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ADEQUACY OF AGE AND SEX DATA IN THE 1969 POPULATION CENSUS OF ZAMBIA FOR ESTIMATES OF FERTILITY

M73-1625

Adequacy of age and sex data in the 1969 population census of Zambia for estimates of fertility

"... while a particular method of approach may be best, it is not infallible. For instance, the demographic history of the population under study ought really to be known in outline before attempting to elucidate the meaning of its age composition. It is otherwise absurd to smooth the ages as reported, since there may be real irregularities which are thus arbitrarily removed. The surest way of finding that a population has stable characteristics is to adjust it until they appear"

T.H. Hollingworth
Journal of the Royal Statistical Society,
Vol. 135, No. 4, 1972
p. 615

I. Introduction

1. The first attempt in Zambia to enumerate Africans by single years of age was made in the 1969 Census of Population and Housing. This enumeration , in many ways, was a significant milestone in the history of census taking in the country. Before the demographic sample survey of 1950, only rough estimates of the African population, including those resident abroad, were regularly made purely for the immediate needs of the governing authorities. The collection of data on age and sex and indeed other demographic measures was therefore never undertaken. Significant advance was made in the 1963 census to collect data covering the age-sex distribution as well as other demographic variables. The results and limitations of this census have been described elsewhere, showing, for present purposes, that the scope and accuracy of the information on age in the 1963 census were very limited 1/. At that time, data were collected mainly in three broad age groups, namely, for persons born before 1918, between 1918 and 1941 and for those born 1942 and after. The methodology and technique of the 1969 census together with its relative merits over the 1963 census have been appraised elsewhere 2/.

2. In spite of the wide coverage of demographic variables in the 1969 census, age and sex distribution of the population have been singled out for critical evaluation and analysis for a number of reasons. The most significant of these, seen especially in the light of recent advancements in the evolution of techniques for appraising defective data, is the tremendous possibility of inferring the specificity and precision of vital rates from age data. Consequently, attempts have been made in recent times in Africa to obtain more refined estimates of

1/ P.O. Ohadike, Some Demographic Measurements for Africans in Zambia : An Appraisal of the 1963 Census Administration and Results. Communication No. 5, Institute for Social Research, University of Zambia, 1969.

2/ P.O. Ohadike, " Counting Heads in Africa : The Experience of Zambia, 1963 and 1969", Journal of Administration Overseas, Vol. IX, No. 4, October 1970.

fertility and mortality in particular from given age and sex data in different African countries. From a more pragmatic angle, detailed information on the age-sex structure, especially after necessary "doctoring", have been used for projections of population size as well as for assessing the supply and demand for social, economic and health services by the population. If these needs are to be adequately met, a critical appraisal of the quality of age and sex distribution is very vital. The extent and nature of the errors and their implied limitations have to be meticulously examined with a view to delineating as much as possible the general spread of the errors in the population.

II. Available estimates of fertility from the census of Zambia 1969

3. In this paper, attempts will be made to study the quality of the age-sex data from the 1969 census of Zambia. The degree and patterns of error will be discussed together with a review of available fertility estimates based on the age-sex data from the census. However, in the presentation, the cart will deliberately be put before the horse by first indicating the already made estimates of fertility from age data in the census by various authors, and then proceeding to examine the quality of the age data. This approach has been followed because of the impression, borne out of previous experience, that the estimated levels of fertility correlate significantly with the degree and pattern of errors in age reporting and recording. The estimates that have been made were undertaken independently but all seem to have a common denominator in terms of the relative level and pattern of estimates, two of which will be briefly outlined here.

4. Extensive analysis of the 1969 Zambia census has been undertaken by J.G.C. Blacker, including estimates of vital rates. Of all the approaches adopted by him, those estimates based on the cumulated age distribution and stable population models seemed, in his assessment, to give rather more sensible results. Since he was afraid that the male age distribution had been distorted by migration, he used the female age distribution to derive a series of estimates based on the proportions under 5, under 10, up to 45. The estimated gross reproduction rates from this procedure ranged from 2.93 to 3.37. After making adjustments particularly for possible declining infant and child mortality, Blacker derived a median total fertility rate of just about 7, assuming a sex ratio at birth of 103. His own feeling to quote him, "is that it is more likely to err on the side of being too high than too low". 1/

5. A corresponding point of view, also emanated from the independent analysis undertaken by Okorafor and Ohadike 2/. The approach followed by the two authors involved estimates of total f ertility by the Brass P/F ratio method and by stable population analysis based on records of population growth and age distribution. The estimates by the Brass P/F ratio method yielded a total fertility rate of 7.4 and a corresponding female gross reproduction rate of 3.6, assuming again a sex ratio at birth of 103. The results of the estimates by the stable population method were of the same order of magnitude. Total fertility rate was 7.5 and female gross reproduction rate was 3.7.

1/ J.G.C. Blacker, Comments on the paper "The Estimation of Vital Rates from Census Data in Zambia", personal communication from J.G.C. Blacker.

2/ A.E. Okorafor and P.O. Ohadike, "The Estimation of Vital Rates from Census data in Zambia", 1972 (draft).

6. Now without going into details of the limitations of the estimates, one gets the impression that the rates appear implausibly high. The rates by the P/F ratio method could have been higher than those reported, but for the fact that use was not made of the P/F ratio based on the 20–24 age group alone. Had this been done, the adjustment would have yielded a rather highly unrealistic level of total fertility as high as 10.3 and a female gross reproduction rate of 5.1, assuming a sex ratio at birth of 103. The reported total fertility rate of 7.4 was consequently derived by basing the P/F correction factor on a wider age group of females. In this case, the adjusted f_i were obtained by multiplying the recorded f_i by $1/3(P_3/F_3 + P_4/F_4 + P_5/F_5)$. It should be noted that the use of the average of three P/F ratios partly involved some subjective judgement, especially when it is recognized that such a choice was not part of the original formulation of the P/F ratio method. But this element of subjectivity together with sensitivity to errors in age reporting and inability to account for natural and socio-cultural changes in fertility constitute some of the already reported limitations of the P/F ratio method 1/. More specifically, some writers have questioned the validity of the fundamental assumption that errors in the reference period of fertility reporting are independent of the age of the women. For example, it has been shown that age misreporting, even if errors in reported age are independent of parity and fertility, can have a very considerable effect on the estimates of fertility by the application of the P/F ratio method 2/.

7. Consequently, in trying to explain the implausibility of the estimates reported above, two reasons, judging from the data, come to mind. In the first place, there may have been some faulty reporting and/or recording of births by either respondents or enumerators. In the second place, there may have been significantly large errors in the reporting of age in the census. It is the latter aspect of the problem that the remaining part of the analysis will dwell on. In general, there exists now a body of knowledge in support of the fact that for the estimation of vital rates in developing countries, the available basic age data could contain a large component of errors, which might vitiate conclusions drastically.

1/ W. Brass et al., The Demography of Tropical Africa, Princeton University Press, Princeton, New Jersey, 1968, p. 90.

ECA, "Recall Lapse in Current Vital Data and in Historical Fertility Data", Seminar on Techniques of Evaluation of Basic Demographic Data, Accra, Ghana, 16-28 July 1973, E/CN.14/POP/88, paras. 43-54.

2/ Etienne van de Walle, "Note on the Effect of Age Misreporting". In W. Brass et al, op. cit., pp. 143-150.

III. Quality of age data: adjustments, graphing and accuracy tests

8. Biases from inaccurate age reporting and recording are probably best demonstrated by data presented in single or individual years. Such data give a clear picture of the extent of distortions which may have occurred as a result of faulty reporting as well as collection procedures. The data also lend themselves to much more detailed and varied scrutiny and adjustment than if they were presented in broad age groups.

9. Figure 1 in the appendix illustrates the pattern of bias for single-year age distributions of males, females and total population of Zambia as shown by the 1969 census. The graphs show ages in percent of total population of each sex and their combined total respectively. Apparently, age misstatement and heaping occurred and certain digits were preferred either in age reporting or recording. Significantly, however, the preference did not exhibit heaping on even numbers only, but also on odd numbers.

10. As can be surmised from figure 2 in the appendix, the digit 9 according to Myer's index was the most prefered of all. This, however, seems to be misleading. Following the suggestion of Ajit Das Gupta in his work on assessing age bias 1/, the sum of the ratios that the numbers returned at each end digit of age constitute of the total returned in the successive decennial age ranges clearly shows that the most preferred digit was 0. This can be seen from table 1 which clearly shows that this was true of the entire male and female population separately at each decennial age group 10-19, 20-29, ..., 60-69. The only other digit generally preferred by males as well as females was 5, while males alone showed a peculiar attraction to 7 and females to 1. The rather intriguing heaping on odd numbers (1, 9, and 7) may have some causal connections which would possibly have methodological, cultural or social origins worthy of further investigations. Peaks and troughs corresponding respectively to the preferred and avoided terminal digits could further be seen in figure 1 in the appendix. In relative terms, the oscillations in the graph marking the pattern of misstatement appear to be more pronounced at adult ages above 15 years than below.

11. For purposes of computing child-woman ratios or fertility and birth rates by the reverse-survival method, a closer examination of the age distribution among the young, especially those under 10 years of age, will be instructive. While a general age misstatement is apparent at these young ages, the most significant under-count occurred for children aged 8 years. No ready explanation can be given for this shifting of ages into adjacent age groups, unless further investigations related to the method of data collection and to the social and cultural attitudes of the people are undertaken.

1/ Ajit Das Gupta, A Technical Note on Age Grouping. The National Sample Survey Number 12, Eka Press, Calcutta, 1958, pp. 21-23.

Table 1. Ratio of Numbers returned at each End-Digit to Total Numbers in the Successive Decennial Age Ranges, Zambia 1969 Census of Population and Housing

Terminal Digits	Age Distribution					
	10–19	20–29	30–39	40–49	50–59	60–69
(1)	(2)	(3)	(4)	(5)	(6)	(7)
			(a) M A L E S			
0	13.8	11.7	12.5	14.3	15.1	18.6
1	12.0	10.8	9.5	11.4	14.0	9.7
2	12.2	11.2	9.2	9.7	5.8	6.9
3	10.4	8.8	9.6	7.4	8.0	7.2
4	9.5	9.2	8.9	7.7	5.4	8.2
5	10.6	8.8	9.2	11.2	20.6	10.2
6	8.5	8.0	7.1	5.4	6.1	5.1
7	8.6	12.1	12.8	9.7	7.8	10.8
8	6.7	8.1	9.1	9.4	6.0	12.3
9	7.7	11.3	12.1	13.9	11.2	11.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
			(b) F E M A L E S			
0	13.4	12.8	15.3	17.0	18.6	23.1
1	11.7	11.6	10.9	11.5	15.1	10.0
2	11.1	10.9	9.4	9.2	7.4	6.6
3	9.7	9.4	10.2	7.9	9.0	7.6
4	8.6	9.5	8.7	7.3	6.7	7.0
5	9.8	9.7	10.1	11.5	13.8	10.9
6	8.5	7.7	6.8	5.6	6.0	5.0
7	9.2	10.2	9.0	7.4	7.2	9.2
8	7.8	7.0	6.8	7.8	5.2	9.6
9	10.2	11.2	12.8	14.8	11.0	11.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 2. Single-year Age Distribution of Population aged 0-9 years from the Zambia 1969 Census and the Ghana 1960 Census

Age (Years)	Zambia 1969 Census			Ghana Census 1960 (total)
	Male %	Female %	Total %	%
0	12.3	11.9	12.1	12.0
1	11.1	11.2	11.2	9.2
2	10.5	10.8	10.7	11.2
3	10.2	10.4	10.3	12.4
4	9.9	10.2	10.0	11.2
5	9.8	10.0	9.9	10.0
6	9.7	9.8	9.8	10.6
7	9.3	9.2	9.2	8.4
8	8.3	8.0	8.1	8.4
9	8.9	8.5	8.7	6.6
Total	100.0	100.0	100.0	100.0

12. But apart from the trough at age 8 and the relative under-enumeration of children especially those under 5 years of age, the relatively better enumeration of the young than the adult is shown by the expected tapering of the age pyramid at the young ages and less so at the adult ones. Table 2 compares the prevailing population structure for persons under 10 in Zambia with that of Ghana in 1960. Among other observations, the marked preponderance and consequent overenumeration of children aged 3 years in Ghana was not observed in Zambia. From the data, the children aged 3 years in Ghana were so many as to constitute the most numerous single-year age group in the Ghana census of that year. One possible reason for this appears to be a significant under-count of children below the age of 3 years. Actually the inflation at this age group appears all the more perplexing when it is considered that childhood mortality, normally relatively high, could have depleted the number of children passing from birth into higher age groups. Apart from the reasons so far preffered, it is now virtually accepted that the inflation had something to do with the use of historical calendar. The year 1957 was the year Ghana achieved independence, and three years elapsed between independence and the census of 1960. By using independence as a bench mark for recording ages, many children were passed as being three years old. But this does not mean that the often encountered under-enumeration of children under 5 years of age did not take place in the Zambia census of 1969. The following estimate shows that the number of persons 0-4 years as enumerated in the Zambian census was less than would be expected on the basis of estimated births and deaths in the preceding five years before the census :

Age 0–4 years	Number enumerated at the 1969 Zambia census	Percent of total population in 1969	Number corrected for under-enumeration	Percent of total population in 1969
Male	369,755	19.1	467,740	24.2
Female	382,736	18.9	483,261	23.9

13. Nevertheless, it must be conceded that the adjusted data appear to lie on the very high side, based as they are on an estimated birth rate of 54 per 1000 population derived by adjusting the total number of births (145,763) recorded to have taken place during the twelve months before the 1969 census using Brass' P/F ratio method. The resulting estimate might have been of a lower magnitude if other adjustment procedures were followed, but would still have been significantly higher than the enumerated number of children aged 0–4 years. Thus, whatever be the case, the result would have pointed to a marked under-enumeration of these young children.

14. Part of the erratic fluctuations in the single-year age distribution can be curtailed by grouping the data into quinary ages. In principle, this procedure can cancel out some but never all of the digit preference errors. There would, in addition, remain a significant residue of age reporting errors as well as distortions explicable in terms of the social and historical experience of the population. In figure 3 in the appendix, the enumerated and adjusted quinary age data for Zambia according to the 1969 census have been plotted in pyramidal as well as straight-line graphs. The smoothening effect of quinary age grouping is very obvious by share comparison with the graph in figure 1 based on single year age groups. However, a close study of the age pyramids reveals the salient fact that the adjustment technique used was not as effective in eroding the distortions in the male age distribution as in the female. The adjustment technique employed for the age segment, 10–74 years, is that derived from a simple parabola and recommended by the UN secretariat for smoothening data with marked inaccuracies 1/. Adjustments of the distribution of persons at the youngest and oldest ages were dealt with separately, using other simple techniques. Briefly, for the age group 0–4, births in the preceding five years were estimated by the forward survival ratio technique. For age 5–9 the estimate was derived by applying the following formula : $\hat{5P_5} = \frac{1}{2}\left[P_5 + P_{10}\right] + P_6 + P_7 + P_8 + P_9$. For ages 75 or more, appropriate proportions from a model stable population corresponding to ages 75–79, 80–84 and 85 + were used to compute the expected population in each of these advanced age groups. Following the sub-group adjustments, a final one was undertaken in order to pro-rate the adjusted total population to fit the total enumerated.

1/ United Nations, Methods for Population Projections by Sex and Age, Manual III, Population Studies, No. 25, pp. 11–12.

15. The main point of variation between males and females in the results of the adjustment features prominently in the broad age group 25-60 years. At these ages the adjusted quinary age data for males still exhibited a bulge suggestive of a possible over-enumeration of males over females. Of course, it is not uncommon in African censuses and surveys that men tend to exaggerate their ages especially at the oldest age groups. But this may not be the only answer. A much more plausible explanation appears to be the contemporary and historical experience of the net immigration of Africans from other African countries to Zambia. Spread possibly over a long period of time and with the more recent immigrants also coming at ages 25 or more, the male immigrants swelled the total number of persons in the broad age group in question. In support of this hypothesis is the fact that although the reported bulge occurred in the female age distribution after adjustment, it was not pronounced nor did it occur in the same age range. The female bulge spanned the relatively shorter age group 15-39 years. Granting that the male immigrants were married, then part of the female bulge could be explained by the enumeration of their wives aged 15-39 years, who invariably must have been younger than their husbands.

16. In addition to adjustments and graphing, some indices have been computed in order to throw more light on the extent of the distortions in the age data from the 1969 census of Zambia. In terms of digit-preference, Whipple's and Nyer's indices, among other available 1/, have been computed in table 3 for lack of time. By standards prevailing in developed countries like Sweden (Whipple's index for 1920, Myer's for 1939) and the USA (both indices for 1940), the indices for Zambia in 1969, being much higher, point to greater inaccuracy in the Zambian data. Reference has already been made in the analysis to the most preferred and most rejected terminal digits in the reporting and recording of ages in single years. The sex, age and joint ratio scores also confirm this and indicate the existence of a considerable degree of inaccuracy in the Zambian age data. The sex ratio score was 15.0, the age ratio scores for males and females were respectively 17.4 and 9.7 and consequently the joint ratio score at 72.1 was, as can be seen from table 2, almost ten times as high as the level for Sweden in 1945 and approximately seven times as that for the USA in 1940. Considering Ceylon (1953) and Brazil (1940) as part of the less developed areas, it is also significant that the joint ratio score in Zambia (1969) is more than double the scores in these countries.

1/ Ajit Das Gupta, op. cit., especially pp. 21-27.

K.V. Ramachandran, "An Index to Measure Digit Preference Error in Age data", Proceedings of the World Population Conference, 1965, Belgrade, Vol. III, New York 1967, pp. 202-203.

N.H. Carrier, "A note on the Measurement of Digital Preference in Age Recordings" Journal of the Institute of Actuaries, Cambridge (England), 85:71-85, 1959.

Table 3. Age Accuracy Indices, Sex and Age Ratio Scores for Selected Countries

Country	Whipple's Index		Myer's Index		Sex Ratio Score	Age Ratio score		Joint Ratio Score
	Male	Female	Male	Female		Male	Female	
Zambia (1969)	119.1	123.1	14.2[a]	15.5[a]	15.0	17.4	9.7	72.1
Ceylon (1953)					4.4	8.8	11.0	33.0
Brazil (1940)	143.3	153.1			3.9	7.0	8.5	27.2
Sweden (1945)	-	-	-	-	1.2	2.1	1.9	7.6
USA (1940)	-	-	-	-	1.9	2.5	2.3	10.5
	Both Sex		Both Sex					
Sweden (1920)	100.4		-		-	-	-	-
Brazil (1940)	-		16.3		-	-	-	-
Sweden (1939)	-		1.2		-	-	-	15.1[b]
USA (1940)	109.7		3.0		-	-	-	12.2[c]

Source : Republic of Zambia, Census of Population and Housing, Zambia, 1969
United Nations, Population Bulletin, No. 2, October 1952, New York, pp. 75-76.

United Nations, Methods of Appraisal of Quality of Basic Data for Population Estimates, Manual II, Population Studies, No. 23, pp. 40-43.

Note : a/ Calculated for ages 10-69, and excludes ages not stated.

b/ Score for 1963.

c/ Score for 1960.

IV. Quality of Age Data: Comparison with Model Distributions

17. Apart from computing indices of inaccuracies in age data, comparison of enumerated age-sex groups with selected models can be used to throw more light on the quality of the Zambian 1969 census data. Reference has already been made to the pattern of differences between the enumerated and the smooth quinary age distribution. Further attempts will now be made to compare the enumerated age distribution with two other major models, namely, (i) Stable population models with given and comparable rates of population growth and level of mortality experienced by the population, (ii) The composite data for thirty African countries compiled by the Economic Commission for Africa. Obviously, it should be conceded, ab initio, that the acceptability of the present approach very much depends on the common recognition that the models only approximate to the realities of the demographic, social and economic conditions prevailing. Therefore, when comparisons are undertaken, the purpose is often to underline the common areas of convergence or divergence between the chosen model and observed population distributions. The choice of the model to be used in the comparison must be guided by certain minimum objective standards or criteria which will ensure a close approximation of the model to the actual population.

(1) Zambia Age Distribution (1969) and Stable Population Model Distribution

18. Comparison of observed age distribution with a corresponding stable population distribution implies the experience of stability or quasi-stability conditions by the actual population under consideration. In the case of Zambia, the assumption, at least on a priori grounds, is that the African population of the country has not experienced marked fluctuations in fertility or very serious changes in mortality. Granting this, the selection of the models used in the present analysis involved the estimation of population parameters based on the age distribution of males as well as females. This was done in the interest of further demonstrating which of the two age distributions would yield better and more dependable estimates of fertility and mortality.

19. Confirming earlier observations, the experience gained from the analysis showed that the female age distribution is relatively much better than the male distribution, which as previously indicated, has been largely affected not only by migration but more serious bias in the reported ages. Additional evidence in support of this relative superiority of the female Age data over the male are presented in Tables 4 and 5. Essentially, the selection of the model stable populations presented in these tables, followed extensive analysis and comparison of the age-specific ogive $/\overline{C(x_s)}/$ values of various models with the $/\overline{C(x_e)}/$ of the enumerated Zambian population. In particular, emphasis was placed on the correspondence between the ogive value $c(35)$ for the two populations.

Table 4 : Comparison of Cumulative Percentage Distribution of Enumerated Female Population of Zambia under Specified Ages with a Selected Coale-Demeny (West) Stable Population Model (e_o^o = 45; r = 2.8%)

Age	Enumerated $C(x_e)$	Stable $C(x_s)$	$\frac{C(x_e)}{C(x_s)}$
(1)	(2)	(3)	(2)÷(3)=(4)
5	.1894	.1817	1.04
10	.3472	.3279	1.06
15	.4557	.4522	1.01
20	.5458	.5574	0.98
25	.6383	.6459	0.99
30	.7165	.7200	1.00
35	.7856	.7815	1.01
40	.8433	.8325	1.01
45	.8850	.8745	1.01
50	.9221	.9088	1.01
55	.9482	.9365	1.01
60	.9680	.9582	1.01
65+	.9805	.9746	1.01
Under 15	.4557	.4522	1.01
15-44	.4293	.4223	1.02
45+	.1150	.1255	0.92

The location was further guided by the calculation of the intercensal rate of population growth between 1963 and 1969 separately for males (2.4%) and females (2.8%).

20. From the point of view of estimating vital rates, especially birth rates, it is apparent that the relatively higher degree of correspondence between the stable $C(x_s)$ and enumerated $C(x_e)$ female age distribution more or less precludes the female data (Table 4) as being better than the male Table 5 and 6). Column 4 of each table gives the index of discrepancy between $C(x_s)$ and $C(x_e)$ values which have also been graphed in Figure 4 in the Appendix.

21. In spite of the better enumeration of the ages of females, it is obvious from Table 4 that there was a relatively large number of females reported as aged 0-9 followed by a sharp drop beginning in the age group 10-14 up to 20-24. It is possible that the depletion was due to the shifting of persons aged 10-14, 15-19 and 20-24 into adjacent age groups. After age 35, signs of the exaggeration of female ages begin to show up and continue up to age 65+. There may also have been overstatement of ages in the child-bearing period (15-44) as suggested by the comparison of the number of women in this age group enumerated in 1969 with those in the stable model populations. Generally, therefore, the female age distribution conforms to the

pattern typical of tropical Africa, India, Indonesia, Morocco and Pakistan in which the age distribution has a surplus at 5-9 and a deficit at 10-19 followed by a surplus in the central ages of child-bearing 15-34 years.[1/]

22. Tables 5 and 6 underline the existence of marked patterns of error in the reporting and/or recording of the ages of males in the 1969 census. From age 30 onwards, the degree of convergence between $C(x_s)$ and $C(x_e)$ values attained reasonably normal levels and consistently improved up to age 65+. The over-statement of ages at the lower age groups is also very apparent from the tables, and it is significant that, as was shown for the females, the most significant age bracket affected by this over-statement is the 0-9 years age group. The drop in the level of over-statement, once again, commes in the age group 10-14 commences and continues up to 20-24. There is also evidence in the tables that under-enumeration of males aged 15-44 occurred in the 1969 Zambia census. It is of course possible that migration may be connected with this although it also seems highly plausible that the shifting of persons into adjacent age groups, especially into ages under 15 and into those above 45 has been a positive factor. In the latter case, the possible exaggeration of male ages in the later years of life may have been important.

24. Some comments on the presentation of two model stable populations respectively in Tables 5 and 6 are necessary. In the first place, the dual selection merely serves to highlight further how erratic the male age distribution in the 1969 census of Zambia was. In the exercise, the ogive values for C(25), C(30)... C(65+) in Table 5 (enumerated and stable) gave fairly reasonable correspondence, especially at C(35). But the discrepancy at the younger ages were surprisingly very high and besides, the expectation of life at birth of 47.0 given by the stable model appeared too high especially in relation to the female e_0^0 of 45, if we consider that normally male mortality should exceed that of the female. Consequently, attempts were made to improve on the choice of a stable model which, with lower e_0^0(42.0) than for females (45.0) gave the values presented in Table 6. It is significant to point out that while the choice reduced the degree of the bias in the over-enumeration of youths, it indicated some under-enumeration between ages 30 and 55 years, and, in general depicted more erratic distribution at the older ages. AT best, therefore, it must be recognized that the fitting of an appropriate stable model age distribution to the observed male age data for Zambia in 1969 has been problematic. This is so, in spite of the general tendancy of the results of many trials at fitting the models to show large and consistent patterns of deviations and errors which, of course, occurred at varying degrees depending on the model selected.

1/ Methods of Estimating Basic Demographic Measures from Incomplete Data, (United Nations Publication, sales No. E.67.XIII.2), pp.19-20)

Table 5 : Comparison of Cumulative Percentage Distribution of Enumerated Male Population of Zambia under specified ages with a selected Coal-Demeny (West) Stable Population Model (e_0° = 47.0; r = 2.4%)

Age	Enumerated $C(x_e)$	Stable $C(x_s)$	$\frac{C(x_e)}{C(x_s)}$
(1)	(2)	(3)	(2) ÷ (3) = (4)
5	.1911	.1632	1.17
10	.3538	.2999	1.18
15	.4750	.4188	1.13
20	.5632	.5223	1.07
25	.6307	.6117	1.03
30	.6938	.6885	1.01
35	.7520	.7540	0.99
40	.8110	.8096	1.00
45	.8549	.8565	1.00
50	.8979	.8954	1.00
55	.9279	.9270	1.00
60	.9600	.9521	1.01
65+	.9748	.9710	1.00
Under 15	.4750	.4188	1.13
15-44	.3799	.4377	0.87
45+	.1451	.1435	1.01

Table 6 : Comparison of Cumulative Percentage Distribution of Enumerated Male Population of Zambia under specified ages with a Selected Coale-Demeny (West) Stable Population Model (e_0° = 42.0; r = 2.4%)

Age	Enumerated $C(x_e)$	Stable $C(x_s)$	$\frac{C(x_e)}{C(x_s)}$
(1)	(2)	(3)	(2)÷(3) = (4)
5	.1911	.1703	1.12
10	.3538	.3101	1.14
15	.4750	.4312	1.10
20	.5632	.5332	1.06
25	.6307	.6263	1.01
30	.6938	.7030	0.99
35	.7520	.7680	0.98
40	.8110	.8226	0.99
45	.8549	.8680	0.99
50	.8979	.9052	0.99
55	.9279	.9350	0.99
60	.9600	.9582	1.00
65+	.9748	.9753	1.00
Under 15	.4750	.4312	1.10
15-44	.3799	.4368	0.87
45+	.1451	.1320	1.10

(ii) Zambia Age Distribution (1969) and the African Composite Age-Sex Distribution

24. For purposes of further illustrating the consistency in the pattern of age misstatement in the 1969 census of Zambia, additional comparison with the African composite age-sex distribution constructed by the ECA might be fruitful. The composite pattern, derived from the data for thirty African countries reflects barely the major features of the age distribution in Africa without necessarily pretending to present a model distribution typical of the whole continent. Any attempt to do so on the part of the originators would have been tantamount to being deliberately oblivious of the magnitude and implications of the complexities of demographic patterns and relationships in Africa. All the same, as a model, the composite distribution offers a useful bench mark against which reliability and consistancies in age data on the one hand, and the real peculiarities on the other, in individual African countries could be assessed and discussed with some fair degree of objectivity otherwise inaccessible in the absence of other comparably adequate basis for making such analysis. Even if it could be demonstrated that the African composite data fits no particular country distribution of ages, the mere fact that it has been subjected to comparative analysis against data from countries in the region contributes to the enrichment of methodological knowledge in population studies.

25. Table 7 presents the percentage age distribution of the composite data and of the Zambia census of 1969. The pattern of variation between the two is interesting and strengthens earlier observations on the distortions in the age data for Zambia. In the first place, the phenomenon of the relatively large numbers of children aged 0-4 and 5-9 in Zambian population vis à vis the model is once again confirmed by the lower proportions of children in similar age groups in the composite data. In fact, the disparity extends up to the 15-19 years age group. In the second place, persons, males and females, aged 15-44 in the Zambian population were proportionately fewer than in the composite population data. Thus, at higher ages above 15 in general, fewer people were proportionately recorded than in the composite model. But the most interesting feature of the comparison is that the reported bias in the female age distribution tended to be consistent in one direction, while that of the male, as can be seen in Figure 5, tended to be less consistent and more erratic in terms of swings over and above the expected parity mark between the composite distribution and the enumerated age distribution of the Zambian population.

26. Consideration of sex ratio variations by age in the model and in the observed distribution further underlines the magnitude of the discrepancies in the Zambian age-sex data. Table 8 presents the required data for comparisons. Columns (2) and (3) clearly show that generally sex ratio data in Africa are either poorly recorded or reported. This is evident from the pronounced erratic distribution in the Zambian census (column 2) and in the composite sex ratio data for thirty African countries (column 3). By further critical examination, it can also be seen that the level of fluctuations and therefore the degree of error is higher in the Zambian than in the

Table 7 : Comparison of the composite age distribution for thirty African countries with the percentage age distribution in the 1969 census of Zambia

Age Group	Zambia		Composite[1]	
	Male	Female	Male	Female
0 - 4	19.1	18.9	17.5	17.5
5 - 9	16.3	15.8	15.3	14.6
10-14	12.1	10.8	10.8	9.4
15-19	8.8	9.0	8.2	8.3
20-24	6.8	9.3	7.2	8.7
25-29	6.3	7.8	7.7	8.9
30-34	5.8	6.9	6.5	7.4
35-39	5.9	5.8	6.1	6.1
40-44	4.4	4.2	4.8	4.6
45-49	4.3	3.7	4.3	3.8
50-54	3.0	2.6	3.3	3.0
55-59	3.2	2.0	2.3	2.0
60-64	1.5	1.3	2.0	2.0
65+	2.5	1.9	4.0	3.7
Total	100.0	100.0	100.0	100.0
Under 15	47.5	45.5	43.6.	41.5
15-44	38.0	43.0	40.5	44.0
45 or more	14.5	11.5	15.9	14.5

1/ Source: UNECA, "Age Data in African Censuses and Surveys", Seminar on Organization and Conduct of Censuses of Population and Housing, Addis Ababa, 17-29 June 1968, E/CN.14/CPH/13, p.3

Table 8 : Comparison of the Age-Specific Sex-Ratio (M/F) of the Composite African Age-Sex Distribution with the Observed Sex Ratio (M/F) in the 1969 Census of Zambia and with the African Sex Ratio Model.

Age Group	Zambia 1969 Census	Composite African [1]	Sex Ratio Model at Birth (M/F) [1]		
			100	103	105
(1)	(2)	(3)	(4)	(5)	(6)
0 - 4	97.0	99.0	97.6	100.5	102.4
5 - 9	99.0	103.0	96.8	99.7	101.7
10-14	107.0	113.0	96.7	99.6	101.5
15-19	94.0	97.0	96.8	99.7	101.6
20-24	70.0	82.0	96.8	99.7	101.7
25-29	77.0	85.0	96.8	99.7	101.6
30-34	81.0	87.0	96.6	99.5	101.4
35-39	98.0	99.0	96.2	99.1	101.0
40-44	101.0	101.0	95.2	99.3	100.2
45-49	111.0	113.0	96.1	96.9	98.8
50-54	110.0	108.0	91.9	94.7	96.5
55-59	155.0	114.0	88.8	91.5	93.3
60-64	113.0	103.0	85.3	87.9	89.6
65-69	132.0	106.0	81.7	84.2	85.8
70-74	110.0	102.0	78.0	80.3	81.9
75-79	116.0	103.0	73.3	75.5	77.0
80-84	114.0	105.0	66.6	68.6	69.9
85+	120.0	106.0	52.9	54.5	55.5
Total	96.0	99.0	-	-	-

1/ Source: UNECA, Ibid, E/CN.14/CPH/13, p.3 and p.16

composite data. The most striking variation between the two appears from age 55 upwards with a significantly marked masculinity ratio much higher than the expected pattern of mortality would allow for. The erratic and sharply increasing ratio in the Zambian data would be appreciated much better if comparison were made with the model sex ratios given in columns (4), (5) and (6). The sex ratios, derived from a study of sex differentials by age in 12 African countries, are each believed to approximate to a pattern which would normally emerge in populations with similar sex ratios at birth if the normal pattern of higher male mortality than female prevailed. Thus the models clearly show declines of sex ratios with increases in age. But this pattern of decline is not vindicated either in the African composite sex ratios or in the Zambian which, in fact, shows a rather pronounced erratic pattern of rapidly increasing sex ratios at advanced ages.

Conclusion

27. Earlier attempts at estimating vital rates from the age-sex data from the 1969 population census of Zambia proved inconolusive. The need for a better appreciation of the problems involved calls for a critical examination of the quality of the age and sex data reported or recorded in the census.

28. The present analysis underlines the fact that a high degree of age misreporting or poor recording, generally in line with the "African-Southern Asia" pattern of error, occurred. The occurence was more apparent in the male than in the female age distribution. It may be that respondents were mostly females and therefore reported their ages better than those of the males whose ages would have been mostly recorded by estimation, often with the help of the enumerators. Reflecting perhaps the impact of education at younger ages, errors were more pronounced at adult ages above 15 years than below. Various techniques have been employed to demonstrate these error variations in the general level of age misstatement in the census data. In terms of the observed relative advantages of the female data over the male, it seems obvious that for purposes of obtaining relatively reliable estimates of vital rates, the female age distribution should be preferred to the male. Apart from being subject to much higher levels of misreporting and poor recording, the male population has been affected, to a greater degree, by migration, all of which have more seriously distorted the age and sex distribution.

29. The limitations of the Zambian age and sex data clearly emphasizes the need for improving the methods of data collection not only through census and survey enumerations, but also vital registration. Already some efforts at promoting vital registration have been launched by the government of Zambia. But this development is still in its formative stage and will take some time before its effectiveness, adequacy and impact could be objectively assessed.

1/ United Nations, Idem.

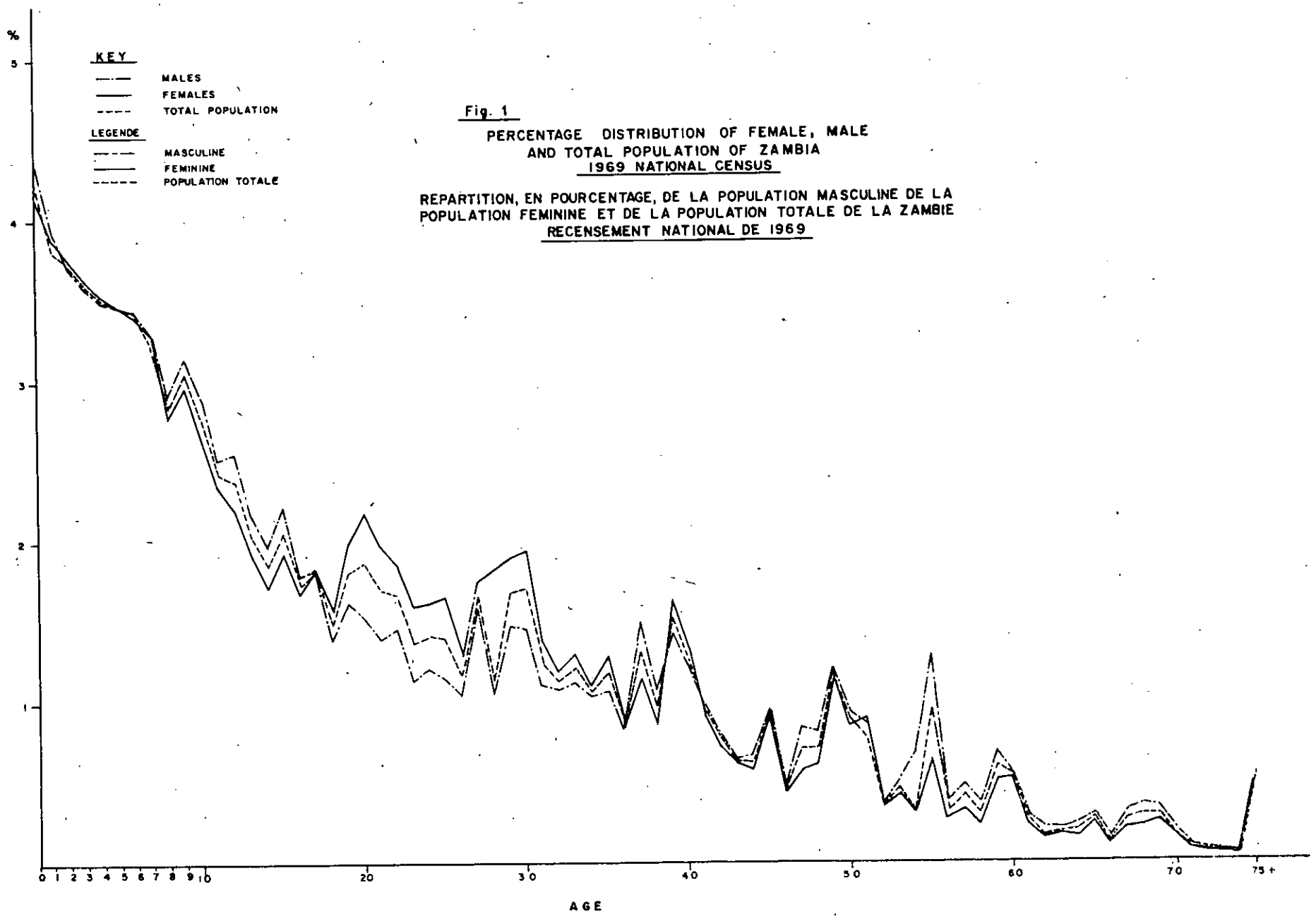

Fig. 1

PERCENTAGE DISTRIBUTION OF FEMALE, MALE AND TOTAL POPULATION OF ZAMBIA
1969 NATIONAL CENSUS

REPARTITION, EN POURCENTAGE, DE LA POPULATION MASCULINE DE LA POPULATION FEMININE ET DE LA POPULATION TOTALE DE LA ZAMBIE
RECENSEMENT NATIONAL DE 1969

Fig. 2

DEVIATIONS OF THE PERCENTAGE DISTRIBUTION OF DIGIT PREFERENCES BY SEX FROM EXPECTED VALUE (ie. 10%) IN CALCULATING MYER'S INDEX, NATIONAL CENSUS OF ZAMBIA, 1969

ECARTS DE LA REPARTITION EN POURCENTAGE DES PREFERENCES NUMERIQUES PAR SEXE PAR RAPPORT A LA VALEUR ESCOMPTEE (SOIT 10%) DANS LE CALCUL DE L'INDICE DE MYERS-RECENSEMENT NATIONAL DE LA ZAMBIE, 1969

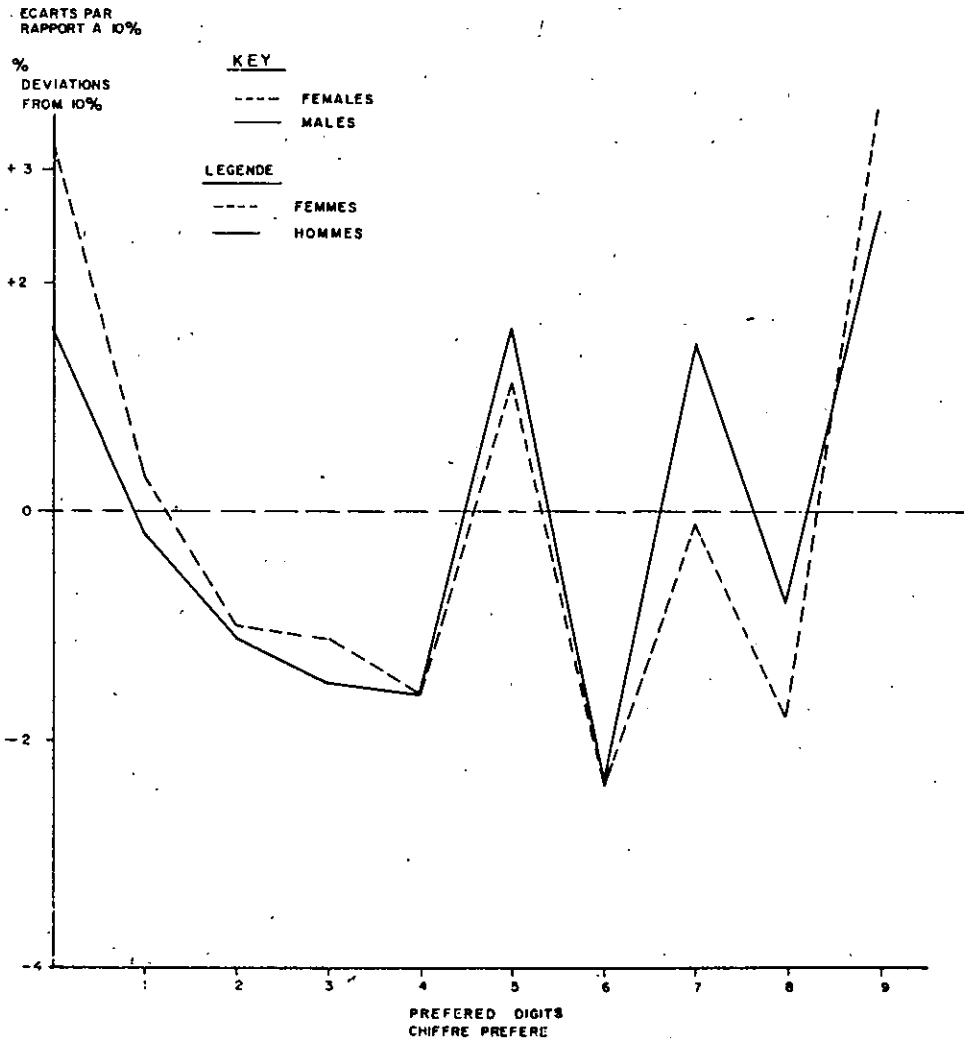

Fig. 3

OBSERVED AND ADJUSTED PERCENTAGE DISTRIBUTION OF MALE AND FEMALE POPULATION OF ZAMBIA, 1969 NATIONAL CENSUS

REPARTITION OBSERVEE ET AJUSTEE EN POURCENTAGE DE LA POPULATION MASCULINE ET FEMININE DE LA ZAMBIE, RECENSEMENT NATIONAL DE 1969

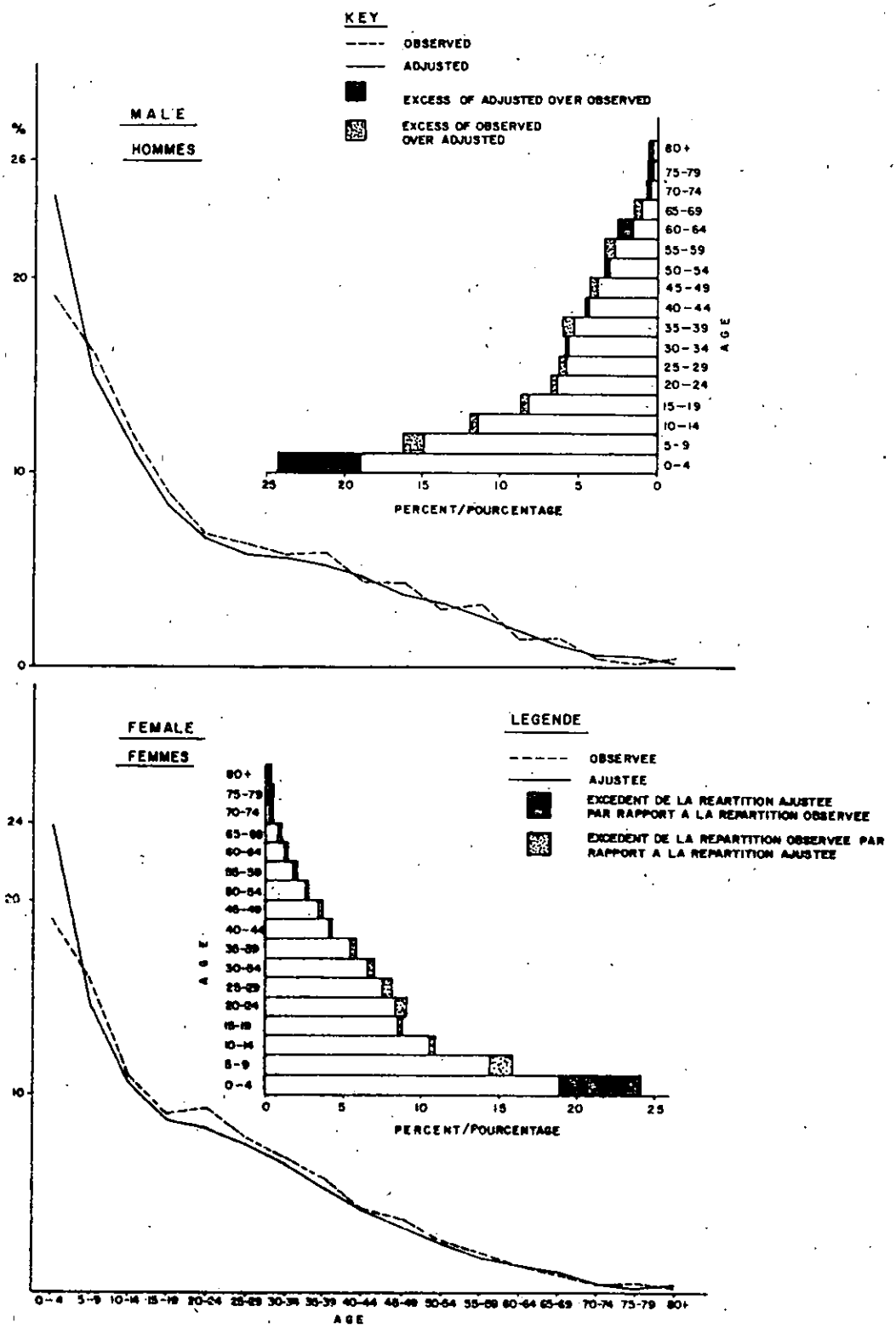

Fig. 4. RATIO $\left(\frac{C(Xo)}{C(Xs)}\right)$ OF CUMULATED PERCENTAGE DISTRIBUTION OF ENUMERATED POPULATION OF ZAMBIA UNDER SPECIFIED AGES TO SELECTED COALE-DEMENY (WEST) STABLE POPULATION MODELS

RAPPORT $\left(\frac{C(Xo)}{C(Xs)}\right)$ ENTRE LA REPARTITION CUMULEE EN POURCENTAGE DE LA POPULATION ZAMBIENNE DENOMBREE AUX AGES SPECIFIES ET CERTAINS TYPES DE POPULATION STABLE. (DU GROUPE "OUEST") DE COALE-DEMENY

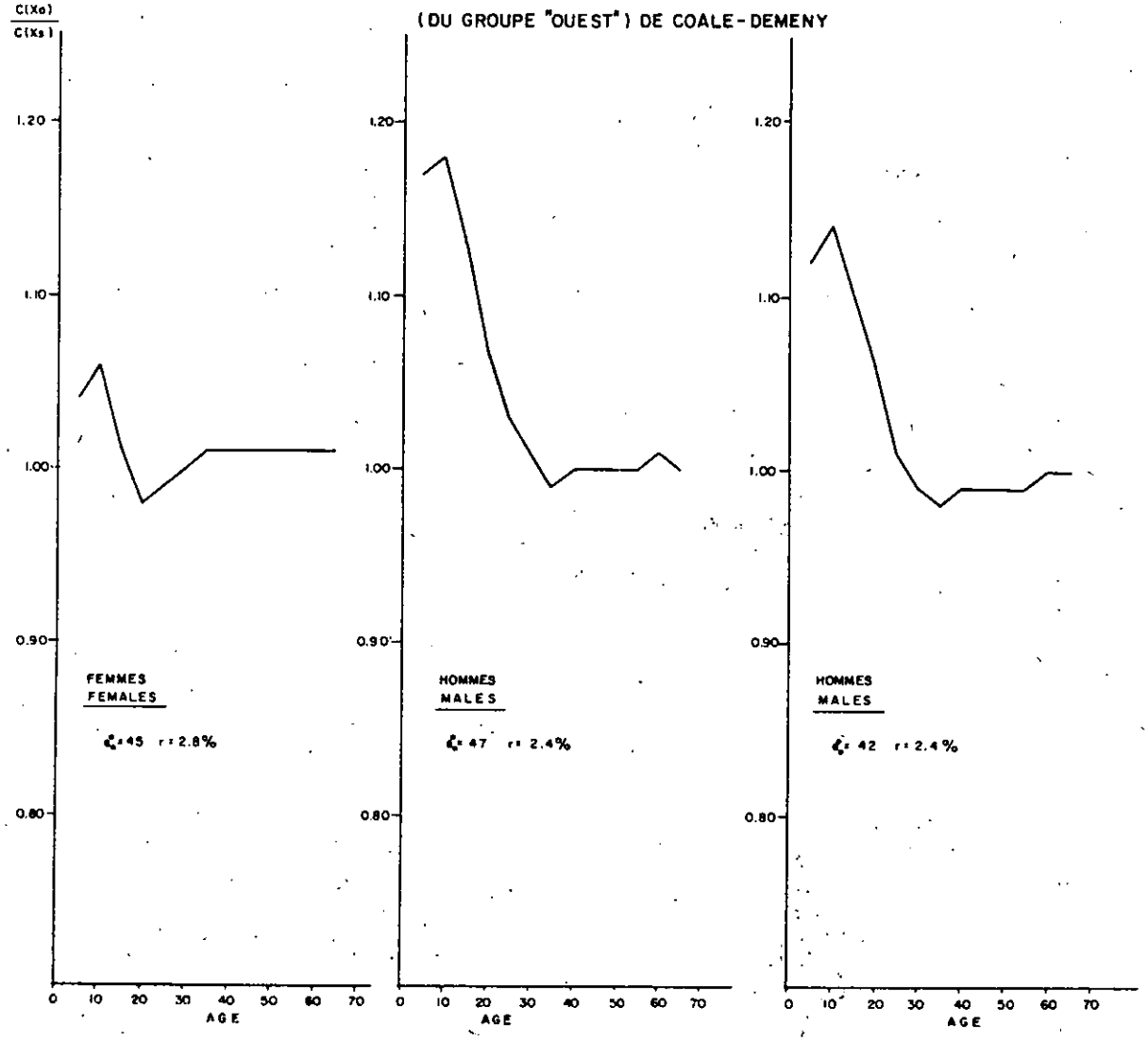

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Fig. 5. RATIO (Ƶ/c) OF THE COMPOSITE AGE DISTRIBUTION FOR THIRTY AFRICAN COUNTRIES (c) TO THE PERCENTAGE AGE DISTRIBUTION IN THE 1969 CENSUS OF ZAMBIA (Ƶ)

RAPPORT (Ƶ/c) ENTRE LA REPARTITION SELON L'AGE POUR TRENTE PAYS AFRICAINS (c) ET LA REPARTITION SELON L'AGE EN POURCENTAGE DANS LE RECENSEMENT DE LA ZAMBIE (Ƶ) DE 1969