IOSR Journal of Mathematics (IOSR-JM)
e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 17, Issue 4 Ser. I (Jul. – Aug. 2021), PP 58-64
www.iosrjournals.org

Statistical Analysis of Age Misreporting On Demographic Data

Ezra Precious Ndidiamaka[1], Ohanuba Felix Obi[2] and Igwe Ndubuisi Obasi[3]
[1&2]*Department of Statistics, Faculty of Physical Sciences, University of Nigeria, Nsukka, Enugu State, Nigeria.*
[3]*Department of Mathematics/Statistics, School of Science, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State, Nigeria.*

Abstract
This research aims at analyzing age report on 2006 population census demographic data. The collected data was analyzed using such techniques as: Age Ratio, the United Nations Age-sex accuracy Index and Myer's Index. The analyses carried out using age ratio showed that among the age groups, there were some people who were not supposed to belong to some age groups but were classified into such groups and there were some people who were supposed to belong to some age groups but were mis-classified into some other age groups. The value for United Nations Age-sex accuracy Index (UNAI) also gave an indication of high level of age misreporting. The value for Myers's Index showed that in the age reporting, some people preferred quoting ages that ended in particular digits .Hence each of the methods of analyses gave an indication of age misreporting during the 2006 population census. One of the recommendations is that statistical analyses should be carried out on the collected age data using the demographic techniques to determine the accuracy of the collected data before using it for developmental planning.

Keywords: *Demographic data, Age misreporting, Age ratio, United Nations Age-sex accuracy index, Myers's index,*

Date of Submission: 14-07-2021 Date of Acceptance: 30-07-2021

I. Introduction

Age according to Moultrie [9] is defined as the calculated interval of time between the date of birth and date of enquiry and it is expressed in a completed calendar year. [14] stated that it is the most important variable in the study of mortality, fertility, nuptiality, migration and certain other areas of demographic analysis. [12] and [13] noted that age composition is important for the evaluation of the quality of the census counts of a given population. [15] declared that age affects all spheres of life of the citizenry of a given area such as the level of consumption, income, social services needed in schools, health services, food and housing, potential manpower, participation of people in productive work, taking part in reproduction process, potential voting population etc. [11] stated that a respondent's age can be computed by subtracting the date of birth from the date of enumeration or by recording the respondent's completed age at the time of the census or survey as the last birth day. He emphasized that infants who are less than one year at the time of survey or census are recorded as age "0" since the child has not completed one calendar year

According to [7] and [5], ages reported in census in developing countries are subject to errors and bias resulting in uncertainties' in population estimates and age distributions. They noted that age mis-reporting is common to most investigations such as National Demographic Health Survey (NDHS), household survey, food consumption survey e.t.c. They also emphasized that age is often mis-reported for sentimental reasons, ignorance of correct age, a general age preference, a tendency to exaggerate length of life at advanced ages, a possibly subconscious aversion to certain numbers and for some other personal motives. [11] noted that the proportion of the population for which date of birth is not reported is ordinarily higher than that of age, and the date of birth approach is hardly applicable to relatively illiterate population.[10], [1] and [8] noted that sometimes, there is this general tendency to state ages in figures ending in certain "preferred" digits which could be 0, 1, … or 9. [9] reported that age is very susceptible to errors and that both the nature and quality of data vary greatly among states and over time. He also said that several methods and Indices for evaluating the accuracy of age-misreporting have been developed widely and employed for a more complete understanding of data structure and anomalies. [4] made known that in the analysis of demographic data, age and sex-ratio, united Nation Age - sex Accuracy index (UNAI) are among the most commonly used techniques for evaluation accuracy of age reporting. [3] in their analysis stratified by sex found out that in some samples, preference is stronger among female than among males. Other issues discovered include ignorance of the true age, low numeracy and problems in the collection of data.

[2] said that the most popular measure of accuracy, the quality of census in terms of age-reporting has improved pronouncedly in Asia but less in African countries. [6] explained that in some indigenous or native

populations like Africa, enquiries regarding age attempts to distinguish merely children, working age population and elderly persons or only children and adult. They included that in such situations where concepts have little meaning, individual may be assigned a broad age group on age basis of birth before and after certain major historical events thereby affecting the population classification.

[14] said that the populations of Northern Europe are seen to have old age dependency ratio over three times as high of developing nations. [15] and [9] made known that among the indices devised to measure the ageing of a population are sex ratio, dependency ratio and United Nation age-sex accuracy index. According to [15], development is not possible without proper planning and proper planning is not possible without accurate information more especially information on the ages of the citizenry. Hence the researcher decided to embark on this research so as ascertain the adequacy or inadequacy of the 2006 age data as regards the developmental planning of this nation (Nigeria). The primary aim of this study is to determine the correctness of the 2006 population census age data, test for the accuracy of the collected 2006 census age data, test for age heaping also known as age preferences in the collected data and make some recommendations based on the findings.

II. Material And Methodolody

This chapter discusses the methods of data analyses.

2.1 MATERIAL

The data used for this work was a secondary data from the 2006 Nigerian population census collected from the National Population Commission (NPC) office, Enugu. The tables below present the data.

***Table1**: The distribution by 5 year age group and sex for Nigeria 2006 population census.*

Age group	***Both sexes***	***Sex***	
		Males	**Females**
0-4	22,594,967	11,569,218	11,025749
5-9	20,005,330	10,388,611	9,616,769
10-14	16,135,950	8,504,319	7.631.631
15-19	14,899,419	7,536,532	7,362,887
20-24	13,435,079	6,237,549	7,197,530
25-29	12,211,426	5,534,458	6,676,968
30-34	9,467,538	4,505,186	4,962,352
35-39	7,331,755	3,661,133	3,670,622
40-44	6,456,470	3,395,489	3,060,981
45-49	4,591,293	2,561,526	2,029,767
50-54	4,249,219	2,363,937	1,885,282
55-59	2,066,247	1,189,770	876,477
60-64	2,450,286	1,363,219	1,087,067
65-69	1,151,048	628,436	522,612
70-74	1,330,597	765,988	564,609
75-79	598,838	327,416	252,422
80-84	760,053	408,680	351,373
85 above	715,225	404,021	311,204
Total	140,431,790	71,345,488	69,086,302

Sources: 2006 population and housing census, Nigeria

***Table 2**: Age Distribution of 2006 Nigerian census data.*

Age group	**Population**
0-4	22,594,967
5-9	20,005,330
10-14	16,135,950
15-19	14,899,419
20-24	13,435,079
25-29	12,211,426
30-34	9,467,538
35-39	7,331,755
40-44	6,456,470
45-49	4,591,293
50-54	4,249,219
55-59	2,066,247
60-64	2,450,286
65-69	1,151,048
70-74	1,330,597
75-79	598,838
80-84	760,053
85+	715,225
Total	140,431,790

2.2 METHODOLOGY

There are arithmetic techniques that have been developed to handle errors on age reporting. Such techniques include age ratios, sex ratios, age accuracy index, United Nations age-sex accuracy index whipple's index, myers's index etc.

The following techniques were used to analyze the data in this work.

2.2.1 AGE RATIO (AR): These are calculated from the census data to check the quality of the census returns by age groups. It may be defined as the ratio of the population in the given age group to half of the sum of the population in the two adjacent age groups multiplied by 100.Hence, AR for a 5 year group, 5^{p}x is defined as

AR= $\frac{5Px}{1/2[(5Px-5)+(5Px+5)]}$ x100 ……. (1)

Where

$5^{p}{}_{x}$ is the population in age group x to age x+5

$5^{p(x-5)}$ Is the population in the preceding age group.

$5^{p(x+5)}$ Is the population in the succeeding age group.

The lower the AR, the more adequate the census data on age.

If AR =100, it implies there is no error in age reporting.

If AR > 100, it implies there were people that were not supposed to be there who were included in the given age group.

If AR < 100, it implies that there were people who were supposed to be there but were mis- classified.

2.2.2 UNITED NATIONS AGE-SEX ACCURACY INDEX

This index was employed to test the accuracy of age enumeration. It uses both age-sex ratios to identify deviation from what might be expressed. The united Nation Age-sex accuracy index (also called joint score) is a single index for the joint evaluation of data on age and sex, proposed by the united Nation, based on empirical evidence. This index is computed as a weighted sum of the united Nation sex ratio score and the United Nation Age ratio score of the studied population. The ratio score consists of the "male" age ratio score and the "female" age ratio score. Therefore it has three components.

Average sex ratio score (s):- this score is first obtained by first calculating the sex ratio at each age group. Successive difference irrespective of the sign are added and averaged.

Age specific sex ratio = $\frac{5P\chi^{M}}{5P\chi^{F}}$ x 100 …… (2)

Where

$5P\chi^{M}$ = Males aged χ to $\chi + 5$

$5P\chi^{F}$ = Female aged χ to $\chi + 5$

Average male age ratio score (M):- for each age group of males. The age ratio is computed thus:

Age ratio (AR) = $\frac{5Px}{1/2[(5Px-5)+(5Px+5)]}$ x100 ……..... (3)

The deviations from unity irrespective of the sign are added and averaged (M).

Average female age sex ratio score (F):- for each age group for females, the age ratios are calculated using the same formula as for males. The deviations from unity irrespective of the sign are added and averaged (F).

The index is then computed as UNAI = 3 (S) +M +F. Therefore, the index can be summarized through the following categories.

It is said to be accurate when the UNAI shows the age sex accuracy index to be between 0-19.9

Inaccurate if the index is between 20-39.9

Highly inaccurate if the index is above 40

2.2.3 MYERS'S INDEX

This is a technique developed to reflect preferences or dislikes of terminal digits. Myers's index is used for each of the ten digits from 0 to 9 to ascertain what proportion of the total population reports at an age ending in each of the digits, x (x=0, 1, 2,…, 9).The bias developed by starting only at a particular digit is minimized by beginning the count at each of the 10 digits in turn and then averaging the results. The method derives a blended population for the digit at age x which is essentially a weighted sum of the number of persons reporting ages ending in each of the ten terminal digits denoted by P_x.The underlying assumption is that if there are no systematic irregularities in the reporting of age, the blended sum at each terminal digit should be approximately equal to 10 percent of the total blended population. The blended population at each of the ten digits($b_{x)}^{P}$ can be compared with the total of the blended population called the blended sum, to obtain the percentage distribution of the blended sum (BSD_x).Hence, the

$BSD_x=\frac{b^p X}{\sum_{x=0}^{9} b^p x}$x100…………………………………………………………………………(4)

Where BSD_x is the proportion of the total population reporting on the given terminal digit. Any b_x^p must therefore be 10 percent of $\sum_{x=0}^{9} b^p\, x$ when there is no preference for any digit x

The blended sum *BSD lies in the range* $0 \leq BSD \leq 100$.

*W*hen BSD_x =10, there is no age heaping; when BSD_x >10, it indicates a tendency towards preference for a particular digit; when BSD_x <10, it indicates a tendency towards avoidance for a particular digit. An overall measure of index of preference for all terminal digits, the myers's Index is one half the sum of the absolute deviations from 10.That is

$$MI=\frac{1}{2}\,|\sum_{x=0}^{9} BSDx\text{-}10| \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

III. Data Analysis

The collected data were analyzed using the techniques discussed above as follows:

3.1 AGE RATIO:

In calculating the age ratios, we use the formular:

$$AR= \frac{5Px}{1/2[(5Px-5)+(5Px+5)]}\text{x}100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (6)$$

Where

$5^p{}_x$ is the population in age group x to age x+5

$5^{p(x-5)}$ is the population in the preceding age group

$5^{p(x+5)}$ is the population in the succeeding age group.

For age group 5-9,

Where $5^p{}_x$ =20,005,330 ; $5^{p(x-5)}$=22,594,967 ; $5^{p(x+5)}$ =16,135,950.

$AR_{5\text{-}9} = \frac{20,005,330}{1/2(22,594,967+16,135,950)}$ x 100 =103.

For age group 55-59,

$$AR = \frac{5Px}{1/2[(5Px-5)+(5Px+5)]}\text{x}100$$

Where $5^p{}_x$ =2,066,247; $5^{p(x-5)}$=4,249,219; $5^{p(x+5)}$=2,450,286

$AR=\frac{2066247}{1/2(4249219+2450286)}$ x100=62.

For age group 80-84,

$$AR = \frac{5Px}{1/2[(5Px-5)+(5Px+5)]}\text{x}100$$

where $5^p{}_x$ =760,053; $5^{p(x-5)}$=598,838; $5^{p(x+5)}$ =715,225.

$AR_{80\text{-}84} =\frac{760,053}{1/2(598838+715225)}$ x100 =116.

Table 3: The numerical and percentage distribution by 5 year age group and sex.

Age group	Male	%	Female	%	Total (both sexes)	%
0-4	11,569,218	16.2	11,025749	16.0	22,594,967	16.1
5-9	10,388,611	14.6	9,616,769	13.9	20,005,330	14.2
10-14	8,504,319	11.9	7.631.631	11.0	16,135,950	11.5
15-19	7,536,532	10.6	7,362,887	10.7	14,899,419	10.6
20-24	6,237,549	8.7	7,197,530	10.4	13,435,079	9.6
25-29	5,534,458	7.8	6,676,968	9.7	12,211,426	8.7
30-34	4,505,186	6.3	4,962,352	7.2	9,467,538	6.7
35-39	3,661,133	5.1	3,670,622	5.3	7,331,755	5.2
40-44	3,395,489	4.8	3,060,981	4.4	6,456,470	4.6
45-49	2,561,526	3.6	2,029,767	2.9	4,591,293	3.3
50-54	2,363,937	3.3	1,885,282	2.7	4,249,219	3.0
55-59	1,189,770	1.7	876,477	1.3	2,066,247	1.5
60-64	1,363,219	1.9	1,087,067	1.6	2,450,286	0.2
65-69	628,436	0.9	522,612	0.8	1,151,048	0.8
70-74	765,988	1.1	564,609	1.8	1,330,597	0.9
75-79	327,416	0.5	252,422	0.4	598,838	0.4
80-84	408,680	0.6	351,373	0.5	760,053	0.5
85 above	404,021	0.6	311,204	0.5	715,225	0.5
Total	**71,345,488**		**69,086,302**		**140,431,790**	

Sources: Nigeria, 2006 population census

***Table 4**: Distribution of 5-year age group and sex ratio of Nigeria 2006 population census.*

Age group	*Male*	*Female*	*Age ratio*
0-4	11,569,218	11,025749	104.93
5-9	10,388,611	9,616,769	108.03
10-14	8,504,319	7,631,631	111.44
15-19	7,536,532	7,362,887	102.36
20-24	6,237,549	7,197,530	86.66
21-29	5,534,458	6,676,968	82.89
30-34	4,505,186	4,962,352	90.79
35-39	3,661,133	6,676,968	99.74
40-44	3,395,489	4,962,352	110.93
45-49	2,561,526	3,670,622	126.20
50-54	2,363,937	3,060,981	125.39
55-59	1,189,770	2,029,767	135.74
60-64	1,363,219	1,087,067	125.40
65-69	628,436	522,612	120.24
70-74	765,988	564,609	135.67
75-79	327,416	252,422	129.71
80-84	408,680	351,373	116.31
85 above	404,021	311,204	129.83
Total	**71,345,488**	**69,086,302**	**103.27**

The Age Ratio for the 2006 population census is 103.27

***Table 5**: The United Nation Age-Sex Accuracy Index using the age ratio from table 5 above*

Age group	Age ratio	First difference	Male age-ratio	Dev. From 100	Female age-ratio	Dev. From 100
0-4	-	3.1	-	-	-	-
5-9	104.94	3.4	103.5	115.1	111.7	3.1
10-14	108.03	-9.1	94.9	-5.1	89.9	-10.1
15-19	111.44	-15.7	102.2	2.2	99.3	-0.7
20-24	102.36	-3.8	95.4	-4.6	102.5	2.5
21-29	86.66	7.8	103.0	3.0	109.8	9.8
30-34	82.89	9.0	98.0	-2.0	96.0	-4.0
35-39	99.74	11.2	92.7	-7.2	91.5	-8.5
40-44	110.93	15.3	109.1	9.1	107.4	7.4
45-49	126.20	-0.8	89.0	-11.0	82.1	-17.9
50-54	125.39	10.4	126.0	26.0	129.7	29.7
55-59	135.74	-10.3	63.8	-36.2	59.0	-41.0
60-64	125.40	-5.2	150.0	50.0	155.4	55.4
65-69	120.24	15.4	59.0	-41.0	63.3	-36.7
70-74	135.67	-6.0	160.3	60.3	145.7	45.7
75-79	129.71	-13.4	55.7	-44.3	55.1	-44.9
80-84	116.31	13.5	111.7	11.7	124.7	24.7
85 above	129.83	-	-	-	-	-
	-	153.5	-	428.8	-	342.1

The joint score for the UNAI is given by 3 (A) + M+ F…….. (7)
Where:

A is average Age ratio
M is average Male ratio
F is average Female ratio

Equation for Age Ratio
FOR MALE:

Average = $\frac{5px^{m}}{\frac{1}{2}(5px-5)+(5px+5)}$ x100

$= \frac{10388611}{\frac{1}{2}(11569+8504319)}$ x100 = 103.5

FOR FEMALE:

$$\text{Average} = \frac{5px^f}{\frac{1}{2}(5px-5)+(5px+5)} \text{ x100}$$

$$= \frac{961679}{\frac{1}{2}(11025749+7631631)} \text{ x100} = 111.7$$

Where $5Px^m$ stands for Male aged from × to × + 5

$5Px^f$ stands for Female aged from × to × +

5px= is the given number in the entire five year

5px -5 = the number in the proceeding five year

5px + 5 = the number in the succeeding five year

Computation from table 5 above:

First differences irrespective of the sign are added and averaged for the ratio.

Average(A)=$\frac{153}{17}$=9.0

Male average = $\frac{428.8}{16}$ =26.8

Female average = $\frac{342.1}{16}$ =21.4

Then, the UNAI = 3 (A) + M. Ave+ F. Ave

=3 (9.0) + 26.8 + 21.4

=75.2

From the distribution by 5 year age group and sex, the UNAI shows that the reported age-sex data for the 2006 population census is highly inaccurate because the index is 75.2, which is above 40.

***Table 6**: Myer's Index*

Term Digit x	10-19 10+x	20-29 20+x	30-39 30+x	40-49 40+x	50-59 50+x	60-69 60+x	70-79 70+x	80-89 80+x	90-99 90+x	Total (10+x) +	Total (20+x) +
1	2	3	4	5	6	7	8	9	10	11	12
0	3689425	2783597	1987524	910534	846271	391038	295132	158103	49103	11110727	18532029
1	2958746	3469210	2569210	1005239	924137	513826	197546	149273	83641	11870828	20782910
2	3023587	2836357	1210468	1624927	758134	352193	220137	185246	57357	10268406	17513225
3	4581355	4900258	1967350	894273	691357	498276	286427	98534	68497	13986327	23391299
4	3247103	2033524	1921096	1218214	714531	283147	114201	100124	94356	9726296	16205489
5	5284133	2846253	2006924	1784259	547136	310248	187023	49268	41637	13056881	20829629
6	2698145	1682382	1632089	846285	482367	267485	197214	93721	50348	7950036	13201927
7	1859503	2085361	1504632	976248	512069	412751	154479	73248	27025	7605316	13351129
8	2570262	1673691	959481	966087	368194	219348	143002	39761	21894	6961720	11353178
9	1123110	1335872	1040519	821697	471270	353220	132274	12775	21367	5312104	9501098

***Table 7**: Final calculation of Myer's Index*

Term digit	Sum (10+x)	Sum (20+x)	Weights for sum (10+x)	Weights for sum (20+x)	Weighted sum (10+x)	Weighted sum (20+x)	Blended sum	Percentage distribution (BSDx)	Dev. from 10	Absolute dev. from 10= $\lvert BSD_x\text{-}10\rvert$
1	2	3	4	5	6 = (2x4)	7=3x5	8=6+7	$9=\frac{P^x}{\sum_b PX}$ x100	10= 9-10	11=(10)|
0	11110727	18532029	1	9	11110727	166788261	177898988	13.5	3.5	3.5
1	11870828	20782910	2	8	23741656	166263280	190004936	14.4	4.4	4.4
2	10268406	17513225	3	7	30805218	122592575	153397793	11.6	1.6	1.6
3	13986327	23391299	4	6	55945308	140347794	196293102	14.9	4.9	4.9
4	9726296	16205489	5	5	48631480	81027445	129658925	9.8	-0.2	0.2
5	13056881	20829629	6	4	78341286	83318516	161659802	12.3	2.3	2.3
6	7950036	13201927	7	3	55650252	39605781	95256033	7.2	-2.8	2.8
7	7605316	13351129	8	2	60842528	26792258	87634786	6.6	-3.4	3.4
8	6961720	11353178	9	1	62655480	11353178	74008658	5.6	-4.4	4.4
9	5312104	9501098	10	0	53121040	0	53121040	4.0	-6.0	6.0
Totl					-	-	1318934063	100	-	33.5

From the table above, $MI=\frac{1}{2}\lvert\sum_{x=0}^{9} BSDx\text{-}10\rvert = \frac{1}{2}(33.5) = 16.75$ which is greater than 10, meaning that during the census, people made preference towards particular digits.

IV. Discussion of Results And Conclusion.

In the analyses carried out on age ratio, 103 for age group 5-9 being greater than 100 likewise the value, 116 for age group 80-84 showed that there were some people who were not supposed to belong to the age groups but were classified into the groups; the value, 62 for age group 55-59 showed that there were some people who were supposed to belong to the age group but were classified into some other age groups. The value, 75.2 for United Nations Age-sex accuracy Index (UNAI) being greater than 40 gave an indication of high level of inaccuracy in the age reporting of the 2006 population census. The value, 16.75 for Myers's Index showed that in the census age reporting, some people preferred quoting ages that ended in particular digits. Based on the findings, we conclude that the 2006 census age data were not accurately reported owning to both mis-statement of age and age heaping. Hence the following recommendations: Since it takes good information to ensure good developmental planning; the National Population Commission should endeavour to embark on post enumeration survey so as to ensure the correctness of the collected information; Statistical analysis of the collected data using any demographic techniques should be done to ensure error free data before using the collected age data for developmental planning; Also, NPC should endeavour to use well trained personnel in the census survey to ensure accuracy in both data collection and recording analysis and interpretation.

Reference

[1]. A'Hearn ,B., Baten, J. and Crayen, D. (2009). Quantifying quantitative literacy: age heaping and the history of human capital. J. Econ Hist; 69(3):783–808.

[2]. Cleland, J. (1996). Demographic data collection in under developed countries from 1946 to 1996 population studies, 50(3): 433-450

[3]. Crayan, D. and Baten, J. (2008). Global trends in numeracy and its implication for long-run growth Leibniz institute for Economic Research at the University of Munich.

[4]. Chevan, A. and Sutherland, M. (2009). Refinement and Extension of Standardization and Decomposition; Demography, vol 46 (3), Aug. 2009: pp 429-449.

[5]. Gilles, P., Bruno, M., Cheikh, T, Ndeye, B.D, Ibrahim, D. and Valerie, D. (2016). Age misreporting in census in developing countries: a record linkage study in health and demographic surveillance system in Senegal. A paper submitted to the European Population Conference (EPC2016), August, 31 to September, 3.

[6]. Hobbis, F.B., Jacob, A. S. and David, A. S. (2004). Age and Sex Composition: the methods and materials of Demography (pp. 125-173). USA: Elsevier Academic press.

[7]. Johanna, F., Laura, A. and Jasimine, T. H. (2015). An assessment of age reporting in the IPUMS-I microdata. A paper presented at the 2014 annual meeting of the Population Association of America.

[8]. Mark, L and Tara, (2017). Trends in Demographic and Health Survey data quality: an analysis of age heaping over time in 34 countries in Sub Saharan Africa between 1987 and 2015, Article number: 760 (2017).

[9]. Moultrie, T. A. (2012). General Assesment of age and sex data. Published on tools for Demographic Estimation. Available at *http.//demographicestimation.iussp.org.*

[10]. Mukherjee, B.N. and Mukhopadhyay, B.K. (1988). A study of digit preference and quality of age data in Turkish censuses. Genus; 44(1–2):201–227.

[11]. Palamuleni, M.E. (2012). Age reporting in north west province, South Africa, 1996-2007. Paper presented at the 2012 Annual meeting of the population Association of America, New Orleans, April 11-13.

[12]. Pardeshi, G. S. (2010). Age heaping and accuracy of age data collected during a community survey in the Yavatmal District, Maharashtra. Indian J Community Med. 2010; 35(3):391–395.

[13]. Pullum T. W. (2017). An assessment of age and date reporting in the DHS Surveys 1985–2003 DHS Methodological Reports No. 5. Calverton, Maryland, USA: Macro International, 2006.

[14]. Raymer, J. and Rogers, A. (2007). Using age and spatial flow structure in the indirect estimation of migration streams. Demography, vol 44(2), may, 2007: 199-223.

[15]. Selome, B. (2006).Analysis on the Quality of sex and age data collected on the two population and housing censuses of Ethiopia.Ethiop. J. Sci., 29(2): 123-132

Ezra Precious Ndidiamaka, et. al. "Statistical Analysis of Age Misreporting On Demographic Data." *IOSR Journal of Mathematics (IOSR-JM)*, 17(4), (2021): pp. 58-64.