

## Research Article

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# Causes and Risk of Death Using Verbal Autopsy in The Ibadan Study of Ageing

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## Abstract

**Background:** The documentation of death is inadequate in many developing countries due to poor coverage of vital registration. In order to fill this gap, Verbal Autopsy (VA) has often been employed as a method of determining the cause of death.

**Method:** A survey of the causes of death in a cohort of elderly persons (aged  $\geq 65$  years) over a 39-month period was conducted using Verbal Autopsy (VA). VA was conducted using a questionnaire designed by the World Health Organization (WHO) and the International Network of Demographic Evaluation of Populations and Their Health (INDEPTH), adapted for local understanding. The questionnaire was administered to household members with adequate knowledge of the circumstances of death in the cohort. Two physicians, with knowledge of local terms of illness and the living conditions of subjects, reviewed each VA form independently to assign one or more causes of death, and subsequently met to reach consensus for cases where there were differences of opinion. If consensus could not be reached, the cause of death was regarded as indeterminate. Assignment of causes of death was based on the 9<sup>th</sup> edition of the International Classification of Diseases (ICD-9), which is the official classification of morbidity and mortality in the country.

**Result:** There were 268 deaths out of the 2149 elderly persons in the study cohort, giving a mortality rate of 33.3 per 1000 person years, with gender specific rates of 35.29 per 1000 person years for males and 31.48 per 1000 person years for females. Infective causes (malaria fever, diarrhoeal disease and febrile illness of unknown cause) accounted for 13.1 deaths per 1000 person years, followed by hypertension/cardiovascular accident and asthma/respiratory pathology which accounted for 6.8 and 4.6 per 1000 person years, respectively. Multivariate logistic analysis reveals that belonging to low to average socioeconomic class (OR=1.4, 95%CI=1.3-2.8,  $p=0.009$ ); significantly increased the likelihood of dying at follow up while engaging in moderate intensity physical activities (OR=0.7, 95%CI=0.5-1.0,  $p=0.049$ ) reduced it.

**Conclusion:** Infections constituted the predominant causes of death among these elderly people and belonging to low to moderate economic status increased the risk of dying.

## Introduction

Countries that cannot record the number of people who die or why they die cannot realize the full potential of their health systems [1,2]. Admittedly, the development of functional civil registration system with medical certification of cause of death

takes time and resources. However, there are cheaper and readily available tools and techniques that can be used to obtain a fairly accurate representation of mortality trends [1-4].

The interest in causes of death for public health purposes goes back to the 17<sup>th</sup> century in London, when “death searchers”

were recording deaths in the population by weekly household visits, with the main target being to estimate mortality from the plague. Since then, VA has been conducted in research settings by in-depth interviews with the family of the deceased persons [5]. Verbal Autopsy (VA) is a method of ascertaining probable causes of a death based on an interview with primary caregivers about the signs, symptoms and circumstances preceding that death [2]. It provides an understanding of the pattern of and trends in cause-specific mortality, mortality differentials between population groups and the effects of interventions in the community. In recent times, two methodological approaches for analysing data obtained from VA have emerged: the first approach is through a judgment made by expert physicians while the second is by use of an automated computer program. The quality of the data is determined by the details of the information obtained with the questionnaire and the method of analysing its content to reach the probable cause of death [5].

The data so produced are important in efforts at reducing mortality rates and monitoring progress towards achieving health targets, for example, as in the Millennium Development Goals [2-6]. In developed countries, data on disease-specific mortality by age are readily available from national vital registration. In contrast, in developing countries, where the proportion of death is significantly higher [7], estimation of cause of death is more difficult because the levels of coverage of vital registration and the reliability of causes of death stated on death certificates are generally low, especially so in rural areas [4-7]. Consequently, information about mortality pattern obtained through VA can be vital for health care planning in developing countries [8,9]. This report from the Ibadan Study of Ageing provides information on cause-specific mortality as well as the relationship between some selected health and lifestyle variables and mortality among the elderly using verbal autopsy reports.

## Methodology

### Sampling

The Ibadan Study of Ageing is a longitudinal cohort study of the mental and physical health status as well as the functioning of elderly persons (aged  $\geq 65$  years) residing in the Yoruba-speaking areas of Nigeria, which consist of eight contiguous states in the south western and north central regions (Lagos, Ogun, Osun, Oyo, Ondo, Ekiti, Kogi and Kwara). At the time of the study, the population of these states was approximately 25 million people, or about 22% of the national population. The baseline survey was conducted between November 2003 and August 2004. The methodology has been described in full elsewhere [10,11] and only a brief summary is provided here. Respondents were selected using a multistage stratified area probability sampling of households. In households with more than one eligible person (aged  $\geq 65$  years and fluent in Yoruba, the language of the study), the Kish table

selection method was used to select one respondent.

### Baseline Assessments

At the baseline in 2003/04, respondents were assessed, among other things, for the presence of chronic physical conditions. We assessed, by self-report, whether respondents had arthritis, diabetes, heart disease and asthma in the previous 12 months using a symptom-based checklist, a method of proven reliability and validity [1,3]. Current and lifetime depression was assessed with the World Health Organization Composite International Diagnostic Interview (CIDI) version three (CIDI.3) and diagnosed according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition. As previously described, all respondents were assessed for functional limitations in six activities of daily living and seven instrumental activities of daily living [11,12].

A number of social and lifestyle features were also assessed at baseline. Participation in household activities and in community activities was assessed using the World Health Organization Disability Assessment Schedule, Version 2 (WHO-DAS II). The relevant items asked “During the last 30 days, how much did you join in family activities, such as: eating together, talking with family members, visiting family members, working together?” and “During the last 30 days, how much did you join in community activities, such as: festivities, religious activities, talking with community members, working together?” Answers are rated as 1) Not at all, 2) A little bit, 3) Quite a bit, and 4) A lot. For this report, responses to each of the items are dichotomized as “Not at all” versus all others.

Respondents were asked about use of alcohol and tobacco and responses were dichotomized as ever use versus never use. This VA survey included those elderly subjects who died between 2003/2004 and 2007. Information about the death of a respondent was obtained during the follow-up study. Once the death of a respondent was confirmed by a member of the household or a neighbour, the VA questionnaire was administered to an informant within the household identified as the person who was most knowledgeable about the circumstances of death. This report is based on the survey of all the 268 deaths during the period.

### The Verbal Autopsy Interview and Questionnaire

We used the VA questionnaire designed by the WHO and INDEPTH (International Network of field sites with continuous Demographic Evaluation of Populations and Their Health in developing countries) [8,9]. The instrument was adapted and translated to reflect local understanding of symptoms and signs of the assessed health conditions. The questionnaire includes open narrative and closed questions and was administered by trained interviewers. The interviewers had all completed secondary (high school) education and had previous experience in survey methodology. The training of the interviewers emphasized issues

such as preferred respondents, period of interviews, approaching grieving respondents and compiling narrative material (ensuring that duration, frequency, severity and sequence of the symptoms were mentioned). Pretesting was done to facilitate understanding by the study population. Each interviewer was assigned to communities on the basis of his/her previous place of work on the project and experience. Field work was coordinated by supervisors who oversaw the data collection process, checked questionnaires for completeness and consistency, and conducted random quality checks by re-interviewing about 10% of the respondents. Two physicians reviewed each VA form independently to assign one or more causes of death, and subsequently met to reach consensus for cases where there were differences of opinion. If there was no consensus after discussion, the causes of death were recorded as indeterminate. The physicians were knowledgeable about study area, population and the common local terms used to express signs, symptoms, causes and conditions of death but they were not restricted in any way in order to preserve their independence. The causes of death were assigned by the physicians using clinical judgement based on the ICD 9 [13]. ICD 9 was used because it is the official classification of disease in Nigeria. Ethical approval for all study procedures within the Ibadan Study of Ageing was obtained from the Joint University of Ibadan/University College Hospital Ethics Committee.

### Data Analysis

The average duration between baseline and follow-up assessments was 39.3 months (95% confidence interval: 39.1 - 39.5). We present the unweighted estimates of the occurrence of death. Mortality rates over the entire follow-up period were calculated by dividing the number of cases of death in each group of interest by the number of person-years of observation in the sample. The person-years at risk for an individual who died were calculated as the time between baseline and the reported time of death, if known, or the midpoint between baseline and time of follow-up, when exact time of death was unknown. We calculated mortality rates per thousand person years at risk for each cause of death and for males and females.

Economic status was assessed by taking an inventory of household and personal items, a standard and validated method of estimating economic wealth of elderly persons in low income settings [14]. Respondents' economic status is categorized by

relating each respondent's total possessions to the median number of possessions of the entire sample. Thus, economic status is rated low if its ratio to the median is 0.5 or less, low-average if the ratio is 0.5 - 1.0, high-average if it is 1.0 - 2.0, and high if it is over 2.0. Education was assessed using the number of years spent in formal education and it is classified as 0, 1-6years, 7-12years and 13 or more years in school. Residence was classified as rural (less than 12,000 households), semi-urban (12,000 - 20,000 households) and urban (greater than 20,000 households).

Bivariate analysis was used to explore baseline predictors of death. Respondents' economic status, presence of any chronic medical condition, level of physical activity, availability of and engagement with social network as assessed by contact with friend's contact and community participation were explored for their association with death at follow-up. Unadjusted logistic regression was conducted for each of these variables. This was followed with multiple logistic regressions in which all significant variables after univariate analysis were entered into the model [15,16]. All analyses were conducted using the STATA (version 10) statistical package.

### Result

The study sample consisted of 1148(53.4%) females and 1001(46.6%) males with a mean age of 77.3 years (SD = 0.3) at baseline. Majority (55.1%) of respondents had no formal education and resided in rural or semi-urban households (74.2%). The total number of deaths recorded over the follow-up period was 268, giving a mortality rate of 33.3 per 1000 person years at risk. These were made up of 136 females and 132 males, with gender specific rates of 35.29 per 1000 person years for males and 31.48 per 1000 person years for females. (Table 1) presents the results of a comparison of the socio-demographic variables of those who died and with those who were alive. The table shows that deaths were more likely to have come from lower economic groups ( $p=0.009$ ). (Table 2) shows the cause specific mortality rates per 1000 person years at follow-up. Infective causes constitute the predominant aetiological factors; malaria fever, diarrhoeal disease and febrile illness of unknown cause accounted for 13.2 deaths per 1000 person years. This is followed by hypertension/cardiovascular accident and asthma/respiratory pathology which accounted for 6.9 and 4.6 per 1000 person years, respectively.

Variables	Those who were dead (268)	Those who were alive (1881)	p-value
	n (%)	n (%)	
<b>Age (years)</b>			
≥80	119 (44.4)	538 (28.6)	0.085
75–79	36 (13.4)	259 (13.8)	
70–74	54 (20.2)	441 (23.4)	
65–69	59 (22.1)	643 (34.2)	
<b>Gender</b>			
Male	132 (49.3)	869 (46.2)	0.732
Female	136 (50.8)	1012 (53.8)	
<b>Education (years completed)</b>			
≥13	28 (10.5)	138 (7.3)	0.362
7–12	33 (12.3)	233 (12.4)	
1–6	74 (27.6)	459 (24.4)	
0	133 (49.6)	1051 (55.9)	
<b>Economic Status</b>			
High	28 (10.5)	196 (10.4)	0.009
High-average	53 (19.8)	442 (23.4)	
Low-average	82 (30.6)	681 (36.2)	
Low	105 (39.2)	562 (29.9)	
<b>Residence</b>			
Urban	80 (29.9)	475 (25.3)	0.135
Semi-urban	100 (37.3)	770 (40.9)	
Rural	88 (32.8)	636 (33.8)	

**Table 1:** Socio-demographic profile among the elderly who died and those who were alive.

Causes	N	Risk years	Rate per thousand years at risk	95% CI
Malaria	69	138	8.6	6.8-10.8
Hypertension /cardiovascular disease	55	110	6.8	5.2-8.9
Lower Respiratory tract infection/Asthma	37	74	4.6	3.3-6.3
Enteric/diarrhea	20	40	2.5	1.6-3.9
Diabetes mellitus	9	18	1.1	0.6-2.2
Sudden unexpected death	11	22	1.4	0.8-2.5

Sepsis/febrile illness of unknown cause	16	32	2	1.2-3.2
Trauma/domestic fall	5	10	0.6	0.3-1.3
Prostate disease	6	12	0.7	0.3-1.7
Unspecified	40	80	5	3.6-6.8
Female deaths	132	264	16.9	14.3-20.0
Male deaths	136	272	16.4	13.8-19.4
Total deaths	268	536	33.3	29.5-37.5

**Table 2:** Cause specific mortality rates per 1000 years at risk.

Univariate analysis was conducted to baseline factors associated with the risk of dying at follow-up (Table 3). The results show that belonging to low to average socioeconomic class, the presence of any reported chronic medical condition, lifetime major depression, impairment in ADL and IADL, presence of any disability, poor community participation and lack of contact with friends were significantly associated with the risk of dying. On the other hand, persons who reported engaging in moderate or high level of physical activity at baseline were less likely to have died at follow-up. Multivariate analysis, in which all variables significant on univariate analysis were included, was next conducted to explore the independent association of each baseline feature. The results confirms that belonging to low to average socioeconomic group (OR=1.4, 95%CI=1.3-2.8, p=0.009) significantly increased the likelihood of dying at follow up while engaging in moderate to high level of physical activity (OR=0.7, 95%CI=0.5-1.0, p=0.049) reduced it.

Variable	Odds ratio	95%Confidence interval	P value
Low-average Socioeconomic class	1.69	1.13-2.34	0.04
Presence of any chronic medical condition, yes	1.4	1.05-1.98	0.02
Lifetime major depression, yes	1.5	0.94-2.38	0.09
Impaired Activities of Daily Living, yes	2.5	1.30-5.00	0.01
Impaired Instrumental Activities of Daily living, yes	4.1	2.46-6.93	0.01
Engagement in at least moderate physical activity	0.4	0.20-0.70	0.04
Poor community participation	1.7	1.00-2.78	0.06
Poor family participation	0.94	0.61-1.45	0.77
Contact with Friends	1.8	1.10-2.90	0.029
Lifetime alcohol use, yes	1	0.60 - 1.60	0.9
Lifetime tobacco use, yes	0.94	0.61 - 1.45	0.8

**Table 3:** Univariate logistic regression analyses exploring baseline predictors of death at follow-up.

## Discussion

In this study we have estimated mortality rate in this elderly cohort to be 33.3 per 1000 person years at risk (35.29 for males and 31.48 for females) and have shown that infective health conditions (malaria fever, diarrhoeal disease and febrile illness of unknown cause) constituted the predominant causes of death. Even though several factors, such as the presence of a chronic medical condition and impairment of IADL and ADL as well poor social engagement at baseline were significant predictors of the likelihood of death over the period, none of these remained significant on multivariate analysis. Instead, the results of multivariate analysis suggest that persons in the lower economic groups are significantly more likely to have died at follow up while engaging in at least moderate level



of physical exercise significantly reduced the likelihood of death. The mortality rate reported in this study is high when compared with the rates reported by Simbai et al. [17] in Beirut and Kanungo et al. [18] in India. Simbai et al. [19] estimated total mortality rates of 33.7 and 25.2/1000 person years among men and women, respectively, over 50 years of age while Kanungo et al [18], whose work included all age groups, recorded an overall mortality rate of 6.2 per 1000 person-years. The higher figures we reported are undoubtedly partly due to the older age group that we studied. However, the differences could also reflect differences in health care between the study sites.

The causes of death recorded in this study were predominantly infective: malaria fever, diarrhoeal disease and respiratory infections. This is unlike the work of Simbai et al. [17] which found cardiovascular diseases as the main causes of death. This may be a further evidence of the difference in the overall public health services between Lebanon and Nigeria. In a similar study among adults in a rural area in Kenya [19], death was attributed to infective causes in about 74% of cases with HIV (32%) and tuberculosis (16%) being the most frequent, followed by malaria, respiratory infections, anaemia and diarrhoeal disease (approximately 6% each). The authors of that report concluded that the majority of adult and adolescent deaths were attributed to potentially preventable infectious diseases. This was also similar to the report of Kyobutungi et al. [20] in a study conducted among adults in a slum in Kenya. Apart from lack of social amenities, many communities in developing countries are also characterized by high unemployment, overcrowding, insecurity, greater involvement in risky sexual practices, social fragmentation, and high levels of mobility [21-23]. This is in contrast to some other developing countries with presumably better healthcare model where cardiovascular diseases, cancer, respiratory ailments and digestive disorders account for the leading causes of death [17,18]. Kanungo et al. [18] found that mortality from cardiovascular problems, mainly ischaemic heart disease and cerebrovascular accidents, increased in people 40 years of age and older over a period of 2 years. Cancer, respiratory diseases and digestive disorders were the second, third and fourth leading causes of death, respectively. Similarly, in Lebanon [17], the leading causes of death were non-communicable, mainly circulatory diseases (60%) and cancer (15%). We found that lower economic class significantly increased the odds for death. In a setting with poorly resourced health system, it is unlikely that elderly persons who are poor can survive for a long period of time.

To our knowledge this is the first report of verbal autopsy study in Nigeria. Verbal autopsy-based as a method of obtaining mortality information is widely used in countries where vital registration and death certification systems are weak and most people die at home and without medical certification of the cause of death. [24-26] This is the situation of Nigeria and many developing

countries. A verbal autopsy is a method used to determine the cause of death from data collected about the symptoms and signs of illness and the events preceding death. [4,5] This method is based on the hypothesis that the symptoms and signs surrounding most causes of death can be recognized, recollected and reported by a person present during the period prior to death. [6,7,20,21] However, there are limitations to the use of verbal autopsies. An important one is the imprecision of some signs and symptoms in regard to the underlying disease process. Another is that any self-report is prone to not just recall bias but also the possibility of individual differences in what is chosen to be reported on. The validity of the diagnoses reported here would have been further supported if we could follow back and determine details of health care that decedents had access to prior to death. This was not possible because most of the elderly people in the study had not sought care in formal public health care prior to their death. These limitations could also account for the high prevalence of the unspecified causes as seen in this survey. According to Snow et al [27] the common causes of death were detected by VA with specificities greater than 80%, sensitivity of the VA technique was greater than 75% for measles, neonatal tetanus, malnutrition, and trauma-related deaths.

However, malaria, anaemia, acute respiratory-tract infection, gastroenteritis, and meningitis were detected with sensitivities of less than 50%. Hence they concluded that VA used in malaria-specific intervention trials should be interpreted with caution and only in the light of known sensitivities and specificities. In this study, the diagnoses were agreed upon between two senior clinicians. The problem of recall bias might constitute a significant limitation to making accurate diagnoses of the cause of death. In addition, there were individuals who moved away from the study site over the period. For these respondents, it was difficult to ascertain whether they had died or were alive in their new location.

In conclusion, this work have shown that infections and their complications constitute the major causes of mortality in this setting and belonging to low to average socioeconomic group significantly increased the likelihood of dying. These findings have implications for mortality prevention policy in our society.

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