Title: Inequalities in Global Healthcare Access Coverage: Econometric Analysis of Geospatial Estimates of 256 Territories

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Conflicts of Interest:
None

Background:
Globally, over 50% of the global population lacks access to essential health services. A major contributing factor is the geographic inaccessibility due to unequal distribution of healthcare facilities. Our aim was to synthesize national and subnational estimates for geospatial access by walking and motorized transport to healthcare facilities and conduct a formal inequality analysis of healthcare accessibility for these regions.

Methods:
We obtained motorized and walking travel times to healthcare facilities raster (1 km^2) data from the Malaria Atlas Project, high resolution population estimates (1 km^2) from WorldPop, and level-0 (national) and level-1 (subnational) administrative boundaries of sovereign states and dependent territories from GADM-3.6. Healthcare access coverages (HAC) were defined as the proportions (%) of the population within 2 hours and 1 hour from their nearest healthcare facility by motorized (HAC-M) and walking (HAC-W) modes of transport, respectively. For these outcomes, we conducted inequality analyses using Theil Index (T). First, overall inequality was calculated for national boundaries using level-0 territories. Next, using level-1 subnational regions as units of analysis, inequality (T') was decomposed into within- (T_W) and between-territory (T_B) components.

Findings:
For HAC-M (level-0 no. of territories, n_0 =242, after removing territories with 0 values), overall inequality was given T = 0.036. In decomposition analysis (level-1 no. of territories n_1 =3519), T' was 0.019 with global T_B = 0.008 and global T_W = 0.011, i.e. T_W = 1.4 T_B. Western Sahara has the highest within-territory inequality (T_W = 1.096), while European countries of Andorra, Hungary, Slovakia and Liechtenstein had the lowest T_W = 0. For HAC-W (n_0 =244) overall inequality was given by T = 3.055. Decomposition analysis (n_1 =3379) found that the total inequality (T' = 1.82) was formed by global T_B = 1.602 and global T_W = 0.218, i.e. T_B = 7T_W. The islands of American Samoa, French Southern Territories, Saint Pierre and Miquelon, and Svalbard and Jan Mayen had T_W = 0 values whereas New Zealand has the highest T_W value of 1.28.

Interpretation:

To our knowledge, this is the first global analysis investigating distributional inequalities in geographic healthcare access coverage. HAC-M within-territories inequality is more than between-territories, contrary to HAC-W. Our findings are limited by limitations of the parent data sources. Future studies should investigate geospatial clusters needing policy attention and infrastructural investments.

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BACKGROUND

- Globally, over 50% of the population lacks access to essential health services according to the World Bank and WHO.
- A major contributing factor is the geographic inaccessibility due to unequal distribution of healthcare facilities.
- Our aim was to synthesize national and subnational estimates for geospatial access by walking and motorized transport to healthcare facilities and conduct a formal inequality analysis of healthcare accessibility for these regions.

METHODOLOGY

Data Sources

- WorldPop, Global motorized and walking travel friction surface from the Malaria Atlas Project and GADM v3.6. for populations estimation through raster-based analysis.

Data Analysis

- Healthcare access coverages (HAC) were defined as the proportions (%) of the population within 2 hours and 1 hour from their nearest healthcare facility by motorized (HAC-M) and walking (HAC-W) modes of transport, respectively.
- For these outcomes we conducted inequality analyses using Theil Index (T) and Gini Index (G).
- First, overall inequality T, G was calculated for national boundaries using level-0 national territories. Next, using level-1 subnational regions as units of analysis, inequality (T'), (G') was decomposed into within- (T_W), (G_W) and between-territory (T_B), (G_B) components.

FINDINGS

Out of 256 territories, n_0 =242 (level-0 no. of territories, after removing territories with 0 population proportion values) were considered for the inequality analysis. For HAC-M the overall inequality was given T=1.855. In decomposition analysis (level-1 no. of territories. n_1 =3519) it was found that $T_B = 3.08T_W$. For HAC-W overall inequality was given T=1.835. Decomposition analysis (n_1 =3379) found that $T_B = 2.37T_W$. A summary of the findings can be seen below.

Theil Index: 0 to ∞
0:Perfect equality
Greater value=Greater Inequality

Extended Gini Index:0 to 1
0:Perfect equality
1:Perfect Inequality

Units of Analysis=States
Groups=Countries

Total Inequality = Between-group + Within-group (+Overlap)

Accessibility Type	Theil Index	Between-group Theil	Within-group Theil	Extn. Gini Index	Between-group Gini	Within-group Gini	Overlap in Gini Decomposition
HAC-M 120	1.704	1.287	0.417	0.806	0.738	0.004	0.064
HAC-W 60	1.710	1.203	0.507	0.821	0.733	0.005	0.084

Table 1. *Summary of Decomposition Inequality analyses*

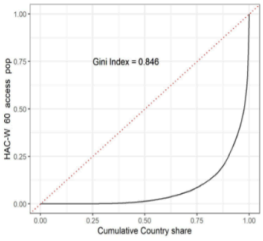

Fig 1. *Lorenz Curve for HAC-W*

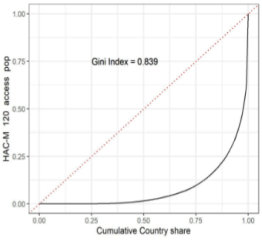

Fig 2. *Lorenz Curve for HAC-M*

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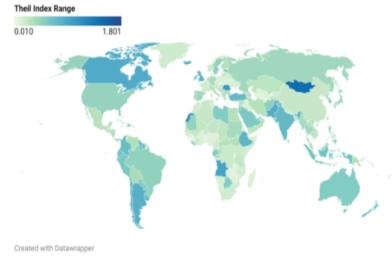

Fig 3. *Choropleth Map representing Theil Index values for HAC-M 120*

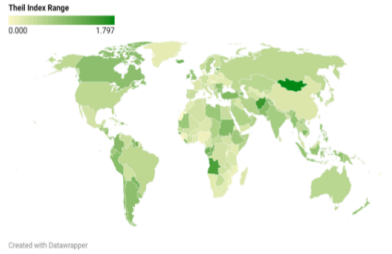

Fig 4. *Choropleth Map representing Theil Index values for HAC-W 60*

CONCLUSION

To our knowledge, this is the first global analysis investigating distributional inequalities in geographic healthcare access coverage. For both modes of transport, it is evident that between-country inequality is more than within-country inequality. Future studies should investigate geospatial clusters needing policy attention and infrastructural investments.