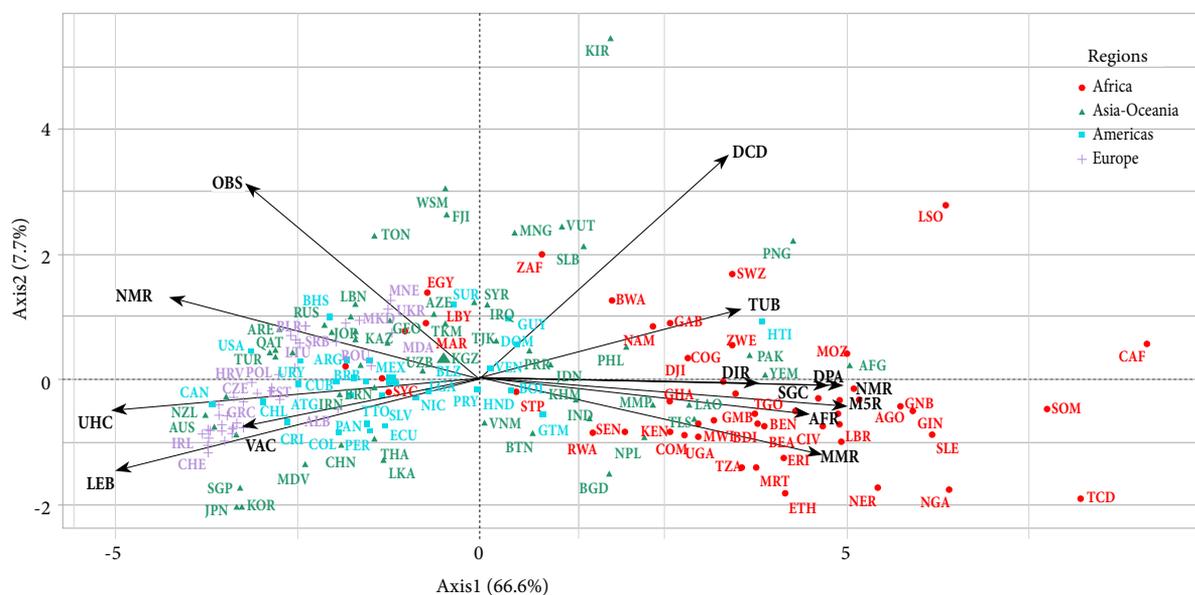
health personnel (BHP). Since these vectors lie at an angle of approximately  $180^\circ$ , they are negatively correlated.

Another negative correlation that stands out from the direction of the vectors represented in Figure 4 is that between the indicators UHC, LEB or VAC (which are located on the left side and represent healthcare coverage, life expectancy at birth, and infants who receive the vaccines recommended by the WHO), and the indicator TUB (which is located on the right and represents the incidence of tuberculosis). Lesotho (LSO), South Africa (ZAF), Central African Republic (CAF) and Philippines (PHL) are the countries of the world with the highest incidence of tuberculosis (TUB), reporting more than 530 cases per 100,000 inhabitants.

Another country that displays major challenges in controlling diseases and causes of death of its population is Sierra Leona (SLE), which has the highest DPA indicator in the world, related to deaths attributable to air or environmental pollution (324 per 100,000 persons). The insular republic of Kiribati (KIR) has the world's highest indicator of deaths arising from cardiovascular disease, cancer, diabetes or chronic respiratory diseases (DCD indicator, located on the top right corner of the plane in quadrant I).

To conclude the description of the patterns displayed in Figure 4, we turn to what is observed in axis 2 (which differentiates between the relative positions of the countries from top to bottom). This axis only reflects 7.7% of the variability of the information. The two vectors that are closest to this axis, and which are therefore those that most contribute to the multidimensional characterization, are OBS (located on the top left corner of the Figure, representing the prevalence of obesity) and DCD (located towards the top right of the plane, in reference to mortality due to cardiovascular disease, cancer, diabetes or chronic respiratory diseases). These two vectors indicate that the second axis of the HJ-Biplot analysis could be interpreted as the countries' efforts to control the prevalence and mortality rates arising from non-communicable diseases.

Continuing with the analysis, and in order to explain in greater detail the current outlook of the studied indicators in the countries of the Americas, we present Figure 5, where we see that Haiti (HTI), towards the right on the plane, stands out from the other countries in the region, reflecting major challenges in achieving the SDG targets related to good health and well-being. On the other hand, Canada (CAN), Chile (CHL), Costa Rica (CRI) and United States (USA) are located at the



**Figure 4.** HJ-Biplot of good health and well-being SDG indicators (plane 1-2).

Source: Calculated using the R statistical package based on the Sustainable Development Report 2022.

far left of the Figure, displaying the best conditions in the continent in terms of promoting the health and well-being of their populations. These countries report high values in the indicators of universal health coverage (UHC), life expectancy (LEB), births attended by medical personnel (BHP), and infants who receive the vaccines recommended by the WHO (VAC vector).

In contrast, Guatemala (GTM), Honduras (HND), Nicaragua (NIC) and Venezuela (VEN) report critical values related to the adolescent fertility rate (AFR indicator), reporting over 77 births per 1,000 women between the ages of 15 and 19. Additionally, Guatemala has the highest SGC indicator in the region, regarding stunted growth among children under the age of 5 (reported in 46.7% of children).

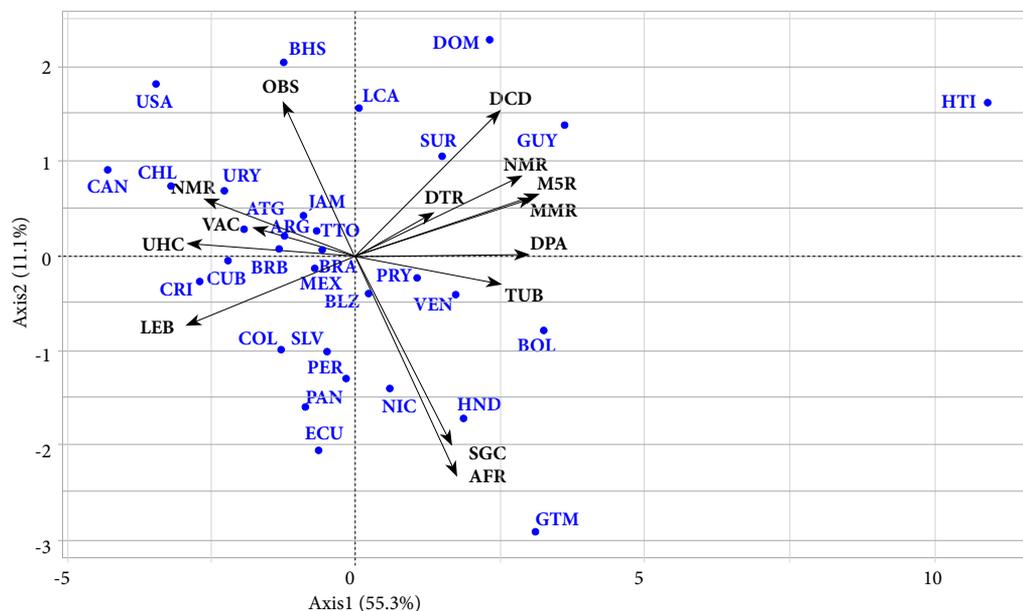
Lastly, it is important to highlight that the highest prevalence of obesity (OBS indicator) is reported in the United States (USA) and Bahamas (BHS), where over 30% of adults have a body mass index higher than 30 kg/m<sup>2</sup>. The plane of Figure 5 shows that, consistently with the behavior displayed in the plane of Figure 4, the OBS vector has one of the smallest angles with respect to axis 2, which implies that it is one of the vectors that most contributes the differentiation that

can be established between countries in the top-down direction.

### Discussion

The effects of COVID-19 on the economy and in transforming the healthcare systems give rise to the need to reassess current global sustainability scenarios<sup>21,22</sup>, which makes it necessary to think of new ways to achieve the development of countries in the different aspects measured by the SDGs. In the post-pandemic era, it will be necessary to pay special attention to the integration between the SDGs in order to search for synergies between the targets, so as to specify the short- and medium-term priorities in all countries<sup>23</sup>.

The global public health crisis and the socioeconomic recession caused by COVID-19 have limited progress towards achieving the SDGs. Not only has the pandemic delayed SDG advancement in general, but it has also amplified spatial imbalances in achieving progress<sup>24</sup>. Currently it can be seen that low- and medium-income countries suffer from the lack of international financing to achieve the Sustainable Development Goals<sup>25</sup>, and specifically for the



**Figure 5.** HJ-Biplot of SDG 3 indicators of countries of the Americas (plane 1-2).

Source: Calculations using the R statistical program based on the Sustainable Development Report 2022.

SDG health targets, which makes it necessary to minimize structural global inequalities.

The data analyzed in this study show how the least developed economies (worldwide, and specifically in the Americas) still face challenges in terms of controlling diseases and causes of death not associated with the pandemic, and which affect the well-being and health of their populations. For example, teen pregnancies; maternal<sup>26</sup>, neonatal, and children under-5 mortality rates; or adult mortality rates due to traffic accidents, air pollution, chronic respiratory diseases, diabetes, cardiovascular diseases, or the incidence of tuberculosis, continue to be challenges for lower-income countries. This is despite the progress made in recent years to reduce their occurrence<sup>27</sup>.

The health emergency caused by COVID-19 led to interruptions or neglect in the normal operation of the health sector in providing services for the detection of cancer, the control of infectious diseases not related to COVID-19, the satisfaction of family planning needs, and the promotion of awareness about health<sup>28</sup>, especially in low-income countries. For this reason, in the near future it will be necessary to promote the effectiveness of health systems throughout the world, to enable countries to address the health-

care needs of their people quickly and effectively, regardless of their socioeconomic status.

Global health diplomacy will play a crucial role in achieving this goal, by acting as a catalyst for effective, innovative and fair policy solutions between the governments and non-government actors<sup>29</sup>. However, given that COVID-19 has impacted several dimensions of the well-being of people and the development dynamics of countries, it has given rise to multiple and interrelated crises that have put to the test the limits of current development paradigms<sup>30</sup>; which will make it necessary to adopt several strategies for recovery.

In addition to the improvement of public health services, other challenges for achieving the goals of the 2030 Agenda include the growth of the labor market, sustainable food systems, environmental and ecological management, inclusive education, support for research and technology initiatives<sup>31</sup>, the reduction of inequalities by promoting human rights, regional economic integration<sup>32</sup>, promoting partnerships among industries<sup>33</sup>, and synergic cooperation between international agencies to drive the cross-disciplinary research required to achieve a more sustainable, equitable and adaptive future<sup>34</sup>.

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