

# Data Exploration of Social Determinants of Health, Health Access and Quality in a Global Health Setting

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**Abstract.** Diseases have no borders, and global health operates from both within and beyond. Global health informatics can adopt an assets-oriented approach to mitigate concerns by maximizing global health data, principles, and resources combined with geographic information systems' use case mapping. This exploratory study utilizes an assets-oriented approach to analyze four global social determinants of health indicators, including Skilled Birth Attendance, Measles Immunization Coverage, Education (Female), and the Healthcare Access and Quality Index in relation to countries' income and geographical region. Data were extracted and analyzed from two publicly available datasets. Positive trends and variations were detected among all variables aggregated by countries' income category and geographical region. These findings pinpoint potential health assets that the discipline of nursing can leverage to build healthier global health communities.

**Keywords.** Social determinants of health, global health informatics, health assets, data analytics, nursing informatics

## 1. Introduction

Diseases have no borders, and global health management calls for collaborative efforts to mitigate threats to the health of international communities. [1] Assets-oriented approaches use protective and promoting factors to help individuals, communities, and populations maintain and sustain health to reduce inequalities. [2-4] This approach allows nurse informaticists to maximize global health informatics data, including geographic information systems (GIS) data, to explore social determinants of health (SDH) and detect patterns of assets and issues that can inform the planning, implementation, and evaluation of nursing interventions to equitably improve health worldwide.

SDH are the conditions in which people are born, grow, live, and work [5] and have been widely recognized as key indicators in determining a population's health status. As such, SDH are often used to describe societies and utilized in health interventions as predictors of health outcomes by researchers and policymakers worldwide. [6] These

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indicators can be included in assets-oriented nursing assessments collectively and cumulatively. A cumulative national-level Healthcare Access and Quality (HAQ) Index [7] can be used by researchers to assess healthcare access and quality, national health-related achievements, and the undesired progress across and within countries to guide decision-making for future improvement. [7] Nurses can leverage health assets to address health concerns and deficits using findings from an assets-oriented assessment.

To this end, this exploratory study utilized an assets-oriented approach to assess SDH indicators in relation to countries' income and geographical region using publicly available datasets. With open-source data, assets-oriented discoveries can be utilized to find structural health concerns and deficiencies. These discoveries can inform nurse-led strategies aimed at positively impacting health outcomes in global communities.

## 2. Assets-Oriented Approach and Story Mapping Framework

GIS story mapping can help identify geographical gaps and health disparities.<sup>[8]</sup> With GIS, complex health data is dynamic and can be interpreted interactively within a geographical context.<sup>[8]</sup> To guide this study, an Assets-Mapping Framework of Healthy Global Communities that incorporates GIS and global health informatics (Figure 1) was created, which is intended to cultivate global health assets to build healthier communities.



Figure 1. Assets-mapping framework of healthy global communities.

## 3. Methods

This exploratory study integrated publicly available 2016 data from 189 countries at the Institute for Health Metrics and Evaluation (IHME). [6] These data comprised selected SDH indicators and HAQ data analyzed in relation to geographical location and income classification using the study framework (Figure 1). Data mining techniques of classification and clustering were applied to organize data, track patterns, and detect aberrations to discover health assets and burdens. Countries were grouped into seven geographical regions (Table 1) and further categorized as: “high income” (HI), “upper middle income” (UMI), “lower middle income” (LMI), and “low income” (LI), which are measures of gross national income per capita. [9]

IHME’s SDH data provide metrics to characterize societal factors and demonstrate the distribution and impact of societal conditions relevant to population health. [6] This study’s variables represented SDH within the global economic and geographical contexts. The variables included a maternal health service of Skilled Birth Attendance measured in percentage, a public health prevention measure of Measles Immunization Coverage in percentage, and a demographic characteristic of Education (Female) in years. [6] Skilled Birth Attendance reflects the presence of a skilled professional at the time of birth. [10]

The Education (Female) and Skilled Birth Attendance variables were intentionally selected because women historically have been a disadvantaged group worldwide. A fourth variable, HAQ Index, measured by a scale from 0 (worst) to 100 (best), was used as a summary estimate of healthcare access and population health quality. [7]

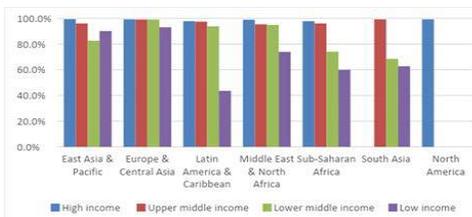
#### 4. Results

As seen in Table 1, the economies differed widely by region. “Europe and Central Asia” had the highest number of countries, and “North America” had the fewest. Most countries in “Europe and Central Asia” were HI, and most countries in “Latin America and the Caribbean” were UMI.

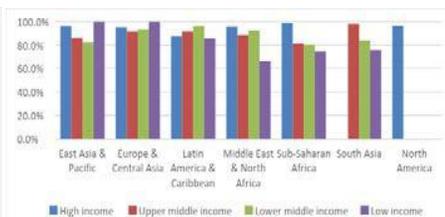
**Table 1.** Number of countries by region and by income categories.

By Region	HI	UMI	LMI	LI	Total
East Asia and Pacific	9	8	13	1	31
Europe and Central Asia	30	15	3	1	49
Latin America & the Caribbean	9	18	4	1	32
Middle East and North Africa	8	6	5	2	21
North America	3	0	0	0	3
South Asia	0	2	4	2	8
Sub-Saharan Africa	1	6	14	24	45
Total	60	55	43	31	189

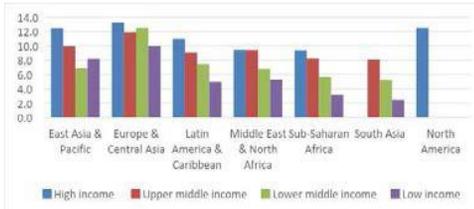
As seen in Figure 2, there were positive trends in Skilled Birth Attendance (%) by income across all regions except “East Asia and Pacific.” The percentage of Skilled Birth Attendance in the LMI category in this region was lower than all other income categories. As seen in Figure 3, there were positive trends in Measles Immunization Coverage (%) by income in “Sub-Saharan Africa” and “South Asia” with variations in other regions. The highest Measles Immunization Coverage occurred in the LI category in “East Asia and Pacific” and “Europe & Central Asia.” Conversely, the lowest Measles Immunization Coverage occurred in the respective LI category in “Latin America and the Caribbean,” “Middle East and North Africa,” “Sub-Saharan Africa,” and “South Asia.”



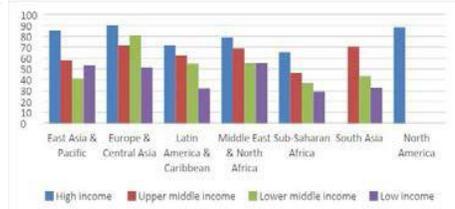
**Figure 2.** Percentage of national Skilled Birth Attendance by income category and by region.



**Figure 3.** Percentage of national Measles Immunization Coverage by income category and by region.



**Figure 4.** National Education (female) level in years by income category and by region.



**Figure 5.** National HAQ Index by income category and by region.

As seen in Figure 4, there were positive trends in Education (Female) (Years) by income in all regions except “East Asia and Pacific” and “Europe and Central Asia.” “East Asia and Pacific” had the lowest level of Education in the LMI category while “Europe and Central Asia” had a higher level of Education in the LMI category compared to the UMI and LI categories. As seen in Figure 5, there were positive trends in HAQ Index (0- 100 scale) by income in all regions except in “East Asia and Pacific” and “Europe and Central Asia” in the LMI category. “East Asia and Pacific” had the lowest HAQ Index in this income category as compared to all others, while “Europe and Central Asia” had a higher HAQ Index in this category as compared to the UMI and LI.

Across all SDH data, similarities and variations were present. Education (Female) and HAQ Index patterns were similar in relation to income and region, while Skilled Birth Attendance and Measles Immunization Coverage patterns varied by income and region

## 5. Discussion

As seen above, income was disproportionately distributed among the seven regions. In recent decades, the number of HI countries has increased, and the number of LI countries has decreased. [10] These variations in income align with differences in health outcomes measured by the SDH indicators, as demonstrated by the positive trends within the regions. In these cases, a country’s income level and economy compose substantial health assets for building healthy communities and populations. Interestingly, isolated instances of variations were also present. Slightly lower levels of SDH indicators and health outcomes were occasionally present among higher-income categories than lower-income categories. These deviations may be linked to health assets other than income or health burdens common to geographical locations. Researchers should explore positive and negative trends and any variations to better understand health assets and burdens to inform the planning, implementation, and management of public health nursing services.

Skilled Birth Attendance is an SDH indicator largely related to a country’s income level. The slight variance suggests countries with lower economies can still perform better than those with higher economies where other health assets are awaiting discovery and better utilization of nursing coordinated public health care. Further research should be pursued surrounding other assets that could contribute to this anomaly in outcome.

Even though measles is no longer a leading cause of child mortality, immunization coverage is a valuable indicator of the strength of such programs and child health programs worldwide. [11] Inequalities in socioeconomic status and spatial differences in location are related to immunization coverage. [12] Health and social inequalities must

be considered to achieve and maintain measles elimination. [13] Measles Immunization Coverage patterns varied greatly among the income categories and thus did not appear to be closely related to countries' economies. Thus, it is critical to recognize the strengths and deficits in Measles Immunization Coverage in each region to cultivate health assets and implement more robust public health nursing immunization programs to enhance disease prevention and health promotion strategies.

Evidence shows that level of educational attainment is a strong predictor of long-term health and quality of life. [13] The positive trends in both Education (Female) and HAQ Index concur with this finding. Negative trends indicate a need to leverage additional SDH assets other than economies to mitigate health deficits and inequalities within and across populations in the design of public health policies [14] and in nursing to facilitate a collaborative process to strategically prioritize health assets and resources.

This study has potential limitations. Since this study used existing data from a single moment in time, these data may not be reflective of current SDH global indicators. There is a potential for selection bias given that the dataset had to include countries with a complete set of study variables.

## 6. Conclusion

In summary, both patterns of positive trends and variations among SDH indicators and the HAQ Index by income category and region helped pinpoint potential health assets by geographic location. To mitigate health concerns in an ever-changing global environment and to positively shape global healthcare outcomes, further studies using real-time GIS data combined with global health resources are needed to facilitate an assets-oriented approach in public health nursing. Future nursing directions should build upon this assets-oriented model and continue to leverage SDH assets and health outcomes data to guide the planning, implementation, and evaluation of nursing interventions.

## References

- [1] World Health Organization. Global report on diabetes 2016, URL [apps.who.int/iris/bitstream/10665/204871/1/9789241565257\\_eng.pdf](https://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf)
- [2] Morgan A, Ziglio E. Revitalising the evidence base for public health: An assets model. *Promotion and Education*, 14:17 (2007), 2.
- [3] Rotegard AK, Moore SM, Fagermoen MS, Ruland CM. Health assets: A concept analysis. *International Journal of Nursing Studies* 47 (2010), 513-525.
- [4] Glasgow Centre for Population Health. Asset based approaches for health improvement: redressing the balance. Oct 2011, [https://www.gcph.co.uk/assets/0000/2627/GCPH\\_Briefing\\_Paper\\_CS9web.pdf](https://www.gcph.co.uk/assets/0000/2627/GCPH_Briefing_Paper_CS9web.pdf)
- [5] World Health Organization. The determinants of health. 2020. URL <https://www.who.int/ia/evidence/doh/en/>
- [6] Institute for Health Metrics and Evaluation [IHME]. Social determinants. URL <http://www.healthdata.org/social-determinants>
- [7] GBD 2016 Healthcare Access and Quality Collaborators. Measuring performance on the Healthcare Access and Quality Index for 195 countries and territories and selected subnational locations: a systematic analysis from the Global Burden of Disease Study 2016. *Lancet*, 2:391(10136) (2018), 2236-2271. doi: 10.1016/S0140-6736(18)30994-2
- [8] ESRI. The changing face of health, in five story maps storytelling with maps. August 07 2015, URL <https://www.esri.com/about/newsroom/insider/the-changing-face-of-health-in-five-story-maps/>
- [9] Prydz EB, Wadhwa D. Classifying countries by income. Sep 09, 2019. URL <https://datatopics.worldbank.org/world-development-indicators/stories/the-classification-of-countries-by-income.html>

- [10] World Health Organization. Sexual and reproductive health. 2020, URL [https://www.who.int/reproductivehealth/topics/mdgs/skilled\\_birth\\_attendant/en/](https://www.who.int/reproductivehealth/topics/mdgs/skilled_birth_attendant/en/)
- [11] World Health Organization. Measles immunization coverage. 2020, URL [https://www.who.int/gho/mdg/child\\_mortality/situation\\_trends\\_measles\\_immunization/en/#:~:text=](https://www.who.int/gho/mdg/child_mortality/situation_trends_measles_immunization/en/#:~:text=)
- [12] Shankar J, Ip E, Khalema E et al. Education as a social determinant of health: Issues facing indigenous and visible minority students in postsecondary education in Western Canada. *Int J Environ Res Public Health*, 10:9 (2013), 3908–3929, doi: 10.3390/ijerph10093908
- [13] Rivadeneira MF, Bassanesi SL, Fuchs SC. Socioeconomic inequalities and measles immunization coverage in Ecuador: A spatial analysis. *Vaccine*, 36:35 (2018), 5251-5257. doi: 10.1016/j.vaccine.2018.07.051
- [14] Gumà J, Solé-Auró A, Arpino B. Examining SDH: The role of education, household arrangements and country groups by gender. *BMC Public Health*, 19:699 (2019), <https://doi.org/10.1186/s12889-019-7054-0>