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STATISTICAL STUDY OF LIFE EXPECTANCY OF MALE AND FEMALE CHILDREN AT BIRTH IN SOME SELECTED AFRICAN COUNTRIES

K.C. Arum, N.J. Nnanyelu, T.E. Ugah and H.E. Oranye

Department of Statistics, University of Nigeria, Nsukka.

ABSTRACT: *This study tries to determine if there is a significant difference in the distribution of life expectancy of male and female children at birth in some selected African countries, to determine if there is a common variation in the distribution of life expectancy of male and female in the selected countries. The sample size is considered in the years of study from 1971 to 2017 which is 47 years of study of life expectancy rate measured in percentages. Ten African countries were used in this study; statistical techniques were employed to test for the equality of mean life expectancy at birth, equality of variance (variation) of life expectancy at birth of male and female. A normality test was carried out using Kolmogorov-Smirnov test. From the findings in this study, it was seen that there is significant difference in the distribution of life expectancy at birth of male and female in the selected African countries, also, there is no association in the distribution of life expectancy at birth for both genders.*

KEYWORDS: Kolmogorov-Smirnov Test, Levene's Test, Z- Test, Life Expectancy

INTRODUCTION

Life expectancy refers to a prediction of the number of years for which a person will live. This number is determined based on the statistical average, considering many factors, including year and place of birth, race, education level, income, and medical history. For instance, according to Galor and Moay (2005), the life expectancy during the Bronze Age was 26 years, while a baby born today in the United States can expect to live 78.08 years.

Worldwide, the average life expectancy at birth was 70.5 years (68 years and 4 months for males and 72 years and 8 months for females) for the period 2010–2015 according to United Nations World Population Prospects 2015, also 69 years (67 years for males and 71.1 years for females) for 2016 according to The World Factbook.

Based on 2016 World Health Organization (WHO) data, women on average live longer than men in all major regions and in all individual countries except for some African countries like Mali and Swaziland.

The countries in Africa with the lowest overall life expectancies per the WHO member countries are Sierra Leone, Central African Republic, Democratic Republic of the Congo, Guinea-Bissau, Lesotho, Somalia, Swaziland, Angola, Chad, Mali, Burundi Cameroon and Mozambique, of these countries, Lesotho, Swaziland, and Mozambique in 2011 recorded lowest because of HIV prevalence rate of greater than 10 percent within their citizens of 15–49 age group (WHO, 2011).

Comparison of life expectancy by continent shows the gap in average life expectancy between Africa and other continent regions. Moreover, countries from across the African regions dominate the list of countries with the lowest life expectancy worldwide. Lesotho, belonging to the region of Southern Africa, had the lowest life expectancy of any country for those born in 2014.

According to the latest world health organization data published in 2018 on life expectancy in Nigeria, male given birth in Nigerian in 2018 is expected to live approximately 54.7 years while for a female is expected to live approximately 55.2 years. The data shows that Nigeria has a world life expectancy ranking of 178 out of 192 ranked countries. However, the average life expectancy at birth in Nigeria is 55.2 years. Also, the release of statistical report by Nigerian Bureau of Statistics (NBS) for 2017 has it that females can live for approximately 51 years while males can live for just 47 years. The report also opined that residents in Nigeria are liable to die due to sicknesses and diseases, as well as other causes which include accident, road traffic and birth trauma among others.

Factors Affecting Life Expectancy

Nationality

One of the most significant factors in determining one's life expectancy is his place of birth. Some Africa countries have a low life expectancy this is due to poor living conditions, limited access to high quality medical care and HIV/AIDS epidemic.

Infant Mortality and Years Lived

Because life expectancy is a statistical measurement, it is affected by outlier events such as high infant mortality rates. Therefore, the actual number of years in a person's life can be much higher or lower than the life expectancy rate. As one gets older, his overall life expectancy increases because the chances of outlying factors of early death, such as infant mortality are reduced. In other words, the longer a person has lived, the longer his life expectancy will be. Therefore, with all other factors being equal, a person who is 50 years old will have a higher life expectancy than a person who is 25.

Additional factors that will increase one's life expectancy are being female, being in the top 50% income bracket, holding a college degree, maintaining a healthy family medical history. The choices that one makes will also affect his life expectancy. Life expectancy is higher for those who eat healthy food, exercise regularly, and avoid alcohol, tobacco, and drugs. It's also higher for those who do not engage in risky behavior such as drinking and driving.

Objectives of the Study

The objective of the research work is as follows:

i. To check if there is a significant difference in the mean life expectancy at birth of males and females in some selected African countries;

ii. To examine if there is significance difference in the distribution of mean life expectancy at birth in some selected African countries.

Scope of the Study

This work is aimed at studying the distribution of life expectancy of female and male at birth in some selected Africa countries and region. These selected African countries are Angola, Benin, Burkina Faso, Botswana, Central Africa Republic, Cote d'Ivoire, Cameroon, Congo Rep, Nigeria and Algeria for a period of 47 years, starting from a base year of 1972 to the given year of 2017.

LITERATURE REVIEW

Gabriele (2001) researched on "lifespan depend on month of birth" he reviews that month of birth influence adult life expectancy at ages 50+ in two countries of the Northern Hemisphere Austria and Demark people born in autumn (October-December) live longer than those born in spring (April-June). Data for Australia show that, in the southern Hemisphere, the lifespan pattern of British immigrants to Australia is similar to that of Australia and Danes and significantly different from that of Australians. These findings are based on population data with more than a million observations. The differences in lifespan are independent of the seasonal distribution of deaths and the social difference in the Northern Hemisphere, the excess mortality in the first year of life of infants born in spring does not support the explanation of selective infant survival.

Hasegawa (2014) worked on "Average and healthy life expectancies and self-rated health in the European Country". Multiple regression analysis was used to clarify the relationship between the lifespan and socio-economic condition, such as the GDP, GiNi index, age-adjusted mortality from cancer, suicide rate and self-rated health in 27 European countries. According to the multiple regression analysis, the average life expectancy was significantly correlated with mortality from cancer, whereas the healthy life expectancy was significantly correlated with self-rated healthy life expectancy and significantly correlated with self-rated health.

Hoi et al (2009), in a work titled "Remaining life Expectancy among older people in a rural area of Vietnam: trends and socioeconomic inequalities during a period of multiple transition". This study accesses the trends and socioeconomic inequalities in RLE at age 60 in a rural area in an effort to highlight this vulnerable group and to anticipate their future health and social needs. An abridged life table adjusted for small area data was used to estimate cohort life expectancies at old age and the corresponding 95% confidence interval from longitudinal data collected by FilaBavi DSS during 1999-2006, which covered 7,668 people at age 60 with 43,272 person- years, out of a total of 64,053 people. Differences in life expectancy were examined according to socioeconomic factors, including socio-demographic characteristics, wealth, poverty and living arrangement.

Kyte and Wells (2010) examined the "Variation in life expectancy between rural and urban areas of England, 2001-2007". The rural and urban area classification (RUAC) 2004 and the index of multiple deprivation (IMD) 2007 were used to categorize area types at the lower super output area (LSDA) level. Population and mortality data used were produced by the Office for National Statistics (ONS). Abridged life table were constructed to calculate life expectancy at birth for male and females, for the years 2001 to 2007 combined. Confidence interval of 95% was also constructed. Overall, life expectancy was higher in rural areas than

in urban areas. Deprivation had a considerable impact on the results and wide inequalities were evident, particularly in men and in urban area. In both area types, male living in the less deprived quintiles had similar life expectancies to female living in the more deprived quintile. Within rural area types, life expectancy was higher in village and dispersed settlements than in town and fringe area.

Chetty et al (2016) determined the association between income and life expectancy in the United States, in 2001-2014. He concludes that in the United States between 2001 and 2014, higher income was associated with greater longevity, and difference in life expectancy across income groups increased over time. However, the association between life expectancy and income varied substantially across area; difference in longevity across income groups decreased income areas and increased in others. The differences in life expectancy were correlated with health behaviours and local area characteristics.

Waldron (2007), in his article presents an analysis of trends in mortality differentials and life expectancy by average relative earnings for male Social Security-covered workers aged 60 or older. Because average relative earnings are measured at the peak of the earnings distribution (ages 45-55), it is assumed that they act as a rough proxy for socioeconomic status. In the study, time trends are examined by observing how mortality differentials by average relative earnings have been changing over 29 years of successive birth cohorts that encompass roughly the first third of the 20th century.

Strauss et al (2005), in an article titled "Estimation of future mortality rates and life expectancy in chronic medical conditions" Point that the estimate of old-age mortality is necessary for the construction of life table and computation of life expectancy and are essential in the growing of life insurance for the elderly. Two common assumptions are that either the excess death rate (EDR) of the relative risk (RR) stays constant with increasing age. Two less-commonly used models, log-linear decline relative risk (LDR) and constant proportional life expectancy (PLE), and compare them to the methods of constant EDR, constant RR and rating up. Generally, LDR give better estimate of mortality and life expectancy.

Lai et al (1996) worked on "Statistical analysis of the standardized mortality ratio and life expectancy" develop a new theoretical relation that does not require the constant age-specific mortality ratio assumption established between the standardized mortality ratio (SMR) and the life expectancy. A set of regression equations was developed from the theoretical relation to derive estimates of the future expectation of life from estimate of the SMR. Curves are presented showing the changes in life expectancy that are associated with a given SMR for individuals within the ages of 25, 45 and 65years. These results will provide practical applications in estimating remaining life expectancy in epidemiologic studies in which the SMR is the summary statistic.

METHODOLOGY

Source of the Data

The data used in this research is a secondary data from the World Bank database (www.data.worldbank.org) of life expectancy of male and female worldwide gathered from

publication of United Nations World population prospectus 2017. Out of 268 countries in the world and 54 countries in Africa, 10 countries were selected from African continent for the purpose of this study.

Normality Test

The Kolmogrov-Smirnov (K-S) test for normality is used to test for the normality of the distribution of life expectancy of male and female at birth. The hypothesis for the Kolmogorov-Smirnov test of normality is stated as follows:

H_0: The data follow a normal distribution.

H_1: The data do not follow normal distribution.

$\alpha = 0.05$

Test Statistic

$$D = Max\left|F(y_i) - \frac{k}{n};\ F(y_i) - \frac{k}{n-1}\right| \quad (1)$$

Where $F(y_i) = P(X \leq x)$

$F(y_i) = P\left(Z \leq \frac{x-\mu}{\sigma}\right),\ \mu = \frac{1}{n}\sum_{i=1}^{n} x_i\ ,\ s = \sqrt{\frac{1}{n}(\sum_{i=1}^{n} x_i^2 - \mathrm{n}\mu^2)}$

k is the total number of observations less than or equal to y

Decision Rule: Reject H_0 if the P value of the result is less than α, accept if otherwise.

This test will be carried out with the aid of SPSS.

Table 1a: One-Sample Kolmogorov-Smirnov Test

Countries		**Angola**	**Benin**	**Burkina**	**Botswana**	**Central Afr Rep**
N		94	94	94	94	94
Normal Parameters	Mean	46.3051	52.8632	49.7700	57.90903	47.0476
	Std.Deviation	8.01967	5.91835	5.68709	5.345836	3.13987
Kolmogorov-Smirnov D		1.586	1.070	.985	.531	.807
Asymp. Sig. (2-tailed)		.103	.202	.286	.940	.532

Table 1b: One-Sample Kolmogorov-Smirnov Test.

Countries		**Cote d'Ivoire**	**Cameroon**	**Congo**	**Nigeria**	**Algeria**
N		94	94	94	94	94
Normal Parameters	Mean	49.71569	51.82644	56.0680	65.6845	65.8384
	Std.Deviation	3.001915	3.103536	3.65935	5.84333	8.14893
Kolmogorov-Smirnov D		.517	.828	1.055	.957	.982
Asymp. Sig. (2-tailed)		.952	.499	.215	.319	.290

Conclusion: The result from Table 1 above shows that the distributions of life expectancy at birth in the individual countries across the years are normally distributed since their P values are greater than $\alpha = 0.05$

Tests for the Equality of the Distribution Mean Life Expectancy at Birth

H_0: $\mu_1 = \mu_2$

H_1: $\mu_1 \neq \mu_2$

$\alpha = 0.05$

Test Statistic

$$Z = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \sim N(0,1) \quad (2)$$

Decision Rule: Reject the null hypothesis if the P-value is less the alpha level of 0.05, accept if otherwise

Table 2a: Test for the Equality of the Mean Life Expectancy at Birth

	Angola	**Benin**	**Burkinafaso**	**Botswana**	**Central Afr Rep**
Z	-2.719	-3.303	-1.829	-4.512	-6.896
Df	92	92	92	92	92
Sig(2-tailed)	.008	.001	**.071**	.0001	.0001

Table 2b: Test for the Equality of the Mean Life Expectancy at Birth

	Cote d'Ivoire	**Cameroon**	**Congo**	**Nigeria**	**Algeria**
Z	-5.376	-4.326	-3.859	-2.825	-1.543
Df	92	92	92	92	92
Sig(2-tailed)	.0001	.0001	.0001	.006	**.126**

Conclusion: from Table 2 above, it is seen that the mean distribution of male and female in the selected African Countries are not the same i.e. significantly different, except Burkina Faso and Algeria that are not significant with a p-value higher than the level of significance of 0.05

Equality of Variance of Life Expectancy

The hypothesis for equality of variance of life expectancy is given as follow:

H_0: $\sigma_1^2 = \sigma_2^2 = \cdots \sigma_i^2$

H_1: $\sigma_1^2 \neq \sigma_2^2 \neq \cdots \sigma_i^2$ for at least one pair (i,j).

$\alpha = 0.05$

Given a random variable Y with sample of size N divided into k subgroups, where N_i is the sample size of the i th subgroup, the Levene's test statistic is stated as

Test statistic

$$W = \frac{(N-K)\sum_{i=1}^{k} N_i(\bar{Z}_{i.}-\bar{Z}_{..})^2}{(K-1)\sum_{ij}^{k}\sum_{ji}^{N_i}(\bar{Z}_{ij}-\bar{Z}_{i.})^2} \quad (3)$$

where k is the total number of different groups for which sample cases belong

N_i is the number of cases in the i[th] group.

N is the total number of casese in all groups.

$$Z_{ij} = \left|Y_{ij} - \bar{Y}_{i.}\right| \quad (4)$$

$Z_{i.} = \frac{1}{N_i}\sum_{j=1}^{N_i} Z_{ij}$ the mean of the i[th] group

$Z_{..} = \frac{1}{N}\sum_{i=1}^{k}\sum_{j=1}^{N_i} Z_{ij}$ the grand mean

Decision rule: reject the null hypothesis if the p value of the test is less than α or that the variances are equal if $W > F_{\alpha,k-1,N-k}$, accept if otherwise. Where $F_{\alpha,k-1,N-k}$ is the critical value of the F distribution with $k-1, N-k$ degrees of freedom at a significance level of α

Table 3a: Equality of Variance of Life Expectancy

	Angola	**Benin**	**Burkinafaso**	**Boastowana**	**Central Afr**
W	.699	1.593	.195	.318	3.613
Sig	.405	.210	.660	.574	.060

Table 3b: Equality of Variance of Life Expectancy

	Cote d'Ivoire	**Cameroon**	**Congo**	**Nigeria**	**Algeria**
W	4.604	.000	.179	.074	.067
Sig	.053	.997	.673	.067	.796

From Table 3 above, it can be seen that the variances of the life expectancy of both male and female (both genders) children are equal; because the p-value obtained from the calculation is greater than the level of significance of 0.05.

Test for the Equality of the Mean Across the Countries

H_0: $\mu = 54.303$

H_1: $\mu \neq 54.303$

$\alpha = 0.05$

Test Statistic

$$Z=\frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}} \sim N(0,1) \quad (5)$$

Decision Rule: Reject the null hypothesis if the P-value is less than the alpha level of 0.05.

Table 4: Equality of the Mean across the Countries

Countries	Z	Df	Sig. (2-tailed)
Angola	-9.669	93	.000
Benin	-2.358	93	.020
Burkina	-7.728	93	.000
Botswana	6.540	93	.000
Central	-22.403	93	.000
Cote d'Ivoire	-14.815	93	.000
Cameroon	-7.736	93	.000
Congo	4.677	93	.000
Nigeria	18.885	93	.000
Algeria	13.725	93	.000

There is a significant difference in the mean distribution of life Expectancy across the selected countries because the P value obtained from the test above is less than 0.05.

DISCUSSION OF RESULT

The results of the analysis carried out in this work, from the result of test for the equality of the mean of the life expectancy of the males and females at birth; there is significant difference between them at 0.05 level of significance. It could also be seen that the test of Equality of variance of males' life expectancy at birth and females' life expectancy at birth is not significant (the same) at 0.05 level of significance.

SUMMARY

This work examines the distribution of life expectancy at birth of male and female children in some selected African countries for a period of 47 years by grouping the life expectancy data into two populations (male and female). Ten African countries were randomly selected for the purpose of this study with the assumption that the data follow normally distribution, which was determine with the test of normality using Kolmogorov-Smirnov (K-S) normality test. The result of the test shows that the data were normally distributed. The test for equality of mean life expectancy for both genders was also conducted using the ten selected African countries which the result shows that life expectancy of children at birth for both genders are significant i.e. not the same. In addition, test for common variance was performed using Levene's test. From the result of Levene's Test for Equality of Variances, we accept the null

hypothesis that there is no difference in the variances between the groups and reject the alternative hypothesis that there is a statistically significant difference in the variances between the groups.

CONCLUSION

From the result obtained in this work, it can be seen that there is a significant difference in the distribution of life expectancy at birth of male and female children in the ten randomly selected African countries.

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