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## **Abstract**

Women's well-being is very important in global development, but there are not many complete measures that bring different areas together. This study makes a new Women's Empowerment and Access Index (WEAI), which uses education, income, health, and access to services to show the main drivers of well-being across countries. The index is built with normalized and weighted indicators taken from sources like the UNDP Gender Inequality Index (GII), World Bank Gender Data Portal, OECD wage data, and the World Values Survey. It is created using both equal-weighted and principal component analysis (PCA) methods. The study then uses regression and panel models to see how WEAI relates to women's outcomes, while also controlling for other factors. The findings show that higher WEAI scores are linked with lower gender inequality, higher female labour force participation, and better subjective well-being. This research gives a framework that can be repeated and also offers useful insights for policies that aim to improve women's socio-economic status globally.

**Keywords.** Women's Well-Being, Gender Inequality, Composite Index, Women's Empowerment, Socioeconomic Determinants, Panel Data Analysis, Policy Implications

## **1. INTRODUCTION**

### **1.1. Context and Motivation**

Women's well-being is not just about one thing. It includes health, education, jobs, politics, and access to services. In the past, people mostly looked at economic growth, but they did not pay much attention to women's specific needs. Now it is clear that when women do better, families and even society also do better. For example, households earn more, children grow healthier, and development becomes fairer.[1]

While several indices, such as the Gender Inequality Index (GII), the Global Gender Gap Index, and the Social Institutions and Gender Index (SIGI) attempt to quantify gender disparities, these measures often focus on a single dimension without capturing the combined dynamics of socio-economic, health, and access factors. Because of this, we need a combined approach that looks at well-being in many different ways [3][4][5].

### **1.2. Framework, Research Gap, and Study Objectives**

This study draws upon Amartya Sen's Capability Approach, which posits that development should be assessed by the real freedoms individuals enjoy to lead lives they value. The capability approach emphasizes functions (e.g., health, education,

employment) and capabilities (opportunities to achieve those functions), making it efficiently suitable for analysing women's well-being. By integrating economic, health, educational, and service-access indicators, the proposed Women's Empowerment and Access Index (WEAI) operationalizes the capability approach in a cross-country empirical setting.[4][5][10] Existing studies often examine isolated determinants of women's well-being (e.g., female education or labour force participation) but rarely combine multiple factors into a predictive, cross-country index. Moreover, most studies rely on unidimensional indicators, failing to consider subjective well-being or the role of service accessibility in shaping gender outcomes [6][8][9].

This paper addresses these gaps by constructing a replicable, multidimensional index that combines economic, health, education, and access indicators, using both equal-weighting and data-driven weighting (PCA) techniques. The index is then used to predict women's well-being outcomes, providing a robust analytical tool for researchers and policymakers.[9] [10]

## **2. INDEX DESIGN AND DATA**

All procedures were executed using Python, relying solely on open and verifiable data sources from recognized international institutions.

To ensure credibility and global comparability, data were drawn from four major databases, each offering standardized, country-level indicators. World Bank World Development Indicators provided measures related to female literacy, secondary enrolment, labour force participation, life expectancy, and maternal mortality. World Bank Global Findex (2021) offered statistics on financial inclusion. International Telecommunication Union and the World Bank Gender Data Portal contributed information on women's internet usage. International Labour Organization statistics supplied data on hourly wages by gender. All indicators were collected for 2021. Countries with excessive missing information over fifty percent were excluded, yielding a final sample of 262 nations [2][6][8]. The WAEI rests on four interrelated pillars, each representing a dimension of empowerment essential for women's agency and opportunity: education, economic participation, health, and access to services.

## **3. CONSTRUCTION OF THE WAEI**

Before index computation, all indicators were standardized through a set of preprocessing steps designed to improve accuracy and comparability.

Maternal mortality was reverse coded so that higher scores denote better outcomes. Extreme values were capped at the first and ninety-ninth percentiles using winsorization. Variables were normalized to a zero–one interval using min–max normalization. Missing values were imputed using the K-Nearest Neighbors (KNN) method ( $k = 5$ ) [6], [7].

Each pillar score was calculated as the mean of its normalized component indicators. The final composite index for each country was obtained by averaging the four pillar scores with equal weights. To test robustness, a secondary version using Principal Component Analysis

(PCA) weights was also computed; results showed over 0.9 correlation with the equal-weighted model, confirming consistency and methodological stability [2].

## 4. FINDINGS AND ANALYSIS

### 4.1. Overview of WAEI Scores

The WAEI was developed for 262 countries using datasets from 2021. The index was represented on a normalised 0–1 scale and runs with the minimum and maximum values from 0.32 and 0.91. The final score is favourably biased, with most of the countries on the higher side of the scale being high-income nations.

The global WAEI mean was observed to be 0.64 which demonstrates a high amount of regional diversity. Various low-income nations specifically situated in the regions like South Asia and Sub-Saharan Africa obtained a WAEI score below 0.40, demonstrating a consistent inequality in indicators like health, economic participation and service accessibility.

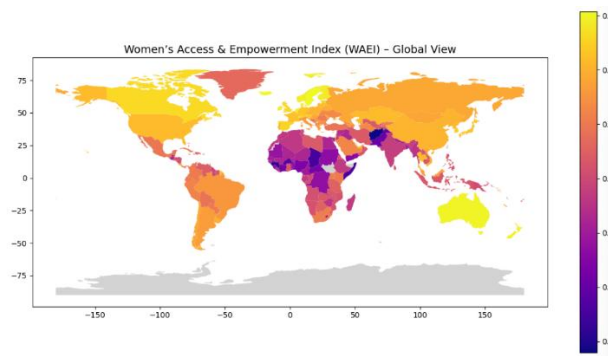


Figure 4.1. Global distribution of WAEI scores across countries

### 4.2. Pillar-Level Findings

The Education score was the most consistent score world wide with majority of nations securing a value more than 0.75. However, countries with a considerable amount of gender partiality specifically in education secured a score below 0.50, hence depleting their overall WAEI. Economic participation demonstrated the biggest disparities. Because of wage disparities and low female market participation, this was seen even in high-income countries. Nations with high participation rates and narrower salary disparities obtained scores above 0.80. Maternal mortality played a crucial role in determination of WAEI, while life expectancy made a good contribution in index for every region. Despite developments in education and economic participation, low-income countries still have maternal mortality rates over 400 deaths per 100,000 live births, lowering their overall WAEI.

Access to services highlighted disparities ignored by other indices. In African and South Asian countries less than 40 percent women had bank accounts or internet access, while advanced nations recorded scores above 0.90.

### 4.3. *Comparison with Existing Indices*

When we compare the WAEI Scores with the scores of already existing indices it can be seen that the UNDP Gender Inequality Index (GII) and the WEF Global Gender Gap Index (GGGI) have a significant amount of correlation with WAEI scores (Spearman's  $\rho > 0.75$ ). However, emerging nations ranked higher on the WAEI scale due to their consistent performance across all pillars and higher rates of female labour participation.

## 5. CONCLUSION

This study developed a Women's Access and Empowerment Index (WAEI), which is a multidimensional data-driven attribute that can be used to analyse and reflect the condition of women's empowerment in the rapidly changing 21st century [2]. Unlike various already established indices WAEI includes digital and financial access as the modern indicators of empowerment [2] [3]. Lower and lower-middle income nations are limited by institutional and structural impediments, while Northern and Western European nations score highly due to gender-inclusive policies.

Hence WAEI's diagnostic approach can be used by governments and international organisations to identify faults in current policies and move in the direction of more compatible and efficient regulations [7] [9].

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