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How far has the globe gone in achieving One Health? Current evidence and policy implications based on global One Health index

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ABSTRACT

Background: In the 21st century, as globalization accelerates and global public health crises occur, the One Health approach, guided by the holistic thinking of human-animal-environment and emphasizing interdisciplinary collaboration to address global health issues, has been strongly advocated by the international community. An immediate requirement exists for the creation of an assessment tool to foster One Health initiatives on both global and national scales.

Methods: Built upon extensive expert consultations and dialogues, this follow-up study enhances the 2022 global One Health index (GOHI) indicator system. The GOHI framework is enriched by covering three indices, e.g. external drivers index (EDI), intrinsic drivers index (IDI), and core drivers index (CDI). The comprehensive indicator system incorporates 13 key indicators, 50 indicators, and 170 sub I-indicators, utilizing a fuzzy analytic hierarchy process to ascertain the weight for each indicator. Weighted and summed, the EDI, IDI, and CDI scores contribute to the computation of the overall GOHI 2022 score. By comparing the ranking and the overall scores among the seven regions and across 160 countries/territories, we have not only derived an overall profile of the GOHI 2022 scores, but also assessed the GOHI framework. We also compared rankings of indicators and sub I-indicators to provide greater clarity on the strengths and weaknesses of each region within the One Health domains.

Results: The GOHI 2022 performance reveals significant disparities between countries/territories ranged from 39.03 to 70.61. The global average score of the GOHI 2022 is 54.82. The average score for EDI, IDI, and CDI are 46.57, 58.01, and 57.25, respectively. In terms of global rankings, countries from North America, Europe and

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Central Asia, East Asia and Pacific present higher scores. In terms of One Health domains of CDI, the lowest scores are observed in antimicrobial resistance (median: 43.09), followed by food security (median: 53.78), governance (median: 54.77), climate change (median: 64.12) and zoonotic diseases (median: 69.23). Globally, the scores of GOHI vary spatially, with the highest score in North America while lowest in sub-Saharan Africa. In addition, evidence shows associations between the socio–demographic profile of countries/territories and their GOHI performance in certain One Health scenarios.

Conclusion: The objective of GOHI is to guide impactful strategies for enhancing capacity building in One Health. With advanced technology and an annually updated database, intensifying efforts to refine GOHI's data-mining methodologies become imperative. The goal is to offer profound insights into disparities and progressions in practical One Health implementation, particularly in anticipation of future pandemics.

1. Background

In the 21st century, as globalization accelerates and global public health crises occur, the United Nations and its member states continue to raise global issues and the need of forming a community of human destiny has become increasingly important [1]. When faced with global health challenges, no country can handle it alone. As a result, global health, a branch of health science, has emerged and developed as a discipline that aims to address issues with global health implications and ultimately improve health equity and reduce health disparities. Contemplating and addressing the global public health crises, the One Health approach has gained widespread support from the international community [2]. This approach not only underscores international collaboration but is also guided by holistic considerations at the human-animal-environment interface. It places significant emphasis on interdisciplinary collaboration to effectively tackle global health issues [3]. Simultaneously, the academia has also been committing resources to the generation of high-quality scientific evidence in support for One Health development [4–6].

After several public health threats, especially the COVID-19 pandemic, international cooperation in tackling emerging infectious diseases has become more important [7]. For decades, tripartite organizations have collaborated to address health risks at the human-animal-environment interface [8]. In 2021, the three organizations called on the United Nations Environment Programme (UNEP) to join the tripartite and formed the One Health High Level Expert Panel (OHHLEP) collaborate to enhance readiness for preventing, predicting, identifying, and responding to global health challenges, while fostering sustainable development [1]. In October 2022, the quadripartite launched the One Health Joint Plan of Action (OHJPA) [9], with the objective of supporting its members and participating states in enhancing One Health capacity building.

In answer to the global demand for a One Health strategy and to pinpoint real-world gaps in the mutual interaction between humans, animals, and the environment, guiding policymakers and practitioners in the application of a One Health approach, we initiated to develop the cellular framework for the global One Health index (GOHI) in 2022 [10]. During the past years, the database has been updated to assess the development status and capacity to apply the One Health approach in 160 countries/territories. It is hoped that the updated results would better facilitate the formulation of effective measures in countries/territories to promote the widespread application of the One Health approach in real-world policy and practice.

2. Methods

2.1. Overview

The investigation of GOHI 2022 is designed to evaluate worldwide advancements in One Health development, employing a modular framework. This structure comprises three essential components, namely external drivers index (EDI), intrinsic drivers index (IDI), and core drivers index (CDI) (Appendix 1). Our examination was grounded in the findings of the GOHI investigation, with the aim of informing the development strategies of One Health in each country through comparing the scores of various countries and digging into the impacts of various influencing factors of One Health capacity building. As part of this effort, we updated the indicator system and database, expanding our coverage from 146 countries in the pilot study to 160 countries around the world.

2.2. Indicator system

The GOHI indicator system has been adjusted to take into account updates in data sources and reflections to real-world scenarios. It is structured into three categories, along with 13 key indicators, 50 indicators and 170 sub I-indicators. Should a nation's data omission rate surpass 50%, its computation outcomes will be omitted. Furthermore, if any country/territory experiences a deficiency exceeding 160 sub-I indicators, that particular indicator will be excluded from the computation.

The methodologies have followed most techniques debriefed in our previous publication [10]. Compared to the previous study, the number of GOHI indicators changed from 57 to 50. Notably, there have been several discernible changes in the process of indicator selection.

Firstly, the indicators under “human health” have been comprehensively adjusted to encompass a broader perspective on human health at the macroscopic perspective. The indicator of “diseases burden” has been added to reflect the impact to human health and the indicator of “universal health coverage and health systems” has been renamed as “health coverage” for more conciseness. Secondly, in animal health section, the previous indicator of “infectious diseases of animals” has been retained while a new indicator, “wildlife and marine life biodiversity” has been introduced along with its sub I-indicators. Thirdly, in response to practical situations and expert consultations, the sub I-indicator of “health outcomes” under the “climate change” indicator has been revised to “mitigation and adaptation capacity”. These changes aim to capture the measures taken by countries/territories to address climate change, as opposed to focusing on health outcomes that can be influenced by various confounding factors.

2.3. Databases

To ensure data validity, we rely on publicly accessible global official data as the primary sources for GOHI development (Table 1).

The detailed technical methodologies in weighting indicators and calculating scores have followed our previously published article [10]. The sources of data for each GOHI indicator are detailed in the Appendix 2.

3. Results

3.1. Overall score

The GOHI 2022 scores indicate that One Health performance worldwide is barely ideal, generally the scores far away from the optimized ones (Fig. 1). The highest score comes from the United States of America (70.61) and the lowest score comes from Guinea-Bissau (39.03). The median score is 54.00. The leading ten countries/territories primarily belong to regions characterized by a high level of economic income, such as North America,

Table 1
Data sources utilized for the development of a global One Health index (GOHI).

Category	Data sources
External drivers index (EDI)	Database from FAO, the World Bank, the International Telecommunication Union (ITU) the Organization for Economic Co-operation and Development (OECD), the International Energy Agency (IEA)
Intrinsic drivers index (IDI)	Databases from the World Bank, WHO, the Sustainable Development Goals (SDGs) dashboard, Environmental performance index of Yale (EPI), World Animal information system of the World Animal Health Organization (WOAH-WAHIS)
Core drivers index (CDI)	
Governance	Data from the Global Health Security Index (GHS Index), the World Bank, the Yale Environmental Performance Index (EPI), government website portal, SDGs reports
Zoonotic diseases	Data from WHO, WOAH, GHS index, Global Health Data Exchange (GHDx)
Food security	Data from the World Bank, WHO, UN data, FAO, the United Nations High Commissioner for Refugees (UNHCR), UNEP
Antimicrobial resistance	Data from the Global Antimicrobial Resistance and Use Surveillance System (GLASS) by WHO, the European Antimicrobial Resistance Surveillance Network (EARS-Net), the Chinese antimicrobial resistance surveillance system (CARSS)
Climate change	Data from WHO, Lancet Countdown, OECD BP Statistical Review of World Energy & Ember, GHDx, Lancet Countdown, State of Global Air

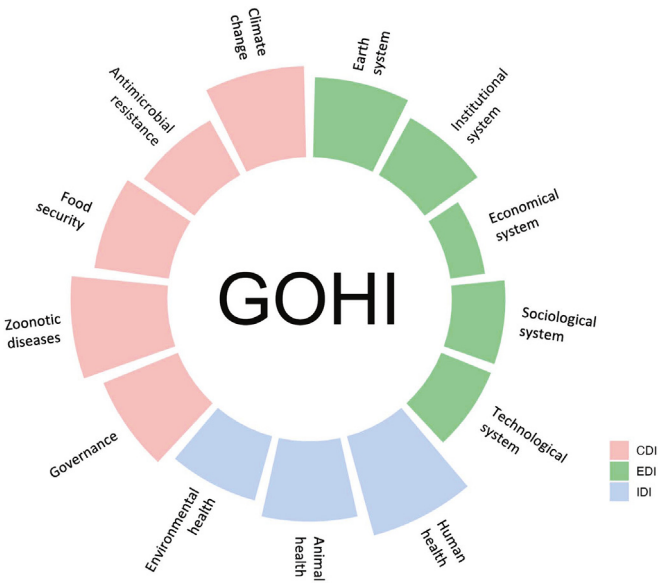

Fig. 2. The global One Health index (GOHI) score distribution by category.

Europe and Central Asia, and East Asia and the Pacific. Conversely, the bottom ten are predominantly situated in sub-Saharan Africa region, characterized by middle or low economic levels.

The average score of the GOHI 2022 is 54.82. The average scores for EDI (A), IDI (B), CDI (C), governance (C1), zoonoses (C2), food security (C3), AMR (C4), and climate change (C5) are 46.57, 58.01, 57.25, 56.51, 68.06, 52.89, 44.05, and 64.19, respectively (Fig. 2). In EDI, the scores range from 32.83 to 50.28 and the median is 39.72 among 160 countries/territories evaluated. In IDI, the scores range from 41.99 to 71.88 with a median of 58.50; in CDI, scores for countries/territories of governance range from 26.75 to 80.52 with a median of 54.77; the global scores of countries/territories in the indicator of zoonoses range from 43.01 to 84.86 with a median of 69.23; the scores in food security range from 24.83 to 73.08 with a standard deviation of 9.80 and the median is 53.78; the scores of AMR range from 14.75 to 81.43 with a median of 43.09; in the indicator of climate change, the scores range from 49.16 to 75.60 with a median of 64.12.

In EDI, "earth system" (A1) has the highest average score (56.21) and the highest median (56.29), while "economical system" (A3) has the lowest average score (24.62) and the lowest median (24.64); in IDI, "human health" (B1) has the highest average score (72.35), in which "diseases burden" (B1.2), "animal epidemic disease" (B2.1), "air quality and climate change" (B3.1) has the highest average score in their corresponding dimensions with 80.74, 94.57 and 53.72, respectively.

In CDI, the highest median scores of the indicators under the governance is awarded to "consensus oriented" (C1.5, median: 94.58); for the indicator of zoonoses, the scores of "case studies" (C2.5) are the highest, with most distributed in the 80.00–90.00 range; in food security, the scores of "food safety" (C3.2) are the highest; for the indicator of AMR, "AMR laboratory network and coordination capacity" scores the highest (55.57); for the indicator of climate change, the score of "health outcome" (C5.2) is the highest.

Regional distribution and medians of GOHI 2022 scores are displayed in Fig. 3. The total scores of GOHI 2022 by regions are as follows: North America (median: 69.11), Europe and Central Asia (median: 60.39), East Asia and Pacific (median: 57.63), Latin America and the Caribbean

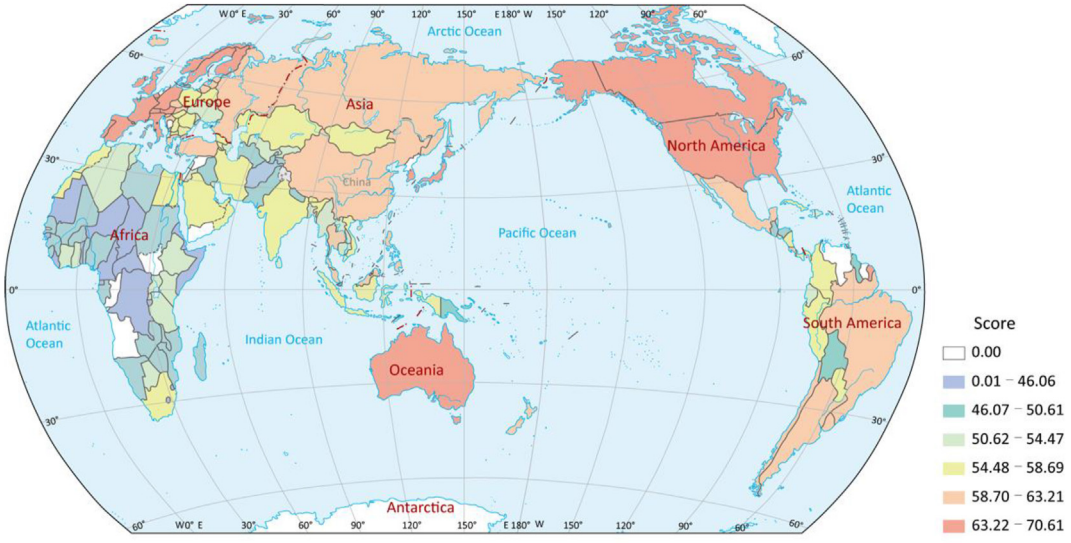

Fig. 1. Global score map of the global One Health index (GOHI).

(median: 54.93), Middle East and Africa (median: 54.33), South Asia (median: 51.39), and sub-Saharan Africa (median: 48.46). Of these, North America, Europe and Central Asia score higher, followed by East Asia and Pacific and Latin America and the Caribbean. Countries/territories with lower scores are concentrated in sub-Saharan Africa (Fig. 3).

3.2. Global ranking

Appendix 3 presents a global ranking of the GOHI 2022 scores for 160 assessed countries/territories. Countries/territories from North America, Europe and Central Asia, East Asia and Pacific demonstrate higher scores, while countries/territories in sub-Saharan Africa, Middle East and North Africa, East Asia and Pacific, and South Asia have lower scores. The top 16 performing countries/territories for the total score of GOHI 2022 are the United States of America, the United Kingdom, Australia, Norway, Germany, France, Switzerland, Canada, Sweden, Finland, the Netherlands, Japan, Austria, Italy, Spain, and Denmark. However, the bottom 16 mainly comprises sub-Saharan African countries/territories, highlighting significant global disparities in One Health capabilities (Appendix 3).

3.3. Global ranking in EDI

The performance in EDI of the top 25 countries/territories among the 160 assessed countries/territories has been listed in Appendix 4. There are two countries/territories from the North America (Canada and the United States of America), 16 leader countries/territories from Europe and Central Asia (representing 10.00% of the region), six countries/territories from East Asia and Pacific, and only one country, Uruguay, from Latin America and the Caribbean (Appendix 4).

The bottom 25 countries/territories in the ranking in Appendix 4 include 11 from sub-Saharan Africa region, five from Middle East and North Africa region, and five from South Asia region. The three countries/territories with lowest scores (Libya, Iraq, and Kuwait) are all from Middle East and North Africa region.

3.4. Global ranking in IDI

The IDI performance of the leading 25 countries/territories among the 160 evaluated entities is detailed in Appendix 5. Within this group, 11 nations/regions are from Europe and Central Asia, constituting 6.88% of the region. Additionally, three are from East Asia and the Pacific, three from South Asia, three from Latin America and the Caribbean, three from Middle East and North Africa and two countries/territories, namely the United States of America and Canada, from North America.

Among the bottom 25 countries/territories in the ranking, as shown in Appendix 5, 18 are from sub-Saharan Africa. In addition, the ten countries/territories with the lowest scores, namely Niger, Democratic Republic of the Congo, Burundi, Cameroon, the Central African Republic, Chad, Somalia, Liberia, Namibia, and Lesotho, are all from sub-Saharan Africa.

3.5. Global ranking in CDI

The performance in CDI of the top 25 countries/territories among the 160 assessed countries/territories has been listed in Appendix 6. Sixteen of these countries/territories are situated in from Europe and Central Asia, accounting for 10.00% of the region. Additionally, there are seven countries/territories from East Asia and Pacific, and two countries/territories, namely the United States of America and Canada from North America.

The lower 25 nations/territories in the ranking, outlined in Appendix 6, comprise 16 from sub-Saharan Africa and four from East Asia and the Pacific. Notably, sub-Saharan African region is home to the two countries/territories with the lowest scores, namely Somalia and Guinea-Bissau.

In terms of governance, 18 of the top 25 scores are from Europe and Central Asia region, topped by Norway. Two countries/territories from North American region (the United States of America and Canada) are all in the top 25, ranking 6th and 7th, respectively. In contrast, the regions of Middle East, South Asia and sub-Saharan Africa do not have any countries/territories in the global top 25 in terms of governance.

Regarding food security, Europe and Central Asia contribute 14 of the top 25 scores, with Australia ranking as the top country. Notably, no countries/territories from South Asia and sub-Saharan Africa are present in the global top 25.

In terms of food security, 14 of the top 25 scores are from Europe and Central Asia, and the top country is Australia. South Asia and sub-Saharan Africa have no countries/territories in the global top 25.

The top 25 countries/territories in the AMR are all from Europe and Central Asia, North America and East Asia and Pacific regions, with France in the top position.

Fifteen of the top 25 climate change score countries/territories are from Europe and Central Asia, with Spain at the top of the list. There are no countries/territories from Middle East and North Africa and South Asia regions ranking in the top 25 (Appendix 7).

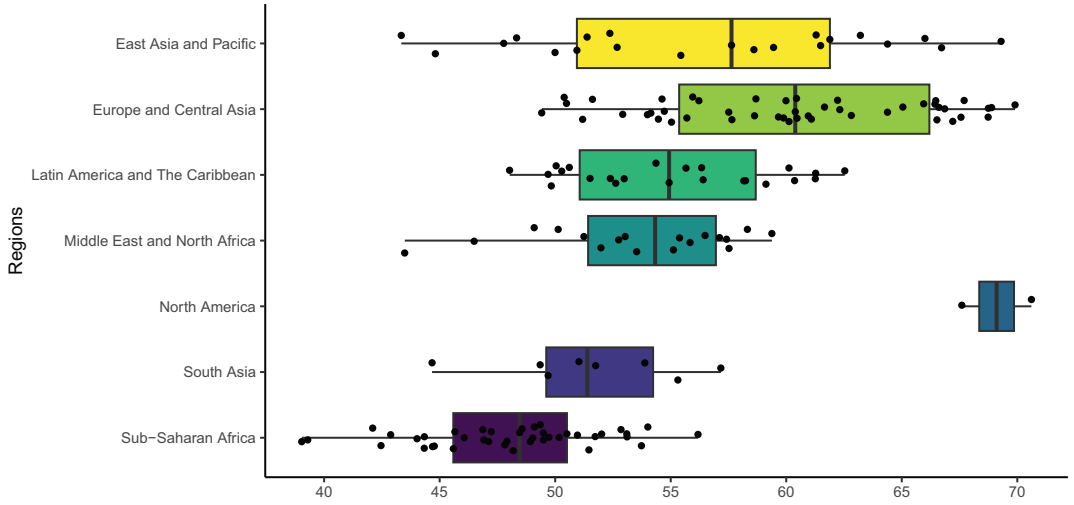

Fig. 3. Regional score distribution of the global One Health index (GOHI).

Table 2 shows the global average score of GOHI 2022 for each indicator within the CDI framework. In the governance category, "consensus oriented" (C1.5) achieves the highest score (86.45) and the "effectiveness and efficiency" (C1.7) has the lowest score (28.38). Among the indicators under zoonoses, the "case studies" (C2.5) has the highest score (66.99) and the "route of transmission" (C2.2) has the lowest score (59.30). In indicators under food security, the "food safety" (C3.2) scored the highest (69.36) and the "government support and response" (C3.5) has the lowest score (16.85). In indicators under AMR, the "AMR laboratory network and coordination capacity" (C4.2) scored the highest (55.57) and the "antimicrobial resistance rate for important antibiotics" (C4.5) has the lowest score (33.03). In indicators under climate change, the "health outcome" (C5.2) scored the highest (85.41) and the "mitigation and adaptation capacity" (C5.3) has the lowest score (28.24). The scores for all indicators and sub I-indicators are detailed in the Appendix 8.

4. Discussions

Globally, there is still room for improvement in the global implementation of One Health practices, since the overall average score of the GOHI 2022 is 54.82. The average score for EDI, IDI, and CDI is 46.57, 58.01, and 57.25, respectively. These results indicated a substantial gap of over 40 points compared to the optimal scores. Among the 160 countries/territories included in the report, no country is able to rank first in all key indicators of CDI. Take Oman and Singapore for example, for total scores of IDI, Oman secures the 2nd position its respective region and performs well in animal and environmental health. Singapore occupies the 20th position of its respective region. As the government of Oman pays much attention to environmental protection, the natural ecology is well preserved, making it a renowned habitat for turtles and birds within protected area [11,12]. However, the human health-related indicators do not score that well, which may pin the poor performance of human health on the low health expenditure. On the other hand, Singapore ranks 1st in human health with the best clinical facilities and health system in the region but ranks 142nd in environmental health, since the low-lying island nation is highly urbanized and faced with ecological risks [13,14]. Even with the United States of America ranking first with a total score of 70.61, it is still 30 points away from the optimal status; Guinea-Bissau ranks 160th with a total score of 39.03, which is 31.58 points lower than the top country (Appendix 9). The average scores of five key indicators in CDI are all below 70.00.

It is noteworthy that the global scores of GOHI 2022 are highly disparate, with considerable variations among different regions and countries/territories. The score of each country/territory ranges from 39.03 to 70.61. Firstly, the scores of EDI (32.83–50.28), governance (26.75–80.52), zoonoses (43.01–84.86), food security (24.84–73.09) and AMR (14.75–81.43) in different countries/territories span a wide range. Sub-Saharan Africa falls to the bottom of rankings in terms of governance and food security, meaning that this region has outstanding problems in One Health governance and food security [15]. Secondly, the IDI score highlights that the IDI performance varies greatly among different countries/territories and regions, as well as among the indicators of human, animal, and environmental health. Developed countries/territories generally have higher IDI scores and higher IDI human health scores, with more attention given to human health, resulting in better overall outcomes, while relatively less attention is given to animal and environmental health. In countries/territories with low IDI scores, resources are often scarce, resulting in insufficient attention given to human, animal, and environmental health. Third, the COVID-19 pandemic has placed considerable strain on governments worldwide, potentially diverting resources away from food security initiatives and towards more immediate public health concerns [16]. Consequently, the reduced focus on food security may have resulted in decreased data availability and a weaker government response, which, in turn, contributed to the low score.

Global health crises, like COVID-19, highlight the need for international cooperation and coordination. Our key findings underscored that

Table 2
Global average score of the global One Health index (GOHI) by each indicator of CDI.

Governance			Zoonotic diseases			Food security			Antimicrobial resistance			Climate Change		
Code	Indicator name	Global score	Code	Indicator name	Global score	Code	Indicator name	Global score	Code	Indicator name	Global score	Code	Indicator name	Global score
C1.1	Participation	41.70	C2.1	Source of infection	69.22	C3.1	Food demand and supply	59.53	C4.1	AMR surveillance system	34.79	C5.1	Climate change risks	80.87
C1.3	Transparency	65.15	C2.2	Route of transmission	59.30	C3.2	Food safety	69.36	C4.2	AMR laboratory network and coordination capacity	55.57	C5.2	Health outcome	85.41
C1.4	Responsiveness	44.42	C2.3	Targeted population	59.90	C3.3	Nutrition	67.17	C4.3	Antimicrobial control and optimization	48.76	C5.3	Mitigation and adaptation capacity	28.24
C1.5	Consensus oriented	86.45	C2.4	Capacity building	72.85	C3.4	Natural and social circumstances	51.54	C4.4	Improve awareness and understanding	48.09			
C1.6	Equity and inclusiveness	73.61	C2.5	Case studies	85.89	C3.5	Government support and response	16.85	C4.5	Antimicrobial resistance rate for important antibiotics	33.03			
C1.7	Effectiveness and efficiency	28.38												
C1.8	Political support	55.89												

some low- and middle-income countries/territories in Latin America and the Caribbean had low vaccination coverage, and the successful experience of the COVID-19 Vaccine Global Access led by national organizations [17], reminded national leaders and international organizations to cooperate in dealing with the shortage of vaccines for zoonotic diseases. Furthermore, science-policy-implementation interfaces under the structure of One Health should be supported to ensure and enhance cooperation in scientific knowledge, techniques, and actions among countries/territories [18]. Henceforth, a more robust focus should be directed towards enhancing collaboration, coordination communication, and capacity-building in the practical implementation of One Health [19]. Transforming national and international strategies calls for establishing a globally integrated, cross-departmental, and multi-disciplinary cooperation platform to align human, animal, and environmental health. Local governments and relevant parties must transcend regional protectionist tendencies and organizational silos, proactively participating in collective endeavors across sectors, disciplines, and regions, while improving communication among involved stakeholders [20].

On a global scale, there are still gaps in data-sharing mechanisms and surveillance systems. Our investigation has unveiled that many countries/territories have made insufficient efforts towards data transparency, with the data required for many key indicators of global One Health governance either being missing or non-transparent. Limited data sources are available to evaluate animal health in the IDI, leading to the inclusion of just 160 out of 220 countries/territories and territories during the final analysis. In addition, limited access to animal and environmental data has been a significant concern during the food security evaluation, resulting in low scores in the "government support and response" dimension and a missing value rate of 20.20% across all indicators. Firstly, the quantitative data of the AMR system are derived from sources such as GLASS, EARS-Net, and CARSS, but the missing data is a significant problem, with missing values exceeding 50.00%. Secondly, surveillance systems are still inadequate or incomplete. In zoonoses, the score of "strategy and regulation" is low (53.85), suggesting legislation related to zoonotic disease surveillance should be improved to fill legal gaps. Thirdly, two of the five AMR indicators, "AMR surveillance system" and "antimicrobial resistance rate on essential antibiotics", significantly lag the others. The median scores for these two indicators are 32.61 and 31.62, respectively, a deficit of more than 10 points from the global median of 43.09. Fourthly, data support is an important foundation for effective One Health governance and monitoring [21]. The construction of data platforms with real-time tracking can be of great significance in global One Health progress and breakthroughs in One Health issues [22,23]. International organizations should work with countries/territories to make global One Health governance data more transparent, accessible and integrated. Fifthly, it is recommended to establish a cross-sectoral, high-level database based on comprehensive surveillance systems [24]. For example, as the threat of hepatitis E grew in China, the Chinese government launched a surveillance system in 2001, which has evolved over time to provide valid data for the One Heath study [7]. The deficiencies in the progress of monitoring systems for the environment should be addressed [25]. To facilitate early detection and response to zoonotic disease outbreaks, natural disasters, and other emergencies, it is crucial to advocate for the enhancement of mechanisms that promote standardized and transparent data sharing [26].

More collective efforts are needed to address shortcomings in global One Health governance. "Consensus oriented" performs the best in governance average scores, with only 9, or 5.63%, of countries/territories scoring below 30.00. This indicates that most countries/territories worldwide have higher performance in consensus and orientation, reflecting a global consensus on One Health governance and a willingness to contribute to improve it. However, in some specific areas, political support remains inadequate. For example, in food security, the "government support and response" indicator has the worst performance among all five indicators of food security, with an average score of 16.84, contributing to the average food security score of 52.89. The low performance of government support and response in food security and suggests potential inadequacies in government efforts to address food security issues from a One Health perspective. In climate change, the average score of "mitigation and adaptation capacity" (28.24) is much lower than that of "climate change risks" (80.87) and "health outcome" (85.40), indicating insufficient government policies, laws, research, and response measures. Although the international consensus on the importance of One Health governance has been growing year by year, the translation of concepts into policy practice by countries still needs to be strengthened. The coordinated mechanism for One Health in the global health governance process should have enhanced leadership to reinforce the practical application of the concept of One Health and emphasize the collaborative role of multiple disciplines and sectors. Actions related to political will, inter-sector governance, and regulatory framework based on the opinion of the OHJPA should be considered a priority to develop a united vision of One Health worldwide [27]. In addition, community participation in the governance of health services is an essential component for engaging stakeholders. In the United States, Minnesota has implemented a zoonoses education campaign for youth [28] that has improved stakeholder relationships and strengthened responses to major public health and animal health issues. This was achieved through collaboration between the government and non-governmental organizations, involving the state Department of Health and others [29].

Zoonoses scores low in blocking the route of transmission and protecting susceptible population demonstrated that high risk of zoonoses outbreak still remain worldwide. Although zoonoses has the highest global performance of the five key indicators of the CDI, reflecting the attention that global communities and UN members have paid to zoonotic disease control, "route of transmission" and "targeted population" score the lowest (59.30, 59.90) compared with other indicators. "Conventional intervention" has average scores of 46.48, while "population coverage" and "cost of interventions" only scores 39.26. The low score suggests inadequate laboratory testing and vaccination for zoonotic reservoirs. The global zoonotic pathogen detection which belongs to "route of transmission", scores only 46.48, suggesting the urgency for countries/territories to strengthen their laboratory capacity to detect zoonotic pathogens. To improve the efficiency of testing, cross-sectoral collaboration should be developed, involving laboratory scientists, diagnosticians, and wildlife specialists in the conception and laboratory program design stages [30]. It is necessary to mention that zoonotic diseases in our case studies retained major public health concerns that affected millions of people worldwide. Thus, to better prevent and control zoonoses, investment in programs that include public education, access to clean water and sanitation, and mass drug administration campaigns are also essential [31]. Additionally, countries/territories should prioritize the development of vaccines and other medical treatments for these diseases so that they can improve the health outcomes of their populations and contribute to global efforts to eliminate these diseases.

5. Limitations

Our investigation remains following limitations. GOHI aims to provide a reference for every country/territory in the world for global One Health governance. However, most data come from literature reviews and data transparency varies in different countries, leading to a certain of uncertainty on the reported data. Moreover, GOHI aims to include as many countries/territories as possible to provide an international reference. But this study only covers 160 countries/territories that meet the basic requirements of inclusion and exclusion criteria, which attributed to some bias by challenges in finding comprehensive metrics that cover key aspects of One Health, such as coordination mechanisms, social mobilization capacity, and resource inputs affect the representativeness of the GOHI scores.

6. Conclusions

Based on GOHI analysis, we measured and ranked the global level of One Health development. The results show that there is still much room for global improvement towards One Health. Overall, global capacity building of One Health requires an international cooperation scheme to foster extensive information sharing and experience exchange among countries/territories on common issues. On key issues, leading countries/territories should increase aid to struggling areas and accelerate the development of a joint global response to One Health by dispatching experts and developing pilot projects. Science-policy-implementation translation under the structure of One Health should be supported to ensure and enhance cooperation in scientific knowledge, techniques, and actions among countries. Moreover, suggestion advocate for the removal of impediments in governance during the systematic redesign of One Health, emphasizing the need to construct a comprehensive framework for social action.

Ethics approval and consent to participate

Not applicable.

CRediT authorship contribution statement

Qiyu Zhang; Jingshu Liu: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: corresponding author is an Editor-in-Chief of the journal Sience in One Health, he was not involved in the peer-review or handling of the manuscript. - XN.Z.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.soh.2024.100064.

List of abbreviations

GOHI	global One Health index
COVID-19	Coronavirus Disease 2019
FAO	Food and Agriculture Organization
OHHLEP	One Health High Level Expert Panel
OHJPA	One Health Joint Plan of Action
UNEP	United Nations Environment Programme
WHO	World Health Organization
WOAH	World Organization for Animal Health
EDI	external drivers index
IDI	intrinsic drivers index
CDI	core drivers index
AMR	Antimicrobial resistance
OECD	the Organization for Economic Co-operation and Development
IEA	the International Energy Agency
ITU	the International Telecommunication Union
SDGs	Sustainable Development Goals
EPI	Environmental performance index of Yale
WOAH-WAHIS	World Animal information system of the World Animal Health Organization
GHS Index	the Global Health Security Index
GHDx	Global Health Data Exchange
UNHCR	the United Nations High Commissioner for Refugees
GLASS	the Global Antimicrobial Resistance and Use Surveillance System
EARS-Net	the European Antimicrobial Resistance Surveillance Network
CARSS	the Chinese antimicrobial resistance surveillance system
RT	Route of transmission
TP	Targeted population
CI	Conventional intervention
PIC	Population coverage and cost of interventions
SDI	Social development index
HDI	Human Development Index

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