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Original Article

Better Index of Public Health to Decide Health Priorities

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Abstract: *Setting priorities in public health involves selection of indicators, domains and method of aggregation to get an index of health satisfying desirable properties. Avoiding problems of scaling, selection of weights and distributions of indicator scores, multiplicative aggregation of ratios of n-indicators in t-th year and a fixed base year is suggested satisfying country index = aggregation of index of all regions = aggregation of index of all domains. Priorities can be decided by relative importance of the indicators computed by change in index due to unit increase in an indicator. The proposed index help in ranking of regions, identification of critical indicators, assessing progress/decline reflecting effectiveness of public health policies and programmes, drawing path of progress/decline of the index across time. The index can be computed separately for different vulnerable groups or on place of dwelling. Proposed method of aggregation irrespective of inter-correlations among the indicators, offering benefits of aggregation consistency has clear theoretical advantages and is recommended.*

Keywords: *Aggregation Consistency, Geometric Mean, Health Index, Priority Setting, Public Health Surveillance.*

I. INTRODUCTION

A healthy population enjoying good physical, mental, and social well-being signifies socio-economic capital of a nation which helps to achieve higher socio-economic development, while reducing the burden on healthcare systems. Health of population in a country considers health outcome metrics reflecting physical, mental, and social well-being of people with positive and negative states of health like life expectancy at birth or condition-specific life expectancy, mortality rate, age-specific mortality rates, patient-reported measure of health and functional status, etc. (Parrish, 2010). India is committed to accelerate progress in the SDGs, including SDG-3 targets relating to good health and well-being for all.

Setting priorities in public health at national level to improve health of population needs to address the basic questions on satisfaction of variety of compelling needs, assessment of size of public health problems, important problem areas, how much to care about and for whom, how to achieve health equity by eliminating health disparities, how to attain health literacy to improve the health and well-being of all, etc. Implementation of the policies involve number of players at various levels like local, state and district, national level, associated industry, health care providers and professionals, the public at large and may run into rough weather due to anticipated and unanticipated factors. Strong Public Health Surveillance (PHS) systems are pre-requisites for implementation of Public Health policy. Implementation challenges in India have been addressed in details in Vision 2035: Public Health Surveillance in India (Blanchard et al. 2020). Appropriate health-policies and programmes need to focus on demographic changes, current and anticipated phases of epidemiological transition, disease burden across the regions or states, vulnerable groups, causes of deaths, etc. which are usually evaluated by secondary data on a number of dimensions, each containing a set of indicators in different units. Questions may arise on adequacy of data. For example, medically certified deaths in India constituted about 21% of registered deaths in 2019 (RGI, 2021). Addressing data gaps in public health is a major concern and could be given priority.

Deciding priorities for public health involves management of public health information unlike clinical information which are mostly concern with assessment of severity of disease, individual patient care and measuring changes with time. Aggregated clinical data may not be sufficient to indicate impact of health policies in the population of a country. Thus, approach to population health includes collection of data pertaining to selected indicators distributed among finite number of chosen domains and appropriate method of aggregation of the indicators and/or domains to get an index reflecting overall status of health. Comprehensive selection of indicators and the adopted aggregation method determine effectiveness in detecting problems, defining priorities, identifying innovative solutions, and allocating resources for improved health outcomes. The set of indicators includes among others social determinants of health, education, environment, lifestyle factors, etc. and data-driven approach for assessment, monitoring, intervening and collaborating across various sectors like healthcare, government, community organizations, private sector to improve overall health of a population.

Many health indices have been developed. While Van de Water et al. (1996) considered a set of indices pertaining to European Union member states; Hyder et al. (2012) listed indices originating from the World Bank and World Health Organization (WHO). However, a health index for developed countries may not be applicable for developing countries like India with pronounced poverty, inequality and inadequate access to healthcare infrastructure and services, etc. (Goli & Arokiasamy, 2014). In addition, disease-related stigma causing inequality in the access and delivery of health-care services can affect public health differently in different societies. Stigma and resulting discrimination towards corpses and survivors of Coronavirus disease-19 (COVID-19) was common even among educated persons (Dar et al. 2020). Disease-related stigma were also found on mental illnesses, AIDS, leprosy, cancer, autism, Down's syndrome, diabetes, obesity, intestinal disorders, epilepsy, etc.(Akbari et al. 2023).

Because of lack of theoretical backgrounds, or framework in construction of health indices, development of health index with focused purposes for a specific population was suggested (Ashraf et al. 2019). However, there is no consensus regarding selection of domains and indicators for comprehensive approach of multi-dimensional index of public health. For example, Health Index by NITI Aayog (2021), Government of India covers 24 indicators on health outcomes, governance and infrastructure including positive indicators like institutional deliveries and negative indicators like Neonatal Mortality Rate (NMR), Under-five Mortality Rate (U5MR), human resource shortfall, etc. The India Health Index (IHI) by Sehgal et al. (2024) considers six domains with 29 indicators. In general, each chosen indicator is made unit free by normalizing or scaling by different transformations like Min-Max normalization (Yang, 2014). However, different normalization methods may affect the results in different ways and incorrect method of normalization can distort the results (Mazziotta and Paretoa, 2021). For example, Min–Max transformation normalizes raw scores of i-th indicator (X_i) to a relative measure by $Y_i = \frac{X_i - Min.X_i}{T_{argeted X_i} - Min.X_i}$*100 where $Min.X_i$ may be an outlier influencing Y_i. A change in $Min.X_i$can change ranking or regions due to change in marginal rates of substitution. Correlation between raw scores (X_i) and normalized scores (Y_i) is not perfect since change in Y due to unit increase in X ($\frac{\Delta y}{\Delta x}$) is not constant. In addition, common reference point like mean is lost by such transformation (Mazziotta and Paretoa, 2021). Z-score standardization of WHO index of health system performance by SPRG, (2001), converted raw scores of indicators into a 1- 100 scales and such normalized scores were aggregated by arithmetic aggregation with or without weights (Mazziotta and Paretoa, 2013). However, different methods of normalizations have methodological limitations. Mhlanga and Lall, (2022) found that different normalizing or scaling transformation produced different rankings. It may be desirable to aggregate indicators of SDGs avoiding normalization or scaling

Multi-criteria decision-making (MCDM) methods usually avoid normalization. Aggregation giving equal weights to the indicators and dimensions is rather controversial, since equal weighting implying equal importance resulting in constant trade-off between a pair of indicators and are not always made explicit (Tofallis, 2024; Yang, 2024). SF-36, transforms raw data to percentages before taking average. However, average of percentages is wrong, when the denominator$d_i \neq k * d_j$. Weights based on Principal Component Analysis (PCA) ignore poorly correlated indictors with the composite index (CI) even if such indicators are important. For covariance matrix, PCA gives more weight to variables with larger variances. PCA weights are data specific and may vary across time. PCA method was not favoured by (Nardo et al. 2005). Ideal weights mentioned by Hartung et al. (2008) are utopia. Weights suggested by Chakrabartty, (2017) by minimizing variance of the weighted sum i.e., Variance (Y= $\sum_{i=1}^{n} W_i X_i$) where $X_1, X_2, \dots\dots, X_n$ are replaced by corresponding standardized scores $Z_{ij} = \frac{X_{ij} - \overline{X_j}}{s_{X_j}}$, resulted in equal correlation between Y and each Z_i i.e., $r_{YZ_i} = r_{YZ_j}$ $\forall\ i \neq j =$ 1, 2, ….., n. However, determination of methodologically sound weights for computation of CI as weighted sum is difficult since no weighting system is beyond criticism (Greco et al. 2019). Comparing various measures of health-status, Essink-Bot et al (1997) found that none of the tools NHP, SF-36, COOP/WONCA charts, EQ-5D-5L performed uniformly as "best" or "worst. Both IHI and Health Index by NITI Aayog, Govt. of India suffer from methodological limitations in terms of transformations used for scaling or normalization, methods of finding weights and aggregation methods without ensuring satisfaction of Translation Invariance (to produce the same result for a given set of inputs irrespective of their locations) and consistency in aggregation (value of an index computed in stages equals the value obtained in a single stage).

One of the major issues in health index of public health at a given year ($I_{Public\ health_t}$) is meaningful aggregation of health related dimensions and constituent indicators facilitating better comparisons, tracking changes over time, identification of critical areas for taking corrective action (policy intervention) and monitoring health trends. Aggregation method to arrive at the index to satisfy desirable properties including aggregation of $I_{Public\ health_t}$ over all sub-groups (like regions, genders, age/income categories, urban & rural, etc.). Translation invariance requires that the index remains the same regardless of the spatial position i.e. numerical descriptors are shifted but not altered.

Avoiding problems of scaling, selection of weights and probability distributions of indicator scores, multiplicative aggregation of ratios of n-indicators in the t-th year and a fixed base year as $I_{Public\ health_t} = \frac{X_{1t}.X_{2t}\dots\dots X_{nt}}{X_{10}.X_{20}\dots X_{n0}}$ is suggested satisfying translation invariance and aggregation consistency i.e. the index for the country = aggregation of index of all regions = aggregation of index of all domains = product of index formed for each indicator. Priorities can be decided by relative importance of the indicators computed by change in the index due to unit increase in an indicator. Properties satisfied by the index and associated benefits are discussed.

II. LITERATURE SURVEY

A chosen indicator varies across regions of a country indicating health disparities (Fineberg, 2025). "Burden of Disease" could be a chosen domain or a set of chosen indicator reflecting mortality (such as heart disease, cancer, stroke, etc.) and also burdens in terms of disability (such as low back pain, dementia, mental depression, substance use disorder). Health Adjusted Life Expectancy (HALE), Disability Adjusted Life Year (DALY), Quality adjusted life year (QALY), etc. requiring medical interventions merit inclusion. Burden of injuries is a neglected area since injuries are reported as accidents or crime obtained from police records which are often under-reported and may not help to adopt strategy for prevention of injury and prevent lives and disability (Dandona et al. 2017). Similarly, institutional capacities may be extended to strengthening local health departments, core health agencies, rebuilding the public health workforce, pandemic preparedness and incorporating tools of contemporary data science into public health and pursuing strategic health research agenda (Fineberg, 2025). Data driven processes in setting priorities was suggested by Baltussen et al. (2016). Predictive, responsive, integrated, and tiered public health system (PHS) based on individual-levels information of patients were emphasized in Vision 2035: Public Health Surveillance in India (Blanchard et al. 2020). Such PHS can better reflect qualities of health care services and other sources along with rationalized referral networks and improved laboratory capacity. Assessment of performance of players involved in public health interventions and their co-ordinations at local, state, and government levels require different set of indicators. Health care expenditure as percentage of GDP is an obvious choice of indicator, but views expressed against "Dollar for Health". For example, life expectancy at birth for US is less than the average of the same for OECD countries despite spending 18% of GDP by US on medical care and hospital services (Bradley et al. 2016). Higher expenditures in social services associated with public health have positive influence in health outcomes (National Research Council and IOM. 2013). Setting public health priorities need longer horizon to cover among others demographical changes. For example, increasing share of elderly population having less income or no income and constant or increased consumption with multimorbidity, impairments, disability, psycho-social problems is a major public health concerns at global level and is likely to increase in future periods. Thus, elderly population is a vulnerable group for which separate set of priorities may be required.

Domains of Health Index 2021 by NITI Aayog (2021) assigned equal weights to indicators in a domain such that weights are proportional to their perceived importance with the health impacts. Details are shown in Table 1.

Table 1 : Domain-Wise Sub-Domains, Weights and Number of Indicators

Domain	Sub-domain	Larger States		Smaller States		UTs	
		Weight	No. of indicators	Weight	No. of indicators	Weight	No. of indicators
Health Outcomes	Key outcomes	500	5	100	1	100	1
	Intermediate outcomes	300	6	300	6	250	5
Governance and information	Health Monitoring & Data Integrity	70	1	70	1	70	1
	Governance	60	2	60	2	60	2
Key inputs/ Processes	Health system/Service delivery	200	10	200	10	200	10
Total		1130	24	730	20	680	19

A. Observations

- Some of the indicators such as NRR, U5MR, Total fertility rate (TFR), Sex ratio at birth (SRB), etc. are not applicable for Smaller States and UTs. Similarly, percentage of HIV patients on antiretroviral therapy (ART) was not applicable for UTs
- Indicator on Average out-of-pocket expenditure per delivery was available for the reference year only.
- The index for larger states is not well comparable with the index for Smaller States and UTs which excluded indicators with no available data.
- Less importance given on mental health (MH) despite emphasizing the burden of MH issues by the National Mental Health Policy, 2017 of Govt. of India (Ministry of Health & Family Welfare, Government of India, 2017).
- Some important indicators like Health insurance coverage, Doctor- patient ratio, etc. are not included, despite implementation of Ayushman Bharat, India's biggest experiment with public health insurance and poor Doctor- patient ratio in rural areas. The report admits non-inclusion of critical areas like mental health, infectious diseases, non-communicable diseases, governance, and protection of financial risk.
- Sum of weights is different from unity and thus, the weighted sum does not satisfy the convex property. Non-satisfaction of convex property may lead to various problems, including inaccurate resource allocation, biased decision-making, and compromised service delivery. Higher weights to larger states for Health Outcomes make the index biased to larger states.
- Larger states, smaller states and UTs are classified into Aspirants, Achievers and Front runners with respect to score ranges of the index in the reference year. However, efficiency of such classification as ratio of within group variance and between group variance is not considered. Different class boundaries for different types of states and UTs are not equivalent in the sense that proportion up to 48 for larger states ≠ proportion up to 50 for smaller states ≠ proportion up to 45 for UTs for Aspirants.
- State-wise changes in value of the Index from the base year measures incremental progress of each State in the reference year. However, it does not facilitate comparing the regions on the basis of year-on-year progress and testing whether the change is significant for a state or for the entire country.
- The composite Index is calculated for the base year and reference year as $\frac{\sum W_i S_i}{\sum W_i}$ where weight and scale value of the *i*-th indicator are denoted respectively by $W_i$and S_i.
- Overall performances of the States were different than the domain-specific performance.
- Scaling: Value of an indicator was scaled using Min-Max transformation as

$$S_i = \frac{X_i - Min.X_i}{Max.X_i - Min.X_i} * 100 \text{ for positive indicator and}$$
$$S_i = \frac{Max.X_i - X_i}{Max.X_i - Min.X_i} * 100 \text{ for negative indicator}$$

Where S_i denotes the scaled value corresponding to the raw value (X_i) of the *i*-th indicator satisfying $0 \leq S_i \leq 100$ and higher S_i implies better performance. But, $MaxX_i$ and $MinX_i$ were based on values of $X_i's$ across all regions (Larger States, Smaller States, and UTs) for that year. $MaxX_i$ and $MinX_i$ could be outliers and get changed for different years. A change in $MinX_i$ can change ranking of $S_i s$. $X_i \pm Min.X_i$ is not meaningful if X_i is in ratio or percentage or in ordinal level. The fixed zero-point of an indicator measured in ratio or percentage gets altered by *Min-Max* transformation. Accordingly, 3rd root and 4th root of average of figures in percentage were considered by Human Poverty Index (UNDP, 2020).

- A different choice of base year and reference year will change $S_i s$ and $W_i s$ and value of the Index may not be comparable with previous choices of the years.
- The index formulated in two stages (scaling and aggregation) is different from the computation in single stage (direct aggregation) and thus, the index lacks aggregation consistency.

The India Health Index (IHI) used logarithmic of value of each indicator and were standardized to have zero mean and unit standard deviation (SD) and combined as weighted sum where weights were obtained by Principal Component Analysis (PCA) (Sehgal et al. 2024). IHI was computed at the district level. Reliability and validity of IHI were obtained respectively by Cronbach alpha and correlation with U5MR from National Family Health Survey (NFHS-5) (0.74) and Subnational Human Development Index (SHDI) (0.87). The SHDI is a version of the Human Development Index (HDI) with a broader indicator of overall quality of life. Major criticisms against IHI based on cross-sectional data are:

- Positively and negatively related key indicators.
- Standardization to have mean = 0 and SD=1 will give negative values also.
- Relative and not absolute measure of health status.

- Ignores indicators like health outcomes for elderly people, mental health and its physical manifestations, burden of disabilities, gender inequality, etc.
- No attempt made to assess changes of IHI over years
- Rankings of districts as per IHI and SHDI were different.
- Changes on health system over time due to policy interventions were not considered.
- Logarithmic transformations of indicators can distort correlation. For example, $r_{Life\ expetancy,HDI} > r_{Life\ expetancy,GDP}$ but $r_{\log\ (Life\ expetancy),HDI} < r_{\log\ (Life\ expetancy),GDP}$ (Kovacevic, 2011). Moreover, logarithmic transformation fails to satisfy desired properties like translation invariance and consistency in aggregation (Chakravarty, 2003).
- Correlating IHI and SHDI with different number of independent factors to find validity is not desirable. Similarly, reliability of IHI by Cronbach alpha violating uni-dimensionality and tau-equivalent assumptions of Cronbach alpha can be questioned.

The scaling methods used in IHI and Health Index 2021 have advantages and disadvantages.

Different methods of normalization can change differently distributions of scaled scores and affect the final index. It is better to construct multidimensional index avoiding scaling/normalization and weights. Ordinal scores fail to satisfy equidistant property due to unknown distance between levels (Rutter and Brown, 2017), leading to non- meaningful addition or subtraction of item/dimension scores (Jamieson, 2004). Meaningful $X \pm Y = Z$ may go beyond equal score range as emerges from Min-Max transformation and requires similar distributions of X and Y leading to known distribution of Z say by convolution and enabling computation of $P(Z = z) = P$ (X= x, Y= z - x) or $P(Z \leq z) = P\ (X + Y \leq z) = \int_{-\infty}^{\infty}(\int_{-\infty}^{z} f_{X,Y}(x, t - x)dt)\ dx$ for discrete case and continuous case respectively.

III. METHOD

For a given country or region and a given year, let $X_{1t}, X_{2t}, \ldots \ldots, X_{nt}$ be the values of the n-chosen indicators with corresponding values $X_{10}, X_{20}, \ldots \ldots, X_{n0}$ in the base year pertaining to public health where high value of each indicator implies better public health. The indicators with varying degree of inter-correlations could be in different units or expressed as percentages, ratios, counts, in ratio or ordinal scales, or even biomarkers indicating responses to a specific intervention. The unit-free multidimensional index $I_{Public\ health_t}$ is suggested to be obtained as $I_{Public\ health_t} = \frac{X_{1t}.X_{2t}\ldots\ldots X_{nt}}{X_{10}.X_{20}\ldots X_{n0}}$ or equivalently as geometric mean (GM) as $I_{Public\ health_t} = \sqrt[n]{\frac{X_{1t}.X_{2t}\ldots\ldots X_{nt}}{X_{10}.X_{20}\ldots X_{n0}}}$

A. Results

- The index reflects overall improvement in the t-th period from the base period by a monotonically increasing continuous variable.
- $I_{Public\ health_t}$ is not affected by change of units and is least affected by outliers
- Substitutability among the component indicators is reduced significantly unlike arithmetic aggregation.
- 1% improvement in $\frac{X_{jt}}{X_{j0}} \Rightarrow$ 1% improvement in $I_{Public\ health_t}$ if all others are unchanged.
- Separate index can be constructed for regions like states and UTs or urban and rural
- or for different vulnerable groups and for each domain satisfying: $I_{Public\ health_t}^{Country} = \prod I_{Public\ health_t}^{Regions} = \prod I_{Public\ health_t}^{Domains} = \prod I_{Public\ health_t}^{Indicators}$.
- The states and UTs can be ranked meaningfully and classified with respect to the index scores.
- The indicators can be ranked by relative importance of the indicators in the index for the country *i.e.* by $\frac{\Delta I_{Public\ health_t}^{Country}}{\Delta\ Indicator_i}$ and public health priorities of the country can be decided accordingly. Similarly, priorities for a region can be decided by $\frac{\Delta I_{Public\ health_t}^{Region}}{\Delta\ Indicator_i}$
- Value of the ratio $\frac{I_{Public\ health_{(t+1)}}^{Country}}{I_{Public\ health_t}^{Country}}$ <1 implies $\frac{\prod I_{Public\ health_{(t+1)}}^{Indicators}}{\prod I_{Public\ health_t}^{Indicators}}$ <1 and there exists one or more indicators which contributed to the decline in (t+1)-th year over the previous year. Such indicators can be found by observing the ratios for which $\frac{X_{i(t+1)}}{X_{it}}$ <1 and mark them as "critical". Such critical indicators merit immediate attention of the planners for necessary corrective action.

- Progress of a country in successive years is given by $\frac{I^{Country}_{Public\ health_{(t+1)}} - I^{Country}_{Public\ health_t}}{I^{Country}_{Public\ health_t}}*100$
- provided $I^{Country}_{Public\ health_{(t+1)}} > I^{Country}_{Public\ health_t}$. The ratio indicates ability of the index to change with time *i.e.* responsiveness and also effectiveness of public health policies and programmes in the country. The reverse inequality indicates decline in ($t+1$)-th year from t-th year. Similarly, extent of progress or decline of *J*-th region can be quantified by $\frac{I^{J-th\ Region}_{Public\ health_{(t+1)}} - I^{J-th\ Region}_{Public\ health_t}}{I^{J-th\ Region}_{Public\ health_t}}*100$
- The index satisfies time reversal test($I^{Country}_{Public\ health_{t0}} * I^{Country}_{Public\ health_{0t}} = 1$) and facilitates formation of chain indices since $I^{Country}_{Public\ health_{20}} = I^{Country}_{Public\ health_{21}} * I^{Country}_{Public\ health_{10}}$
- Satisfaction of time reversal test and formation of chain indices enable drawing path
- of improvement/decline of a country or a region across time with respect to fixed or varying reference period. Zigzag progress paths may throw light on when and where actual achievement went wrong and facilitate better planning. Such paths also help to compare regions in long time span.
- $I_{Public\ health_t} = \sqrt[n]{\frac{X_{1t}.X_{2t}.........X_{nt}}{X_{10}.X_{20}.....X_{n0}}}$ implies $logI_{Public\ health_t} = \frac{1}{n}\sum_{i=1}^{n} log[\frac{X_{it}}{X_{i0}}]$. Thus,
- SD of $I_{Public\ health_t}$ is equal to Geometric standard deviation (GSD) since
- *log*(GSD of $X_1, X_2, \ldots\ldots, X_n$) = SD of log$X_1$, log$X_2$, ..., log$X_n$, which in turn can be used to compute coefficient of variation (CV) to indicate consistency of the data.
- As n increases, bias of GM decreases and distribution of *GM* approaches lognormal distribution. Thus, it is possible to estimate population *GM* as sample *GM* and standard error of *GM* is $\frac{GM*GSD}{\sqrt{n-1}}$ and to test equality of mean of two GMs by t-tests based on logarithms of the observations.

IV. DISCUSSION

Major limitations of arithmetic aggregation of indicators in different units are avoided by the proposed index generating continuous, monotonic scores satisfying desired properties including country index = aggregation of index of all regions = aggregation of index of all domains = product of index formed for each indicator. Thus, the index $I_{Public\ health_t}$ satisfies translation invariance and aggregation consistency and helps to decide public health priorities by relative importance of the indicators, by change in $I_{Public\ health_t}$ due to unit change in $\frac{X_{jt}}{X_{j0}}$ for the *j*-th indicator.

Other benefits of the proposed index include ranking and classification of regions, identification of critical indicators, assessing progress or decline in successive years reflecting effectiveness of public health policies and programmes, drawing path of progress/decline of the index across time, and facilitating better statistical inferences based on logarithms of the observations. The proposed index with improved quality of measurement facilitates meaningful comparisons and is critically relevant to players involved in public health including planners and researchers. The index can be multiplies by 100 to indicate percentage change in *t*-th period over the base period.

V. CONCLUSIONS

Proposed method of aggregation irrespective of inter-correlations among a number of indicators under a finite number of domains satisfying desired properties and offering benefits of aggregation consistency has clear theoretical advantages and is recommended.

There is no alternate way but to elevating the quality of health care, for all citizens enabling India to reach *Amritkaal* to fulfill the nation's aspirations. Future studies may be undertaken on how health is affected by anticipated future developments like climate change or increased potential of artificial intelligence.

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VI. REFERENCES

[1] Akbari H, Mohammadi M, Hosseini A. (2023). Disease-Related Stigma, Stigmatizers, Causes, and Consequences: A Systematic Review. *Iran J Public Health*. 52(10):2042-2054. DOI: 10.18502/ijph.v52i10.13842.

[2] Ashraf K, Ng CJ, Teo CH, Goh KL. (2019). Population indices measuring health outcomes: A scoping review. *J Glob Health*. 9(1):010405. DOI: 10.7189/jogh.09.010405.

[3] Baltussen R, Jansen M. P., Mikkelsen E, Tromp N, Hontelez J, Bijlmakers L, Van der Wilt G. J.(2016). Priority setting for universal health coverage: we need evidence-informed deliberative processes, not just more evidence on cost-effectiveness. *Int J Health Policy Manag*.5 (11):615–618. doi:10.15171/ijhpm.2016.83

[4] Blanchard J, Washington R, Becker M, Vasanthakumar N, Madangopal K, *et al.* (2020). *Vision 2035: Public Health Surveillance in India. A White Paper*. NITI Aayog. Govt. of India. DOI: 10.6084/m9.figshare.14093323

[5] Bradley, E. H., Canavan, M., Rogan, E., Talbert-Slagle, K., Ndumele. C., Taylor, L., and Curry. L. A. (2016). Variation in health outcomes: The role of spending on social services, public health, and health care, 2000–09. *Health Affairs (Millwood)*, 35:760–768. DOI: 10.1377/hlthaff.2015.0814

[6] Chakrabartty, Satyendra Nath (2017): Composite Index: Methods and Properties, *Journal of Applied Quantitative Methods,* 12(2), 31-41

[7] Chakravarty, S. R. (2003). A Generalized Human Development Index. *Review of Development, Economics*, 7(1), 99-114. DOI: 10.1111/1467-9361.00178

[8] Dar, S. A., Khurshid, S. Q., Wani, Z. A., Khanam, A., Haq, I., Shah, N. N., Shahnawaz, M., Mustafa, H. (2020). Stigma in coronavirus disease-19 survivors in Kashmir, India: A cross-sectional exploratory study. *PLoS One*. 15(11):e0240152. DOI: 10.1371/journal.pone.0240152.

[9] Dandona, R., Bertozzi-Villa, A., Kumar, G. A, and Dandona, L. (2017). Lessons from a decade of suicide surveillance in India: who, why and how? *Int J Epidemiol*; 46: 983–93. DOI: 10.1093/ije/dyw113

[10] Essink-Bot, M. L., Krabbe, P. F., Bonsel, G. J., Aaronson, N. K. (1997): An empirical comparison of four generic health status measures. The Nottingham Health Profile, the Medical Outcomes Study 36-item Short-Form Health Survey, the COOP/WONCA charts, and the EuroQol instrument. *Med Care;* 35(5):522–537. DOI: 10.1097/00005650-199705000-00008

[11] Fineberg, H. V. (2025). Setting Public Health Priorities in the United States. *JAMA*. doi:10.1001/jama.2025.0485

[12] Goli, S. & Arokiasamy, P. (2014). Trends in health and health inequalities among major states of India: Assessing progress through convergence models. *Health Economics, Policy, and Law, 9*(2), 143–168. DOI: https://doi.org/10.1017/S1744133113000042

[13] Greco, S, Ishizaka, A, Tasiou, M and Torrisi, G. (2019): On the Methodological Framework of Composite Indices: A Review of the Issues of Weighting, Aggregation, and Robustness, *Soc Indic Res* 141:61–94 https://doi.org/10.1007/s11205-017-1832-9

[14] Hartung, J., Knapp, G. and Sinha, B.K. (2008): *Statistical Meta-Analysis with Applications*. John Wiley & Sons, Hoboken, 44. https://doi.org/10.1002/9780470386347

[15] Hyder, A. A., Puvanachandra, P., Morrow, R. H. (2012). Measuring the health of populations: explaining composite indicators. *J Public Health Res*. 1:222–8. Doi: 10.4081/jphr.2012.e35.

[16] Jamieson, S. (2004). Likert scales: How to (ab) use them. *Medical Education,* 38, 1212 -1218

[17] Kovacevic, M. (2011). *Review of HDI Critiques and Potential Improvements*, The Human Development Research Paper (HDRP) Series, Research Paper 2010/33.

[18] Mazziotta, M. and Paretoa, A. (2021). Everything you always wanted to know about normalization (but were afraid to ask). *Italian Review of Economics, Demography and Statistics*, 75(1), 41–52.

[19] Mazziotta, M. and Pareto, A. (2013): Methods for constructing composite indices: One for all or All for one? Rivista Italiana di Economia Demografia e Statistica, 67(2), 67-80

[20] Mhlanga, S. T. and Lall, M. (2022). Influence of Normalization Techniques on Multi-criteria Decision-making Methods. *Journal of Physics: Conference Series*; Vol. 2224, doi:10.1088/1742-6596/2224/1/012076

[21] Nardo, M., Saisana, M., Saltelli, A. and Tarantola, S. (2005). Handbook on Constructing Composite Indicators: Methodology and User Guide, *OECD Statistics Working Papers*, 2005/3, OECD Publishing.

[22] Ministry of Health & Family Welfare, Government of India. National health policy 2017. https://www.nhp.gov.in/1nhpfiles/national_health_policy_2017.pdf

[23] NITI Aayog (2021). Healthy States, Progressive India Report on the Ranks of States and Union Territories. Ministry of Health & Family Welfare, Government of India. http://social.niti.gov.in/

[24] NRC (National Research Council) and IOM. (2013). US health in international perspective: Shorter lives, poorer health. Washington, DC: The National Academies Press; 2013

[25] Parrish, R. G. (2010). Measuring population health outcomes. *Prev Chronic Dis*;7(4). http://www.cdc.gov/pcd /issues/2010/jul/10_0005.htm

[26] Registrar General of India, Government of India (2021). Report on medical certification of cause of death 2019. New Delhi: Government of India. Census India.

[27] Rutter L. A and Brown T. A. (2017).Psychometric properties of the generalized anxiety disorder scale-7 (GAD-7) in outpatients with anxiety and mood disorders. *J. Psychopathol. Behav. Assess.*39 140–146.

[28] Scientific Peer Review Group (SPRG) (2001): *Report of the Scientific Peer Review Group on Health Systems Performance Assessment*, WHO: Geneva. http://www.who.int/health-systemsperformance

[29] Sehgal, M., Jatrana, S. & Johnson, L. (2024). A comprehensive health index for India: development, validation, and spatial variation. *J Pop Research*, 41, 21. DOI: 10.1007/s12546-024-09341-2

[30] Tofallis, Chris (2014): Add or Multiply? A Tutorial on Ranking and Choosing with Multiple Criteria. INFORMS Transactions on Education 14(3):109-119. http://dx.doi.org/10.1287/ited.2013.0124

[31] UNDP (2020). *Human Development Report 2020: The Next Frontier: Human Development and the Anthropocene*. New York. http://report2020.archive.s3-website-us-east-1.amazonaws.com

[32] Van de Water HP, Perenboom RJ, Boshuizen HC. (1996). Policy relevance of the health expectancy indicator; an inventory in European Union countries. *Health Policy*. 36:117–29. DOI: 10.1016/0168-8510(95)00803-9

[33] Yang, L. (2014). An inventory of composite measures of human progress, Technical report, United Nations Development Programme Human Development Report Office.