ABSTRACT

Background: Adult mortality has largely remained a major health concern and an under-researched area thus it does not feature prominently on the national development agenda of Zambia, even in development plans, health policy, national health strategic plan, consequently there are no specific programmes to address adult mortality in the country. Equally, the past Millennium Development Goals (MDGs) did not have a specific focus on adult mortality; the Sustainable Development Goals (SDGs) as well have a broader health agenda but no specifics on adult mortality. Adult mortality just like child mortality is also linked to the socioeconomic development of a country. In Zambia, adult mortality has remained among the highest in southern Africa as noted by the National Population Policy of Zambia. The probability of dying between ages 15 and 60 years for the period 2010-2015 was estimated at 306.5 deaths per 1,000 persons alive at age 15 and above. Yet the adult population in age group 15 to 59 years constitutes about 50 per cent of Zambia's total population of over 13 million. Adult mortality has been an issue of public health concern for several decades now because of its impact at individual, household, community and national level in development terms as the consequences are immense to be neglected. Studies have shown that the community context plays a mediating role by influencing the type of life style which eventually determines individual outcomes like adult mortality. Previous studies have also argued that adult mortality is associated with factors such as education, income, marital status, religion, age, sex, neighbourhoods, smoking, and alcohol among others. However, these studies did not adequately address some of the contextual factors such as place of death, community health care utilisation, and community illness treatment received as they relate to adult mortality. This study addresses these issues with special attention to their effects on adult mortality at community level by applying an ecological model to reveal the previously unexamined associations between contextual factors and adult mortality variations. The study set out to achieve four specific objectives: (i) establish the level of adult mortality situation in Zambia; (ii) examine the causes of adult mortality in Zambia; (iii) explore the age- and cause-specific mortality contributions, and differentials in adult mortality; and (iv) determine the extent to which individual-, household-, and community-level factors influence adult mortality variations in Zambia.

Methodology: The study utilised two datasets, the 2010 census (10 per cent sample) and 2010-2012 Sample Vital Registration with Verbal Autopsy survey (SAVVY). The 2010 census reported 16,445 total deaths of which 6,693 occurred in age group 15-59; whereas the 2010-2012 SAVVY recorded 2,759 total deaths of which 1,078 were adult deaths in age group 15-59. The 2010

census data were utilised in deriving adult mortality rates in objective one as they were more appropriate with the methods applied. The 2010-2012 SAVVY dataset was utilised in addressing all the study objectives. Objective one was achieved by employing direct (life table and siblinghood), and indirect (Hill's Generalized Growth Balance (GGB), Bennett and Horiuch's Synthetic Extinct Generations (SEG)) demographic methods of adult mortality estimation to establish the level of adult mortality at national and sub-national levels in Zambia, that is, the probability of dying between ages 15 and 60 years ($_{45}q_{15}$). Objective two was achieved by computing proportions of causes of death, age-sex and cause-specific mortality rates to examine the causes of death among adults in the age group 15-59 years. Objective three was achieved by constructing cause-deleted life tables to determine the impact of cause of death elimination on adult mortality. In addition, decomposition analysis was performed to determine the age- and cause-specific adult mortality rates' contributions to widening the life expectancy gap between males and females. Multivariate multilevel survival analysis was employed to determine the extent to which individual-, household-, and community-level factors influence adult mortality variations in Zambia, to achieve objective four. Multivariate multilevel survival analysis was employed because it is the appropriate method for the nature of time-to-event data, that is, the risk of dying between ages 15 and 60 years. The unit of analysis was deceased adults in age group 15-59 years. The dependent variable is adult mortality operationally defined as the risk of dying between ages 15 and 60 years and was measured as "1" mortality of deceased persons in age group 15 to 59, and "0" deaths of persons in other ages. Independent variables at individual-, household-, and community-levels were selected based on the literature reviewed and the study conceptual framework. Analysis was performed at univariate, bivariate and multivariate levels. The study hypothesized that place of death, community health service utilisation, and community illness treatment received were associated with the risk of adult mortality. Data analysis was performed using Stata 14 and Microsoft Excel.

Key findings: The results show that the level of adult mortality in Zambia remains high and varies by province. Adult mortality is concentrated in age group 25-39 years, with higher mortality for females than males. Western province had the highest adult mortality rate ($_{45}q_{15}$) for males, 59% while North-western had the lowest, 36.7%. For females, Copperbelt province had the highest mortality rates, 47.9% and North-western province had the lowest, 34.8%. The top five leading causes of death among adults are HIV/AIDS (40.7%), Injuries and accidents (11.2%), tuberculosis (7.9%), malaria (6.6%), and diseases of the circulatory system (5.5%). HIV/AIDS is the leading cause of death for both males and females. The second leading causes

of death among males are injuries and accidents while for females it is tuberculosis. The causes of death among adults vary by sociodemographic, socioeconomic and ecological factors, except HIV/AIDS. The epidemiological transition is underway in Zambia as the proportion of deaths attributable to non-communicable diseases is on the increase especially in age group 40 and above. Eliminating HIV/AIDS will have the most impact in additional years of life and a significant reduction in the rate of adult mortality. Age-and cause-specific adult mortality rates contributed about 50 per cent to widening the life expectancy gap between males and females. Injuries and accidents were the major contributor to the gap in life expectancy.

The risk of adult mortality was significantly lower among the married/living with partner [Hazard Ratio (HR) = 0.28; 95%, CI: 0.182, 0.445] compared with the never married decedents. Marital status is, therefore, an important predictor of adult mortality risk. Adult mortality risk decreased with an increase in the level of educational attainment. Higher level of educational attainment [HR = 0.50; 95%, CI: 0.382, 0.659] lowered the hazards of adult mortality. This shows that education is a strong predictor of adult mortality risk. Low status occupation types, craft and trade related [HR = 2.28; 95%, CI: 1.542, 3.372] and elementary occupations [HR = 2.36; 95%, CI: 1.647, 3.376] had an elevated risk of adult mortality compared with high status occupation types among the decedents. This result confirms what previous studies found.

Adult mortality risk was significantly lower among female decedents who had no HIV/AIDS [HR = 0.85; 95%, CI: 0.735, 0.976]. Male decedents who did not drink alcohol had significantly higher adult mortality risk [HR = 1.39; 95%, CI: 1.017, 1.909]. Previous studies equally found mixed results with respect to alcohol consumption. Unexpectedly, non-smoking of tobacco elevated the risk of adult mortality among deceased persons, males [HR = 1.68; 95%, CI: 1.286, 2.200] and females [HR = 3.29; 95%, CI: 2.001, 5.400]. This result is unusual, however, wide confidence intervals point to the small numbers effect in the sample size. The risk of adult mortality was significantly lower for decedents who had a spouse [HR = 0.29; 95%, CI: 0.214, 0.378] and sibling [HR = 0.67; 95%, 0.474, 0.959] as a family relation. This is consistent with previous studies and confirms the protective effect of family relations against the risk of mortality.

In multilevel survival analysis, living in a community with a high proportion of educated individuals was associated with lower risk of adult mortality [HR = 0.59; 95%, CI: 0.491, 0.718]. For males, living in a community with a high proportion of individuals receiving treatment for their health conditions was associated with a significantly elevated risk of adult mortality [HR = 1.32; 95%, CI: 1.053, 1.664] whereas for females the hazard of adult mortality was statistically insignificantly. For females, residing in a community with a high proportion of health care

utilisation was associated with a significantly lower risk of adult mortality [HR = 0.76; 95%, CI: 0.592, 0.974]; conversely for males it significantly increased the hazard of mortality [HR = 1.32; 95%, CI: 1.049, 1.658]. Gender differences in health seeking behaviour as well as sociocultural socialisation in communities between males and females may explain these disparities. Place of death was associated with the risk of adult mortality. Other place of death had significantly higher risk of adult mortality compared with health facility place of death [HR = 1.47; 95%, CI: 1.218, 1.767]. Ecological factors influenced adult mortality besides the individual effect.

Ecological factors at community level, therefore, contributed to lowering the risk of adult mortality for females while they elevated the risk of adult mortality for males. This reaffirms the socioecological theory and the ecological argument that societal context has an influence on individual health outcomes. A higher proportion of female (85.2%) than male (76.9%) decedents sought and received treatment prior to their death. Typically, in a Zambian society, the socialisation process by gender is such that men are socialised to be strong even when they are not in good health, hence will only seek health care in the late stages of an ailment when the disease has progressed and by then it may be too late. Men's wait and see attitude towards symptoms of illness and health seeking behaviour is shaped by powerful internalised societal and cultural factors based on gender norms of masculinity.

Conclusion: The study has shown that ecological factors contribute to the risk of adult mortality as well as mortality variations in addition to the individual factors in Zambia. The study findings on ecological factors influencing adult mortality in Zambia that have not been examined before provide evidence and are a valuable resource for health policy planning, programmes and interventions. The study derived adult mortality rates at regional level which were previously not available and has also shown the emerging disease burden of non-communicable diseases in line with the epidemiological transition in Zambia. Investment in education is a long-term solution to health problems as an educated population has lower morbidity and mortality. Deliberate government policies and programmes targeted at promoting family welfare will guarantee that the family continues to play the protective effect of providing good health, longevity and ultimately lower adult mortality. Increasing personal healthcare access at community level through expanded health infrastructure development and health promotion programmes around leading causes of death among adults will contribute to a reduction in adult mortality. Future research should investigate the influence of sociocultural, religious, and ethnic factors on adult mortality in Zambia using a life course approach.

Key words: Adult mortality, Zambia, Ecological model, Multilevel survival analysis, Demographic mortality estimation, Life tables, Cause of death, Decomposition analysis, Proximate determinants, Verbal autopsy