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IS SUB-SAHARA AFRICA CLOSING THE GENDER INEQUALITY GAPS? A PRINCIPAL COMPONENT-CLUSTER ANALYSIS

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ABSTRACT

Gender inequality in the labor market has long been a source of concern in the global human rights and development agenda, it's not just a necessary human right but it's a precondition for economic development. Despite the realization of some MDGs, SDGs, and Agenda 2030 goals, women in SSA continue to be marginalized. Notably, SSA nations have eliminated 66.45 percent of gender disparities in general. The region, in specific, has achieved remarkable strides toward gender parity in education, reducing the gap by approximately 88 percent, 98 percent in health, and 71 percent in economic participation. However, there exist major gender differences in political empowerment, where only 21.8% of the gender gap has been closed. The study recommends that SSA countries should fully implement and live up to the requirements of the ILO and UN conventions and treaties on gender equality for economic prosperity.

Keywords: Gender Equality, Gender gap Index, Gender Inequality Index, Social Institution and Gender Index, Principal Component Analysis.

1.0 Introduction

Gender equality is stated to be achieved when men and women have equal entitlements and opportunities in all facets of life, and when their needs are acknowledged and prioritized equally (Barnat et al., 2020). Several composite indices have been established to evaluate and quantify gender disparities in the labor market. For instance, the 2030 Agenda for Sustainable Development includes more than 80 gender-related indicators that promote gender equality and equity in society (Barnat et al., 2020). The Universal Declaration of Human Rights, adopted by the United Nations in 1948, states that every individual is born equal and entitled to the same respect and privileges. Gender equality improves social, political, and economic equity and, more importantly, it is a human rights issue (Robles, 2012). In a country's labor market,

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achieving gender equality ideals promotes economic efficiency and other aspects of economic development (World Bank, 2011). When women's full potential in the job market is realized, macroeconomic efficiency is enhanced. In addition, through increasing earnings, labor force participation positively promotes women's economic development (Cunningham et al., 2018). Furthermore, expanding women's labor market possibilities may have beneficial spillover effects on women's agency, control, and power, all of which are important for family well-being (Cunningham et al., 2018).

Gender is defined by the responsibilities, actions, activities, and qualities that a given society believes proper for men and women at a given period (UN women, 2001). Surprisingly, the UN has prioritized gender equalitarian over gender equity as a critical objective to accomplish (UN Population Fund [UNPF], 2017). Gender equity, according to UNPF (2017), is the process of treating men and women equally, suggesting a social justice factor in society based on culture, customs, tradition, and religion. Gender equality, on the other hand, is broader and richer in terms of women's empowerment, therefore it is supported by gender equity (Barnat et al., 2020). Gender equality, according to UN Women (2001), is defined as equal rights, roles, and opportunities for all individuals, considering the needs and interests of diverse gender sub-groups. The International Labor Organization (ILO, 2017) defines gender equality as the mechanism through which equality exists for men and women to exercise all their basic rights, as well as to participate in and gain from the political, social, and economic contexts. As a result, gender equality includes equality at home, in the community, and in society (ILO, 2017).

Gender inequality in the labor market has long been a source of concern in the global human rights and development agenda, it’s not just a necessary human right but it’s a precondition for economic development, notwithstanding its importance in promoting macroeconomic efficiency and poverty alleviation (Robles, 2012; Barnat et al., 2020). The United Nations (UN) charter, which was endorsed in 1945, and the Universal Declaration of Human Rights, which was approved by the UN General Assembly in 1948, acknowledge, foster, and advocate respect for human rights and essential liberties for all women and men. In addition, the UN Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), which was enacted in 1979 and describes prejudice against women and establishes a national action plan to abolish it, is another key milestone in women's rights. Female efforts and interests have been underappreciated in market economies. This is because gender analysis has not been given enough consideration., according to the Beijing Declaration and Platform for Action (Women, U.N, 1995). Therefore, several legislation and initiatives must be put into place to combat gender inequities. (Women, U.N, 1995).

In 2000, the Millennium Development Goals (MDGs) were established and encompassed gender issues explicitly in the 3rd goal “promote gender equality and empower women”. Regarding this

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MDG goal, women are marginalized in waged employment compared to their male counterparts in SSA and are often concentrated in vulnerable sectors of employment (UN, 2000). The MDGs status report, according to the UN (2015a), showed progress in achieving gender equality in education, females' accessibility to economic opportunities, and elective positions. Despite the realizations, women continue to be excluded, with considerable disparities in incomes, labor force participation, poverty levels, and decision-making power (UN, 2015b). The UN General Assembly initiated a UN Women entity in 2010 to fast-track the progress of gender equality and empowering women (UN Women, 2018). Furthermore, the International Labor Organization (ILO, 2012) highlights four vital gender conventions; the equal remuneration convention (No. 100), the discrimination, employment, and occupation convention (No. 111), the workers with family obligations convention (No. 156), and maternity protection convention (No. 183). Many nations, including the majority of SSA countries, have accepted, and adopted these treaties, especially Conventions Nos. 100 and 111, having approvals from 51 and 53 of Africa's 54 ILO partner states, respectively (Robles, 2012). To achieve SDG targets and increase economic prospects and output, gender inclusivity, particularly social, economic, and political inclusion are all crucial., according to the Addis Ababa Action Agenda (UN, 2015c). Furthermore, according to the UN (2015d), the 2030 Agenda places a greater emphasis on gender equality than the MDGs, with a specific focus on ending all kinds of prejudice and aggression towards females. In addition, the SDGs included the abolition of forced and early marriages and FGM, and ensuring all people have access to reproductive and sexual health services (UN, 2015).

Even though many African countries have ratified and accepted the International Labor Organization's conventions (Robles, 2012), their effective implementation and enforcement remain a challenge. The enforcement of ILO labor market requirements to promote gender equality and empower women for macroeconomic efficiency, social fairness, and poverty reduction is threatened by social, cultural, tribal, customary norms, and religious views, which are predominantly prevalent in SSA nations. As a result, this study presents an assessment and comparative analysis of three gender disparity indices; Gender Gap Index (GGI), Gender Inequality Index (GII), and the Social Institution and Gender Inequality Index (SIGI), and hence analyze their impact on economic growth in Sub-Sahara Africa. The objective is to address the research query on what's the extent and prevalence of gender inequality indices and their implications in SSA. To answer this research question, principal component analysis and cluster analysis are used to identify and cluster the most important dimensions of gender indices that significantly influence gender equality measures and assess their prevalence in the SSA region.

2.0 Empirical Literature

There is empirical evidence that when an economy develops, women's workforce engagement assumes a U-shaped design. This pattern holds for African and other developing countries

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(Anyanwu, 2016). Theoretically, the U-shaped growth path is because women's workforce involvement drops before soaring as the economy progresses (Anyanwu, 2016). In addition, males' better educational attainment and access to economic opportunities signify the marginalization of females during the take-off stage of the economic growth path. However, as a country grows and develops, females' proportion of the workforce and access to economic opportunities grows as well. In addition, when the household's unearned income rises, the inducement for females to work in market labor rather than at home decreases. Because of the inverse income impact, families can afford more leisure time for females, while on the other hand, when women's earnings increase, additional females are persuaded to participate in the labor market through the substitution effect (Bloom et al., 2009; Chaudhuri, 2009; Tam, 2011).

Gender equality and economic development have a bidirectional causal relationship, according to UNCTAD (2017). This meant that both variables influenced each other: economic development influenced gender equality, and gender biases influenced macroeconomic outputs, such as GDP per capita, trade, and prices. Gender equality benefits economic development from different perspectives, especially in social, economic, educational, and career opportunities, including access to financial resources (Klassen &Lamnna, 2009; Dollar &Gatti, 1999). Reverse causality, according to Busse and Spielmann (2005), can also occur. Firms that specialize in the manufacturing of labor-intensive goods may use women's lower incomes as a comparative advantage strategy. Busse and Spielmann (2005) observed that nations with large earnings inequality recorded more labor-intensive exports. Furthermore, disparities in workforce engagement between men and women, education disparities, and the comparative advantage of labor-intensive enterprises all have an inverse connection. Therefore, gender disparities in earnings, workforce participation, and educational attainment have a big impact on the economy's macroeconomic consequences (Busse&Spielmann, 2005).

In Finland, Lindroos et al. (2019) examined gender equality and income distribution in international trade and found that profits from international trade are unequally distributed across gender. In 2016, women made up 18% of entrepreneurs in export-oriented businesses and 27% of the labor force. Interestingly, trading operations paid better wages to women than other businesses, while employing fewer females and having a larger wage disparity across the gender divide. Furthermore, female entrepreneurs hired more women than male entrepreneurs. This meant that females' lower workforce engagement in foreign trade increased the possibility of differences in capital and gender wages. Gender equality in the workplace has a substantial impact on macroeconomic gains, specifically increasing GDP per capita (Loko & Diouf, 2009; Aguirre et al., 2012; Cuberes&Teigner, 2012; Elborgh-Woytek et al., 2013). Equal employment for women would allow organizations and businesses to better utilize the existing skill pool, thereby resulting in increased growth (Barsh& Yee, 2012; OECD, 2021a). Prospects to enhance

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women's earnings to exercise financial independence is a significant strategy for eradicating poverty, particularly in emerging economies (Heintz, 2010), on the other hand, improved workforce engagement coupled with increased incomes would result in higher household expenditures on education, eventually prompting a virtuous cycle, particularly among professional females who serve as mentors in the society (Aguirre et al., 2012; Miller, 2008).

Kucera and Milberg (2000) found that between 1978 and 1995, trade expansion between OECD countries and developing countries resulted in a disproportionate loss of employment for females, especially those employed in import-oriented firms. Bussolo and De Hoyos (2009) found comparable results, particularly in agriculture-oriented countries where women dominate industries such as food production and processing that compete with imported goods. Furthermore, Seguino and Grown (2006) observed that the uplifting of tariff restrictions on labor-intensive imports displaces more females than males from the workforce in Africa. International trade, according to development economists, is a key pillar of economic growth and development and signifies the diverse responsibilities and comparative gains of states in the global economy, as well as gender equality challenges (Barnat et al., 2020). Whether one adheres to the Ricardian Orthodox school of thought that trade liberalization is important (Friedman, 2005) or leans toward heterodox thinking about trade benefactors and losers (Stiglitz, 2002; Sach, 2005, Piketty, 2014; Bourguignon, 2015), there is a consensus that trade plays an important role in economic development (UN, 2012). Higher gender equality indices, on the other hand, are not a guarantee of equitable trading in the labor market (Barnat et al., 2020).

With three stages of growth, Eastin and Prakash (2013) discovered a curved correlation between economic expansion and gender equality. The first stage of the S-shaped curve implies that economic development promotes gender equality by encouraging more women workforce engagement, whereas the second phase implies that division of labor and prejudice promote differing gender earnings paths, lowering the forgone value of women workforce withdrawal and strengthening social resistance to rising gender norms, resulting in a decrease in initial equality benefits. Gender equality improves in the last phase when women get access to economic possibilities, the opportunity cost of staying at home rises, and new social institutions and norms emerge to counteract previous discriminatory behaviors. Gender equality in education, according to Chen (2004), has a favorable impact on equalities in workforce possibilities. Similarly, there exist high prospects for highly educated females to join the workforce, particularly in metropolitan regions, resulting in higher incomes and a larger opportunity cost of workforce inactiveness (Ogawa & Akter, 2007; World Bank, 2010). Campa et al. (2011) found that the index of gender culture based on a firm's attitude, women's education, and literacy are vital determinants of employment gender disparities in the Italian provinces.

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Vallanti et al. (2012) found that enhancing women's access to education and lowering fertility choices greatly explains women's labor market involvement, with significant differences observed across European nations with different institutional and welfare structures. Increased spending on social programs reduces gender gaps in democracy. A quadratic association between democracy and gender inequality was established by Hegre (2001) and Anyanwu and Augustine (2013). Similarly, Eastin and Prakash (2013) asserted that democracy has a considerable favorable impact on female workforce engagement in the labor force and gender equality. Democracies unleash females' labor market capability and allow marginalized people, including females, to contribute to the decision-making process, leading to the design of redistributive policies that benefit the marginalized (Anyanwu, 2016). Globalization improves gender equality, according to Richards and Gellemy (2007), because international commerce and foreign direct investment create jobs and economic prospects for females in the domestic labor market.

3.0 Methodology

3.1 Data and Definition of Variables

To comprehend the picture of gender inequalities in Sub-Sahara Africa, three major gender indices are analyzed and juxtaposed: the Global Gender Gap Index (GGI), the Gender Inequality Index (GII), and the Social Institutions and Gender Index (SIGI). The indicators were chosen mainly because they cover most countries in Africa; are formed as composite indicators suitable for the PCA and cluster analytic approaches; and are revised regularly, ensuring that the data is relatively current.

The Index (GGI) was created by the world economic forum in 2006 to address the demand for a standardized and elaborative measure of gender parity to be used to assess an economy's development progress (WEF, 20180). The underpinning of this index is based on the interactions between social, economic, and political aspects of life that result in gender disparities (WEF, 2018). In this regard, GGI entails economic participation, education level, health & survival, and political empowerment as the main sub-indicators which are used to rank countries based on gender parity instead of women empowerment (WEF, 2018).

Gender Inequality Index (GII) developed by United Nations Development Program (UNDP, 2018), assess how unequally males and females co-exist in society. The underlying idea is the prejudice against women in all aspects of life which is essentially against fundamental human rights (UNDP, 2018). Labor force participation, women empowerment, and reproductive health form the key sub-indicators for this index.

The Organization for Economic Cooperation and Development (OECD, 2009) developed the SIGI to examine gender parity across countries based on social institutions. The principal idea is

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that gender disparities in social institutions contribute to gender gaps in all other dimensions of life; social, political, and economical (OECD, 2019). As a non-weighted composite index, SIGI encompasses family discrimination, constrained physical integrity, restricted access to financial inputs, and regulated civil liberties as key sub-indices, however, there exist multiple subcategories inside each sub-index (OECD, 2019). The sub-indicators envisage disparities in rights and opportunities across the gender divide arising from individual attitudes and preferences, practices, and legislation. An index score of zero denotes total gender parity while a score of 1 denotes complete inequality (OECD, 2019).

The 15 sub-indices that make up the three gender equality indices are utilized as inputs. Table 1 lists all the variables and the sources of data used in the analysis. The gender equality indexes covered 40 of the 46 countries in Sub-Saharan Africa. The GII had data for 40 nations, the SIGI had data for 22 nations, and the GGI had data for 38 nations. These, of course, differed from one indicator to the other as some countries had missing data for some sub-indices. Only 22 nations' data were available for the 15 sub-indices of interest. As a result, only 22 countries were subjected to PCA and Cluster analysis in this study. It should be emphasized that this sample comprises nearly half of the countries in Sub-Saharan Africa.

Table 1: Summary of Gender Inequality Indices

Sub-Index	INDEX CATEGORY	SOURCE
Health and Survival	GGI	World Economic Forum
Education attainment	GGI	World Economic Forum
Political Environment	GGI	World Economic Forum
Economic participation and Opportunity	GGI	World Economic Forum
Discrimination in family	SIGI	OECD
Restricted Physical Integrity	SIGI	OECD
Restricted Access to Productive and Financial resources	SIGI	OECD
Restricted Civil Liberties	SIGI	OECD
Labor force participation, female	GII	UNDP
Labor force participation, male	GII	UNDP
Adolescent birth rate	GII	UNDP
Female with at least secondary education	GII	UNDP
Maternal Mortality ratio	GII	UNDP
Male with at least secondary education	GII	UNDP
Share of seats in parliament, female	GII	UNDP

Source: Own construction

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3.2 Principal Component Analysis

To analyze these high-dimensional datasets, a dimensionality reduction technique is needed to ensure that the retained data contains as much information as before (Barnat et al., 2020). The most used approach for this purpose in the empirical investigation is the Principal Component Analysis (PCA) and the Cluster Analysis (Barnat et al., 2020). PCA and Cluster Analyses are the best methodologies for reducing dimensionality for a set of continuous factors while preserving more information than before, optimizing the twin challenge of diminishing linear dimensions while also minimizing mean-square error (Jackson, 1991; Jolliffe, 1990). As a result, PCA and cluster analyses are employed in this study to determine the most essential elements or dimensions that underpin the gender parity indicators. PCA decreases observable factors to orthogonal principal components that account for as much variance in the data as possibly conceivable (Jolliffe, 2002).

PCA aids in the identification of patterns in multivariate data. It identifies a vector in N-dimensional space using an orthogonal linear transformation. The first principal component (PC1) explains the most overall variation in a set of factors, where total variability within the data is the sum of the observed variables' variances after each variable has been normalized (mean 0, std. dev 1). The maximum of the remaining variability in the original variables is accounted for by a second component (PC2), which is orthogonal to the first. Each subsequent principal component is linearly uncorrelated with the previous ones and accounts for much of the remaining variance (Sorzano et al., 2014; Weng & Young, 2017; Jolliffe, 1986). To address variable incommensurability, PCA can be employed as a descriptive, statistical technique for data transformation (Barnat et al., 2020). The eigen values associated with the vector for each PC represent the ranking of the main components in order of their importance. This helps in determining whether the gender indices have an economic component, and if so, how much of the variance it explains in comparison to other factors. The PCA gives a more synthetic perspective of the indexes' disparities. The PCA method is used to investigate correlations between dependent variables while retaining as much data as possible. Using the principal component and cluster analyses, the study not only finds connections between distinct sets of input data but also finds commonalities between nations regarding gender disparity strengths and weaknesses (Barnat et al., 2020).

4.0 Results and Discussions

4.1Principal Component Analysis

The KMO test, Commonalities, and the Total Variance Explained according to Hair (2006) are all used to determine whether PCA is appropriate. To achieve the minimal criteria for doing PCA

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evaluation, the Kaiser-Meyer-Olkin (KMO) sample sufficiency test values must be greater than 0.5, the relevance of the variables shown by commonality must be greater than 0.4, and the total variance explained must be greater than 60%. The result in Table 2 indicates that the KMO measure is 0.658 which meets the threshold. Based on the commonalities results (Table 3), the extraction scores are all > 0.4 implying that the importance of each variable is important in determining the components while also the components formed explain 70.314% of the variations (Table 4), hence we meet the minimum criteria for conducting PCA (Hair, 2006).

Table 2: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.658
Bartlett's Test of Sphericity	Approx. Chi-Square	205.644
	Df	120
	Sig.	.000

Source: Own computation

Table 3: Communality Extractions

Communalities		
	Initial	Extraction
Economic Involvement	1.000	0.617
Educational Attainment	1.000	0.649
Health and Survival	1.000	0.713
Political Empowerment	1.000	0.809
Maternal death proportion (Death per 100000 live births)	1.000	0.732
Adolescent birth rate (births per 1000 live births)	1.000	0.638
Women's share of seats in parliament (%)	1.000	0.757
Individuals with at least secondary education (female, %)	1.000	0.920
Individuals with at least secondary education (male %)	1.000	0.898
Labor force participation rate (female %)	1.000	0.905
Labor force participation rate (male %)	1.000	0.856
Discrimination in the family	1.000	0.757
Constrained physical integrity	1.000	0.578
Restricted access to productive and financial resources	1.000	0.542
Restricted civil liberties	1.000	0.549

Source: Own computation Extraction Method: Principal Component Analysis.

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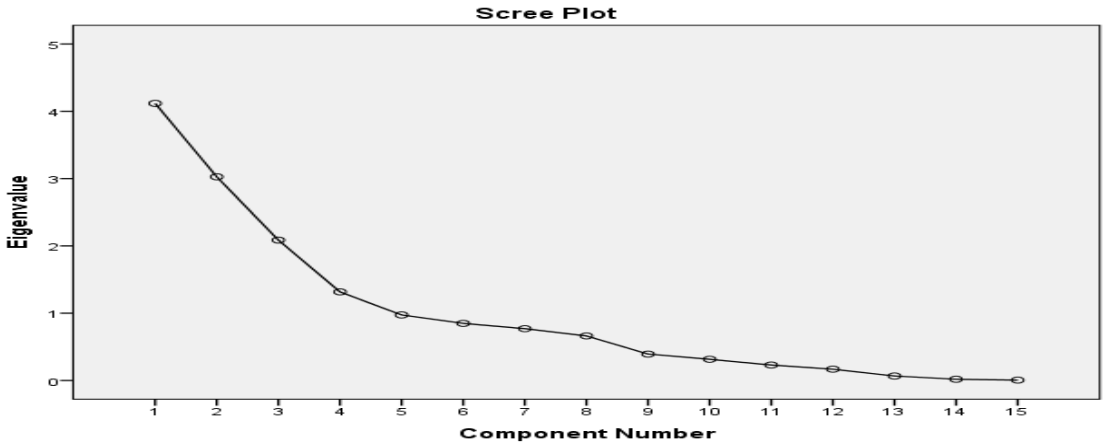
Table 4: Total Variance Explained Matrix

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.117	27.450	27.450	4.117	27.450	27.450	3.588	23.920	23.920
2	3.027	20.178	47.628	3.027	20.178	47.628	2.970	19.801	43.721
3	2.086	13.910	61.538	2.086	13.910	61.538	2.339	15.595	59.316
4	1.316	8.776	70.314	1.316	8.776	70.314	1.650	10.998	70.314
5	.974	6.493	76.807						
6	.849	5.660	82.466						
7	.770	5.136	87.602						
8	.662	4.416	92.018						
9	.393	2.618	94.636						
10	.316	2.104	96.740						
11	.230	1.531	98.272						
12	.168	1.119	99.391						
13	.067	.446	99.836						
14	.019	.126	99.962						
15	.006	.038	100.000						

Source: Own computation Extraction Method: Principal Component Analysis.

Catell's (1996) Scree test is used in the study, it's a graphical display of the eigenvalues of the input elements. The gradual decline in eigenvalues appears to level off at a certain point on the plot. Only "factorial scree" is visible to the right of this point. Five components were extracted for analysis after looking through the scree plot. Only those components with a value > 1 (Kaiser rule) are kept and utilized, i.e., simply those with the least explanatory power (Raîche et al., 2013).

Figure 1: Scree Plot for Component Analysis



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We find four major components of gender equality indices using a rotational component matrix. Following a study of the sub-indices to determine which are highly correlated, the following four main components are identified: The first component (PC1) is highly correlated by population with least secondary education for both males and females, maternal death proportion, Education Attainment, and Adolescent birth proportion. All the indices in PC1 relate to education and health conditions, hence, we label the component "Education and Health Conditions". The second component (PC2) comprises political empowerment, women's seats in parliament, restricted physical integrity, and constrained access to financial and productive inputs. All these indicators can be labeled as the "Political empowerment and Accessibility" component. The third component (PC3) is characterized by; the labor force participation rate (male, female) and the restricted civil liberties; all of which can be referred to as the "Labor force participation and Civil liberties" component. The fourth component (PC4) comprises economic involvement and family discrimination. These two indices can be labeled as the "Economic participation and Discrimination" component. focuses on health (PC4). PCA does not explain the results; instead, each of the components or pillars must be analyzed and given a proper name. These four main components together account for 70% of the variance in the 15 sub-indicators that make up the gender gap index, gender inequality index, and social institutions and gender index.

Table 5: Rotated Component Matrix

	Component			
	1	2	3	4
Individuals with at least secondary education (female %)	0.950	-0.079	-0.103	-0.037
Individuals with at least secondary education (% male)	0.928	-0.160	-0.103	0.015
Maternal death proportion (Death per 100000 live births)	-0.778	-0.337	-0.100	0.049
Educational Attainment	0.686	0.414	0.032	-0.084
Adolescent birth proportion (births per 1000 live births)	-0.628	0.005	0.029	0.493
Political Empowerment	-0.016	0.894	-0.034	-0.091
Women's seats in parliament (%)	0.049	0.864	0.036	-0.082
Constrained physical integrity	0.017	-0.733	0.151	0.133
Constrained access to productive and financial inputs	-0.309	-0.606	-0.280	0.027
Labor force involvement (%, female)	-0.240	0.265	0.881	0.042
Labor force involvement (%, male)	-0.365	-.0014	0.757	0.387

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Constrained civil liberties	0.074	-0.068	0.652	-0.338
Health and Survival Score	-0.234	0.230	-0.478	0.045
Family Discrimination	-0.048	-0.158	0.074	0.851
Economic Participation and Opportunity Score	0.053	0.221	0.442	-0.608

Source: Own computation

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.

The four components are listed in the table below, along with their impact on the total explanatory power. PCA1 namely Education & Health accounts for 39% of the total variance while PCA2 (Political Empowerment and Accessibility) explains 28.7% of the total variations. PCA3 and PCA4, respectively, account for 19.8 and 12.6 percent of the remaining variance. It's worth noting that each of the extra components has two distinct properties. It explains a maximum number of variations in the output that the previous component did not account for, and it is uncorrelated with all other components (Barnat et al., 2020).

In the first component (PC1) as shown in Table 5, there is a high direct link between education conditions for both males and females with the component. This means that investment in education and gender equality in education increases the values of the component. Health outcomes: maternal death proportion (-0.778) and adolescent birth level (-0.628) are inversely correlated with the component. This has the implication that as the values of the component increase, the health outcomes in this component decrease. It's worth noting that a higher level of education across the gender divide is connected to a decreased maternal death rate and adolescent births.

The PC2 is highly defined by women's political participation indices which are positively correlated with the component while restriction to physical integrity (-0.733) and restriction to access to productive and financial resources (-0.606) are negatively correlated with the component. This implies that an increase in a restriction on financial and productive resources by women lowers the efforts for women's political empowerment and accessibility. Similarly, PC3 is positively driven by labor force participation for females (0.881), and males (0.757) and restricted civil liberties (0.652). This indicates that a surge in the coefficients of labor force participation across the gender divide measured by income and leadership increases the value of the component. Furthermore, PC3 is positively correlated with discrimination in the family implying that the prevalence of females' discrimination in the family increases females' economic accessibility.

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Table 6: Retained Principal Components (Eigenvectors)

	Education& Health outcome	Political Empowerment & Accessibility	Labor force Participation & Civil liberty	Economic participation & Discrimination
Individuals with at least secondary education (%, female)	0.950			
Individuals with at least secondary education (%, male)	0.928			
Maternal death rate (Death per 100000 live births)	-0.778			
Educational Attainment	0.686			
Adolescent birth proportion (births per 1000 live births)	-0.628			
Political Empowerment		0.894		
Women share seats in parliament		0.864		
Constrained physical integrity		-0.733		
Regulated access to productive and financial input		-0.606		
Labor force involvement (%, female)			0.881	
Labor force involvement (%, male)			0.757	
Regulated civil liberties			0.652	
Health and Survival				
Discrimination in the family				0.851
Economic Participation and Opportunity				-0.608
Proportion of total variance	**0.390**	**0.287**	**0.198**	**0.125**

Source: Own Computation.

Note: The numbers (or factor loadings) with the same sign contribute within a given component in the same direction, while those with opposite signs contribute to a component but in an opposing direction.

4.3 Cluster Analysis

Using gender gap index (GGI) as the input variables, Correlation coefficients between the sub-indicators (Table 7) are all lower than 0.9 hence we meet the minimum criteria for applying cluster analysis. Based on the line chart, 3 clusters, and 4 clusters are considered appropriate. Moreover, the standard deviations are lower for 4 clusters hence the most appropriate, however,

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gender inequality indices are ranked on a 3-point Likert scale (low, medium, and high) hence the study adopted 3 clusters for analysis.

Table 7: Correlation Matrix

		Economic Participatio&Opportunity	Educational Attainment	Health and Survival	Political Empowerment
Economic Participation and Opportunity	Pearson Correlation	1	0.192	-0.249	0.258
	Sig. (2-tailed)		0.391	0.264	0.247
Educational Attainment	Pearson Correlation	0.192	1	0.134	0.305
	Sig. (2-tailed)	0.391		0.552	0.167
Health and Survival	Pearson Correlation	-0.249	0.134	1	0.198
	Sig. (2-tailed)	0.264	0.552		0.376
Political Empowerment	Pearson Correlation	0.258	0.305	0.198	1
	Sig. (2-tailed)	0.247	0.167	0.376	
	N	22	22	22	22

Source: Own Computation

Figure 2: Agglomeration Schedule Coefficients.

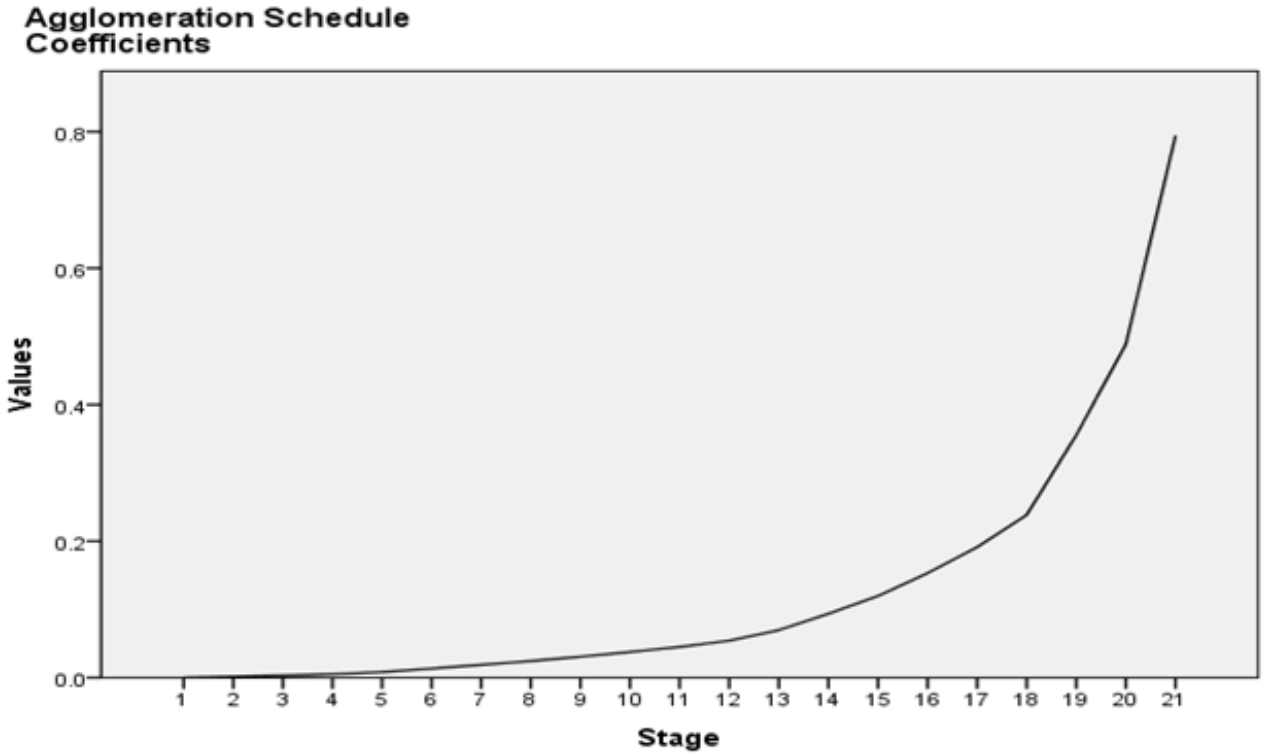

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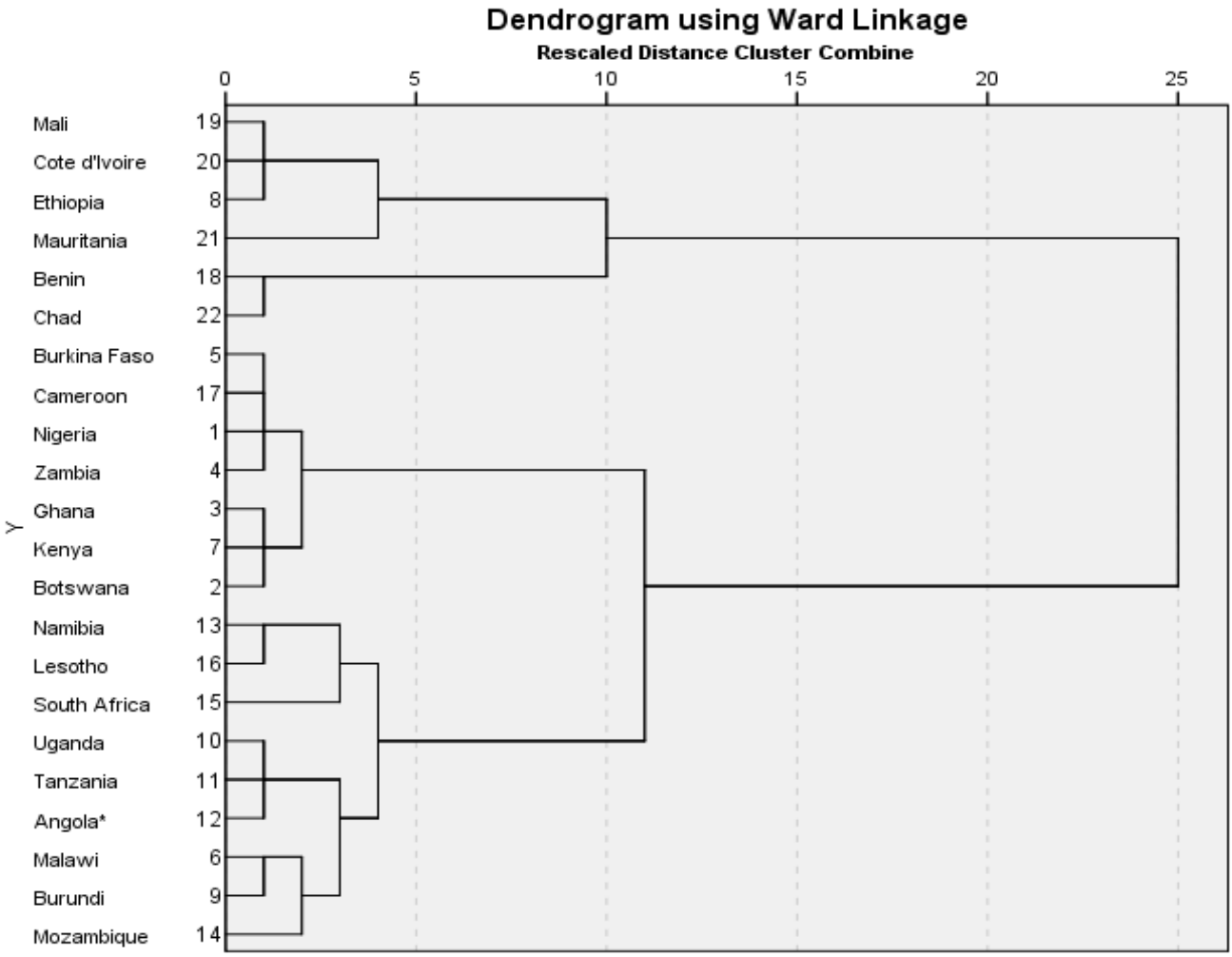
Figure 3: Dendrogram Using Ward Linkage for clustering.



In all the clusters, the standard deviations for the clusters are lower than the standard deviations of all countries in total, so the means can be considered for naming the clusters as depicted in Table 8. But based on the means, in the first cluster, the means for economic participation and educational attainment are higher than the total means for all countries while health & survival, and political empowerment have mean values lower than the total means of all countries hence countries in cluster 1 have medium gender gap indices. The mean of countries in the second cluster are all higher than the total mean values of the countries hence Cluster 2 can be named as countries with a higher gender gap index. In the third cluster, the average scores are less than the total average values of all countries hence cluster 3 is named as countries with lower gender gap index scores.

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Table 8: Ward Method output for Cluster naming.

Ward Method		Economic Participation and Opportunity	Educational Attainment	Health and Survival	Political Empowerment
1	Mean	0.714	0.875	0.964	0.088
	Std. Dev	0.042	0.0705	0.00535	0.0282
2	Mean	0.731	0.902	0.973	0.269
	Std. Dev	0.079	0.0725	0.0122	0.0729
3	Mean	0.583	0.682	0.972	0.108
	Std. Dev	0.0126	0.103	0.0086	0.0312
Total	Mean	0.685	0.834	0.969	0.168
	N	22	22	22	22
	Std. Dev	0.1039	0.129	0.00988	0.1002

Source: Own computation

Seven nations were identified as having medium gender gap index scores based on the findings in Table 9. This indicates that GGI was common and that gender equality in economic involvement, education level, health conditions, and political environment is moderate. The gender gap index scores of nine countries in the study were found to be high, indicating that gender inequalities are widespread in these countries. Therefore, women in these 9 countries have limited access to the gender gap sub-indicators. The countries with the lowest GGI scores were six. This means that in these nations, women have more economic, political, health, and educational chances than in other Sub-Saharan African countries, implying that gender equality is a priority.

Table 9: Cluster Membership.

Case Summaries				
				Country
Ward Method	Countries with Medium GGI score	1		Nigeria
		2		Ghana
		3		Burkina Faso
		4		Burundi
		5		Tanzania
		6		Cameroon
		7		Benin
		Total	N	7
	Countries with High GGI score	1		Botswana
		2		Zambia

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	3		Kenya	
	4		Ethiopia	
	5		Uganda	
	6		Namibia	
	7		Mozambique	
	8		South Africa	
	9		Lesotho	
	Total	N		9
	1		Malawi	
	2		Angola*	
	3		Mali	
Countries with Lower GGI score	4		Cote d'Ivoire	
	5		Mauritania	
	6		Chad	
	Total	N		6
Total	N			22

Source: Own Computation.

Figure 4: Economic participation vs Education attainment cluster membership

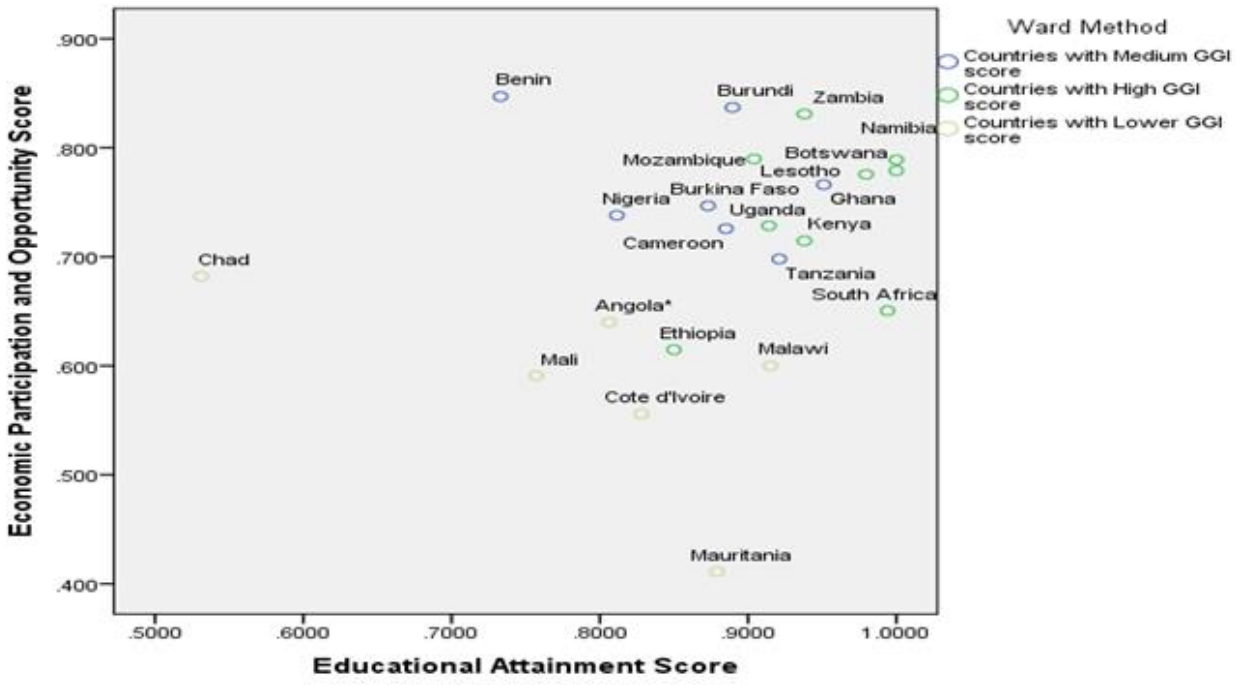

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Figure 5: Education attainment vs Health condition cluster membership

Figure 6: Health Survival vs Political Environment cluster membership

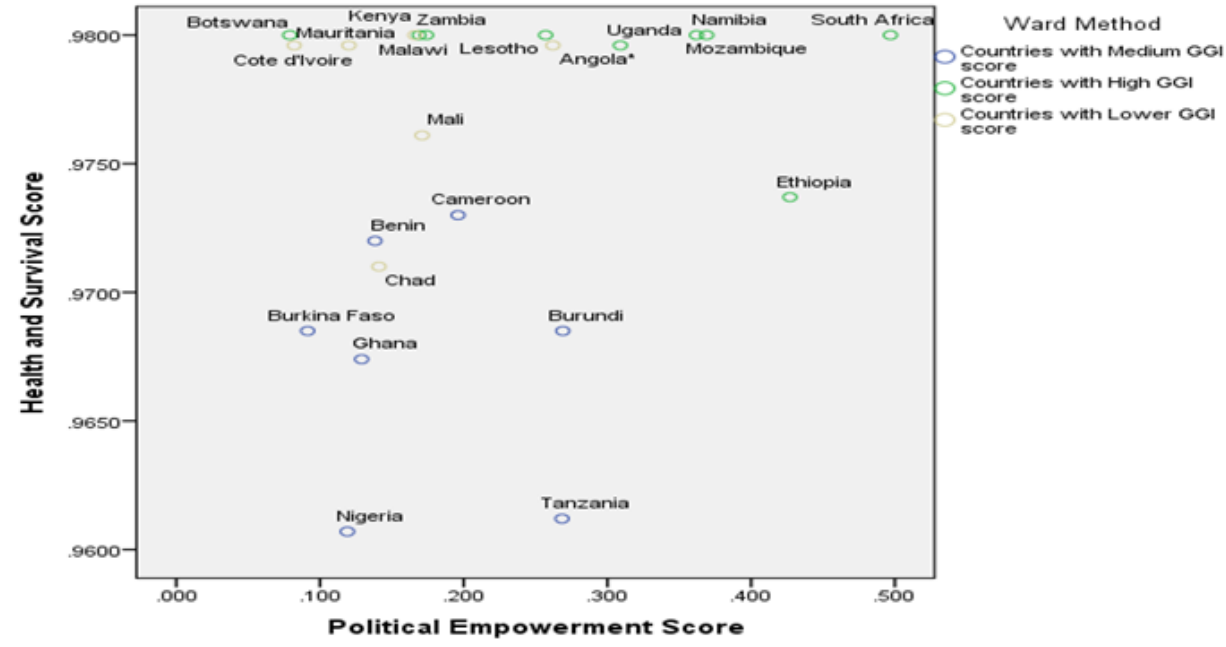

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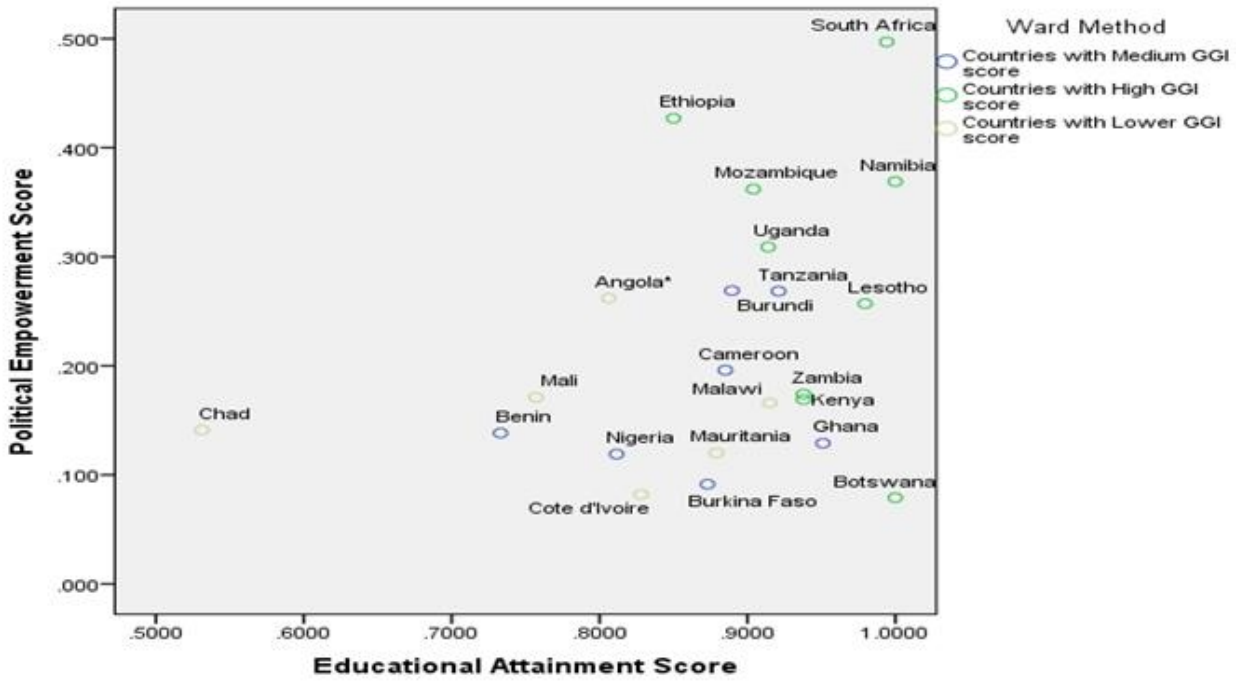
Figure 7: Education attainment vs Political Empowerment Cluster membership



Using the GGI sub-indices as the input variables, we visualized the clusters using scatter plots as shown in Figures 4, 5, 6, and 7 to determine the distribution of countries within the clusters. Each sub-index in the cluster was plotted against the other to give a clear picture of the prevalence of these indicators in different countries within the same cluster and across clusters. Figures 4,5,6, and 7 show that SSA countries with high and low GGI scores have larger indices for economic involvement and educational attainment, whereas countries with medium GGI values have lower-to-moderate gender gap indices. Even with a low gender gap index score, SSA nations still have gender inequalities in economic and educational dimensions, implying that gender inequality in educational achievement and economic involvement is still pervasive. Figure 5 depicts large differences in health access and survival in SSA nations. Figure 6 shows that SSA nations have made progress in reducing gender inequality in politics. This suggests that women can hold political office and leadership positions.

We further grouped the countries into different regions within Sub-Sahara Africa namely, West Africa, East Africa, and Southern Africa to examine gender equality performance within the SSA region. Table 15 and Figure 8 show that within countries with medium gender gap index scores, the ratio of West African countries (71.4%) is higher than the average score (40.9%) while East Africa (28.6%) had a lower ratio than the average score. This implied that the attainment of gender equality regarding GGI sub-indices was high in West African countries than in other

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regions in SSA; the west African countries performed better to curb gender gaps in education, economic participation, health, and political empowerment. The ratio of South African countries within countries with high GGI scores was higher (66.7%) than the average score of all countries implying that within the cluster, the gender inequalities regarding GGI sub-indices were low in South African countries than in any other SSA region. Furthermore, within countries with a lower gender gap index cluster, the ratio of west African countries (66.7%) was higher than the average (40.9%) indicating that within the cluster, West African countries account for higher gender equality than in any other SSA region.

Table 10: Regional grouping Crosstabulation *Ward Method

			West Africa	East Africa	Southern Africa	Total
Ward Method	Countries with Medium GGI score	Count	5	2	0	7
		% within Ward Method	71.4%	28.6%	0.0%	100.0%
	Countries with High GGI score	Count	0	3	6	9
		% within Ward Method	0.0%	33.3%	66.7%	100.0%
	Countries with Lower GGI score	Count	4	0	2	6
		% within Ward Method	66.7%	0.0%	33.3%	100.0%
Total		Count	9	5	8	22
		% within Ward Method	40.9%	22.7%	36.4%	100.0%

Source: Own Computation

5.0 Discussion and Conclusion

In the SSA region, where the gender gap varies widely among the four sub-indicators, the results in Figure 11 show the percentage of the gender gap index that has been narrowed. Notably, SSA nations have eliminated 66.45 percent of gender disparities in terms of political empowerment, economic involvement, health, and education. Even though the results show that more than half of the gender gap has been closed in SSA, the region still ranks poorly when compared to other global regions, including West Europe (76.4%), North America (72.9%), Latin America & the Caribbean (72.1%), East Europe & Central Asia (71.5%), East Asia & Pacific (68.5%), South Asia (66.1%), and the Middle East & North Africa (61.1%) according to WEF (2020).

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The best-performing sub-indicators are health and survival and educational achievement, where 97.5 percent and 87.55 percent, respectively, of the gender inequalities, have been closed. With the gender gap having been reduced to about 71 percent, economic participation comes in third. Unsurprisingly, there are major gender differences in political empowerment, where only 21.8% of the gender gap has been addressed. This represents the underrepresentation of women in elective positions, specifically the percentage of seats held by women in parliament and the number of women serving as ministers and other government appointment positions. Notably, the gender difference in political empowerment in the SSA region is much lower than the overall gender gap index score (66.4 percent).This is a sign that SSA nations are not taking full advantage of women's capabilities in political arenas where their opportunities are constrained and limited. Iceland, which has closed about 70% of the gender gap and is ranked first in terms of political empowerment, indicates that there are many women elected to positions of power, including seats in parliament and government ministries (WEF, 2020).

Figures 6 and 7 illustrate how South Africa, which has closed nearly half (49.7%) of the female gap in political empowerment, rates highly in SSA and 14th internationally, whereas Ethiopia, which has closed 42.7% of the gender gap in political empowerment, is placed 16th globally (WEF, 2020) where women hold 38.8% of the legislative seats and nearly half (47.6%) of ministerial positions. Interestingly, a woman was elected as the head of state in 2018 as well (WEF, 2020). Ethiopia still lags other SSA nations in achieving gender parity in education (85%) and health (97.3%) as well as economic involvement (61.5 percent) despite these tremendous efforts to close the gender gap in political empowerment. Women hold more than half of the government positions, as well as a majority of the ministerial and parliamentary seats in Rwanda, which is one of the leading countries for political empowerment (WEF, 2020). There are few notable SSA nations where women have held the position of head of state. Tanzania, which has only closed 26.8% of the gender gap in political empowerment, currently has a female head of state. Malawi, which had a female president from 2012 to 2014, has a gender gap of 16.6% closed, while Liberia and CAR had a female head of state between 2005-2018 and 2014-2016 respectively. Women's potential, presence, and engagement in politics are severely constrained and limited as evidenced by the fact that the majority of SSA nations are still trailing in reducing gender inequalities in political empowerment. Most nations still have 80 percent or more gender gaps in political empowerment to fill, including Nigeria, Botswana, Ghana, Zambia, Burkina Faso, Malawi, Kenya, Cameroon, Mali, Mauritania, and Chad. Despite the 2010 constitution's two-thirds gender rule and the flagship initiative Vision 2030, which advocates gender equality in all social, political, and economic dimensions, according to the Republic of Kenya (2016), Kenya still has one of the largest proportions of gender imbalance in political representation (88%) in the world.

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Figure 4 illustrates how gender disparities in education have significantly decreased in each of the three clusters' member nations. High scores for men's and women's educational attainment are found in South Africa (0.994), Botswana (1), Namibia (1), Lesotho (0.978), Ghana (0.851), Zambia (0.938), and Kenya (0.923). This implies that women have nearly equal access to schooling as their male counterparts in these nations, while Botswana and Namibia have complete gender parity in educational attainment. The biggest gender inequality in education is seen in Chad (0.5311) where women are, on average, less likely than men to have access to educational opportunities by 47%.

Burundi (0.837), Lesotho (0.7756), Ghana (0.7662), Botswana (0.779), Cameroon (0.7258), Benin (0.847), Zambia (0.837), and Mozambique (0.7897) have the highest scores in terms of economic participation, suggesting that, on average, women are just as empowered economically as men, albeit with a smaller gender gap. The country with the lowest score is Mauritania (0.411), meaning that on average, women are 59 percent less likely to engage in economic activity than men. This is a result of cultural and religious conventions that restrict women's access to the labor force and the labor market. It's important to note that Chad and Mauritania appear to be outliers in Figure 4 and both have high levels of gender equality in economic participation and educational attainment respectively, but both nations also score low in terms of education accessibility and economic participation respectively, suggesting that on average, women in these nations have better access to one dimension of gender gap index than the other indicator. Because of this, a nation, like Chad and Mauritania, may have better institutional and governmental policies that support the achievement of gender equality in one dimension yet perform poorly in another gender sub-index (Barnat et al., 2020). According to Figure 6, where all the countries considered in the analysis have scores of more than 0.95, Sub-Saharan African nations have good ratings for gender equality in health and survival. This suggests that in SSA, men and women have equal access to healthcare services. For instance, the governments of Kenya and Ghana started universal healthcare programs to provide better healthcare services to lower death rates and enhance maternal health.

Except for Mauritania, which has the largest (almost 60 percent) gender disparity in economic involvement, most of the SSA nations have reduced the gender gap in the workforce and economic participation by about 71 percent. Due to the traditional division of labor, discrimination, occupational segregation, conventions, and religious views, the low engagement of women in labor market activities in the SSA region greatly contributes to the expanding gender inequalities in economic participation. Additionally, SSA nations have made outstanding progress in achieving gender parity in education, closing the gap by almost 88 percent. To give the younger generations and the youth—who make up the largest share of the unemployed—the technical skills they need to flourish in the world of tomorrow, new policies and educational

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initiatives must be implemented. In this sense, attaining gender parity in formal education attainment is a necessary but insufficient need to provide the millions of youths with the pertinent skills required in the current job market in the era of the Fourth Industrial Revolution. As a result, the skills gap between supply/demand and gender is still wide in SSA nations. Therefore, the governments should start the process of changing the educational system and structure in SSA countries to a more competency-based curriculum, equipping students with useful labor market skills while also developing the talents of the millions of young people whose potential is untapped. To give additional light on these dynamics, the gender gaps in emerging jobs, and the pertinent skills necessary for those jobs, we also propose that a comprehensive empirical inquiry be carried out in SSA nations.

Furthermore, gender disparity can be reduced to four primary components: PC1 Education & Health Conditions, PCA2 Political Empowerment, PCA3 Labor Market Participation, and PCA4 Economic Opportunity and Discrimination which were found to have greater explanatory power than the other components which are in line with 2030 Agenda, the SDGs and the MDGs. The Millennium Development Goals (MDGs) featured 21 goals, 13 of which might be deemed gender linked. We can see that these targets mostly align with PC1 (Education & Health conditions) when we map them into the four components, addressing MDG goals #2,3,4,5 & 6. PCA 3 and PCA 4 (economic and labor market involvement) align with MDG goal #1 on eradication of abject poverty and hunger. PCA 2 (political empowerment) was not addressed by the MDGs, however, 39 goals and 54 sub-indices of SDG indicators are being recognized by UN women as gender parity issues (UN Women, 2018). When these metrics are mapped to the same four components, the SDGs show a better acknowledgment of Economic & labor market participation and Political empowerment than their predecessors, the MDGs. Health, as well as Education and Social Conditions, are crucial in the SDGs, as they were in the MDGs. This is evidence that gender equality is a priority on the international development agenda. The global agenda's approach to gender equality has developed, and it now considers all facets of gender equality. Over time, the emphasis on economic equalitarian as a key component of gender parity has grown. However, new empirical investigations reveal how the linkages between gender parity and economic participation are complicated and that the sub-indicators of gender inequalities examined in this study do not shed more light on the linkage. Global trade, a key component of a country’s economic progress, has been demonstrated to have a significant impact on women's economic equality.

Based on study findings, we recommend that SSA countries should fully implement and live up to the requirements of the ILO and UN conventions and treaties on gender equality. Lowering gender inequalities will not only ensure social, political, and economic equity but will also have a significant effect on economic prospects. Furthermore, Women's engagement in trade was first

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included in the Addis Ababa Action Agenda in 2015, and the importance of trade for gender equality was stressed in the signing of the Buenos Aires Declaration on Trade and Women's Economic Empowerment in December 2017. The absence of international trade in this study, a key driver of economic growth and development creates a lacuna in empirical discussion for SSA. More evidence is required to justify the government's escalating policies and incorporation of global trade into gender inequality indices.

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APPENDIX

Figure8: Economic participation vs Political Empowerment Cluster membership.

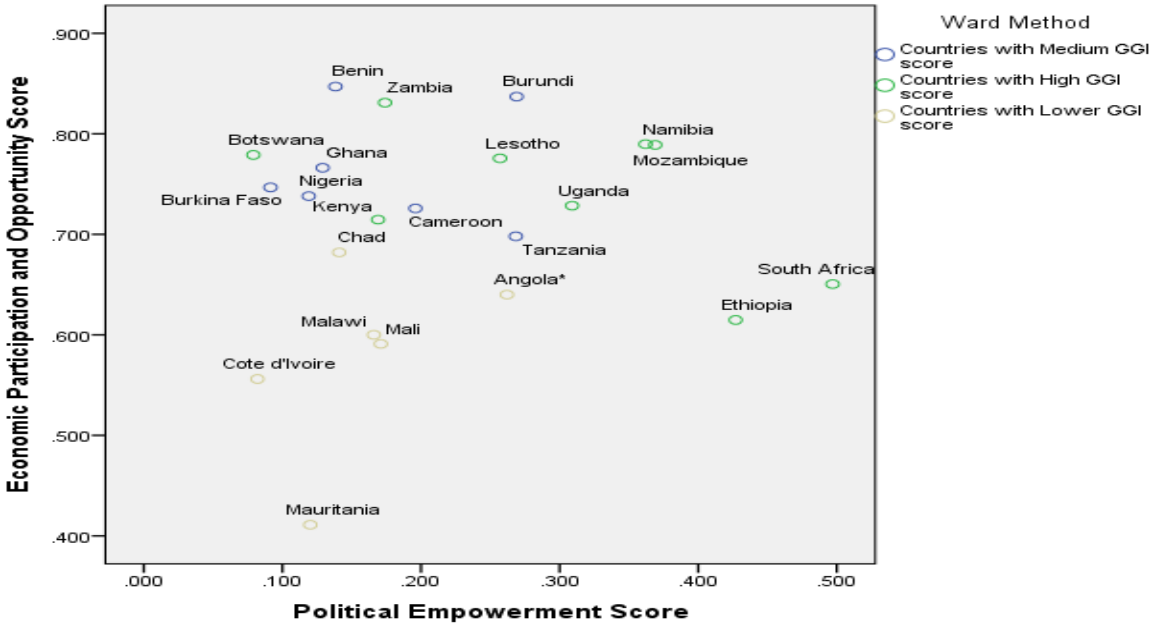

Figure 9: Health and Survival vs Political Empowerment Cluster membership.

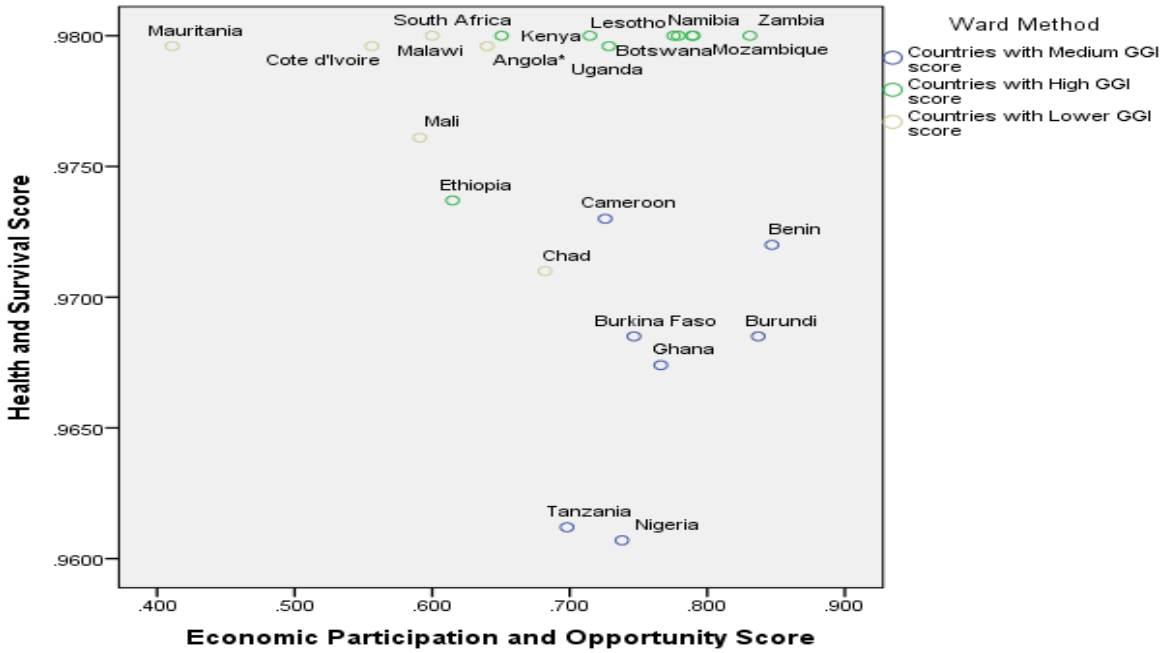

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Figure 10: Regional grouping of Gender inequality scores in SSA

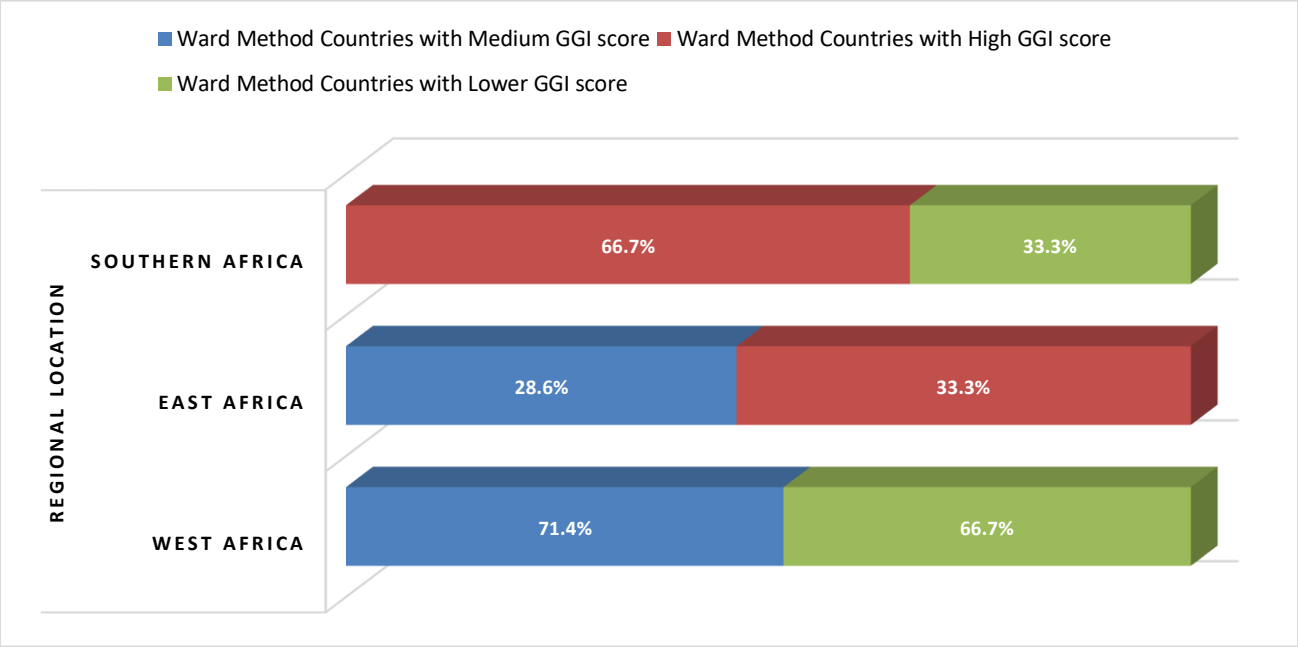

Figure 11: Proportion of gender gap closed in Sub-Sahara Africa.

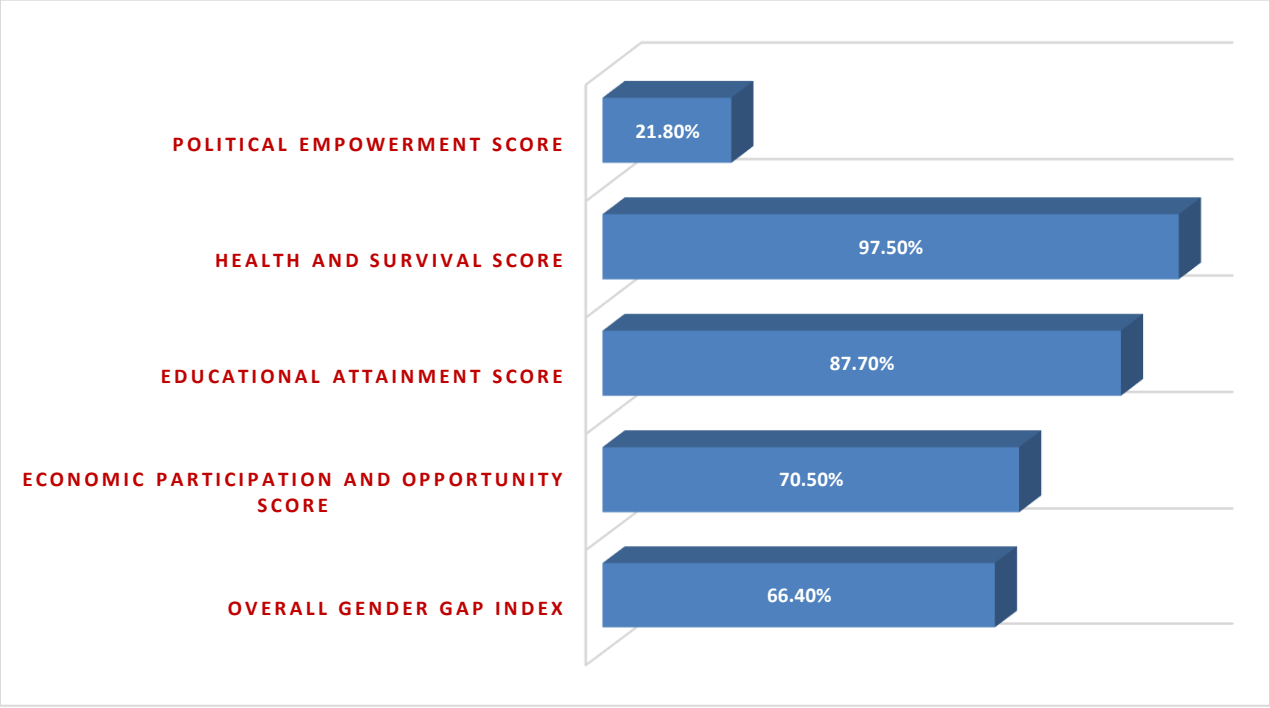

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Figure 12: Prevalence of gender gap index across SSA countries.

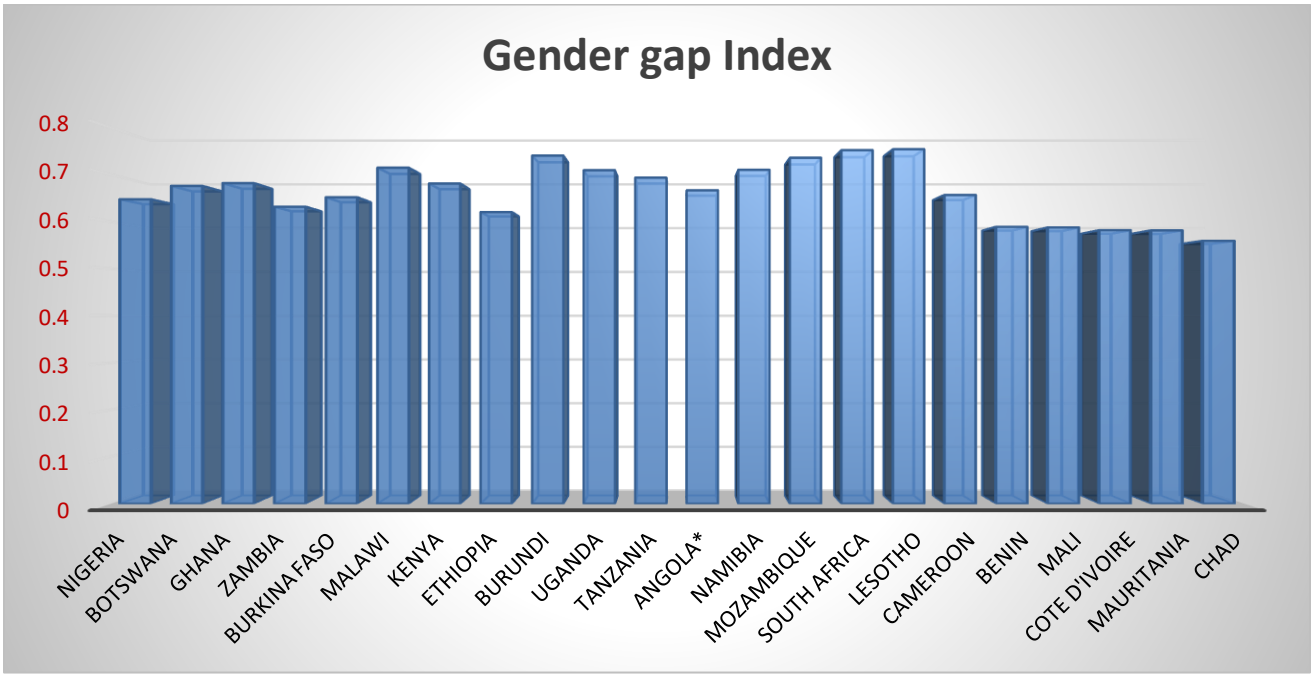

Figure 13: Economic participation & opportunity in SSA.

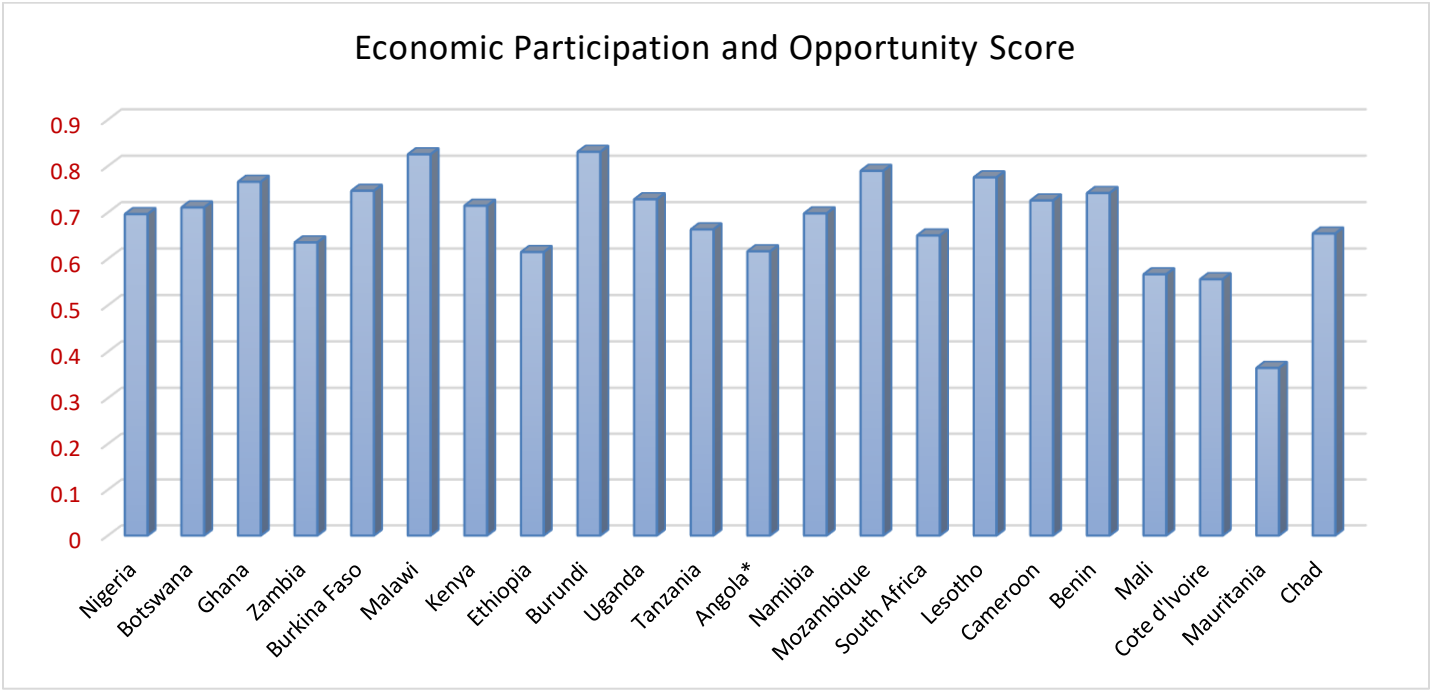

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Figure 14: Gender Inequality in Education in SSA.

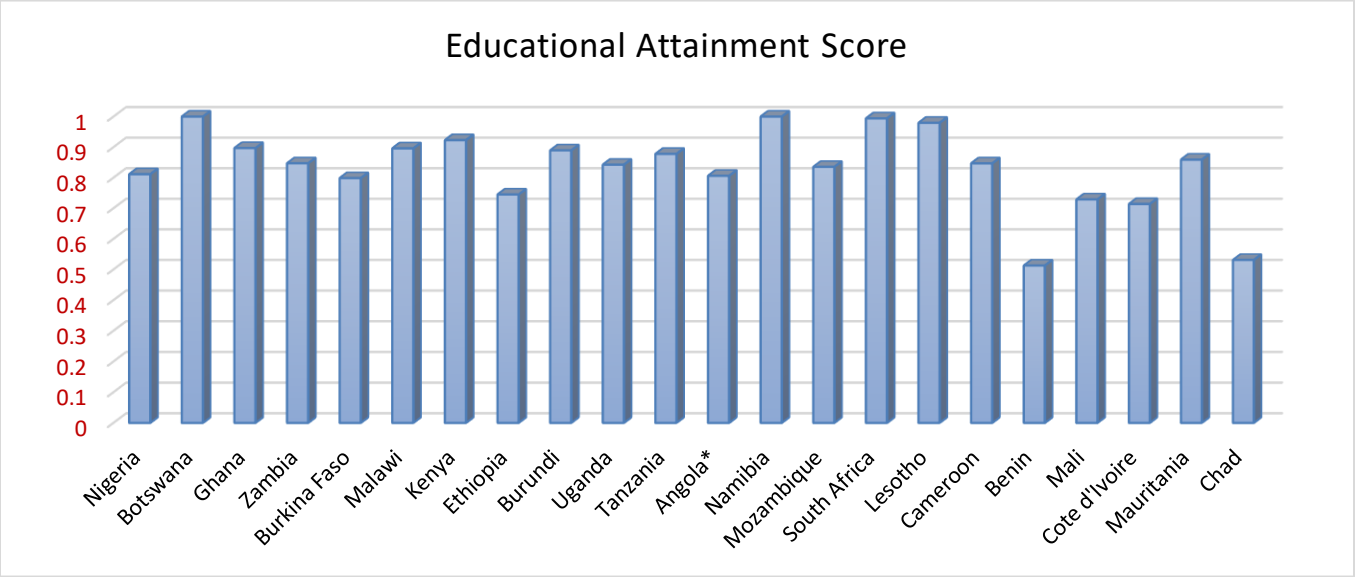

Figure 15: Gender Parity in Health and Survival in the SSA region.