Adult mortality in sub-Saharan Africa: A cross-sectional study of causes of death in Zambia

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Abstract OBJECTIVE To describe the age-sex pattern and socioeconomic differentials in causes of death among adults between the ages of 15 and 59 years in Zambia.

METHODS Using data from the 2010-2012 Zambia sample vital registration with verbal autopsy survey, we calculated the percentage share of causes of death; the age-sex cause-specific death ratio and cause eliminated life expectancy at age 15.

RESULTS HIV/AIDS was the leading cause of death across all socioeconomic subgroups contributing 40.7% of total deaths during the study period. This was followed by deaths due to injury and accidents (11.2%). The age-cause-specific death ratios due to HIV/AIDS increased by age and peaked in the 35 to 39 age group, and were higher among females than males. While for males, injuries and accidents were the second leading cause of death, it was tuberculosis among females. Diseases of the circulatory system were the third leading cause of death among female decedents, while tuberculosis was the third leading cause of death among males. We observed notable variation in cause of death patterns by the socioeconomic characteristics of adults. Adult deaths attributable to non-communicable diseases were more evident in older age groups–45 to 59 years. Eliminating HIV/AIDS in Zambia as a cause of death can raise years of life expectancy at age fifteen by 5.77 and 6.40 years for males and females, respectively.

CONCLUSION Health programmes and interventions on HIV/AIDS should be further supported and strengthened, as they would significantly contribute to the reduction of adult mortality in Zambia.

Keywords: Cause of death, adult mortality, verbal autopsy, HIV/AIDS, cause-deleted life table, Zambia

Introduction

The critical need for information on causes of death for health policy formulation, planning, targeting, allocation of resources, monitoring and evaluating population health programmes and interventions is well documented in the demographic, public health and epidemiological literature [1-5]. Yet, in 2013, only 44% of deaths worldwide were registered [6], indicating an absence of information on the causes of death of the remaining fatalities. The causes of deaths are relatively unknown in most sub-Saharan African countries, as death registration is incomplete due to inefficient and rudimentary civil registration systems [7, 8]. The coverage of death registration for in-hospital and outside-hospital is less than 25% in the majority of sub-Saharan African countries [8]. Another challenge in determining causes of death in these countries is that a significant portion of deaths occurs outside health facilities, mostly at home, where they are not attended by health service providers. Even in cases where deaths are captured, the cause of death may not be reported or may be misclassified– particularly in rural areas. In addition, qualified medical personnel may not be available to sign on medical certificates indicating causes of death [3]. Causes of death data captured by censuses are subject to serious limitations, since systematic medical procedures are not followed to establish the cause of death. Equally, the Health Management Information System (HMIS) has its own limitations, such as lack of integration across various levels of hospitals, poor patient record management systems at health facilities, etc. [9].

To overcome this situation, in 2006, Rao and colleagues recommended that the World Health Organization (WHO) introduce the Sample Vital Registration and Verbal Autopsy (SAVVY) survey in selected sub-Saharan African countries. Rao et al. [3] suggested the SAVVY as the most viable interim solution to obtaining information on causes of death to meet the needs of both health policy and the monitoring of the impact of health programmes

and interventions in sub-Saharan Africa. Since then, the SAVVY has become an alternative source of cause of death in a few countries [10, 11]. The use of verbal autopsy (VA) data is increasing in the most sub-Saharan Africa countries [12, 13]. Previous studies have used VA data to analyse cause-specific mortality, behavioural risk factors, and the impact of public health interventions [14-17].

In Zambia, a sub-Saharan African country with a population of about 15.5 million people as estimated in 2015 [18], the SAVVY was implemented from 2010 to 2012 [19]. Previous studies using SAVVY examined the causes of death across all ages of the population without a detailed focus on the adult population [19, 20]. These studies neither explored the variations of causes of death by socioeconomic characteristics nor estimated the relative contribution of important causes of death in improving life expectancy at adult age. Also, global burden of diseases studies use more of modelled data [6]. However, the adult age group (15 to 59 years) is the most economically productive segment of the population and their health status has an impact on household welfare and the socioeconomic development of a country. This means that causes of death in this age group has to be understood in order to develop appropriate health programmes and interventions to reduce mortality.

This study examined individual and grouped causes of death among adults in age group 15 to 59 years using the 2010 to 2012 SAVVY. We first analysed the relative importance of various causes of death through rank analysis and percentage contribution of individual and group causes of deaths to total adult deaths. Thereafter, we estimated the impact of eliminating the top five causes of death on adult mortality. Second, we analysed the age-sex cause specific mortality pattern for five major causes of deaths. Finally, we investigated the socioeconomic disparity in causes of death among the adult population. The findings of this study are crucial to achieving the Sustainable Development Goals on preventable deaths and the African Agenda 2063.

Data and Methods

Data

We used data from a nationally representative survey called SAVVY for the 2010 to 2012 period conducted by the Central Statistical Office (CSO), the Ministry of Health (MoH), and the Department of National Registration, Passport and Citizenship (DNRPC). A total sample population of 109,200 was targeted. A baseline census population was adjusted to the national level using the 2000 census population figures. The WHO standard SAVVY questionnaires and methodology of reporting causes of death were used. A household questionnaire asked the following questions as a basis for verbal autopsy interviews: "Is there a member of this household who died in the last 12 months?"; "Was this person male or female?", and "How old was this person?" For all deaths identified, a verbal autopsy questionnaire for the death of a person aged 15 years and older was administered to a close relative or caregiver to collect more detailed information about the deceased person. The causes of death were classified and coded using the WHO International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) guidelines and coding practice [19]. A detailed methodology of the SAVVY is elaborated elsewhere [19]. The 2010 to 2012 SAVVY data were obtained with permission from the Central Statistical Office (Zambia). Prior to the release of the dataset, all personal identifiers were removed. In undertaking the SAVVY, the Central Statistical Office abided by all ethical procedures and approvals as required by the Ethics Review Committee.

Following the Global Burden of Diseases (GBD) classification, we grouped causes of death into: Group I-communicable diseases (CDs), Group II-non-communicable diseases

(NCDs), and Group III-external causes or injuries. Group I-CDs include infectious and parasitic diseases caused by pathogens such as HIV/AIDS, tuberculosis (TB), malaria, diarrhoea, measles, rabies, and others. Maternal and perinatal causes (e.g., maternal haemorrhage or birth trauma) and nutritional deficiency conditions are also included in group I. Group II-NCDs are non-infectious diseases, which include diabetes mellitus, neoplasms, cancer, malignant conditions, asthma, cardiovascular conditions, etc. Group III-comprises external causes or injuries, and includes accidents, suicide, homicide, and others. The external causes are also referred to as unnatural causes, for example, road traffic accidents, suicide, or violence.

Statistical analysis

Descriptive statistics in the form of frequencies and percentages were used to describe the causes of death of the deceased persons in age group 15 to 59 years. Cause-specific mortality rates were calculated using standard demographic methods [21, 22]. Age-cause-specific death ratios (ACSD Ratios) were also calculated to show the effect of the top five leading causes of death by dividing cause-specific deaths in a particular age by all deaths in that age and multiply by 100 [22].

Cause-deleted/associated single decrement life tables (ASDLTs) and all-cause life tables were constructed to assess the contributions of the causes of death, thereby establishing their relative significance to adult mortality [23, 24]. A detailed description of this method can be found in appendix A. To estimate the number of additional years of life gained because of eliminating a specific-cause of death, the life expectancy at each age of the cause-deleted life table was subtracted from that of the all-cause SAVVY life table for the corresponding age.

Pearson's chi-square test was used to examine associations between causes of death and categorical variables. We used Stata version 14.2 for our analysis. The Stata command, *svy*, was used to account for the weight in survey design and to ensure that the sample was nationally representative.

Results

Leading causes of death

There were 1,078 deaths of adults in age group 15 to 59 years between 2010 and 2012. HIV/AIDS emerged as the leading cause of death among adults in this age group (Table 1). The proportion of HIV/AIDS deaths is higher among deceased adult females than males (44.1% vs 37.9%) (Table 1). The top five leading causes of death are HIV/AIDS (40.7%), injuries and accidents (11.2%), TB (7.9%), malaria (6.6%), and diseases of the circulatory system (5.5%), although the ranking of these diseases varies by gender. For males, injuries and accidental deaths are the second leading cause of death, while for females it is TB. TB is ranked third as a cause of death for males, whereas for females it is diseases of the circulatory system. Interestingly, injuries and accidents are ranked fifth for females, while diseases of the circulatory system occupy this position for males. Malaria is ranked fourth as a leading cause of death for both males and females.

[Table 1 about here]

Cause of death by Global Burden of Diseases major groups

Overall, more than two-thirds (65.3%) of the deaths among adults aged 15 to 59 years are due to communicable diseases (Figure 1). The proportion of communicable and non-communicable causes of death is higher among females than males (Figure 1). The

proportion of adult deaths due to external causes or injuries was higher among males than females.

[Figure 1 about here]

Figure 2 demonstrates an interesting pattern of changes to causes of deaths by age. While share of communicable diseases is the largest across all ages, share of non-communicable diseases rise continuously from age group 35 to 39 years. The share of external causes of death is the highest in the younger (15 to 30 years) and older adult (55 to 59 years) age groups.

[Figure 2 about here]

Communicable causes of death

Table 2 presents the proportions of individual cause of death to the total communicable causes of death. HIV/AIDS remains the leading cause of death of adults in age group 15 to 59 years, with higher proportions among females than males. Tuberculosis is the second leading communicable cause of death. Adult male decedents had a higher proportion of deaths attributable to TB than females. Malaria is the third leading communicable cause of death for both males and females. Pneumonia/ARI is the fourth leading communicable disease among the deceased males, while among the female decedents it is maternal causes.

[Table 2 about here]

Non-communicable diseases causes of death

Table 3 presents the proportions of individual causes of death to the total non-communicable causes of death. Diseases of the circulatory system were the leading causes of death among adults (Table 3). The proportion of deaths was higher among females than males. The second leading cause of death were neoplasms for females, while for males it was

diabetes mellitus. Neoplasms were the third leading cause of death among deceased adult males, while for females it was diabetes mellitus.

[Table 3 about here]

External causes of death

A disaggregation of injuries and accidents shows that road traffic accidents were the leading cause of death among external causes for males, while for females it was intentionally inflicted injuries (Table 4). The proportion of male road traffic accident deaths was twice as high as that of female deaths. Intentionally inflicted deaths were the second leading cause of death among males, while among females it was road traffic accidents. Animal/insect bite deaths were the third leading cause of death among both males and females. Males accounted for a higher proportion of animal/insect bite deaths in Zambia.

[Table 4 about here]

Age-sex-cause-specific mortality patterns

The age-cause-specific death ratios magnify the effect of each of the top five leading causes of death based on all deaths (Figure 3). For both males and females, the HIV/AIDS curves show the concentration of deaths attributable to the cause between ages 15 and 55 years. HIV/AIDS deaths progressively increase with age and peaks in age group 35 to 39 years. Malaria deaths are more concentrated in males between age 20 and 50. Injuries and accidental deaths were higher among males between the ages of 15 and 35 years. Tuberculosis deaths are higher for males than females between the ages of 45 and 60 years.

[Figure 3 about here]

Cause of death elimination

A significant number of additional years of life would be gained by eliminating HIV/AIDS as a cause of death for both males and females (Table 5). For males, the highest number of years gained is 5.77 years, while for females it is 6.40 years in the 15 to 19 age group. It is evident that males would gain more years of additional life than females if injuries and accidents were eliminated (Table 5). Both males and females would gain additional years of life, but males would gain more years if TB were eliminated as a cause of death (Table 5). Males would gain more additional years of life (1.71 years) than females (1.44 years) in the 15 to 19 age group.

Almost the same number of additional years of life gained is 1.10 years among males and 1.09 years among females at age 15 if malaria were eliminated as a cause of death (Table 5). Females would gain more additional years of life than males if diseases of the circulatory system were eliminated as a cause of death (Table 5). The impact of eliminating the other causes of death on improving adult survivorship is far less when compared to eliminating HIV/AIDS alone. Therefore, eliminating HIV/AIDS should be a priority for public health interventions.

[Table 5 about here]

Variations in causes of death by demographic, socioeconomic, behavioural and geographic characteristics of deceased persons

The leading cause of death among males and females across all selected background characteristics of the deaceased adults in age group 15 to 59 years is HIV/AIDS (Table 6).

At provincial level, share of HIV/AIDS deaths varies between 25.5% (Northern province) to 45.1% (Western province). The regional pattern is also clear in other CODs such as neoplasm, TB, diseases of the circulatory system, etc. However, at both rural-urban and provincial residences the variations in cause of death were statistically insignificant.

HIV/AIDS deaths were higher among decedents with primary level educational attainment and lower among the deceased who had higher levels of educational attainment. Deaths due to injuries and accidents were higher in decedents who had a higher level of educational attainment than those who had a primary level of educational attainment. The variations in causes of death by educational attainment were not statistically different (p-value>0.05). More than half of HIV/AIDS deaths were among the widowed/divorced/separated marital status category. Injuries and accident deaths were higher among never married and married individuals, than the widowed/divorced/separated ones. The differences in causes of death by marital status are not statistically significant (p-value>0.05).

We observed an interesting social gradient in share of deaths by occupation of the deceased. A higher share of HIV/AIDS deaths occurs among the service/shop/market sales workers, whereas a lower share is seen among the legislators/senior officials/managers. Malaria deaths were higher among clerks and plant machine operators/assemblers than the other occupations. Diabetes mellitus deaths were higher among decedents who were legislators/senior officials/managers than the other occupations. The proportion of TB deaths appeared to be higher among legislators/senior officials/managers and those who were professionals, than among the other occupations. Deaths due to injuries and accidents were higher among professionals and lower among those who were technicians/associate professionals. More than two-fifths of HIV/AIDS deaths occurred among adults who drank alcohol. In addition, more injuries and accident deaths occured among those who consumed

alcohol. About 43% of HIV/AIDS deaths occurred among those who smoked tobacco, as well as 12.6% of injuries and accident deaths. Across all relationship types, HIV/AIDS deaths were common with a peak among siblings. The proportion of TB deaths was higher among siblings than other type of relationships. Injuries and accident deaths were higher among the deceased who were fathers and lower among those who were children of respondents. The share of HIV/AIDS deaths that occurred in a hospital is higher than that of those that occurred at home. Almost half of injuries and accident deaths occurred at other places. The variations in causes of death by type of relationship and place of death were statistically significant (p-value<0.001).

[Table 6 about here]

Discussion and conclusion

The study examined causes of death among adults in the age group 15 to 59 years using 2010 to 2012 SAVVY data. To our knowledge, this is the first study to describe COD among adults in age group 15-59 years in Zambia. This study highlights several interesting findings on COD in a high mortality setting with limited information on COD. First, unlike in developed and other emerging countries of the world, sub-Saharan African countries are still fighting communicable diseases in adult age groups. Communicable diseases like HIV/AIDS, TB and malaria still ranks among the top five CODs in Zambia. This is consistent with previous studies conducted in other sub-Saharan African countries [2, 3]. Our findings are also consistent with the global burden of diseases studies [6]. At the same time, non-communicable diseases have been appearing as emerging diseases, with diseases of the circulatory system being the third leading cause of death among females. Adult deaths

attributable to non-communicable diseases increased with age and were more evident at older ages (45 to 59 years). Thus, contrary to the conventional epidemiological transition theory, sub-Saharan countries like Zambia are experiencing a simultaneous burden of both communicable and non-communicable diseases. There is growing concern that the burden of NCDs will be heavier than the HIV/AIDS burden in the long term and that the impact will be more severe for poor populations of low- and middle-income countries [7]. The country's health infrastructure is inadequate to effectively deal with the emerging epidemic of NCDs. This finding is consistent with studies that have revealed evidence of the rising epidemic of NCDs in low- and middle-income countries influenced by changes in life style, rural-urban migration and industrialisation [6, 17, 25-32].

Secondly, HIV/AIDS is the major leading cause of deaths across all demographic and socioeconomic background characteristics of the deceased adults. Our study found that eliminating HIV/AIDS would lead to maximum gain in life expectancy at adult age. Eliminating HIV/AIDS as a cause of death would have the most significant impact in reducing adult mortality in Zambia. This finding provides evidence that should reaffirm the necessity of HIV/AIDS programmes, that is, antiretroviral therapy (ART) interventions, to further strengthen their efforts in ensuring coverage of and access to the drugs for those who need them. Early ART of HIV/AIDS prevents opportunistic infections and deaths ultimately reducing mortality in this age group. Also, counselling and adherence to treatment as well as good nutrition and health education ensure prolonged longevity. HIV/AIDS prevention programmes targeting adolescents as well as prevention of mother to child transmission of the HIV virus should also be further strengthened.

Thirdly, consistent with other studies, this study also found that the burden of accidents and injuries among adult males were almost twice as high as among females. Injuries and

accidents were the second leading cause of death among males. In addition, the study found a high proportion of deaths attributed to injuries and accidents among young people in age group 15 to 25 years [14, 16, 33]. Some studies claim that young people are more adventurous and end up in hazardous life-threatening situations compared to older adults who are usually more careful [3, 33, 34]. The study found higher proportions of injury and accidental deaths among male and female decedents who had higher levels of education. This finding is consistent with studies conducted in Ethiopia [14, 16]. This is a cause of great concern as highly educated persons contribute significantly to the country's economy and socioeconomic development. Productive adult lives are lost in significant numbers each year through injuries and accidents. There is a need for government and its agencies responsible for road safety to devise interventions that will curb the needless loss of adult lives through injuries and accidents. The country will continue to lose its most productive human resources if it fails to address this issue.

Deaths attributed to suicide and violence were also higher among males than females. Among females, deaths resulting from intentionally inflicted injuries were higher than for males. Some studies have linked suicide and violent deaths to economic stress [35-37]. Poverty levels are high in Zambia and the economic performance of the country has been sluggish [18]. This has put many people under economic pressure in terms of their livelihoods. Other studies conducted in South Africa [36, 38, 39], Japan [40, 41], Canada [40, 41], South Korea [42] and Europe [35, 37, 40] had similar findings with deaths due to suicide and violence being high among males as a result of economic pressure, alcohol and drug abuse, and poverty.

Finally, we see important regional variations in selected diseases. For instance, Northern, North Western and Luapula provinces had higher proportions of tuberculosis

compared to the other provinces. This could probably be due to inadequate health infrastructure, considering that these are predominantly rural provinces and the populations are too sparsely distributed to effectively provide health services. The government Directly Observed Treatment, Short-Course (DOTS) strategy on TB has helped to reduce the deaths attributed to TB through provision of free TB drugs at points of health service. Though, availability of TB drugs in remote areas and treatment of multi-drug resistant TB have been some of the challenges. It is also well known that tuberculosis is closely associated with HIV/AIDS [43, 44] and probably some of the HIV/AIDS deaths might have been misclassified as TB deaths.

This study proposes that eliminating HIV/AIDS as a cause of death would have the most significant impact on reducing adult mortality in Zambia. Government health programmes and interventions on HIV/AIDS should be prioritised to reduce adult deaths. However, at the same time, policies and programs should emphasize raising awareness to prevent the emerging burden of non-communicable diseases, as these have a large impact on workforce productivity, health expenditure, absenteeism, presentism (present at work but unable to work due to ailment), and loss of critical skills and disability. With Zambia's high poverty level and in the absence of health insurance schemes, NCDs are costly to treat and manage. Despite this, the Ministry of Health has attempted to develop an NCD strategic plan, but it does not comprehensively address all the major NCDs in Zambia, for example, epilepsy, sickle cell disease, asthma and mental health conditions [45]. The epidemic of NCDs may continue to pose a challenge to meeting the sustainable development goals if government does not respond effectively to this burden. Investing in implementing a strategic plan for NCDs is however a great challenge, as available resources are already overstretched in fighting communicable diseases like malaria, tuberculosis, lower respiratory infections,

and above all, the HIV/AIDS pandemic. This study recommends that injury related deaths among young adult males be prevented through evidence based measures applied in other parts of the world. Finally, we strongly recommend that surveys like SAVVY are continued in order to monitor long term changes in COD in Zambia.

The study has several limitations. First, due to a lack of data, we analysed COD patterns in Zambia only for the 2010 to 2012 period. We cannot examine the trajectory in COD, which is important for both academic and policy reasons. Second, the accuracy and reliability of the verbal autopsy data used in the study is dependent on the quality of information provided by the close relations of the deceased, as well as the expertise of the interviewers. With the passage of time, there is recall bias on the part of the respondents to provide reliable information about events that led to the deceased dying. In addition, when determining the cause of death by medical professionals based on verbal autopsy data, misclassifications could occur. Therefore, cause of death data from verbal autopsies are different from cause of death data from clinical records. Third, the low number of deaths overall could not permit further disaggregated analysis as this might have resulted in small sample sizes in some cells. However, to ensure that verbal autopsy data were of high quality and useable, quality control measures were put in place during data collection. Despite these limitations, the findings of the study remain plausible in high mortality settings with limited information on COD.

Declarations

Availability of data and material

The dataset used in this study is publicly available from the Central Statistical Office-Zambia upon request and with written permission indicating the purpose for which the data will be used.

Competing interests

The authors declare no competing interest.

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Appendix

A. Calculation of cause eliminated life expectancy

By relating observed deaths in the population in the age interval *x*, *x*+*n* ($_nM_x$) to the deaths of the life table in the same age interval ($_nm_x$) and assuming that they are equal, implying that the force of mortality is constant ($_nM_x = {}_nm_x$), where $_nM_x$ are age-specific mortality rates in the study population and $_nm_x$ are life table age-specific mortality rates [23]. By extension, the cause-deleted/associated single life tables were constructed by assuming that the force of mortality is constant ($^*_nm_x = {}_nM^i_x = {}_nm^i_x$) and the associated single decrement probability of dying from cause *i* in the age interval *x*, *x*+*n* is computed as: $^*_nq_x = 1 - e^{-n \times {}_nM^i_x}$ [23]. The other life table functions were computed as per the standard life table relationships [23].

Authors' response to Reviewers' Comments

12th August, 2019

Dr. Helen Fletcher
Editor
Tropical Medicine & International Health

Dear Dr. Helen Fletcher,

Thank you for considering our manuscript entitled "Adult mortality in sub-Saharan Africa: A cross-sectional study of causes of death in Zambia" (Ref.: Ms. No. TMIH-D-19-00162) and for having it undergo a peer review. We benefited a lot from the reviewers' expert and insightful comments. The comments they helped us improve the manuscript. The issues raised by the reviewers in the comments have been addressed and changes made. A revised and updated manuscript has been attached as well as the responses to the reviewers' comments. The following pages summarize our responses to the reviewers' comments and how we handled their suggestions to improve the manuscript.

We are grateful for considering our manuscript. We look forward to your response and advice on the next step.

Sincerely,

Vesper H. Chisumpa
Corresponding Author

Response to Reviewers' Comments
Ref.: Ms. No. TMIH-D-19-00162
Title: Adult mortality in sub-Saharan Africa: A cross-sectional study of causes of death in Zambia
Tropical Medicine & International Health

Comments from the reviewers:

Reviewer #1:
General comments
In this paper, the authors provide empirical evidence on causes of death among adults in Zambia. Cause of death is scanty in many African countries. This makes the work presented to be very interesting and worth publishing. Though purely descriptive, the findings are interesting and have several implications for policies and programmes. Authors need to read through and improve on the grammar. A few ones are identified in the relevant sections

Abstract
Objective: Better to say "To describe the age-sex pattern and socioeconomic differentials in causes of death among adults between the ages of 15 and 59 years in Zambia"

Response:
Done

Results: major and leading are synonyms. Retain only one of the two

Response:
Done

Introduction
Delete "data" on page 3 line 24

Response:
Done

Page 4, line 16: revise the sentence….."foremost individual……

Response:
Revised

It is curious that authors did not present any prior evidence on COD patterns in Zambia. There could have been some from facility-based studies or even the global burden of disease studies. Of course the limitations of these sources could be argued as a knowledge gap to justify the present report

Response:
We agree this was an oversight. We have revised and made reference to other prior studies.

Statistical analysis
Calculation of gains in life expectancy and probability of death when certain causes are eliminated appear to be a redundant exercise. Both imply the same thing but life expectancy gains is more useful and easier for non-technical readers to appreciate.

Response:
We have maintained the gains in life expectancy and dropped the probability of death.

The use of Chi square for all variables in Table 4: Are the authors sure that all variables met assumptions for Chi-square? I suspect that the number of deaths for some categories of variables might have been too small and may require use of Fisher's exact test instead. This is even obvious from some cells with 0.0%

Response:
We agree with the reviewer, however, it appears that exact tests and sample weights in Stata are incompatible. The Stata manual advises to use its default tests for "svy: tabulate twoway." The default method accounts for the survey design the statistic is turned into an F statistic with non-integer degrees of freedom by using a second-order Rao and Scott (1984) correction. Quote: *"The Pearson chi-squared statistic is corrected for the survey design with the second-order correction of Rao and Scott (1984) and is converted into an F statistic."*

Authors should indicate that the figures presented in Table 4 are percentages.
Response:
Done

Results
Page 7 line 11-12: Provide percentages for the top five causes of death

Response:
Done

Page 7 line 21: Include percentage
Page 11 line 6-7: there appear to be a contradiction to previous statements in the paragraph. Pls harmonize the points here

Response:
This has been corrected.

Figure 3-5 might be better as a Table because some colour codes were too tiny to be obvious

Response:
We have converted the figures into tables

Discussion
Page 12, line 18. Revise the sentence starting with "to our knowledge"
Page 12, line 20: high mortality set up should be revised as "high mortality setting"

Response:
Revised

How do these findings compare to evidence from global burden of disease which is usually based on models with lots of assumptions.

Response:
The point is valid. This is actually the strength of the study as it is not based on modeled data, rather on actual data. We have added a statement in the discussion comparing the study's findings to those of the global burden of disease.

Reviewer #2:

Introduction

The critical need for information on causes of death for health policy formulation, planning, targeting, allocation of resources, monitoring and evaluating population health programs and interventions is well documented in the demographic, public health and epidemiological literature [1-5]. Yet, in 2013, only 44% of deaths worldwide were registered [6], indicating an absence of information on the causes of death of the remaining fatalities. The causes of deaths are almost unknown in most sub-Saharan African countries, as death registration is incomplete due to inefficient and rudimentary civil registration systems [7, 8](Almost unknown is over 75%. The writer needs to give a specific percentage.).

Response:
We have revised the sentence.

The coverage of death registration is less than 25% in the majority of sub-Saharan African countries [8]. (There's need to be specific again here. Does this suggest that 75% of mortalities happen outside the hospital? Does the writer mean deaths in hospitals or outside hospitals are poorly registered in sub Saharan Africa ?).

Response:

We cited the World Health Organization which also does not give an exact figure but a range of under registration. By this sentence, we mean that deaths in hospitals or outside hospitals are poorly registered in sub Saharan Africa.

Another challenge in determining causes of death in these countries is that a significant portion of deaths occurs outside health facilities, mostly at home, where they are not attended by health service providers. Even in cases where deaths are captured, the cause of death may not be reported or may be misclassified–particularly in rural areas [3](This maybe true in some rural areas, but there are some rural places that do have health centres. However most of these health centres do not have Medical doctors to sign medical certificates but the health personnel do know how many people died in the area, for instance, they know how many TB patients died, but they may not know those who die of other diseases or conditions).

Response:
Yes, this is possible. We have added a sentence to reflect this point.

2. Data and Methods
Data

…A detailed methodology of the SAVVY is elaborated elsewhere [19]. The 2010 to 2012 SAVVY data were obtained with permission from the Central Statistical Office (Zambia) (Specify other sources of mortality data that Central statistical Office collected, such as hospitals, district health offices, council or police).

Response:

In Zambia, the Central Statistical Office does not collect mortality data from hospitals, district councils or police. The Department of National Registration, Passport and Citizenship in collaboration with the Central Statistical Office are implementing a pilot project of death registration in selected hospitals in order to find ways of improving the registration of deaths in health facilities.

4. Results

Leading causes of death

There were 1,078 deaths of adults in age group 15 to 59 years between 2010 and 2012. HIV/AIDS emerged as the leading cause of death among adults in this age group (Table 1) (HIV/AIDS is usually combined with TB, Africa CDC.). The proportion of HIV/AIDS deaths is higher among deceased adult females than males (44.1% vs 37.9%) (Table 1). The top five leading causes of death are HIV/AIDS, injuries and accidents, TB, malaria, and diseases of the circulatory system,(Did you mean cardiovascular diseases?)

Response:

Yes. Please see the ICD-10 classification in WHO website for all the diseases in circulatory systems. https://icd.who.int/browse10/2016/en#/IX

Figure 3 presents the share of individual cause of death to the total communicable causes of death. HIV/AIDS and TB remains the leading cause of death of adults in age group 15 to 59 years, with higher proportions among females than males. Tuberculosis is the second leading communicable cause of death. Adult male decedents had a higher proportion of deaths attributable to TB than females. Malaria is the third leading communicable cause of death for both males and females. Pneumonia/ARI is the fourth leading communicable disease among the deceased males, while among the female decedents it is maternal causes.

[Figure 3 about here]

Non-communicable diseases causes of death

Figure 4 presents the share of individual causes of death to the total non-communicable causes of death. Diseases of the circulatory system(What are the diseases of the circulatory system? Cardiovascular diseases? By circulatory system do you specifically mean Hypertension?..it could mean many things.)

Response:

We have categorized the diseases according to ICD-10. Details of these diseases can be seen in the link: https://icd.who.int/browse10/2016/en#/IX

External causes of death

A disaggregation of injuries and accidents shows that road traffic accidents were the leading cause of death among external causes for males, while for females it was

intentionally inflicted injuries (Figure 5)(Intentionally inflicted, do you mean suicide or violence? Homicide?).

Response:

Yes

The proportion of male road traffic accident deaths was twice as high as that of female deaths. Intentionally inflicted deaths were the second leading cause of death among males, while among females it was road traffic accidents. Animal/insect bite deaths were the third leading cause of death among both males and females. Males accounted for a higher proportion of animal/insect bite deaths. (Specify the country)

Response:

Done

[Figure 5 about here]

Age-sex-cause-specific mortality patterns

[Table 2 about here]

Impact of eliminating causes of death on adult mortality

The highest percentage reduction in the probability of dying between ages 15 and 60 years is 30.6% overall and this would be achieved by eliminating HIV/AIDS as a cause of death (Table 3). Adult females would greatly benefit from eliminating HIV/AIDS (HIV/AIDS is a disease. Commonly, the AIDS defining conditions, opportunistic infections are the cause of death in HIV/AIDS patients. This means that early anteretrovial treatment of HIV/AIDS can prevent opportunistics infections and death thereby greatly reducing mortality in HIV/AIDS group, those adherent to treatment can live for many years.)

Response:

We have added a sentence in the discussion based on the comment.

as a cause of death, as it would reduce their probability of dying by 35%. The impact of eliminating the other causes of death on improving adult survivorship is far less when compared to eliminating HIV/AIDS alone. Therefore, eliminating HIV/AIDS should be a priority for public health interventions.(Elimination also includes prevention of mother to child transmission of the virus, Early treatment, adherence counseling, good nutrition and education.

Response:

We have added a sentence in the discussion based on the comment.

[Table 3 about here]

Variations in causes of death by demographic, socioeconomic, behavioral and geographic characteristics of deceased persons. More than half of HIV/AIDS deaths were among the widowed/divorced/separated marital status category.(This statement should be qualified, at what time did they become widows? To say deaths were high among the widows, did the statement mean the widows were dying because their partners had died of HIV/AIDS and hence chances of them dying were high?)

Response:

Ours is cross-sectional data collecting information about dead individual and their socio-economic status prior to two years of survey. There is no information at what time a

woman become widow. We have information on out of total currently married women, what percent died and out of total widowed/separated/divorced women, what percent died. Our conclusion is based on this data. Also, we are describing or correlating the findings, rather than establishing causality between marital status and death.

Injuries and accident deaths were higher among never married and married individuals, than the widowed/divorced/separated ones. The differences in causes of death by marital status are not statistically significant (p-value>0.05). We observed an interesting social gradient in share of deaths by occupation of the deceased. A higher share of HIV/AIDS deaths occurs among the service/shop/market sales workers, whereas a lower share is seen among the legislators/senior officials/managers (The reason might be that educated people with good paying Jobs had access to information pertaining to early treatment, adherence good nutrition and hence prevented occurrence of opportunistic infections and lived longer thereby reducing HIV/AIDS related infections in this group).

Response:
We have added a statement in the discussion based on the comment.

Malaria deaths were higher among clerks and plant machine operators/assemblers than the other occupations. Diabetes mellitus deaths were higher among decedents who were legislators/senior officials/managers than the other occupations (Lifestyle influenced diseases). The proportion of TB deaths was higher among legislators/senior officials/managers and those who were professionals, than among the other occupations. (This statement also should be qualified and reference provided. 70% of TB patients are HIV positive and TB usually affect the socially low economic status group, which means very few managers, senior officials and legislators will be affected by TB. The above statement should be revised).

Response:
We have revised the statement based on the comment. We are using actual reported data. It is a possible that due to social stigma attached to HIV, the respondents may have reported more of TB as cause of death as opposed to HIV.

Thus, contrary to conventional epidemiological transition theory, sub Saharan countries like Zambia are experiencing a simultaneous burden of both communicable and non-communicable diseases. There is growing concern that the burden of NCDs will be heavier than the HIV/AIDS burden in the long term and that the impact will be more severe for poor populations of low- and middle-income countries [7]. The country's health infrastructure is inadequate to effectively deal with the emerging epidemic of NCDs. This finding is consistent with studies that have revealed evidence of the rising epidemic of NCDs in low- and middle-income countries [6, 17, 24-31]. (Because of lifestyle changes, industrialization and rural-urban migration).

Response:
We agree this is possible. We have added a statement to this effect.

Finally, we see important regional variations in selected diseases. For instance, Northern, North Western and Luapula provinces had higher proportions of tuberculosis compared to the other provinces.(These are the poorest provinces in Zambia with Western being the poorest, and so prevalence of TB should be high. But Earlier on, your inference stated that TB is high among senior officials, managers and legislators, this sounds like a contradiction).

Response:
Here we are a looking at residence rather than occupation. It is also not clear to establish a link between the two, residence and occupation, with respect TB deaths.

This could probably be due to inadequate health infrastructure, considering that these are predominantly rural provinces and the populations are too sparsely distributed to effectively provide health services. The government Directly Observed Treatment, Short-Course (DOTS) strategy on TB has helped to reduce the deaths attributed to TB through provision of free TB drugs at points of health service. Though, availability of TB drugs in remote areas and treatment of multi-drug resistant TB have been some of the challenges. It is also well known that tuberculosis is closely associated with HIV/AIDS [42, 43] and probably some of the HIV/AIDS deaths might have been misclassified as TB deaths.(Like Earlier stated, 70% of the sub-saharan Africa is infected with TB, but its in latency and is kept under control by strong immune system. But active disease comes as a result of reduced immune system brought about by the retrovirus, HIV).
Response:
We have noted this observation.

The epidemic of NCDs may continue to pose a challenge to meeting the sustainable development goals if government does not respond effectively to this burden. Investing in implementing a strategic plan for NCDs is however a great challenge, as available resources are already overstretched in fighting communicable diseases like malaria, tuberculosis, lower respiratory infections, and above all, the HIV/AIDS epidemic.(Pandemic?)
Response:
Changed

Tables

Table 1. Leading causes of death among adults in age group 15-59, Zambia, 2010-2012

Cause of Death	Male %	Rank	Female %	Rank	Total %	Rank
HIV disease	37.9	1	44.1	1	40.7	1
Tuberculosis	8.3	3	7.5	2	7.9	3
Disease of the circulatory system	4.6	5	6.5	3	5.5	5
Malaria	6.6	4	6.5	4	6.6	4
Injuries & Accidents	15.3	2	6.3	5	11.2	2
Neoplasms	1.9		4.6		3.1	
Maternal causes	-		3.9		1.8	
Nutritional & other anemias	0.8		1.7		1.2	
Pneumonia/ARI	2.9		1.7		2.3	
Diabetes mellitus	1.9		1.6		1.7	
Meningitis	1.5		1.6		1.6	
Diarrhoeal diseases	1.3		1.5		1.4	
Other disorders of the digestive system	1.4		1.2		1.3	
Malnutrition	0.6		0.4		0.5	
Disorders of the kidney	1.0		0.2		0.6	
All other causes	7.9		7.5		7.7	
Ill-defined & undetermined causes	6.0		3.3		4.8	
Total	**100.0**		**100.0**		**100.0**	
Number	**582**		**496**		**1,078**	

Source: Computations from SAVVY data files, 2010-2012

Table 2. Percentage distribution of adult deaths according to communicable causes of death by sex, Zambia, 2010-2012

Cause of death	Male (%)	Female (%)	Total (%)
Diarrhoeal diseases	1.3	1.5	1.4
HIV disease	37.9	44.1	40.7
Malaria	6.6	6.5	6.6
Remainder of infectious & parasitic	0.5	1.4	0.9
Nutritional & other anemias	0.8	1.7	1.2
Malnutrition	0.6	0.4	0.5
Tuberculosis	8.3	7.5	7.9
Meningitis	1.5	1.6	1.6
Pneumonia/ARI	2.9	1.7	2.3
Leprosy	0.1	0.0	0.1
Maternal causes	-	3.9	1.8
Rabies	0.0	0.2	0.1
Measles	0.2	0.2	0.2
Total	**60.8**	**70.7**	**65.3**
Number	**582**	**496**	**1,078**

Source: Computations from SAVVY data files, 2010-2012

Table 3. Percentage distribution of adult deaths according to non-communicable causes of death by sex, Zambia, 2010-2012

Cause of death	Male (%)	Female (%)	Total (%)
Neoplasms	1.9	4.6	3.1
Sickle cell disorders	0.2	0.2	0.2
Other blood diseases	0.0	0.2	0.1
Diabetes mellitus	1.9	1.6	1.7
Mental/behaviour disorders due to alcohol	0.8	0.2	0.5
Other mental/behaviour disorders	0.7	0.6	0.6
Epilepsy	1.1	0.8	1.0
Other CNS disorders	0.5	0.4	0.4
Disease of the ear & mastoid process	0.0	0.2	0.1
Disease of the circulatory system	4.6	6.5	5.5
Asthma	0.0	0.2	0.1
Chronic Obstruc. pulmonary disease	0.5	0.4	0.4
Diseases of oesophagus, stomach & du	1.0	0.6	0.8
Hernias	0.2	0.0	0.1
Liver disease	0.5	0.4	0.4
Other disorders of the digestive system	1.4	1.2	1.3
Disorders of the skin & subcutaneous	0.3	0.4	0.4
Disease of musculoskeletal & connect	0.1	0.0	0.1
Disorders of the kidney	1.0	0.2	0.6
Other diseases of the urinary system	0.2	0.2	0.2
Other disorders of female genital organ	0.2	0.4	0.3
Specified symptoms NEC	0.5	0.4	0.5
Total	**17.9**	**19.7**	**18.7**
Number	**582**	**496**	**1,078**

Source: Computations from SAVVY data files, 2010-2012

Table 4. Percentage of adult deaths according to external causes of death by sex, Zambia 2010-2012

Cause of death	Male (%)	Female (%)	Total (%)
Road traffic accident	4.8	2.2	3.6
Fall	1.0	0.2	0.6
Drowning	1.1	0.2	0.7
Poisoning	0.5	0.2	0.0
Burns	0.4	0.1	0.3
Violence/Assault	0.3	0.0	0.1
Intentional inflicted	2.5	2.1	2.3
Suicide	2.3	0.3	1.4
Animal/Insect bite	2.4	1.1	2.1
Total	**15.3**	**6.3**	**11.2**
Number	**582**	**496**	**1,078**

Source: Computations from SAVVY data files, 2010-2012

Table 5. Number of years gained in life expectancy at age 15 by eliminating the risk of each of the top five leading causes of death, Zambia

Total			Male			Female		
Life expectancy at age 15 -Cause of Death Eliminated	Life expectancy at age 15 - All Causes	Number of years Gained	Life expectancy at age 15-Cause of Death Eliminated	(e_0)- All Causes	Number of years Gained	Life expectancy at age 15 - Cause of Death Eliminated	Life expectancy at age 15 - All Causes	Number of years Gained
HIV/AIDS eliminated								
47.5	41.4	6.0	45.7	39.9	5.7	49.5	43.1	6.4
Injuries and accidents eliminated								
43.1	41.4	1.6	42.1	40.0	2.2	44.13	43.1	1.0
Tuberculosis eliminated								
43.08	41.4	1.6	41.7	40.0	1.7	44.58	43.1	1.4
Malaria eliminated								
42.58	41.4	1.1	41.1	40.0	1.1	44.24	43.1	1.1
Diseases of the Circulatory System eliminated								
43.13	41.4	1.6	41.2	40.0	1.2	45.34	43.1	2.2

Source: Computations from SAVVY data files, 2010-2012

Table 6. Percentage distribution of causes of death by demographic and socioeconomic background characteristics of the deceased adults in age group 15-59 years, Zambia

Variable	Diarrhoeal diseases	HIV disease	Malaria	Neoplasms	Nutritional & other anemias	Diabetes mellitus	Malnutrition	Tuberculosis	Meningitis	Disease of the circulatory system	Pneumonia/ARI	Other disorders of the digestive system	Disorders of the kidney	Maternal causes	Injuries & Accidents	All other causes	Ill-defined & undetermined causes	Total (%)	Number (15-59)	P-value
Residence																				**0.3057**
Rural	1.7	40.8	6.0	2.9	1.3	1.4	1.0	8.0	1.1	5.9	2.4	1.0	0.4	2.4	11.7	8.6	3.4	100.0	596	
Urban	1.0	40.7	7.3	3.4	1.1	2.1	0.0	7.9	2.1	5.0	2.2	1.7	1.0	1.0	10.5	6.5	6.5	100.0	482	
Province																				**0.5667**
Central	0.0	43.2	4.4	0.0	2.6	5.2	0.0	4.4	7.0	6.5	2.9	1.5	0.0	1.6	12.6	5.4	2.8	100.0	69	
Copperbelt	0.0	37.9	15.7	1.4	3.0	1.4	1.4	7.2	0.0	1.5	2.9	5.9	1.4	0.0	8.8	7.3	4.4	100.0	67	
Eastern	3.1	44.9	6.4	3.8	1.0	2.2	1.2	4.7	0.5	4.3	2.6	0.5	0.0	2.0	9.6	8.6	4.6	100.0	183	
Luapula	1.3	37.4	8.2	1.3	1.3	0.0	1.1	10.9	3.1	6.9	2.4	1.3	0.7	2.5	11.3	9.0	1.2	100.0	153	
Lusaka	1.2	40.4	5.3	4.1	1.6	0.5	0.0	7.4	0.9	5.4	2.1	1.8	1.2	0.8	12.5	6.9	8.1	100.0	245	
Northern	4.0	25.5	4.4	0.0	1.4	4.4	0.0	11.8	1.4	7.4	2.7	0.0	0.0	6.9	12.3	16.5	1.5	100.0	70	
North Western	2.1	37.8	2.6	4.4	0.0	2.8	0.0	10.7	2.5	15.8	4.4	0.0	0.0	0.0	7.3	7.0	2.5	100.0	40	
Southern	0.0	44.6	2.4	5.4	0.7	3.2	0.0	8.6	0.9	5.1	0.9	1.6	1.7	0.0	13.2	5.4	6.3	100.0	126	
Western	0.7	45.1	9.9	4.0	0.0	0.8	0.8	8.9	0.8	3.3	2.2	0.0	0.0	3.2	9.8	5.3	5.2	100.0	126	
Educational attainment																				**0.0807**
None	4.0	34.1	7.7	2.2	2.1	3.1	2.9	7.0	2.0	2.9	0.9	1.0	0.0	1.0	10.1	10.7	8.3	100.0	96	
Primary	1.1	45.1	5.1	2.5	1.1	0.7	0.4	8.3	1.0	7.1	2.8	0.8	0.6	2.1	9.6	7.7	3.9	100.0	511	
Secondary	1.2	39.6	8.7	3.9	1.5	2.4	0.0	7.6	1.8	3.6	2.0	2.1	0.3	1.8	12.3	6.1	5.2	100.0	377	
Higher	1.6	24.9	4.8	1.5	0.0	3.2	1.5	7.7	1.5	7.7	3.0	1.5	4.5	1.6	19.6	12.4	3.0	100.0	63	
Marital Status																				**0.1364**
Never Married	1.5	33.8	7.0	2.7	1.1	1.2	0.7	7.9	2.0	3.4	2.6	0.8	0.4	1.5	16.9	9.3	7.3	100.0	253	
Married/Living with a partner	1.7	38.6	6.8	3.3	1.2	2.3	0.5	7.8	1.6	6.4	2.1	1.6	0.9	2.6	11.5	7.1	4.2	100.0	566	
Widowed/Divorced/Separated	0.8	53.2	5.8	3.1	1.5	1.1	0.3	8.1	1.1	5.2	2.6	1.2	0.4	0.4	5.0	7.0	3.2	100.0	255	
Occupation																				**0.0523**
Legislators/Senior Officials/Managers	5.0	23.7	5.0	5.3	0.0	10.6	5.1	10.1	0.0	5.0	0.0	5.0	0.0	5.1	9.8	5.1	5.2	100.0	20	
Professionals	0.0	27.1	0.0	4.3	0.0	4.5	0.0	17.8	0.0	0.0	0.0	0.0	8.6	0.0	24.0	8.9	4.8	100.0	22	
Technicians/Associate Professionals	0.0	43.4	0.0	0.0	0.0	4.5	0.0	9.2	4.3	0.0	4.1	4.2	0.0	0.0	4.8	12.6	12.9	100.0	23	
Clerks	0.0	42.8	11.6	2.9	0.0	0.0	0.0	9.3	0.0	7.3	2.8	3.1	0.0	1.5	5.7	8.8	4.3	100.0	67	
Service/Shop/Market sales workers	0.0	46.5	5.8	5.4	1.1	3.5	0.0	8.0	1.0	6.1	0.0	2.1	0.0	1.1	10.4	7.0	2.0	100.0	99	
Skilled Agricultural/Fishery workers	1.9	39.6	6.9	2.9	0.9	1.5	0.6	7.9	0.9	5.2	3.2	1.2	1.0	2.3	13.5	6.7	3.8	100.0	332	
Craft and related trade workers	0.0	42.9	3.3	0.0	0.0	7.4	0.0	6.6	10.1	0.0	0.0	0.0	0.0	3.2	10.3	9.5	6.8	100.0	30	
Plant and Machine Operators/Assemblers	1.8	35.8	10.2	3.5	3.5	0.0	0.0	9.2	0.0	4.9	0.0	3.9	0.0	1.7	18.7	5.2	1.6	100.0	55	
Elementary Occupations	1.6	41.8	6.2	2.9	1.7	0.9	0.7	7.0	2.1	6.3	2.7	0.5	0.4	1.6	9.2	8.4	6.0	100.0	430	
Alcohol Consumption																				**0.0534**
Yes	1.0	44.2	6.4	2.4	0.4	1.0	0.8	8.7	0.8	4.5	2.3	1.1	0.6	0.0	12.2	8.6	4.9	100.0	469	
No	1.7	38.3	6.6	3.7	1.9	2.3	0.3	7.5	2.1	6.4	2.3	1.5	0.7	3.2	10.0	6.9	4.6	100.0	601	
Tobacco Smoking																				**0.2128**
Yes	0.7	42.6	5.5	2.5	1.0	0.4	1.1	11.0	1.1	3.8	2.6	0.8	0.4	0.4	12.6	9.5	4.1	100.0	261	
No	1.6	40.4	6.8	3.4	1.3	2.2	0.4	6.9	1.7	6.1	2.3	1.5	0.7	2.3	10.5	7.2	4.8	100.0	808	
Family Relationship																				**0.0089**
Father	1.0	32.2	5.4	2.4	0.0	3.4	0.0	5.7	1.2	6.1	2.1	1.3	1.1	5.6	22.5	6.6	3.4	100.0	86	
Mother	2.4	44.8	10.6	2.4	2.3	0.4	0.0	7.4	2.1	4.6	0.5	1.0	0.5	2.0	9.3	5.6	4.2	100.0	202	
Spouse	1.6	32.1	6.2	5.0	0.4	2.9	0.5	8.8	1.3	7.8	3.1	2.4	0.5	1.0	13.0	9.7	3.7	100.0	216	
Sibling	0.0	50.4	3.6	1.0	1.5	1.0	1.5	10.4	1.0	4.8	2.5	0.5	0.0	2.0	9.3	4.0	6.5	100.0	192	
Child	2.6	38.4	8.7	6.2	0.6	2.0	0.6	6.1	0.6	6.0	1.3	1.9	0.6	1.9	7.6	9.7	5.2	100.0	149	
Other relative	0.9	42.3	4.8	2.1	1.7	1.4	0.5	7.6	2.7	4.5	4.0	0.9	0.9	0.8	10.5	9.4	5.0	100.0	220	
No relation	0.0	45.9	0.0	0.0	0.0	0.0	0.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	18.1	18.0	8.7	100.0	11	
Place of Death																				**0.0000**
Hospital	0.9	45.1	6.7	5.1	1.5	2.5	0.0	7.9	2.1	5.0	2.2	1.6	0.9	2.4	6.5	7.3	2.2	100.0	434	
Other health facility	3.4	39.1	7.8	0.0	0.9	1.7	0.0	7.0	1.8	6.6	6.2	1.8	0.0	4.4	8.9	7.0	3.5	100.0	111	
Home	1.3	41.6	6.3	2.5	1.3	1.4	1.3	9.3	1.1	6.3	1.9	0.9	0.7	0.7	9.0	7.0	7.4	100.0	447	
Other	2.1	16.1	5.6	0.0	0.0	0.0	0.0	2.2	1.2	2.2	0.0	1.1	0.0	1.2	49.1	13.7	5.7	100.0	86	
Total	**1.4**	**40.7**	**6.6**	**3.1**	**1.2**	**1.7**	**0.5**	**7.9**	**1.6**	**5.5**	**2.3**	**1.3**	**0.6**	**1.8**	**11.2**	**7.7**	**4.8**	**100.0**	**1078**	

Source: Computations from SAVVY data files, 2010-2012

Figures

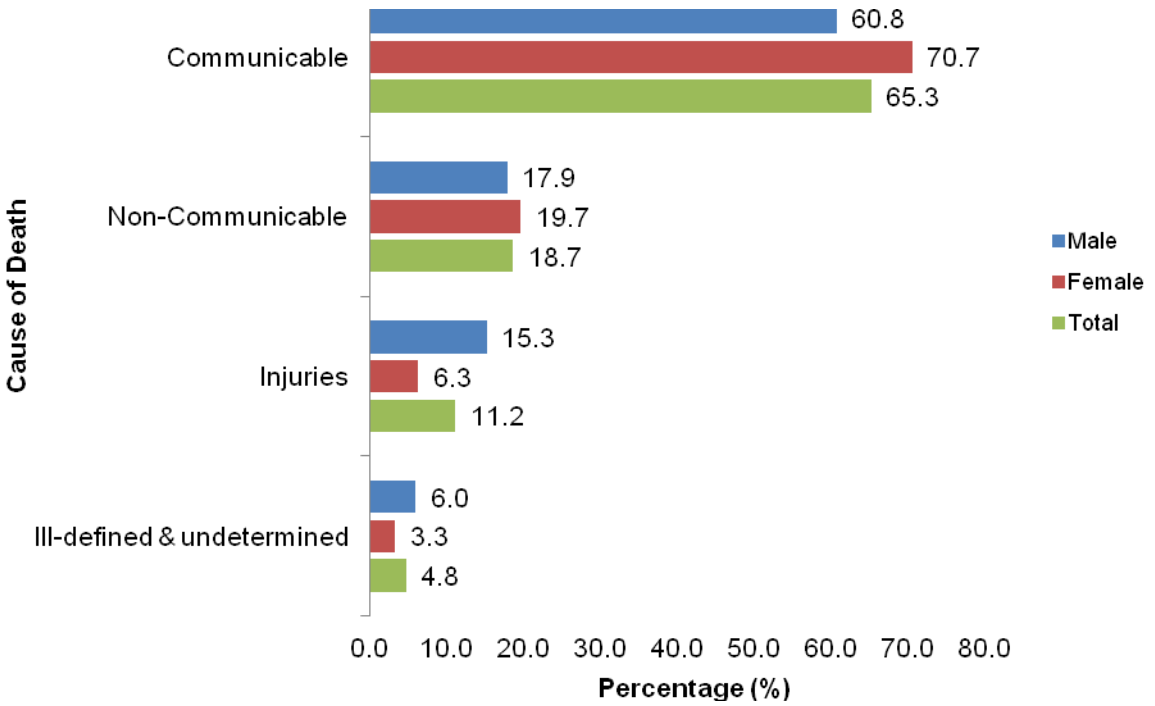

Figure 1. Percentage of adult deaths by major groups of causes of death (according to the classification of Global Burden of Diseases) by sex, Zambia 2010- 2012 (n=1078)**.** (Source: Computations from SAVVY data files, 2010- 2012).

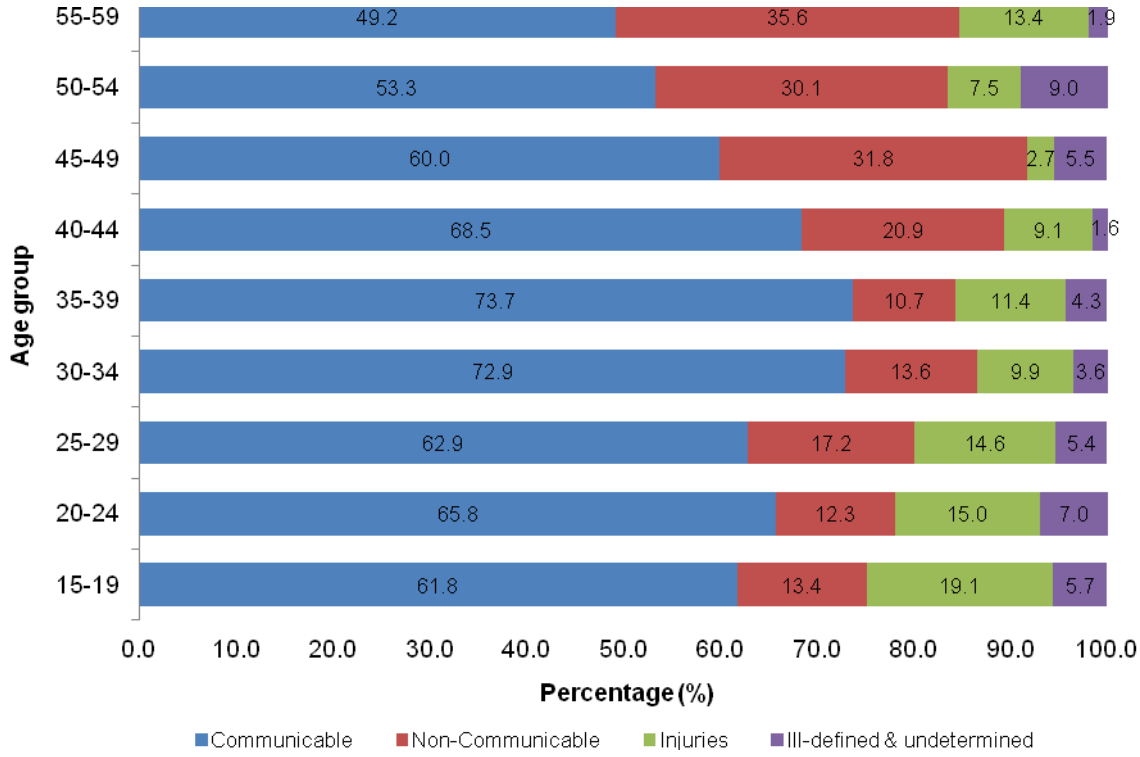

Figure 2. Percentage of adult deaths by major groups of causes of death (according to the classification of Global Burden of Diseases) by age group, Zambia 2010-2012 (n=1078). (Source: Computations from SAVVY data files, 2010-2012)

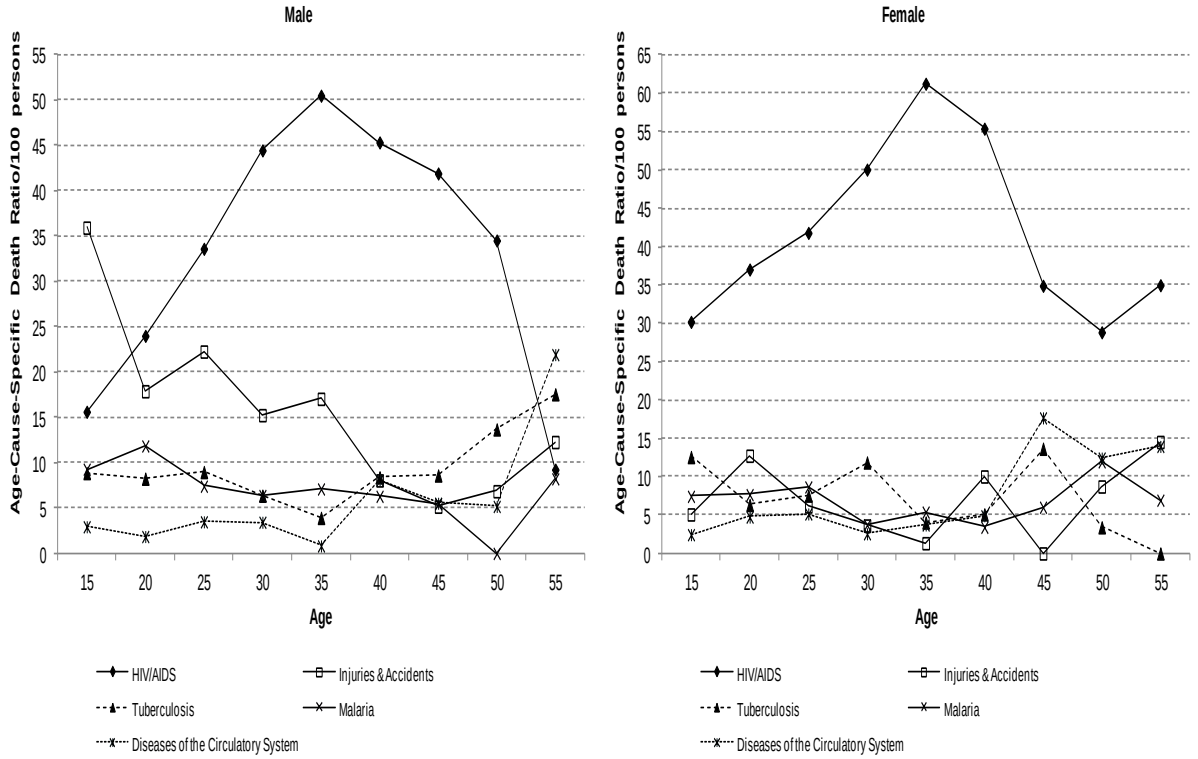

Figure 3. Male and female age-cause-specific mortality pattern, Zambia, 2010-2012.
(Source: Computations from SAVVY data files, 2010-2012)

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I have made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

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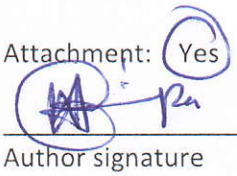

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