RESEARCH

A global perspective on the governance-health nexus

Mohammad Naim Azimi[1*], Mohammad Mafizur Rahman[1] and Son Nghiem[2]

Abstract

Background This study raises two key arguments: First, government health expenditure (GHE) and per capita out-of-pocket expenditures on healthcare (OPEH) are sensitive to contemporary good governance practices, giving policy importance to the exogeneity of healthcare determinants, i.e., governance for health rather than health governance. Second, it is the income level of countries that reflects the volatility of the governance spillovers on the subject.

Methods The present study constructs a composite governance index (CGI) and employs a set of panel data for 144 countries over the period from 2002 to 2020. To allow comparability and extract specific policy implications, the countries are classified as full, high-, middle-, and low-income panels. Meanwhile to delve into the short- and long-run effects of CGI on GHE and OPEH, the study employs the cross-sectionally augmented autoregressive distributed lags (CS-ARDL) model. Further, to establish a causal link between the variables, it uses the Dumitrescu-Hurlin panel causality technique.

Results The results indicate that CGI is significantly cointegrated with GHE and OPEH in all recipient panels. It indicates that while CGI has significantly positive impacts on GHE and OPEH, its effects vary according to the income level of the underlying economies. The findings support the idea of governance for health and show that CGI drives the stabilization and enhancement of GHE and OPEH in the long run. Furthermore, the findings reveal that economic growth, the age dependency ratio, and tax revenue have positive effects, while the crude death rate and the child mortality rate exert negative impacts on the subject. Finally, the results highlight a unidirectional causality running from CGI to GHE and OPEH, while no feedback response is evident.

Conclusions Although an increase in GHE and OPEH is associated with the improvement of the population's healthcare, the results suggest the recognition of the importance and institutionalization of good governance to streamline this improvement through effective channelization, outreach, and social environment development for extensive health inclusion.

Keywords Healthcare, Governance, Health expenditures, Income level, Cross-sectional dependence

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Introduction

The ever-increasing discussion in contemporary literature about the effects of good governance on various macro- and socio-economic indicators and, as such, human capital well-being as a major driver of social and growth inclusion owes to the seminal work of North [1], which was further expanded by Lott and North [2] in the early 1990s. The contributions made by good governance in the purview of education, defense, justice, economic development, and human capital accumulation to offset potential market failures and promote economic output

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at macro-levels are undeniable [3]. However, establishing a link between good governance and health outcome indicators has often been controversial and a priori indeterminate, despite the fact that it has recently gained importance due to its emerging policy implications [4]. Moreover, it is well-evident that human well-being does not necessarily flourish in economies with sufficient resources; rather, it thrives when available resources are effectively accumulated and distributed through a well-designed bureaucratic system. Nevertheless, both government and out-of-pocket expenditures on healthcare have increased during the past two decades, while the percentage of mortality rates due to various health risk factors has also increased in parallel worldwide [5]. Figure 1 shows that government health expenditures

have increased from 6.11% to 2002 to 9.21% of the GDP in 2020 in high-income economies, which is above the world's average (6.9% in 2020). On the other hand, comparatively, while government health expenditures moved slightly higher in middle-income countries, catastrophically, they declined in low-income economies from 1.99% of the GDP in 2002 to 1.27% in 2020.

Almost a similar scenario can be seen from household perspectives. Figure 2 shows that per capita out-of-pocket expenditures on health rose from 2002 to 2020 by 3.9% in high-income economies, while a constant decrease is evident in low-income countries throughout the cited period. Thus, considering the theoretical assumptions that good governance ensures the integration of various macroeconomic strands, boosting
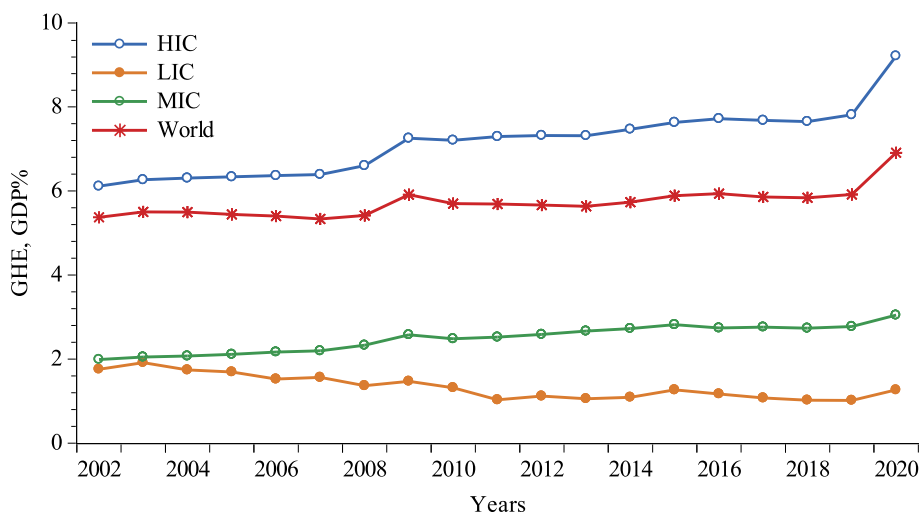

Fig. 1 Government health expenditure (GHE, GDP%) plot. Source: World Development Indicators (WDI) [6]
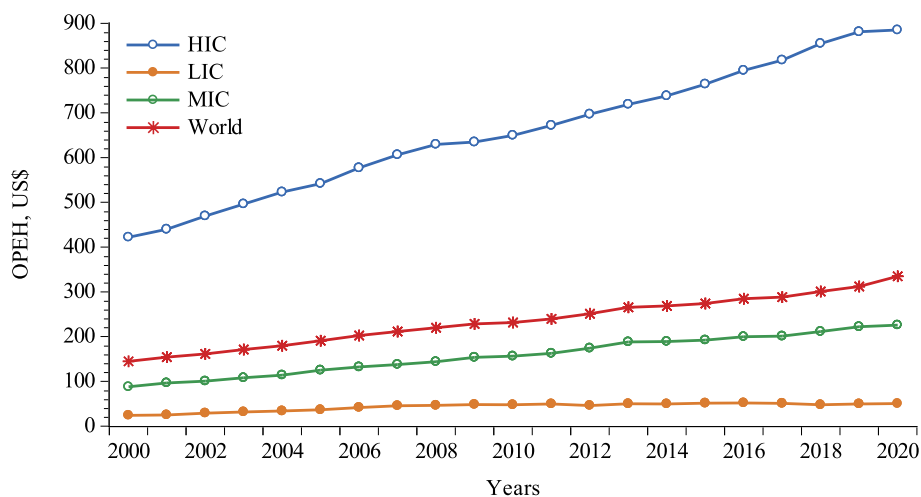

Fig. 2 Per capita out-of-pocket expenditures on healthcare (OPEH) plot. Source: World Health Organization (WHO) [17]

economic performance and productivity through human capital well-being [7], it is of importance to delve more explicitly into its link with contemporary health expenditures. Indeed, the penetration of healthcare, availability, and accessibility of people to quality healthcare services are the key dimensions of human well-being and have direct effects on human capital development, reduction of mortality rates, and contemporary living standards. On the other hand, for instance, it is also well-evident in low- and middle-income countries that the healthcare sector falls short of providing the desired quality of healthcare services to people due to low institutional quality arising from low regulatory quality, extensive corruption, low efficacy of government, absence of the absolute rule of law, political instability in some instances [8], and weak accountability [9]. Thus, low governance efficacy not only traps people in losing their money; it also perpetuates the existing rampant corruption in the administration of healthcare services, limits accessibility to healthcare, increases unnecessary patients' costs, deprives poor people of essential healthcare services, and thereby significantly impacts the overall social and economic development of a country [10]. Two empirical strands, as developed throughout recent decades, explain the function of health expenditures, such as the income view and the governance view of healthcare. The former has been critically analyzed by Yang et al. [11], Wu et al. [12], Bloom et al. [13], Bilgili et al. [14], Chireshe and Matthew [15], Raghupathi and Raghupathi [16], and many others, who confirm that health expenditure is positively connected with economic growth, implying that the higher the per capita income, the higher the health expenditures will be, whereas the governance view of healthcare has received little attention from scholars.

Therefore, the present study primarily aims to explicitly delve into the governance view of healthcare, using appropriate econometric techniques and large panel dataset to provide consistent results from a global perspective. In doing so, it is important to lead the discussion by formulating three key questions, among others. First, do health expenditures move together with good governance in the long run? Second, regardless of the income-level categories of the economies, does good governance have positive effects on health expenditures that correspond to the connotation of "governance for health"? Third, are the effects of good governance on health expenditures non-monotonic and vary both in terms of duration and income-level classifications of the economies? Providing consistent and accurate answers to these questions will not only fill the existing gaps in the literature but will also help policymakers understand the significant health policy implications of good governance from a different perspective.

The study's novelty incorporates the determination of the impacts of good governance on health expenditures as a new step in the existing literature, and its contribution can be outlined as follows: First, it innovatively constructs a comprehensive composite governance index (CGI) under three key governance dimensions to capture the extensive effects of CGI on government health expenditures and per capita out-of-pocket health expenditures. In addition to highlighting the confounded results presented by most of the recent studies, it builds a new foundation in the empirical literature of governance for health through the construction of CGI that addresses the over-specification errors and encourages future studies to build upon it. Second, despite analyzing a panel of 180 countries, the study highlights serious policy shifts from income-view to governance-view by statistical confirmation of the non-monotonic and swift response of health expenditures to good governance both at income-level and global perspectives. It emphasizes that, despite the fact that health expenditures move with growth, good governance is critical to the long-term stabilization of this association.

The remaining parts of this article are organized as follows: Section two reviews the literature. Section three explains the data, variables, and key measurement issues. Section four explains the conceptual framework and the econometric techniques used to analyze the data. Section five presents the results. Section six provides a comparative discussion. Section seven concludes the study.

Literature review

The literature documents several studies discussing the effects of good governance on health expenditures, providing mixed results. For instance, Farag [18] in low- and middle-income economies, Boz [19] in Turkey, Hilaire [20] in African countries, Kim and Lane [21], and Ahmad and Hasan [22] in Malaysia accentuate the effective role of good governance in the administration of health expenditures. Aljunid [23] explores the effects of governance on healthcare in Asia, using both empirical datasets and case studies about health expenditures, human capital, the distribution of health facilities, and utilization rates. They noticed that differences in healthcare utilization are primarily explained by quality of governance. Further, Radin [24] employed datasets from two surveys for 2007 and 2009 in Croatia to test the effects of healthcare corruption on public trust in the healthcare system. In 2007, the author discovered that corruption in healthcare services negatively impacts public trust in the healthcare system, whereas the results in 2009 were found to be insignificant. Lazarova and Ilaria [25] explored the effects of governance in 112 states and found that in countries below a certain threshold level,

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income is a significant determinant of healthcare, while in countries above a certain threshold level, governance significantly affects the outcome of healthcare. Likewise, Ouedraogo et al. [26] investigated the determinantal impact of institutional dimensions on healthcare outcomes in Sub-Saharan Africa. They found that governance is a key dimension that enhances the outcome of the healthcare system. Bovenkamp et al. [27] explored the effects of institutional quality layering on healthcare administration in Germany and employed market-based system analysis. They argued that using institutional quality arrangements affects healthcare quality and that hospitals need to deal with certain policy reforms to rectify the incremental change in the quality of healthcare demand. Dhrifi [28] examined the effects of public health expenditures on children's health consequences, linked to the role of institutional quality in developed economies. The authors employed a two-step system generalized method of moment (GMM) and found that health expenditures are only significant in affecting children's healthcare status in high-income economies, while it was found to be insignificant in low-, lower-middle-, and upper middle-income countries. They also indicated that institutional quality is a significant predictor in explaining the enhancement of healthcare system efficacy.

Furthermore, Rehmat et al. [29] investigated the impact of good governance on health expenditures in 105 countries. Their findings indicated that good governance has positive impacts on the population's healthcare outcomes, increases life expectancy, and decreases the child mortality rate. They also found that economic growth, population density, and physicians' practices have positive effects on life expectancy. Rajkumar and Vinaya [30] examined the links between governance, health expenditures, and health outcomes. They claim that the quality of governance largely explains the differences in health expenditures, lowering child mortality rates, enhancing school enrollment ratio, and increasing the efficacy of healthcare outcomes in countries exhibiting a higher quality of governance. Klomp and Jakob [31] analyzed the impact of the political system and its stability on healthcare using factor analysis and structural equation models. The authors employed national health indicators and economic and demographical variables. Their findings suggest that democracy has positive effects, while political instability has negative impacts on an individual's healthcare status. Luca et al. [32] evaluated the effects of institutional quality on the provision of healthcare in Italy. They found that an increase of one standard deviation in institutional quality leads to the cesarean rate decreasing by ten basis points, showing that institutional quality enhances the healthcare outcome in Italy's hospitals. Sharma et al. [33] examined the impact of the quality

of economic institutions on health expenditures in European Union countries. They observed that an improvement in institutional quality has positive effects on the subject, showing that an efficient legal system and regulatory quality are the most effective indicators of the overall health outcomes.

In sum, an in-depth review of the existing literature demonstrates that, despite having many studies that explored the effects of good governance on health expenditures and significantly contributed to advance contemporary body of knowledge, most of the results presented by them might be confounded for two key reasons. First, while an exception is given to the work of Lazarova and Ilaria [25], who employed a quasi-governance index, almost all others are confronted with omitted variable bias. Second, the incorporation of perplexing governance proxies led to muddled policy implications. More importantly, prior literature reveals a scarcity, if not a complete absence, of studies that explicitly highlight the non-monotonic behavior of good governance on health expenditures, translated by income level rather than economic development classifications. With an exception to the work of Farag [18], who only covered low- and middle-income countries, global perspective has been totally ignored in the literature about the subject matter. Thus, to address these gaps, the study develops four new hypotheses, as follows: ***Hyp-1***: Good governance moves together with health expenditures (government and per capita out-of-pocket) in the long run; ***Hyp-2***: Good goverannce positively explains health expenditures both in the short and long run; ***Hyp-3***: The effects of good governance are non-monotonic and vary according to the countries' income level; and ***Hyp-4***: Good governance has significant causal effects on health expenditures.

Data and variables
Data
This article employs annual balanced panel datasets for 144 countries spanning from 2002 to 2020. The selection of the data period was primarily conditional on its availability for the recipient countries included in our panel. For comparative analysis and extracting specific policy implications about the subject, we first employ a full sample (144 countries) and then use the World Bank's economic classifications [34] to split the panels into high-income (49 countries), middle-income (40 countries), and low-income (55 countries) countries (see Appendix A of the Supplementary information (SI) for a complete list of countries).

Selection of variabes
With reference to the primary objectives of the present study and to capture the precise impacts of good

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governance on health expenditures, the study constructs a comprehensive composite governance index (*CGI*) using six measures of Worldwide Governance Indicators. These measures include voice and accountability (*VoA*), political stability (*PoS*), government effectiveness (*GeF*), regulatory quality (*ReQ*), control of corruption (*CoC*), and the rule of law (*RoL*). The indicators are expressed in percentile ranks ranging from 0 (low) to 100 (high). For *CGI* construction, the study follows similar statistical methodology proposed by Sarma [35]. This method has several preferences over common index construction techniques and has recently gained empirical prominence in prior literature for generating both aggregate and dimensional indices [36], [37] in various macro- and socio-economic studies. Appendix B of the SI explains the construction methodology in detail. The choice of other variables is based on the conceptual background of the study and recent empirical literature. Consistent with studies by Wang et al. [38], Hameed et al. [39], and Rahman and Alam [40], government health expenditures (*GHE*, % of *GDP*) is used as the dependent variable. *GHE* includes all expenditures, both public and private, for the provision of health services, cost-bearing actions for family planning, nutrition, and emergency aid [41]. Although *GHE* measures contemporary healthcare status at the macro-level, the study employs per capita out-of-pocket expenditures on healthcare (*OPEH*) as another dependent variable to highlight the effects of *CGI* on the direct outlays by households. *OPEH* includes gratuities and in-kind payments to health practitioners and suppliers of medicines, therapeutic appliances, and other goods and services whose primary objectives are to contribute to the restoration or improvement of the individual's health status [42]. Furthermore, considering the importance of endogenous variables, the study controls the effects of several predictors on the subject. They include the crude death rate (*CDR*), expressed as the number of deaths per 1,000 people; the child mortality rate (*CMR*), expressed as the number of deaths of children under 5 years old; and the age dependency ratio (*ADR*), expressed as the number of working people younger than 15 and older than 64 years old. Moreover, following prior studies (see, for instance, [43], [44]), the study employs tax revenue (*TAR*, % of *GDP*) to capture its effects on contemporary *GHE* and *OPEH*. While economic performance postulates direct effects on the subject [45], the study controls for the effects of *GDP* growth (annual%) on *GHE* and the effects of per capita *GDP* (*PCGDP*, constant 2015 US$) on *OPEH*.

Source of compilation

We screened the available reliable sources to compile the required datasets for the present study. The datasets for *HE, CMR, GDPG, PCGDP, CDR*, and *ADR* were compiled from the World Development Indicators (WDI), sources that are relevant to the World Bank Group [6]. The datasets for governance indicators such as *VoA, CoC, RoL, ReQ, PoS*, and *GeF* come from the Worldwide Governance Indicators developed by Kaufmann and Kraay [46]. Finally, the data for *OPEH* has been compiled from the World Health Organization [17].

Methodology
Conceptual framework

In light of the governance-healthcare perspective, ideas about how countries address the determinants of healthcare are rapidly shifting, due to which two initial concepts have emerged. The first one emphasizes improving the output of healthcare systems through promoting the efficacy of contemporary governance, which is known as sector-specific governance [47]. The second concept promotes the synergistic triangle actions of private, public, and citizen sectors for a common social interest, known as the governance for health (say, comprehensive governance) [48]. Due to this imperative macroeconomic factor, comprehensive governance requires an increasing level of engagement from public organizations, societies, business firms, and citizens to achieve its fundamental objectives. As defined by the World Health Organization [49], health is essential to well-being and is a human right, which requires equity and social justice, gaining traction as an important component of society, resulting in economic prosperity, environmental sustainability, and social inclusion [50]. Comprehensive governance ensures that these interests are protected through the exercise of effective controls in utilizing the avaibale resources for the benefit of a country's nation [51]. Pursuant to that, it gains ground on how to measure the efficacy of the so-called good governance. However, Kaufmann et al. [52] conceptualized the conduits to measure the efficacy of governance by six governance indicators, Acemoglu and Robinson [53] and Greif [54] have emphasized the social elements of these indicators to maintain the significance of their social comprehensiveness. Theories suggest that comprehensive governance plays a vital role in governance for health when formulating and enacting policies to encourage a participatory development viewpoint. Therefore, good governance increases people's agency in the sense of the triangle engagement of private, public, and citizen sectors to actively engage in, plan for, and implement policies based on their development priorities and needs [55]. Having said so, we empirically conceptualize the study using the notion of governance for health and proceed with model specifications.

Model specification

Pursuant to the connotation of "governance for health," this study argues that both government health expenditures (*GHE*) and out-of-pocket expenditures on healthcare (*OPEH*) are significantly influenced by the practice of good governance at macro-levels, regardless of the size and economic structure of the underlying economies. Therefore, substantiating the exogeneity of health expenditures by good governance, the study specifies the following long-run linear multivariate panel models:

$$GHE_{it} = \delta_i + \eta_1 CGI_{it} + \eta_2 GDPG_{it} + \eta_3 CDR_{it} + \eta_4 CMR_{it}$$
$$+ \eta_5 ADR_{it} + \eta_6 TAR_{it} + \eta_7 \zeta_{it} + u_{it} \quad (1)$$

where δ_i =intercept, η_1 to η_6 =long-run parameters, η_7 =coefficient of the dummy variable (ζ_{it}) used to capture the effects of any structural breaks, $i = 1, 2, 3, \ldots, = N,\ t = 1, 2, 3, \ldots, = T,$ and $u_{it} =$ error term. Equation (1) assumes that, in the long run, *GHE* is influenced by *CGI* at a macro-level and that the effects of *CGI* vary due to the income-level of the underlying panel. Due to the argument, the signs of the coefficients are expected to be η_1, η_2, η_5, and $\eta_6 = (+)$and η_3, $\eta_4 = (-)$. Further, the study attempts to examine the effects of *CGI* on *OPEH* across the recipient panels. Thus, having all other vectors and variables similar to Eq. (1), except for the *PCGDP*, the following long-run multivariate panel equation is specified:

$$OPEH_{it} = \delta_i + \eta_1 CGI_{it} + \eta_2 PCDPG_{it} + \eta_3 CDR_{it} + \eta_4 CMR_{it}$$
$$+ \eta_5 ADR_{it} + \eta_6 TAR_{it} + \eta_7 \zeta_{it} + u_{it} \quad (2)$$

Moreover, for well-presented methods and results, the study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [56]. Thus, Fig. 3 explains the step-wise procedures that are carried out to estimate Eqs. 1 and 2 (say, models I and II).

Estimation techniques

The existing literature offers numerous techniques for panel data analysis. It includes fixed effects (FE), random effects (RE), pooled ordinary least squares (POLS), autoregressive distributed lags (ARDL), and the generalized method of moment (GMM). These methods would be inconsistent and provide inefficient results in the presence of cross-sectional dependence (CD) among countries [57]. For instance, FE, RE, and the GMM models are used to correct for panel heterogeneity issues in cases of small T and large N [58], but they are unable to capture the CD among panels. In real-life examples, panel data is generally subject to CD. It is obvious that due to common economic structures, common consumption behavior, international trade, and human capital mobility, CD exists among countries. Confirming the existence of CD by the rejected null of cross-sectional independence among the units through Pesaran's [59] CD test, the study employs the cross-sectionally augmented autoregressive distributed lags (CS-ARDL) model of Chudik and Pesaran [60]. The CS-ARDL model augments the ARDL with a linear combination of the cross-sectional averages of the predictors
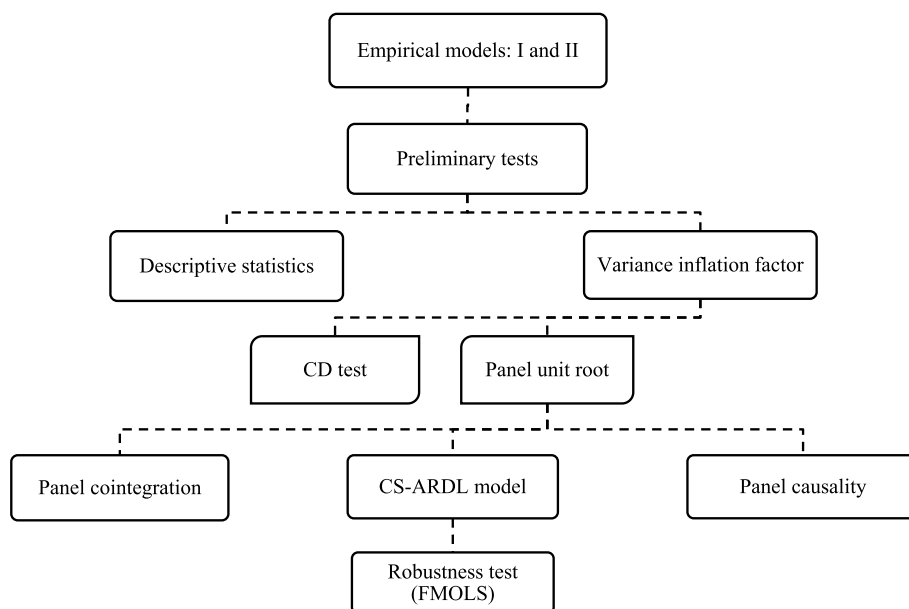
Fig. 3 Estimation procedures. Source: Authors's creation

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to rectify the CD in the error term of the model [61]. Moreover, the CS-ARDL model captures the unobservable factors that are augmented to estimate the long-run effects in the regression. It also regards the 1-year lag period of the dependent variable as a weakly exogenous indicator within the error-correcting process [62]. For estimation, the CS-ARDL model utilizes both mean group (MG) and pooled mean group (PMG) estimators. However, we do not aim to outline the preference of the PMG over MG estimators (see [58] for technical review), but due to empirical facts—that is, if the long-run coefficients are similar across units, the PMG estimator is efficient and consistent [63]. Moreover, the MG estimator estimates biased and inconsistent coefficients in the presence of CD [64]. In this faith, the study specifies the CS-ARDL model as:

Dumitrescu-Hurlin [67], which is rational in the presence of CD and is specified as:

$$Y_{it} = \varphi_i + \sum_{i=1}^{k} \eta_i^{(k)} Y_{it-k} + \sum_{i=1}^{k} \xi_i^{(k)} X_{it-k} + \varepsilon_{it} \tag{5}$$

$$Hyp = \begin{cases} \xi_{i=0} \forall_i = 1, 2, 3, \dots, = N \\ \xi_{i \neq 0} \forall_i = N_1 + 1, N_2 + 2, N_3 + 3, \dots, = N \end{cases} \tag{6}$$

where φ_i =intercept, η_i^k =coefficient of *GHE* and *OPEH*, $\xi_1^k, \dots, \xi_n^k$ =coefficients of the explanatory variables, $K\varepsilon N^+ (K\varepsilon N^\times)$ =constant, and ε_{it} =error-term. Equation (5) tests the null of no panel Granger causality between the variables vs. its alternative hypothesis. Both null and alternative hypotheses are presented in

$$\Delta Y_{it} = \varphi_i + \alpha_i \left(Y_{it-1} - \lambda_i' X_{it-1} + \alpha_i^{-1} \eta_i \bar{Y}_t + \alpha_i^{-1} \phi_i' \bar{X}_t \right)$$
$$+ \sum_{j=1}^{v-1} \delta_{ij} \Delta Y_{it-j} + \sum_{j=0}^{u-1} \vartheta_{ij} \Delta X_{it-j} + \sum_{j=1}^{v-1} \varsigma_{ik} \Delta \bar{Y}_{it-j} + \sum_{j=0}^{u-1} \xi_{ik} \Delta \bar{X}_{it-j} + \gamma_i \zeta_{it} + u_{it} \tag{3}$$

where $Y_{it} = GHE_{it}$ and $OPEH_{it}$ for unit *i* at time *t*, $X_{it} = 5 \times 1$ vector of the explanatory variables, v =lag operator of of the dependent variables, u =lag operator of the explanatory variables, λ =long-run coefficients, ϑ = short-run coefficients, $\bar{Y}_t$ =cross-sectional averages of the dependent variables, $\bar{X}_t$ =cross-sectional averages of the explanatory variables, and γ_i =referes to the long-run coefficient of the dummy variable (ζ_{it})to capture the effects of structural breaks. Though conventional panel models ignore the presence of cross-sectional correlations, Eq. (3) rectifies the CD and estimates consistent coefficients [65]. Equation (3) also computes both short- and long-run coefficients. To test the robustness of the estimated long-run coefficients obtained from Eq. (3), the study employs the fully modified ordinary least squares (FMOLS) method of Pedroni [66], which corrects the serial correlation and panel endogeneity issues. The FMOLS model with asymptotic distribution can be expressed as:

(6). Equation (5) assumes that the individual effects are constant when using different lags across units, but the coefficients of the slope and lag parameters vary across countries. All estimations are carried out using STATA-17/BE, R-Progamming, Eviews-11, and OriginLab-2023 software packages.

Results

Summary statistics

The analysis begins with some descriptive statistics (Table 1) to highlight important trends in the data. The results show that the mean value of *GHE* is 7.09% in the full sample, while it is 7.206% in the high-income, 6.211% in the middle-income, and 5.356% in the low-income panels, respectively. The mean value of *OPEH* stands at 33.716% of the GDP in the full sample, whereas it rounds to 31.961%, 33.241%, and 35.8% in the high-, middle-, and

$$\varphi_{NT}^* - \varphi = \left(\sum_{i=1}^{v-1} L_{22i}^{-2} \sum_{i=1}^{u-1} \left(y_{it} - \bar{y}_{it} \right)^2 \right) \sum_{i=1}^{v-1} L_{11i}^{-1} L_{22i}^{-1} \left(\sum_{i=1}^{v-1} \left(y_{it} - \bar{y}_i \right) \vartheta_{it}^* - T \widehat{\lambda}_i \right) \tag{4}$$

where $\vartheta_{it}^* = \vartheta_{it} - \left(\widehat{L}_{21i} \div \widehat{L}_{22i} \right) \Delta y_{it}$, $\widehat{\lambda}_i = \widehat{\xi}_{21i} \widehat{\psi}_{21i}^0 - \left(\widehat{L}_{21i} \div \widehat{L}_{22i} \right) \left(\widehat{\lambda}_{22i} + \widehat{\psi}_{22i}^0 \right)$, and $\widehat{L}_i$ refers to the sample estimator of L_i presenting the lower triangulation of $\widehat{\psi}_i$. To extend the analysis, it is important to explore the causal links between the *CGI*, *HE*, *OPEH*, and the control variables. In this faith, the study employs the panel causality test of

low-income panels, respectively. Further, the mean value of *CGI* is 0.731 in the full sample, 0.771 in the high-income panel, 0.456 in the middle-income panel, and 0.443 in the low-income panel, respectively. Irrespective of the control variables, the results indicate that *GHE*, *OPEH*, and *CGI* have an increasing trend, while *GHE* in the middle- and

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Table 1 Descriptive statistics

Tests	GHE	OPEH	GDPG	PCGDP	ADR	CMR	CDR	CGI	TAR
Full sample									
Mean	6.219	233.921	5.070	8,628.31	60.524	38.394	8.332	0.731	16.739
Standard Deviation	2.500	11.991	6.011	3,299.13	18.848	41.015	3.207	0.567	7.668
Minimum	1.263	144.659	-3.338	255.100	16.172	1.800	0.795	0.213	0.079
Maximum	20.413	334.618	6.826	11,037.23	111.196	214.8	20.884	0.837	47.661
VIF			4.68	4.22	4.09	3.68	3.01	2.88	2.67
High-income panel									
Mean	7.206	657.566	1.991	35,874.98	47.486	8.543	7.860	0.771	17.192
Standard Deviation	2.701	31.428	4.575	27,921.92	9.023	8.342	2.899	0.711	6.864
Minimum	1.532	451.729	-4.782	4,125.33	16.172	1.945	0.816	0.715	0.586
Maximum	18.815	885.177	6.170	112,417.9	94.035	72.611	15.900	0.968	48.563
VIF			5.01	4.98	5.46	6.17	4.65	3.44	4.28
Middle-income									
Mean	6.211	158.045	3.339	6,343.945	54.747	24.500	7.704	0.546	16.353
Standard Deviation	2.120	9.409	7.117	2,601.32	10.745	19.881	3.084	0.449	5.918
Minimum	1.263	87.982	-5.338	1,527.93	35.399	2.640	2.718	0.408	0.420
Maximum	12.814	225.406	6.826	14,222.50	88.608	133.12	18.00	0.802	37.612
VIF			3.39	3.15	3.06	2.45	2.39	2.02	1.98
Low-income panel									
Mean	5.356	43.024	3.985	1,479.937	78.454	74.403	9.270	0.443	16.549
Standard Deviation	2.230	1.999	5.139	996.638	17.035	42.344	3.380	0.506	9.340
Minimum	1.701	23.947	-4.082	255.100	39.125	7.000	3.670	0.213	0.079
Maximum	20.413	51.430	10.629	4,495.710	111.196	214.80	20.884	0.565	27.108
VIF			4.14	3.87	3.62	2.99	2.26	2.19	1.68

Source: Authors' estimations

low-income panels exhibits weak volatility. Moreover, *CGI* also shows an improvement over time in both the middle- and low-income panels. Additionally, the study explores the multicollinearity among the variables of interest using the variance inflation factor (VIF) method. VIF has been computed as a post-estimation of the pooled OLS technique. The results are reported in Table 1 and demonstrate that VIF values are below the threshold level of 10 across all panels. Thus, it concludes that the variables do not exhibit any perfect or extreme multicollinearity.

Optimal lag length

To accurately estimate the subsequent regressions, it is important to determine the optimal lag length. Empirically, adding more lags causes observations to be lost, while using a lower number of lags leads to an estimation that ignores detecting the dependence of variables on their past values. Thus, the study estimates the Akaike information criterion (AIC), Hannan-Quinn information criterion (HIC), and Schwarz information criterion (SIC) methods using the unrestricted vector autoregressive environment with the "*VARSOC*" command for the variables of interest employed in models

(1) and (2). Altogether, the results suggest using one lag for panel data analysis.

Cross-sectional dependence test

Due to world prices, common socioeconomic factors, similar technological advancements, and common trade and consumption behavior, panel data may exhibit cross-sectional dependence (CD), whether the predictors are correlated or not. To highlight this issue in the present analysis, Pesaran's [59] CD test has been computed, and the results are reported in Table 2. The results indicate that the ARD and CDR are statistically insignificant to reject the null of cross-sectional independence across all the panels, while the remaining variables reject the null at a 1% significant level. Empirically, the existence of CD imparts serious bias problems in estimating the coefficients via common panel techniques; only adjustments are insufficient in the error term, as in [68].

Panel unit root test

In the presence of CD, the study uses the second-generation panel unit root test of Pesaran's [69] and Ditzen et al.'s [70] structural break techniques. The results are

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Table 2 Cross-sectional dependence test results

Variables	Full sample		High-income		Middle-income		Low-income	
	CD-test	*p*-value	CD-test	*p*-value	CD-test	*p*-value	CD-test	*p*-value
GHE	61.26***	0.000	18.21***	0.000	35.45***	0.000	10.67***	0.000
OPEH	57.66***	0.000	33.47***	0.000	17.21***	0.000	49.02***	0.000
CGI	18.69***	0.000	10.33***	0.000	15.00***	0.000	21.12***	0.000
GDPG	163.63***	0.000	4.81***	0.000	4.33***	0.000	8.16***	0.000
PCGDP	217.80***	0.000	3.99***	0.000	110.27	0.000	88.32***	0.000
ADR	1.84	0.210	1.04	0.550	0.98***	0.525	1.12	0.475
CMR	48.47***	0.000	18.92***	0.000	42.19***	0.000	11.37***	0.000
CDR	1.40	0.325	0.91	0.612	1.16	0.375	0.77	0.612
TAR	3.15***	0.002	55.47***	0.000	18.99***	0.000	20.36***	0.000

Source: Authors' estimations

Notes: *** indicates significance at a 1% level

presented in Table 3. It shows that for the rejected null of non-stationarity in the full sample, *GHE, OPEH, CGI, GDPG,* and *CMR* are significant at a 1% level, while the remaining variables can only reject the null after taking their first difference. In the panel of high-income economies, almost similar results are achieved except for *PCGDP*, which is a level-stationary variable. In the middle-income panel, *OPEH, CGI, ADR,* and *CMR* are significant for rejecting the null at the level, whereas other predictors are found to be first difference stationary. Finally, in the low-income panel, *GHE, OPEH, CGI, GDPG, PCGDP,* and *TAR* are found to be significant

Table 3 CIPS panel unit root results

Variables	Full sample			High-income panel		
	Level	First-difference	Break	Level	First-difference	Break
GHE	-3.08***	-3.92***	2004	-4.11***	-4.67***	2004
OPEH	-2.28***	-3.80***	2006	-4.39***	-4.98***	2009
CGI	-3.25***	-5.09***	2011	-3.48***	-4.10***	2003
GDPG	-2.92***	-4.71***	2008	-4.00***	-4.29***	2008
PCGDP	-1.34	-2.66***	2008	-2.55***	-3.12***	2008
ADR	-1.52	-2.41***	2012	-0.99	-2.26***	2011
CMR	-2.42***	-2.51***	2012	-2.81***	-3.25***	2006
CDR	-1.19	-2.66***	2005	-1.32	-2.49***	2003
TAR	-1.25	-2.87***	2009	-1.16	-2.67***	2007
	Middle-income panel			Low-income panel		
GHE	-1.82	-2.74***	2007	-3.21***	-3.98***	2005
OPEH	-2.33***	-2.89***	2007	-4.45***	-4.99***	2008
CGI	-4.13***	-4.87***	2015	-2.31***	-3.05***	2003
GDPG	-1.10	-2.29***	2010	-3.16***	-3.66***	2009
PCGDP	-0.99	-2.21***	2009	-4.22***	-4.78***	2009
ADR	-1.11***	-2.37***	2011	-1.14	-2.27***	2012
CMR	-4.18***	-5.00***	2012	-1.49	-2.67***	2004
CDR	-0.67	-2.19***	2007	-1.01	-2.21***	2005
TAR	-1.44	-2.63***	2016	-0.66***	-2.19***	2008
CIPS critical values	1%	5%	10%			
	-2.14	-2.04	-1.99			

Source: Authors' estimations

Notes: *** indicates significance at a 1% level

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for rejecting the null of non-stationarity, whereas the remaining variables exhibit significance after the first difference. Besides, the results also confirm the existence of structural breaks in different years led by data trends. The results provide important insights, leading the study to explore any cointegration between the variables.

Cointegration analysis

Based on our primary objectives, it is crucial to delve into the long-run association between the variables. Thus, the study employs Westerlund's [71] cointegration model for heterogeneous panels. This method is appropriate and produces consistent results in the presence of structural breaks and CD in the panels. Furthermore, it also employs the proposed panel cointegration test of Pedroni [72] for cross-validation. The results are presented in Table 4. Altogether, the results of Pedroni's test are significant to reject the null of no cointegration across all panels, though they might be inconsistent in the presence of CD. Nevertheless, based on the outcome of Westerlund's test, the results confirm the rejection of the null of no cointegration for all the panels across both models I and II.

CS-ARDL estimation

Confirming the long-run association between the variables, the study proceeds to explore the effects of *CGI* on *GHE* (model I) and *OPEH* (model II) using the CS-ARDL ($u = 1$, $v = 1$) model. The results are reported in Tables 5 and 6. The estimation of the CS-ARDL model is in line with the primary objective of the study, that is, to provide a comparative analysis of the world's performance viz-à-viz countries classified by income levels. For clarity, the study presents each panel's results separately as follows:

Full sample

For *CGI*, the results indicate that it is only significant to positively influence *GHE* and *OPEH* in the long run; short-run effects are found to be insignificant. A 1% increase in *CGI* causes *GHE* and *OPEH* to rise by 0.85% and 0.011%, respectively. The specificity of *CGI*'s long-term effects on *GHE* and *OPEH* is due to policy adjustments, implementation, the institutionalization of good governance practices, and the assessment of relevant policy outcomes. Moreover, the results show that *GDPG* (*PCGDP*) improves *GHE* (*OPEH*) by 0.16% (0.69%) and 0.31% (0.82%) in the short and long runs, respectively. It indicates that the growth at the macro-level has a comparatively lower power to explain *GHE* than that of per capita income, which explains *OPEH*. It is linked to facts. Lack of access to health insurance and free public health centers in rural areas in most of the developing economies causes individuals to bear health expenses.

The results also demonstrate that a 1% increase in *CMR* and *CDR* causes *GHE* and *OPEH* to decline by 0.34% (0.33%) and 0.26% (0.28%) in the short run and by 0.42% (0.27%) and 0.28% (0.42%) in the long run, respectively. The *ADR* is also found to have positive effects on both *GHE* and *OPEH*, while the *TAR* is only found to have a weak positive impact on the subject in the long run.

High-income panel

In the high-income panel, the results obtained from both models I and II indicate that *CGI* is substantial to influence *GHE* and *OPEH* in the long run, while the short-run effects are statistically insignificant. It indicates that a 1% increase in *CGI* causes *GHE* and *OPEH* to improve by 0.97% and 0.91%, respectively. In contrast to the full sample, the results indicate that *CGI* has a higher positive effect on both *GHE* and *OPEH*. It implies that governance establishments and higher-quality institutions are highly effective in improving contemporary *GHE* and *OPEH* in the high-income panel compared to those in the full sample. For the control variables, similar results were found. The findings show that *GDPG* has a significant positive impact on *GHE*. *PCGDP* is found to have a comparatively lower effect on *OPEH* in the high-income panel countries. This might be, again, due to the higher access of the population to health centers, health insurance, and well-developed establishments in high-income countries. Furthermore, *CMR* and *CDR* exert positive effects on both *GHE* and *OPEH*, while *ADR* negatively explains the

Table 4 Panel cointegration results

Models estimated	Westerlund's test	Pedroni's test		
	Variance ratio	M.PP-stat.	PP-stat.	ADF-stat.
Model I- Dependent variable: HE				
Full sample	-10.33***	-3.49***	-3.26***	-3.61***
High-income panel	-5.67***	-4.33***	-3.44***	-3.82***
Middle-income panel	-4.12***	-4.21***	-3.90***	-3.98***
Low-income panel	-4.87***	-4.99**	-4.37***	-4.06***
Model II-Dependent variable: OPEH				
Full sample	-9.69***	-4.18***	-3.82***	-3.90***
High-income panel	-14.58***	-9.37***	-6.41***	-8.34***
Middle-income panel	-3.72***	-3.55***	-3.19***	-4.00***
Low-income panel	-4.17***	-3.61***	-3.15***	-3.92***

Source: Authors' estimations

Notes: *** indicates significance at a 1% level. M.: Modified, PP: Phillips-Perron, ADF: Augmented Dickey-Fuller

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Table 5 CS-ARDL estimates-model (I)

Model I-Dependent variable: GHE	Full sample		High-income		Middle-income		Low-income	
	Statistics	*p-value*	**Statistics**	*p-value*	**Statistics**	*p-value*	**Statistics**	*p-value*
Short-run effects								
CGI	1.37	0.420	0.81	0.325	0.61	0.410	0.55	0.625
GDPG	0.16***	0.000	0.12***	0.000	0.22***	0.002	0.19***	0.000
ADR	0.29*	0.067	0.14***	0.000	0.11***	0.000	0.16***	0.000
CMR	-0.34***	0.000	-0.17***	0.000	-0.18***	0.001	-0.15***	0.000
CDR	-0.26***	0.000	-0.35***	0.000	-0.28***	0.000	-0.21***	0.000
TAR	0.0071	0.725	0.003	0.965	0.0009	0.510	0.0017	0.119
Constant	-6.42***	0.000	-2.13***	0.000	-4.67***	0.000	-6.09***	0.000
Long-run effects								
CGI	0.85***	0.000	0.97***	0.000	0.68***	0.000	0.57***	0.000
GDPG	0.31***	0.000	0.18***	0.000	0.25***	0.000	0.18***	0.000
ADR	0.36***	0.000	0.20***	0.000	0.14***	0.000	0.33***	0.000
CMR	-0.42*	0.062	-0.24***	0.000	-0.19***	0.000	-0.22***	0.000
CDR	-0.28**	0.033	-0.41*	0.072	-0.35*	0.051	-0.27**	0.018
TAR	0.049**	0.047	0.026*	0.089	0.041**	0.027	0.046*	0.057
ζ_{it}	0.0013	0.555	-0.008	0.410	-0.0009	0.625	-0.00003	0.720
Robustness checks								
R-squared	0.54		0.41		0.38		0.55	
F-statistics	44.98***	0.000	19.45***	0.000	10.33***	0.000	28.67***	0.000
CD-statistics	-1.016	0.325	-0.991	0.410	-1.67	0.310	-0.847	0.425
JB-normality	1.762	0.210	1.88	0.175	2.018	0.120	1.156	0.255

Source: Authors' estimations

Notes: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively

subject. The *TAR* has only long-term positive effects on *GHE* and *OPEH*, with no short-term effects.

Middle-income panel

In the middle-income panel, the results indicate that *CGI* has only long-run effects on both *GHE* and *OPEH*. It shows that a 1% increase in *CGI* causes *GHE* (*OPEH*) to rise by 0.68% (0.28%) in the long run. Comparatively, the size of the effects of *CGI* in the high-income panel is higher than that of the middle-income panel, indicating that larger economies attract higher *CGI* effects. Moreover, the results show that *GDPG* (*PCGDP*) spurs *GHE* (*OPEH*) by 0.22% (0.84%) in the short run and 0.25% (0.99%) in the long run. *CMR* and *CDR* are found to negatively associated with *GHE* and *OPEH* in the short- and long-run, while the *ADR* is positively linked with both *GHE* and *OPEH*. Likewise, the *TAR* only has long-run weak positive impact on the subject, showing that it increases *HE* (*OPEH*) by 0.04% (0.0013%).

Low-income panel

Finally, the results for the low-income economies show that *CGI* is only significant to improve both *GHE* and *OPEH* in the long run by 0.57% and 0.13%, respectively.

Again, it shows that, compared to the full, high- and middle-income countries, the health outcomes in low-income countries are less affected by *CGI*. However, the results show that while *GDPG* (*PCGDP*) is positively associated with *GHE* (OPEH), CMR and CDR have a negative influence on both *GHE* and *OPEH*. Specifically, a 1% increase in *GDPG* (*PCGDP*) improves *GHE* (*OPEH*) by 0.19% (0.15%) in the short run and 0.18% (0.78%) in the long run. For other control variables, similar results are found. For instance, while *ADR* has positive effects, *CDR* and *CMR* have negative impacts on both *GHE* and *OPEH* in the short and long run. Similarly, the *TAR* is found to have only long-run effects on both *HE* and *OPEH*. It shows that a 1% increase in *TAR* improves *GHE* (*OPEH*) by 0.046% (0.0009%) in the long run.

Robustness tests

For statistical validation of the results obtained from the CS-ARDL estimations reported in Tables 5 and 6, we adopted two approaches. First, we computed some important diagnostic checks and reported the results in the rear part of Tables 5 and 6. They indicate that the CS-ARDL model estimates have corrected the CD across all panels, and the residuals are normally distributed.

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Table 6 CS-ARDL estimates-model (II)

Model I-Dependent variable: OPEH	Full sample		High-income		Middle-income		Low-income	
	Statistics	p-value	Statistics	p-value	Statistics	p-value	Statistics	p-value
Short-run effects								
CGI	0.046	0.000	0.012	0.620	0.071	0.425	0.72	0.240
PCDPG	0.69**	0.000	0.109***	0.000	0.84***	0.000	0.72***	0.000
ADR	0.027***	0.000	0.18***	0.000	0.109***	0.000	0.15***	0.000
CMR	-0.33***	0.000	-0.12*	0.077	0.20**	0.043	-0.17*	0.091
CDR	-0.28*	0.099	-0.32*	0.069	-0.30*	0.055	-0.22*	0.058
TAR	0.008	0.333	0.0004	0.815	0.0002	0.525	0.00015	0.444
Constant	-4.33***	0.000	-9.46***	0.000	-9.21***	0.000	-5.67***	0.008
Long-run effects								
CGI	0.61*	0.052	0.91***	0.001	0.28***	0.000	0.13***	0.000
PCDPG	0.82***	0.000	0.097***	0.000	0.99***	0.000	0.78***	0.000
ADR	0.033*	0.077	0.041***	0.000	0.51***	0.000	0.33***	0.000
CMR	-0.27***	0.000	-0.16***	0.000	-0.13***	0.000	-0.17**	0.036
CDR	-0.42***	0.009	-0.37***	0.000	-0.46***	0.000	-0.28***	0.000
TAR	0.0012*	0.081	0.007***	0.000	0.0013*	0.098	0.0009**	0.025
ζ_{it}	-0.0671	0.965	-0.0044	0.880	-0.0009	0.245	-0.00016	0.710
Robustness checks								
R-squared	0.67		0.81		0.59		0.48	
F-statistics	8.33***	0.000	12.65***	0.000	7.94***	0.000	18.19***	0.000
CD-statistics	-0.67	0.450	-1.111	0.375	-1.099	0.320	-0.95	0.410
JB-normality	2.08	0.110	1.88	0.115	1.905	0.122	2.001	0.110

Source: Authors' estimations

Notes: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively

Additionally, the estimates have taken the effects of structural breaks into account. The results indicate that the coefficients of the structural breaks (ζ_{it}) are insignificant to influence the GHE and OPEH in all recipient panels. Second, we estimated the FMOLS model to check the robustness of the long-run coefficients. The results reported in Table 7 indicate that the coefficients are robust and correspond to those of the estimations shown in Tables 5 and 6.

Panel causality test

To conclude the analysis, we compute the Dumitrescu-Hurlin [67] panel causality test and report the results in Table 8. The results show that, in all panels, CGI is significant at a 1% level to cause both *GHE* and *OPEH*. It also shows that in models I and II, *GDPG, PCGDP, CDR,* and *ADR* have a statistically significant causal nexus with *GHE* and *OPEH* in all recipient panels. Furthermore, the results indicate that CMR and TAR are insignificant in causing *GHE* and *OPEH* across all panels. The findings also do not lend statistical support for reverse causality from GHE and *OPEH* to the explanatory variables. Thus, they are not reported.

For brevity, we display the overall result of the panel causality for all panels in Fig. 4. The dashed lines indicate the significant causal relationships with corresponding *p-values* at 1%, 5%, and 10% running from *CGI* and explanatory to both *GHE* and *OPEH* (say, models I and II).

Discussions

This study raised two key arguments. First, macro-level institutional quality (governance for health) viz-à-viz health sector-specific governance is more critical to explaining health outcomes. Second, the volatility of the effects of good government on health outcomes is translated by the income level of the underlying economies. The initial descriptive statistics (Table 1) highlight varying trends of *GHE* (government health expenditures), *OPEH* (per capita out-of-pocket expenditures on healthcare), and *CGI* (composite governance index) that sharply increase in the full sample and high-income panel, but they indicate comparatively weak volatility in the middle-income and low-income panels. The slow-shifting trend of *CGI* in middle- and low-income countries might be due to their level of commitment to practicing good governance or the lack of sufficient specificity of governance

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Table 7 FMOLS estimates

Variables	Full sample		High-income panel		Middle-income panel		Low-income panel	
	Statistics	*p-value*	Statistics	*p-value*	Statistics	*p-value*	Statistics	*p-value*
Model I-dependent variable: GHE								
CGI	0.66***	0.000	0.82***	0.000	0.91***	0.000	0.49***	0.000
GDPG	0.47***	0.000	0.31***	0.000	0.22***	0.000	0.45***	0.000
ADR	0.22***	0.000	0.28***	0.000	0.18***	0.000	0.25***	0.000
CMR	-0.88***	0.000	-0.29***	0.000	-0.11***	0.000	-0.13***	0.000
CDR	-0.19***	0.008	-0.36***	0.000	-0.30***	0.001	-0.29***	0.000
TAR	0.0049***	0.000	0.00016***	0.003	0.00026***	0.000	0.0004***	0.000
Constant	28.916***	0.000	33.412***	0.000	18.009***	0.000	10.682***	0.007
ζ_{it}	-0.00089	0.277	-0.000021	0.418	-0.000096	0.850	-0.00067	0.650
Post-estimations								
R-squared	0.45		0.38		0.33		0.49	
Normality test	1.88	0.325	2.11*	0.099	0.94	0.520	1.98	0.111
Model II-dependent variable: OPEH								
CGI	0.44***	0.000	0.86***	0.000	0.23***	0.000	0.29***	0.000
PCGDP	0.67***	0.000	0.101***	0.000	0.84***	0.000	0.51***	0.000
ADR	0.11***	0.000	0.003***	0.000	0.67***	0.000	0.42***	0.000
CMR	-0.22***	0.000	-0.19***	0.000	-0.10***	0.000	-0.19***	0.000
CDR	-0.37***	0.000	-0.24***	0.000	-0.55***	0.000	-0.12***	0.000
TAR	0.003***	0.000	0.0006***	0.000	0.0003***	0.000	0.00011***	0.009
Constant	19.33***	0.000	21.45***	0.000	-6.77***	0.000	9.38***	0.000
ζ_{it}	-0.0185	0.510	-0.0044	0.920	-0.0066	0.567	-0.0093	0.465
Post-estimations								
R-squared	0.47		0.52		0.38		0.50	
Normality test	0.87	0.510	1.87	0.325	0.92	0.475	1.32	0.425

Source: Authors' estimations

Notes: *** indicates significance at a 1% level

Table 8 Dumitrescu-Hurlin causality results

Causality direction	Full sample		High-income		Middle-income		Low-income	
	Z-stat.	*p-values*	Z-stat.	*p-value*	Z-stat.	*p-value*	Z-stat.	*p-value*
Model I-dependent variable: GHE								
CGI→GHE	4.13***	0.000	8.11***	0.000	4.16***	0.000	5.67***	0.000
GDPG→GHE	6.47***	0.000	3.43***	0.000	5.68***	0.000	7.22***	0.000
CMR→GHE	1.11	0.440	1.32	0.425	0.88	0.310	1.28	0.325
CDR→GHE	4.67***	0.000	4.33***	0.000	5.45***	0.000	2.19*	0.055
ADR→GHE	9.88***	0.000	6.36***	0.000	3.99***	0.000	5.41***	0.000
TAR→GHE	0.94	0.410	0.67	0.420	1.36	0.455	0.88	0.420
Model II-dependent variable: OPEH								
CGI→OPEH	3.99***	0.000	5.17***	0.000	8.04***	0.000	9.85***	0.000
PCGDP→OPEH	4.17***	0.000	2.82**	0.045	3.96***	0.000	9.14***	0.000
CMR→OPEH	0.58	0.555	1.24	0.440	0.46	0.630	1.39	0.450
CDR→OPEH	6.45***	0.000	8.19***	0.000	10.11***	0.000	7.82***	0.000
ADR→OPEH	2.98***	0.009	4.33***	0.000	6.87***	0.000	7.11***	0.000
TAR→OPEH	1.21	0.425	0.55	0.625	1.53	0.310	1.44	0.305

Source: Authors' estimation

Notes: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively

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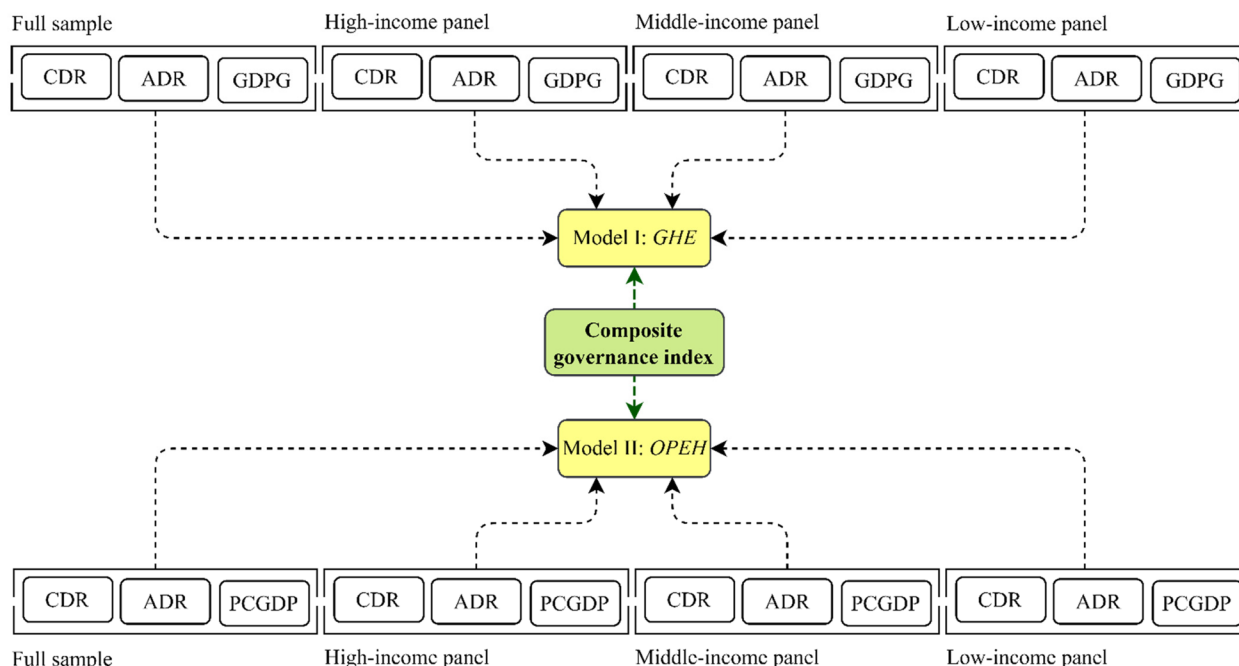
Fig. 4 Overall panel causality results. Source: Authors' estimation

in their enacted policies [73]. The analysis determines that *CGI* has a long-run relationship with *GHE* and *OPEH* in all recipient panels (Table 4), showing evidence that *CGI* differently affects *GHE* and *OPEH* in the long run. The results are consistent with those of Atay et al. [74], Dhrifi [28], Rahman and Alam [75], and Zhang et al. [76], who also found cointegration between institutional quality and health outcome indicators.

Furthermore, the results obtained from the CS-ARDL model (Tables 5 and 6) clearly indicate the partial non-rejection of the second hypothesis. The results fail to provide short-run effects of *CGI* on both *GHE* and *OPEH*. This is truly literal: the slow-shifting trend of *CGI* takes a long time to exhibit effects on the subject. From an economic viewpoint, the effects of *CGI* on *GHE* and *OPEH* can be tracked through three key conduits: First, *CGI* is central to facilitating a stable environment to attract sound healthcare projects and efficiently channelize *GHE* and *OPEH* to extend coverage and outreach to more individuals. Second, it optimizes both *GHE* and *OPEH* through effective administrative interventions. Third, the *CGI*, which is built on three key dimensions such as accountability, transparency, and participation shows that effective engagement of the private, public, and citizen sectors leads to greater efficiency in increasing both *GHE* and *OPEH*. Thus, an increase in *GHE* and *OPEH* that is effectively governed results in the enhancement of a healthcare system's outcome. The findings are consistent with those of Filmer and Pritchett [77], Farag et al.

[18], Ibukun [78], Ahmad and Hasan [22], and Chireshe and Ocran [79], who found that institutional quality improves health outcomes and enhances the effectiveness of healthcare outcomes. Moreover, and interestingly, the results show that *CGI*'s coefficients are higher in high-income economies, experiencing a slow decline in middle-income and low-income countries. This implies that health outcome indicators are less sensitive to *CGI* in high-income countries but more sensitive in middle- and low-income economies. Therefore, it significantly favors the non-rejection of the third hypothesis.

Altogether, the results of the CS-ARDL model in all the panels confirm the positive effects of *PGDP* on *GHE* and *PCGDP* on *OPEH* in both the short- and long-term. Recent studies by Chaabouni et al. [80], Bozkurt [81], Zaidi and Saidi [82], Rahman and Alam [83], and Wang [84], also found that economic growth has positive impacts on health outcomes. Furthermore, the *ADR* is positively associated with both *GHE* and *OPEH* in all panels. This implies that higher *ADR* has a negative impact on many people's earnings and savings—that is, increasing the cost of health insurance provided by employers not only reduces wages but may also force employers to replace skilled labor with semi-skilled or unskilled labor to bear lower wage payments to cover higher health insurance costs [85]. For the *CMR*, the findings reveal that it negatively effects both *GHE* and *OPEH* in all panels in the short- and long-runs. In an empirical sense, this negativity might be due to two key

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reasons. First, the limited availability of healthcare services both to urban and rural populations caused by either a limited number of healthcare centers or higher cost of healthcare services; and second, the limited accessibility of people to healthcare services provided both by private and public healthcare centers. The elasticities of the effects of the *CMR* in different income-level groups support this empirical notion. For instance, the effects are lower in high-income economies than in low-income countries, indicating that both the availability and accessibility dimensions of healthcare services are higher in high-income and lower in low-income economies. Maruthappu et al. [86] and Rahman et al. [87] discovered that reductions in health expenditures significantly increased *CMR*, whereas Ortega et al. [88] provided statistical evidence on the direct effects of good governance, proxied by government effectiveness on reducing *CMR* and healthcare inputs. Among all others, Kiross et al. [89] and Novignon and Lawanson [90] reflected almost similar findings for Sub-Saharan African countries. The *CDR* is also found to be negatively affecting both *GHE* and *OPEH* in all panels both in the short- and long-runs. Again, the negativity of *CDR* occurs when there is a significant imbalance between the birth rate and the *CDR*—that is, the death rate is higher than the birth rate. The results also show that the size of the effects is higher in high-income countries than in middle and low-income economies, indicating a real-life example of the suppression of the birth rate in high-income economies and a higher birth rate in low-income countries. Similar findings were presented in recent studies by Rahman et al. [91], Berger et al. [92], and Elola et al. [93]. Finally, the study tested the effects of *TAR* on both *GHE* and *OPEH*. The results demonstrate that *TAR*, though weak in effect size, is significant in improving health outcomes in the long run across all the recipient panels. Likewise, Behera and Dash [43] found that tax revenue is positively associated with health expenditures in Indian states' context. In a bid to offer more insights, the study explored the causal links between *GHE*, *OPEH*, *CGI*, and other control variables (Fig. 3). The results indicate a strong causal relationship running from *CGI*, *GDPG*, *PCGDP*, *ADR*, and *CDR* to both *GHE* and *OPEH*, while *CMR* and *TAR* were found to be insignificant. It displays that there is a unidirectional causality running from the cited predictors to *G*HE and OPEH across all panels, whereas feedback response was not observed. These findings favor the acceptance of the fourth hypothesis. These results are partially supporting the findings of Ashiabi et al. [94], Owusu et al. [95], and Rana et al. [96], while the results are in contrast with those of Akinlo and Sulola [97].

In sum, the overall findings show that *CGI* is a significantly effective tool for a conservative enhancement of health expenditures both at macro- and individual-levels, resulting in improved healthcare coverage rather than bearing unnecessary costs that force *GHE* and *OPEH* to rise. The results also support the emerging notion of "governance for health" rather than health sector-specific governance due to its comprehension and the engagement of three key societal forces.

Conclusions

This article examined the effects of good governance on health expenditures. It hypothesized that good governance is central to channeling the enhancement of healthcare services through effective interventional conduits. The study employed a large panel dataset to provide a comprehensive empirical image to support decision-making at macro-policy levels. The datasets contain 144 countries (full sample), classified into high-income (49 countries), middle-income (40 countries), and low-income (55 countries), and were collected from various reliable sources over the period from 2002 to 2020. To capture the extensive impact of good governance on health expenditures, the study constructed a composite governance index (*CGI*) under three key dimensions such as accountability, transparency, and participation. Considering the stationarity properties of the variables, the study used the CS-ARDL model to analyze the data.

The findings reveal that *CGI*—the key variable of interest—has significantly positive effects on *G*HE and OPEH in the long run, implying that *CGI* is an essential tool to improve health expenditures. An in-depth analysis also indicates three more important findings. First, it confirms that the effect of *CGI* on *G*HE and OPEH is partially dependent on the economic size of the countries. It substantively implies that the effects of *CGI* are lower (higher) in high-income (middle- and low-income) countries. Second, it implies that *G*HE and OPEH are highly sensitive to *CGI*, improve with the practice of good governance, and achieve stabilization through the steady and long-term implementation of good governance. Third, the findings also reveal that *GDPG*, *PCGDP*, *TAR*, and *ADR* increase both *G*HE and OPEH. It notes that *GDPG*, *PCGDP*, and *TAR* enhance the scope of healthcare outcomes, while *ADR* increases the cost burden of *G*HE and OPEH as a force majeure. Moreover, *CMR* and *CDR* are found to have significant negative impacts on the subject across all panels, both in the short and long runs. The study concluded with the test of causality and found that *CGI*, *PCGDP*, *GDPG*, *CDR*, and *ADR* have a unidirectional causal effect on *G*HE and OPEH with no feedback response, while *TAR* and *CMR* were insignificant.

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Policy implications

The findings entail several important policy implications that can be outlined as follows: First, good governance is found to be essential in effectively and conservatively increasing health expenditures both at macro- and micro-levels, resulting in the enhancement of the efficacy of healthcare services and the improvement of the population's health status across the globe. Thus, regardless, it is imperative that governments attempt to formulate (revise) relevant policies for the health sector to support, promote, and institutionalize the practice of good governance dimensions. Second, given the importance of the multifaceted impact of good governance along with other macroeconomic indicators, it is important that governments attempt to enhance growth-inclusiveness to increase the health-input value of per capita expenditure to ensure greater health output, particularly in middle- and low-income countries. Third, healthcare is fundamental to human capital development. Considering the non-monotonic impact of good governance on health expenditures, it is necessary for low- and middle-income countries to recognize the important role of good governance in their sustainable development strategies via a strong commitment to channelize good governance as an important healthcare administration.

Limitations

The present study suffers from one key limitation. Although the construction of *CGI* has empirically improved the incorporation of many explanatory variables into the health-governance model, it still suffers from the lack of a single health proxy as the outcome variable. Future studies may attempt to overcome this empirical shortcoming by constructing a health-inclusive index to assure the amalgamation of relevant healthcare dimensions into the so-called "composite health index.".

Abbreviations

ADF	Augment Dickey and Fuller
ADR	Age dependency ratio
CD	Cross-sectional
CMR	Child mortality rate
CDR	Crude death rate
CGI	Composite governance index
CS-ARDL	Cross-sectionally augmented autoregressive distributed lags
GDPG	Gross domestic product growth
GHE	Government health expenditures
OPEH	Per capita out-of-pocket expenditures on healthcare
PCGDP	Per capita gross domestic product
PP	Phillips-Perron
WDI	World Development Indicators
WGI	Worldwide Governance Indicators
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-023-10261-9.

> **Additional file 1.**

Availability of data and materials
The datasets for *OPEH, CMR, GDPG, PCGDP, CDR*, and *ADR* were compiled from WDI. The datasets for governance indicators such as *VoA, CoC, RoL, ReQ, PoS*, and *GeF* come from WGI and the data for *OPEH* has been compiled from WHO. All sources are publicly and freely available. The complete CGI constructed dataset will be made available upon request.

Declarations

Ethics approval and consent to participate
The study used secondary datasets that are publicly and freely available to potential scholars of the field. No animal and human practices have been employed in writing this piece of inquiry.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

References

1. North DC. Institutions, Institutional Change and Economic Performance. 1990;Part III:105–40. https://doi.org/10.1017/CBO9780511808678.
2. Lott JR, North DC. Institutions, Institutional Change and Economic Performance. J Policy Anal Manag. 1992;11(1):156–9. https://doi.org/10.2307/3325144.
3. Azimi MN. A DCCE Approach to the governance-growth nexus: global perspective. Glob Bus Rev. 2022;OnlineFirst:1–17. https://doi.org/10.1177/09721509221104247.
4. Chattopadhyay S. Corruption in healthcare and medicine: why should physicians and bioethicists care and what should they do? Indian J Med Ethics. 2013;10(3):153–9. https://doi.org/10.20529/ijme.2013.049.
5. Dessie ZG, Zewotir T. Mortality-related risk factors of COVID-19: a systematic review and meta-analysis of 42 studies and 423,117 patients. BMC Infect Dis. 2021. https://doi.org/10.1186/s12879-021-06536-3.
6. Bank W. "World development indicators | data," *World Development Indicators*, 2023. https://databank.worldbank.org/source/world-development-indicators Accessed 23 Mar 2020.
7. Hashem E. The impact of governance on economic growth and human development during crisis in Middle East and North Africa. Int J Econ Financ. 2019;11:1–16. https://doi.org/10.5539/ijef.v11n8p61.

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8. Zwi A, Ugalde A. Political violence in the third world: a public health issue. Health Policy Plan. 1991;6(13):203–17. https://doi.org/10.1093/heapol/6.3.203.

9. Verhoeven M, Gupta S, Tiongson E. Does higher government spending buy better results in education and health care? IMF Work Pap. 1999;99:1–25. https://doi.org/10.5089/9781451843897.001.

10. Owusu PA, Sarkodie SA, Pedersen PA. Relationship between mortality and health care expenditure: sustainable assessment of health care system. PLoS ONE. 2021;16(2): e0247413. https://doi.org/10.1371/journal.pone.0247413.

11. Yang Y, Zheng R, Zhao L. Population aging, health investment and economic growth: based on a cross-country panel data analysis. Int J Environ Res Public Health. 2021;18(4): 1801. https://doi.org/10.3390/ijerph1804 1801.

12. Wu CF, Chang T, Wang CM, Wu TP, Lin MC, Huang SC. Measuring the Impact of Health on Economic Growth using Pooling data in regions of Asia: evidence from a quantile-on-quantile analysis. Front Public Heal. 2021;9:1–7. https://doi.org/10.3389/fpubh.2021.689610.

13. Bloom DE, Canning D, Sevilla J. The effect of health on economic growth: a production function approach. World Dev. 2004;32(1):1–13. https://doi.org/10.1016/j.worlddev.2003.07.002.

14. Bilgili F, Kuşkaya S, Khan M, Awan A, Türker O. The roles of economic growth and health expenditure on CO2 emissions in selected Asian countries: a quantile regression model approach. Environ Sci Pollut Res. 2021;28:3–4. https://doi.org/10.1007/s11356-021-13639-6.

15. Chireshe J, Ocran MK. Financial Development and Health Outcomes in Sub-saharan African Countries. J Dev Areas. 2020;54(3). https://doi.org/10.1353/jda.2020.0030.

16. Raghupathi V, Raghupathi W. Healthcare expenditure and economic performance: insights from the United States Data. Front Public Heal. 2020;8:156. https://doi.org/10.3389/fpubh.2020.00156.

17. Organization WH. "Global Health Observatory data repository. Out-of-pocket expenditure as percentage of current health expenditure (CHE) (%)." 2023. Available: https://apps.who.int/gho/data/view.main.GHEDO OPSCHESHA2011v.

18. Farag M, Nandakumar AK, Wallack S, Hodgkin D, Gaumer G, Erbil C. Health expenditures, health outcomes and the role of good governance. Int J Health Care Finance Econ. 2013;13(1):33–52. https://doi.org/10.1007/s10754-012-9120-3.

19. Boz C, Ozsarı SH. The causes of aging and relationship between aging and health expenditure: an econometric causality analysis for Turkey. Int J Health Plann Manage. 2020;35(1):162–70. https://doi.org/10.1002/hpm.2845.

20. Hilaire HG. Does good governance improve public health expenditure-health outcomes nexus? New empirical evidence from Africa, Université d'Abomey Calavi (UAC), 2018. https://retanet.org/ecoasso/articles/HOUENINVO_Hilaire1.pdf.

21. Kim TK, Lane SR. Government health expenditure and public health outcomes: a comparative study among 17 countries and implications for US health care reform. Am Int J Contemp Res. 2013;3(9):8–13.

22. Ahmad R, Hasan J. Public health expenditure, governance and health outcomes in Malaysia. J Ekon Malaysia. 2016;50(1):29–40. https://doi.org/10.17576/JEM-2016-5001-03.

23. Aljunid S. The role of private medical practitioners and their interactions with public health services in Asian countries. Health Policy Plan. 1995;10(4):333–49. https://doi.org/10.1093/heapol/10.4.333.

24. Radin D. Does corruption undermine trust in health care? Results from public opinion polls in croatia. Soc Sci Med. 2013;98:46–53. https://doi.org/10.1016/j.socscimed.2013.08.033.

25. Lazarova EA, Mosca I. Does governance matter for aggregate health capital? Appl Econ Lett. 2008;15(3):199–202. https://doi.org/10.1080/13504850600721916.

26. Ouedraogo I, Dianda I, Adeyele IT. Institutional quality and health outcomes in Sub-saharan Africa. Res Appl Econ. 2020;12(4):22–45. https://doi.org/10.5296/rae.v12i4.18103.

27. Van De Bovenkamp HM, De Mul M, Quartz JGU, Weggelaar-Jansen AMJWM, Bal R. Institutional layering in governing healthcare quality. Public Adm. 2014;92(1):208–23. https://doi.org/10.1111/padm.12052.

28. Dhrifi A. Public Health Expenditure and child mortality: does institutional quality matter? J Knowl Econ. 2020;11(2):692–706. https://doi.org/10.1007/s13132-018-0567-4.

29. Rehmat AZ, Sania MT, Majeed. Panel Data Analysis of Institutional Quality and Population Health outcomes, Empir Economic Rev, 2020. https://ojs.umt.edu.pk/index.php/eer/article/view/435.

30. Rajkumar AS, Swaroop V. Public spending and outcomes: does governance matter? J Dev Econ. 2008;86(1):96–111. https://doi.org/10.1016/j.jdeveco.2007.08.003.

31. Klomp J, de Haan J. Is the political system really related to health? Soc Sci Med. 2009;69(1):36–46. https://doi.org/10.1016/j.socscimed.2009.03.033.

32. De Luca G, Lisi D, Martorana M, Siciliani L. Does higher institutional quality improve the appropriateness of Healthcare Provision? J Public Econ. 2021;194: 104356. https://doi.org/10.1016/j.jpubeco.2020.104356.

33. Sharma T, Anand, Sharma, Vipin, Shekhar. Institutional quality and health outcomes: evidence from the EU countries. Econ Bus Lett. 2022;11(2):70–8. https://doi.org/10.17811/ebl.11.2.2022.70-78.

34. Bank W. World Bank list of economies, List of Economies, 2020. https://www.ilae.org/files/dmfile/World-Bank-list-of-economies-2020_09-1.pdf.

35. Sarma M. Index of financial inclusion – a measure of financial sector inclusiveness. Berlin Work Pap Money Financ Trade Dev. 2012;24(8):472–6 (**Accessed: Jun. 12, 2022. [Online]. Available**).

36. Azimi MN, Rahman MM, Nghiem S. Linking governance with environmental quality: a global perspective. Sci Rep. 2023;13(1):15086. https://doi.org/10.1038/s41598-023-42221-y.

37. Azimi MM, Naim M, Rahman. Impact of institutional quality on ecological footprint: new insights from G20 countries. J Clean Prod. 2023;423:138670. https://doi.org/10.1016/j.jclepro.2023.138670.

38. Wang KM, Lee YM. The impacts of life insurance asymmetrically on health expenditure and economic growth: dynamic panel threshold approach. Econ Res Istraz. 2018;31(1):440–60. https://doi.org/10.1080/1331677X.2018.1429943.

39. Hameed MA, Rahman MM, Khanam R. The health consequences of civil wars: evidence from Afghanistan. BMC Public Health. 2023;23(1):154. https://doi.org/10.1186/s12889-022-14720-6.

40. Rahman MM, Alam K. The role of access to electricity, female education, and public health expenditure on female health outcomes: evidence from SAARC-ASEAN countries. BMC Womens Health. 2021;21(1):383. https://doi.org/10.1186/s12905-021-01520-0.

41. World Health Organization., World Health Organization Global Health expenditure database, WHO, 2014. http://apps.who.int/nha/database.

42. World Health Organization., "Metadata Glossary." 2023. Available: www.who.int/nha/country/en/index.html.

43. Behera DK, Dash U. Prioritization of government expenditure on health in India: a fiscal space perspective. Socioecon Plann Sci. 2019;68:100667. https://doi.org/10.1016/j.seps.2018.11.004.

44. Behera DK, Dash U. Impact of macro-fiscal determinants on health financing: empirical evidence from low-and middle-income countries. Glob Heal Res Policy. 2019;4(1).10.1186/s41256-019-0112-4.

45. Ogundipe MA, Lawal NA. Health expenditure and Nigerian economic growth. Eur J Econ Financ Adm Sci. 2011;30:125–9.

46. Kaufmann D, Kraay A. Worldwide Governance indicators (WGI) Project, World Bank, 2018.

47. Wolfson MC, "A SYSTEM OF HEALTH STATISTICS TOWARD A NEW CONCEPTUAL FRAMEWORK FOR, INTEGRATING HEALTH DATA. " Rev Income Wealth. 1991;88:24–30. https://doi.org/10.1111/j.1475-4991.1991.tb00339.x.

48. Ansell C, Gash A. Collaborative governance in theory and practice. J Public Adm Res Theory. 2008;18:543–71. https://doi.org/10.1093/jopart/mum032.

49. Kickbusch I, Gleicher D. "Governance for Health in The 21st century," 2012. Available: https://www.euro.who.int/__data/assets/pdf_file/0019/171334/RC62BD01-Governance-for-Health-Web.pdf.

50. Imperial MT. Using collaboration as a governance strategy: lessons from six watershed management programs. Adm Soc. 2005;37:281–320. https://doi.org/10.1177/0095399705276111.

51. Fayissa B, Nsiah C. The impact of governance on economic growth in Africa. J Dev Areas. 2013;47(1):91–108. https://doi.org/10.1353/jda.2013.0009.

52. Kaufmann D, Kraay A, Mastruzzi M. "Governance matters VII: Aggregate and individual governance indicators 1996–2007," in *Non-State Actors as Standard Setters*, 2009, pp. 146–188.

53. Acemoglu D, Johnson S, Robinson JA. The colonial origins of comparative development: an empirical investigation: reply. Am Econ Rev. 2012;102(6):3077–110. https://doi.org/10.1257/aer.102.6.3077.

Azimi *et al. BMC Health Services Research*   (2023) 23:1235

Page 18 of 18

54. Greif A. Contract enforceability and economic institutions in early trade: the maghribi traders' coalition. Am Econ Rev. 1993;83(3):525–48. https://doi.org/10.2307/2117532.

55. Bennett NJ, Satterfield T. Environmental governance: a practical framework to guide design, evaluation, and analysis. Conserv Lett. p. 2018;e12600. https://doi.org/10.1111/conl.12600.

56. Cuschieri S. The STROBE guidelines. Saudi J Anaesth. 2019;13(5):31–4. https://doi.org/10.4103/sja.SJA_543_18.

57. Hao LN, Umar M, Khan Z, Ali W. Green growth and low carbon emission in G7 countries: how critical the network of environmental taxes, renewable energy and human capital is? Sci Total Environ. 2021;752: 141853. https://doi.org/10.1016/j.scitotenv.2020.141853.

58. Lau L-S, Ng C-F, Cheah S-P, Choong C-K. "Panel Data Analysis (Stationarity, Cointegration, and Causality)," in *Environmental Kuznets Curve (EKC)*, 2019, pp. 101–113.

59. Pesaran MH. General diagnostic tests for cross section dependence in panels. Univ Camb Fac Econ Camb Work Pap Econ No. 2004;0435:1–37.

60. Chudik A, Pesaran MH. Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. J Econom. 2015;188(2):393–420. https://doi.org/10.1016/j.jeconom.2015.03.007.

61. Erülgen A, Rjoub H, Adalıer A. Bank characteristics Effect on Capital structure: evidence from PMG and CS-ARDL. J Risk Financ Manag. 2020;13(310):1–13. https://doi.org/10.3390/jrfm13120310.

62. Kilinc-Ata N, Alshami M, Munir K. How do strategic mineral resources affect clean energy transition? Cross-sectional autoregressive distributed lag (CS-ARDL) approach. Min Econ. 2023. https://doi.org/10.1007/s13563-023-00373-3.

63. Arnold J, Bassanini A, Scarpetta S. Solow or Lucas? Testing speed of convergence on a panel of OECD countries. Res Econ. 2011;65(2):110–23. https://doi.org/10.1016/j.rie.2010.11.005.

64. Pesaran MH, Pesaran MH, Shin Y, Smith RP. Pooled Mean Group Estimation of dynamic heterogeneous panels. J Am Stat Assoc. 1999;94(446):621–34. https://doi.org/10.1080/01621459.1999.10474156.

65. Phillips PCB, Sul D. Dynamic panel estimation and homogeneity testing under cross section dependence. Econom J. 2003;6(1):217–59. https://doi.org/10.1111/1368-423x.00108.

66. Pedroni P. Fully modified OLS for heterogeneous cointegrated panels. Adv Econom. 2000;15:93–130. https://doi.org/10.1016/S0731-9053(00)15004-2.

67. Dumitrescu EI, Hurlin C. Testing for granger non-causality in heterogeneous panels. Econ Model. 2012;29:1450–60. https://doi.org/10.1016/j.econmod.2012.02.014.

68. Driscoll JC, Kraay AC. Consistent covariance matrix estimation with spatially dependent panel data. Rev Econ Stat. 1998;8(4):549–60. https://doi.org/10.1162/003465398557825.

69. Pesaran MH. A simple panel unit root test in the presence of cross-section dependence. J Appl Econom. 2007;22(2):265–312. https://doi.org/10.1002/jae.951.

70. Ditzen J, Jan, Karavias, Yiannis W. Testing and estimating structural breaks in Time Series and Panel Data in Stata, arXiv:2110.14550, 2021. Available: [econ.EM].

71. Westerlund J. Testing for error correction in panel data. Oxf Bull Econ Stat. 2007;69:0305–9049. https://doi.org/10.1111/j.1468-0084.2007.00477.x.

72. Pedroni P. Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxf Bull Econ Stat. 1999;61(s1):653–70. https://doi.org/10.1111/1468-0084.0610s1653.

73. Punyaratabandhu S. "Commitment To Good Governance, Development, and Poverty Reduction: Methodological Issues in the Evaluation of Progress At National and Local Level," 2004. Available: https://www.un.org/en/development/desa/policy/cdp/cdp_background_papers/bp2004_4.pdf.

74. Atay PM, Ergun S. The relationship between economic growth, CO2 emissions and health expenditures in Turkey under structural breaks. Bus Econ Res J. 2018;9(3):481–97.

75. Rahman MM, Alam K. The nexus between health status and health expenditure, energy consumption and environmental pollution: empirical evidence from SAARC-BIMSTEC regions. BMC Public Health. 2021;21:1694. https://doi.org/10.1186/s12889-021-11534-w.

76. Zhang D, Ozturk I, Ullah S. Institutional factors-environmental quality nexus in BRICS: a strategic pillar of governmental performance. Econ Res Istraz. 2022;35(1):5777–89. https://doi.org/10.1080/1331677X.2022.2037446.

77. Filmer D, Pritchett L. "Child Mortality and Public Spending on Health: How Much Does Money Matter?" Washington, DC, 1864, 1997.

78. Ibukun CO. The role of governance in the health expenditure–health outcomes nexus: insights from West Africa. Int J Soc Econ. 2021;48(4):557–70. https://doi.org/10.1108/IJSE-06-2020-0404.

79. Chireshe J, Ocran MK. Health care expenditure and health outcomes in sub-saharan African countries. Afr Dev Rev. 2020;32(3):349–61. https://doi.org/10.1111/1467-8268.12444.

80. Chaabouni S, Zghidi N, Ben Mbarek M. On the causal dynamics between CO2 emissions, health expenditures and economic growth. Sustain Cities Soc. 2016;22:184–91. https://doi.org/10.1016/j.scs.2016.02.001.

81. Bozkurt C. R&D expenditures and economic growth relationship in Turkey. Int J Econ Financ Issues. 2015;5(1):188–98.

82. Zaidi S, Saidi K. Environmental pollution, health expenditure and economic growth in the Sub-saharan Africa countries: Panel ARDL approach. Sustain Cities Soc. 2018;41:833–40. https://doi.org/10.1016/j.scs.2018.04.034.

83. Rahman MM, Alam K. Effects of globalization, energy consumption and ICT on health status in Australia: the role of financial development and education. BMC Public Health. 2022;22(1):1565. https://doi.org/10.1186/s12889-022-13911-5.

84. Wang KM. Health care expenditure and economic growth: quantile panel-type analysis. Econ Model. 2011;28(4):1536–49. https://doi.org/10.1016/j.econmod.2011.02.008.

85. Lopreite M, Zhu Z. The effects of ageing population on health expenditure and economic growth in China: a Bayesian-VAR approach. Soc Sci Med. 2020;265: 113513. https://doi.org/10.1016/j.socscimed.2020.113513.

86. Maruthappu M, Ng KYB, Williams C, Atun R, Zeltner T. Government health care spending and child mortality. Pediatrics. 2015;135(4):e887-894. https://doi.org/10.1542/peds.2014-1600.

87. Rahman MM, Alam K, Khanam R. Socio-economic factors affecting high infant and child mortality rates in selected African countries: does globalisation play any role? Global Health. 2022;18:69. https://doi.org/10.1186/s12992-022-00855-z.

88. Ortega B, Sanjuán J, Casquero A. Determinants of efficiency in reducing child mortality in developing countries. The role of inequality and government effectiveness. Health Care Manag Sci. 2017;20:500–16. https://doi.org/10.1007/s10729-016-9367-1.

89. Kiross GT, Chojenta C, Barker D, Loxton D. The effects of health expenditure on infant mortality in sub-saharan Africa: evidence from panel data analysis. health. Econ Rev. 2020;10(5):1–9. https://doi.org/10.1186/s13561-020-00262-3.

90. Novignon J, Lawanson AO. Health expenditure and child health outcomes in Sub-saharan Africa. Afr Rev Econ Financ. 2017;9(1):96–121.

91. Rahman MM, Khanam R, Rahman M. Health care expenditure and health outcome nexus: new evidence from the SAARC-ASEAN region. Global Health. 2018;14(113):1–1. https://doi.org/10.1186/s12992-018-0430-1.

92. Berger MC, Messer J. Public financing of health expenditures, insurance, and health outcomes. Appl Econ. 2002;34(17):2105–13. https://doi.org/10.1080/00036840210135665.

93. Elola J, Daponte A, Navarro V. Health indicators and the organization of health care systems in Western Europe. Am J Public Health. 1995;85(10):1397–401. https://doi.org/10.2105/AJPH.85.10.1397.

94. Ashiabi N, Nketiah-Amponsah E, Senadza B. The effect of health expenditure on selected maternal and child health outcomes in Sub-saharan Africa. Int J Soc Econ. 2016;43(12):1386–99. https://doi.org/10.1108/IJSE-08-2015-0199.

95. Owusu PA, Sarkodie SA, Pedersen PA. Relationship between mortality and health care expenditure: sustainable assessment of health care system. PLoS ONE. 2021;16(2):1–15. https://doi.org/10.1371/journal.pone.0247413.

96. Rana RH, Alam K, Gow J. Health expenditure, child and maternal mortality nexus: a comparative global analysis. BMC Int Health Hum Rights. 2018;18(1): 29. https://doi.org/10.1186/s12914-018-0167-1.

97. Akinlo AE, Sulola AO. Health care expenditure and infant mortality in sub-saharan Africa. J Policy Model. 2019;41(1):168–78. https://doi.org/10.1016/j.jpolmod.2018.09.001.

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