Decomposition of Ethiopian Life expectancy by age and cause of mortality; 1990-2010

Gizachew Balew, Youngtae Cho

**Background:** Ethiopia, a sub-Saharan country with over 94 million populations growing at a rate of 2.6 percent is showing a fast socio-economic improvement. According to World Health Organization 2014, life expectancy in the country has increased by about 19 years with in the last two decades. It has also reduced child mortality by 2/3rd; two years ahead of millennium development goal deadline. This research will focus in decomposing the improvement in life expectancy in the country from 1990 to 2010.

**Methods:** We used a secondary data on cause and age specific mortality estimate of Ethiopia from institute of health metrics and evaluation. Burden of disease is measured using potential life years lost and potential life years gained using survival 6 program and compared across time. Further improvement in life expectancy is decomposed across age and specific causes using Pollard’s life expectancy decomposition method.

**Results:** Burden of disease measured in weighted years of life lost (YLL) shows that lower respiratory infection at a value of 5.35, neonatal disorders [4.058], diarrheal diseases [3.6], neglected tropical diseases [2.4], meningitis [1.49] and tuberculosis [1.19] are the top causes of burden in 1990 which showed a slight shift in 2010. Lower respiratory tract infections showed the highest reduction in YLL by about 41.27%, followed by diarrheal disease (32.8%) and meningitis (26.46%). Decomposition of life expectancy shows among the total 15.25 years increase in life expectancy from 1990 to 2010, about 5.8 (35.78%) years of increase in life expectancy is achieved through improved longevity in children’s aged 1-4 year. On the other hand diarrheal diseases reduction contributes about 3.12 [15.96%] followed by lower respiratory infection about 2.54 [12.98%], neglected tropical diseases by 1.45 [7.43%] and tuberculosis by 1.2 [6.25%] years.

**Conclusions and recommendation:** Burden of disease in Ethiopia has declined dramatically which has contributed to the improvement in life expectancy, with the highest reduction already recorded in major communicable diseases. Though it is encouraging that mortality from children has reduced in the country, the slow change in mortality and burden of disease in the general adult population needs future public attention.
Decomposition of Ethiopian Life expectancy by age and cause of mortality;

1990-2010

Gizachew Balew (BSc, MPH, PhD Student)

Seoul national University

gbalew@snu.ac.kr

Cho Youngtae (Professor, Seoul National University)

younhtae@snu.ac.kr

Seoul National University

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Abstract

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- Keywords: Life expectancy, decomposition, Ethiopia, years of life lost, burden of disease
Background

Life expectancy has been utilized as a quantitative measure of mortality and longevity of life within and across societies. According to Raza et al, the last decade in the 20th century was characterized by stagnation in life expectancy owing to an increase in morbidity and mortality from HIV/AIDS especially in sub-Saharan Africa (1).

Despite this challenge, the United Nations homepage came up with a news notifying that globally a girl who was born in 2012 can expect to live for around 73 years, and a boy for the age of 68, which is about six years above the 1990 average (2). This report however also shows the large divide between the rich and the poor; while the largest gain in life expectancy being from the developing countries is a source of optimism for development workers and communities in these countries. By gaining a total of 20 years and 19 years in life expectancy from 1990 to 2010, Liberia and Ethiopia are on the top list in the longest life expectancy gain (2, 3). The improved management of non-communicable diseases in developed nations and the reduction in child mortality were praised for the improvement in the life expectancy.

According to the life expectancy table from WHO, most of sub-Saharan Africa countries have gained life expectancy in the last two decades. Eritrea, Ethiopia, Liberia, Malawi, Rwanda, Uganda and Tanzania all from East Africa gaining life expectancy of more than 10 years. On the other hand the result from the institute of health metrics and evaluation indicates that DALYs of communicable disease have reduced from 148 to 68 from 1990 to 2010. Specifically diarrheal and lower respiratory infections have reduced from 67 to 19 and from 22 to 7.6 respectively.

Ethiopia, a country with over 94 million population and a total fertility rate of 4.8, is one of the least developed countries that has recently registered an improvement in the human development index (4). One of the sectors where relative improvement is registered is the public health sector. The number of health centers has increased from about 600 in 1990 to 2999 in 2011, and a previously non-existing 35,000 community health extension workers were trained and dispatched to the community. However, the health service utilization estimated by the outpatient service utilization is still very low, 0.2 to 0.29 from 1990 to 2011 (5, 6) with high rural urban gap. The 2011 demographic
and health survey on the other hand pointed out an improvement in the proportion of children underweight to 29% down from 47.6% in 1990. Similarly under-five mortality has reduced to 88 from 184 Infant mortality to 59 from 111(6, 7). Generally there are overwhelming evidences supporting the improvement in child health condition in Ethiopia; achieving a 2/3rd reduction in child mortality, two years ahead of the millennium development goal time line(8).

Living in a resource scarce world, health sector planning, resource allocation and implementation requires understanding of the major causes of morbidity and mortality that affect longevity and productivity at a community level. Taking this in to the Ethiopian case, understanding the age and cause specific contributions for the improvement in life expectancy will help for further planning and resource allocation, despite data limitations that pose a huge bottleneck to disentangle these issues in most developing countries. Nonetheless, after the introduction of DALY in 1990(9-11); there are various small scale and large scale studies to decompose mortality by age and cause to understand premature mortality, disability adjusted life years, years of potential life lost and similar mortality and morbidity burdens. On the other hand, in spite of the increase interest in life expectancy, and the availability of various methods to decompose life expectancy, there are few researches conducted in the area to understand what the dynamics of life expectancy are across communities. This gets much worse while taking low-income countries where adequate data, especially vital registrations are almost nonexistent to understand the age and cause specific morbidity and mortality in a community.

Unlike such challenges, thanks to the global burden of disease estimates from world health organization and institute of health metrics and evaluation, estimates of such cause specific mortality for every country is available online. The main objective of this study is to analyze the gain in life expectancy in Ethiopia from 1990 to 2010 using such data. Specifically life gained in the past two decades will be decomposed to investigate the age and cause specific contributions in the improvement of life expectancy in the county.

Methods

A number of statistical methods have been developed to explore the causes of variations in life expectancy. Among those scholars Pollard (1982, 1988), Arriaga (1984), Pressat (1985), Andreev (1982) and Key Fitz (1977, 1985) are
pioneers in the field(12). Current literatures indicate that Pollard's method is an exact decomposition of life expectancy whereas Arriaga’s method is slightly easier to calculate but an approximate method. However, comparisons of these methods have showed that the results obtained in either of the methods are comparable, especially for Arriaga’s and Pollard’s method(13, 14). In this research Pollard’s method will be used to decompose the changes in life expectancy in Ethiopia from 1990 to 2010(12, 13):

**Pollard’s Life Expectancy Decomposition Formula**

\[
\text{life}\ exp\ (diff) = e_{01} - e_{02} = \Sigma (m_{x1} - m_{x2}) \times w
\]

\[
w = \frac{n}{2} \times \left( \frac{l_{x1}e_{x1} + l_{x2}e_{x2}}{2} + \frac{l_{x+n1}e_{x+n1} + l_{x+n2}e_{x+n2}}{2} \right)
\]

Where; the two expressions in the bracket from right to left indicate the weights at time \( t_i \) and \( t_i + n \). To decompose the last open group in the age interval the formula is replaced with

\[
e_{01} - e_{02} = \Sigma (m_{x1} - m_{x2}) \times \frac{1}{2} \times \left( \frac{T_{x1} + T_{x2}}{nm_{x1} + nm_{x2}} \right)
\]

**Keys:**

- \( n \) = age interval(5 years commonly)
- \( e_{1} \) = life expectancy at age 0 in population one
- \( e_{2} \) = life expectancy after age 0 in population two
- \( e_{x+n1} \) = life expectancy after age \( x+n \) in population one
- \( e_{x+n2} \) = life expectancy after age \( x+n \) in population two
- \( l_{x1} \) = radix at age \( x \) in population one
- \( l_{x2} \) = radix at age \( x \) in population two
- \( l_{x1+n1} \) = radix at \( n \) years after age \( x \) in population one
- \( l_{x2+n2} \) = radix at \( n \) years after age \( x \) in population two
- \( w \) = weight
- \( m_{x1} \) = mortality at age \( x \) in population one
- \( m_{x2} \) = mortality at age \( x \) in population one

The data imported from IHME is presented in different hierarchical levels, Level I – communicable diseases, maternal causes, perinatal conditions and nutritional deficiencies; Level II – non-communicable diseases; and Level III – intentional and unintentional injuries. The data for both sexes from the 155 list of mortality in the level three were filtered and top causes of mortality were arranged based on the total number of deaths. A final list of 20 causes of mortality including
other causes were arranged with the corresponding age specific population, extracted from the United Nations population data released in 2012 projection. This file was then imported into this survival program software where multi decrement abridged life tables were constructed. Decomposition of life expectancy using Pollard’s method was done using excel format based on the life expectancy output from the survival program.

Results

Around 19 different causes of mortality and morbidity were included in the model to explain the burden of disease among the total 155 causes of mortality at level three and level two identified by the GBD study. A simple age specific mortality ratio of the top 19 causes of mortality shows that these causes explain about 65% of mortality in under one and around 58% in under-five in the year 1990, whereas more than 80% of the mortality is explained by these factors above age 60 and over. However in the 2010 data the same causes of mortality explains much higher portion, more than 75% of child mortality, and more than 80% of mortality above 35 years of age (Figure 1). This figure shows that mortality from lower respiratory tract infection, cardiovascular diseases, neglected tropical diseases and tuberculosis to be the major causes of mortality in 2010 with a slight shift in order from 1990.

A further analysis of burden of mortality using potential life years lost from multi decrement life table [Table 1] shows the mean life years lost for each specific year and the percentage reduction in years of life lost. Mean years of potential life years lost quantifies the average year that a person would have lived had s/he not died. A higher value indicates a premature death and a lower value tells improved longevity.

\[
YLL = d_i \times e_t, \\
\text{Where: } d_i = \text{number of deaths}, \ e_t = \text{standard life expectancy at age of death in years}
\]

Years of life lost is a function of actual number of deaths and the mean age of mortality. A reduction in life years lost could either be due to a reduction in number of deaths or an upward shift in age of death, which is the goal of public health, reduction of mortality and elongation of life. However the dynamics might be complex and careful interpretation is important, as the estimator gives much weight to child deaths. For the sake of comparison, YLL is weighted based on the number of deaths and this finding suggests lower respiratory infection[5.35], neonatal disorders[4.058], diarrheal diseases[3.6], neglected tropical diseases[2.4], meningitis[1.49], tuberculosis[1.19] and nutritional problems[0.91] are the top causes of burden in 1990 which showed a slight shift in 2010 where neonatal...
disorders[5.14], lower respiratory tract infection[4.54] and neglected tropical diseases[2.95] lead the burden followed by diarrheal disease[2.67], nutritional deficiencies[1.59], tuberculosis[1.47], meningitis[1.38] and cardiovascular diseases[1.31].

The result table [Table 1] shows that from 1990 to 2010, generally there is a reduction in number of deaths and shift in age of mortality. For example the mean years of life lost for diarrheal disease increased from 38.6 to 45.13 while its mortality has also declined dramatically. The shift in age indicates that diarrheal diseases that have been affecting a larger part of the age category have now targeted only the lower age group. This hides the true effect of reduction in burden of disease at a community level; however it is a signal of the improvement in the national disease prevention and control strategy by bringing the disease burden focused to a specific age category. Similarly, neonatal problems with mean YLL at 63.36 years, STI at 61.38 years, meningitis[48.65 years] and NGTDS[44.71 years] affect more of children in 2010, while cardiovascular diseases with mean YLL [14.6 years] and neoplasms [19.72 years] affect more of the elderly population, which shows a shift in age of mortality compared to 1990.

The highest reduction in YLL is observed in lower respiratory tract infections by about 41.27%, followed by diarrheal disease (32.8%), meningitis (26.46%), chronic respiratory (25.13%) and maternal disorders (21.77%). On the other hand; still neglected tropical disease and neonatal disorders that explain much of the burden do have a lower change in YLL. The mean years of life lost at a national level in 1990 and 2010 are 36.67 and 35.67 with a fall in entropy from 0.47 to 0.28 respectively. Entropy which is a measure of the ratio of mean YLL to life expectancy at age zero, has already fallen below 0.2(16) in most developed countries , and a higher entropy means that more people are losing their age prematurely. This implies how a big fall in YLL has the country achieved in its national burden of disease in the past 20 years, though it is still a very big figure compared to the global average. The rate of life years lost indicates a general reduction in years of life lost per 1000 population from 684.65 to 289.9 calculated using the following formula(17)

\[
rate \ of \ YLL = \frac{\sum e_i d_i}{N} \times 1000 ,
\]

Where: \( e_i \) is life expectancy at time \( 'i' \), and \( "d_i" \) indicates deaths at time \( i \) and \( N \) indicates total population in the
Another method of evaluation of burden of disease was calculated using cause elimination life table construction. Based on this method, we estimated the potential life years that would have been gained if a specific cause of mortality is removed from the community [Table 2]. The higher the potential gain, the higher the burden of that disease in the community. This finding illustrates that the order of causes of mortality matches with burdens measured using life years lost with slight change in ranking. Lower respiratory diseases, diarrheal diseases, neglected tropical diseases, cardiovascular diseases and tuberculosis still take the lead in the potential life years gained at an estimated value of around 2.2, 1.1, 1.4, 1.7, 1.3 and 0.89 years respectively. This figure was around 4.2, 3.1, 2.24, 1.8, 2 and 0.9 years respectively in 1990, much more than the one in 2010 [table 2].

Even though we have tried to estimate the burden of disease using life years lost and potential life years gained using cause elimination outputs from multi decrement outputs, and tried to show the progress in terms of percentage changes in life years lost, an improvement in life expectancy from a specific mortality will come through either shift in age specific mortality from an early age to late age or through a reduction in the incidence of disease and that intern leads to reduction in morbidity and mortality. This necessitates the application of decomposition method to decompose the gain in life expectancy.

The multi decrement life table output has displayed that life expectancy has increased by about 15.25 years from 47.74 in 1990 to 62.99 in 2010. A further decomposition of the gain in life expectancy indicates the highest increase in life expectancy comes from improvement in under one and under five children’s health condition. Among the total 15.25 years that is increased in life expectancy from 1990 to 2010, about 5.8 years which is about 35.78 percent of the total increase in life expectancy is achieved through improved longevity in children’s aged 1-4 year of old and another 3 years which represents about 17.29 percent improvement in longevity of under one children only [Table 3].

It is natural to ask what specific cause of death or mortality has really contributed to the improvement in life expectancy in children. Before a general look at cause specific decomposition, decomposition of the under-five mortality by cause and age shows that the major improvement in life expectancy in this group comes from improvements in lower respiratory infection, diarrheal diseases and neonatal disorder for under one children, all together accounting for more than 42% of the gain in life expectancy. On the other hand a similar observation of the
contributors for improvement in life expectancy for children aged one to five years of age indicates that a reduction
in LRT infection, diarrheal disease, neglected tropical disease, nutritional deficiencies and meningitis have
contributed almost more than 50 percent of the gain in life expectancy for this age interval [Table 3].

The spider chart in figure 3 shows the contribution of specific causes of mortality in the improvement of life
expectancy. The biggest improvement in life expectancy comes from diarrheal diseases and lower respiratory
infection by two years and one and half years respectively followed by neglected tropical diseases, tuberculosis,
nutritional deficiencies and meningitis at a value of 1.45, 1.22, 0.74, 0.79 years respectively.

Discussion

This current research finding substantiates the presence of significant progress in reducing burden of disease in
Ethiopia. For most communicable disease conditions both the numbers of deaths, age specific mortality rates, and
potential life years lost (YLL) have reduced from 1990 to 2010. The order of major causes of burden in 1990 and
2010 based on YLL indicates that the top causes of mortality are almost communicable diseases with a slight shift in
order. Beyond this, there is also a huge decline in YLL from 1990 to 2010 and a shift in age of mortality can be
noticed from the mortality ratio and mean years of life lost. Lower respiratory infection, for instance, has displayed
increased prevalence in the elderly population in 2010, where its concentration was much pronounced in the
younger population in 1990. The highest burden of sexually transmitted diseases in children might indicate a result
of vertical transmission from an infected mother [18, 19] that needs further investigation and public intervention.

Specifically the burden of disease and the change over time using the potential life years gained showed the changes
in a much focused way. With a slight change in order of burden, LRT infection has a higher burden both in 1990
followed by diarrheal diseases, neglected tropical diseases and tuberculosis. Similarly in 2010 LRT infection,
cardiovascular disease, neoplasms and neglected tropical diseases are the leading causes of disease burden followed
by tuberculosis and diarrheal diseases. This methodology clearly shows the downward shift in neglected tropical
disease, diarrhea, and tuberculosis from 1990 to 2010 and a total reduction in potential life years gained from 32.95
years in 1990 to 18.954 years in 2010, a fall by about 42%. It is also very important to note that in the 1990s other
causes of mortality have explained 8 years of potential life years to be gained while only 3 years is explained by
other causes of disease in the year 2010. Even though it is not included in the model, an in-depth analysis of other
causes of mortality showed that war and legal interventions used to account a large portion of the burden of disease in 1990. From which one can clearly notice that peace dividend that the country has enjoyed in the past 20 years might have also played its part. The term peace dividend is coined to indicate the extra money, time and human resource gained from reduced defense budgets that can be invested in various social and economic sectors. Most literatures agree that, a cut in military expenditure will give public sector an opportunity to fund social and other economic sectors (20, 21).

Decomposition results on the other hand validate that both under one infants and children aged 1-4 contribute almost half [53.07%] of the life expectancy gained from 1990 to 2010. This indicates the tremendous improvement in under-five health condition. These findings are supported by findings from global child mortality analysis (22-24), where evidences of reduction in child mortality are found at a global level with a reduction of 2·0–2·4 million deaths every year with major reductions in pneumonia, diarrhea and measles according to Li Liu and his colleagues (22).

However on the other hand, despite the slight improvement in life expectancy for the teen age and adult’s population, the gain in life expectancy from this part of the population is not encouraging. This also signals the presence of a big room for improvement of the lives of the general population, which needs a further identification of the major causes of morbidity and mortality for these age groups and designing an appropriate strategy to address these health problems. Further findings supporting this one can be found in the works of Tiamaeus et.al who showed that adult mortality in eastern Africa is rising (25).

On the other hand diarrheal diseases by 3.12 years [15.96%] and lower respiratory infection by 2.54 years [12.98%], followed by neglected tropical diseases by 1.45 years [7.43%], tuberculosis 1.2 years [6.25%] are the leading contributors to the improved life expectancy which matches with GBD 2010 report (26, 27). Further evidence supporting this finding may lie on the works of GBD 2013 collaborators (28) who found a trend of reduction in child deaths from diarrhea, lower respiratory infections, and neonatal causes in low-income regions using life expectancy decomposition.

However, being the second to cause high premature death, the improvement in neonatal health condition and that of maternal health condition seems very weak, which is evidenced by the small gain in life expectancy. This finding
supports the works of (29) who indicates the slow progress in neonatal disorders despite child mortality reduction. Indeed, it needs further exploration of the underlying factors to understand the major risk factors in respiratory diseases as these are the major causes of morbidity and mortality in the nation. Summed up with upper respiratory diseases, lower respiratory diseases and tuberculosis make up the major share of mortality at a national level.

Beyond the need to focus on increasing life expectancy, chronic diseases are emerging causes of mortality, led by cardiovascular disease, neoplasms of different kinds and diabetes. This needs further attention and strategic planning to address chronic disease prevention and access to services through lifestyle improvements and access to better chronic disease services. This is supported by a number of overwhelming evidences that show the growth of non-communicable disease burden in developing nations (30). Nonetheless; it might be hard to conclude that the country is transitioning from a communicable to a non-communicable disease pattern, considering the high burden of communicable diseases at a national level, however it is clear that the country is in a triple burden of disease from communicable, non-communicable and transport related problems. Despite the weight it might have, mortality from interpersonal violence and fire and hot substances has showed increase in burden. Comparing this findings with global burden of disease makes Ethiopia among the top, being 14th in interpersonal violence with 32.1 standardized deaths per thousand and 12th in road traffic related deaths with 37.8 deaths per thousand and 37th in fire and hot substance related deaths with 5 per 1000 deaths(31). We argue that the high burden of communicable disease has diverted the attention to be given to the mortality caused by these causes. This is a critical point that needs public attention where, as the country’s productive labor force increases that might face challenges in employment or underemployment, fast urbanization and growing of population, interpersonal conflicts and violence’s might increase. Indeed it might go beyond that and cultural, legal and other forms of violence have to be further explored and addressed at an early phase.

Conclusion

Measuring the burden of disease in Ethiopia using life years lost and potential life years gained showed that lower respiratory disease, neonatal disorders, diarrheal disease and neglected tropical diseases, all being communicable diseases, are the leading causes of disease burden nationwide. However a percentage change in YLL shows that
there are a slight shift in the order of these causes of mortality and a huge decline in burden of disease as well as
shift in age distribution in this disease conditions. These dynamic of change have contributed to an improvement in
the life expectancy of the community from 1990 to 2010. This is encouraging for the government and
development workers in the local setup. The current research appears to confirm this view. Specifically
the finding that more than half of the improvement in life expectancy is attributed to improvement in
under-five health condition is great news for a country which had a very high child mortality globally.
Most of these improvements on the other hand are attributed due to reduction in diarrheal diseases, lower
respiratory diseases, neglected tropical diseases and tuberculosis which account about 15.96, 12.98, 7.43,
and 6.25 percent of the gain in life expectancy respectively. However it is also important to note that there
is a potential of further improvement in the health condition of the general adult population, which
requires further attention by the public sector and likeminded development workers. The growing burden
of mortality from cardiovascular diseases and diabetes, neoplastic conditions also need a proactive
intervention. However, interpersonal violence and traffic accidents seem to be overlooked and their
burden is found increasing over time, calling the public attention and strategic planning through
comprehensive approaches.

List of abbreviations used (if any)

AFI..................................................Acute febrile illnesses
DALY..............................................Disability adjusted life years lost
HIV/AIDS..........................................Human immune virus/acquired immune deficiency syndrome
IHME..............................................Institute of health metrics and evaluation
YLD................................................Years lost due to disability
YLL................................................Years of life lost
NGTDS............................................Neglected Tropical Diseases

Competing interests

While preparing, analyzing or interpretation of this data, we the authors of this article declare
that there is no any personal, financial and other nonfinancial competing interest with other
people or organizations.
Authors' contributions

Gizachew Balew and Cho Youngtae designed the study, preformed the analysis, interpreted the result and wrote the paper.

Gizachew Balew: Mr. Gizachew Balew is currently a PhD student in Health Demography, Seoul National University. He got his master’s in public health from Ethiopia and has been working in Reproductive health area in Ethiopia. His main research interest is in Family planning and maternal health in developing countries.

Cho Youngtae: Professor in Health Demography in Graduate School of Public Health Seoul National University.

Tables and captions

Table 1: Weighted mean years of life lost

<table>
<thead>
<tr>
<th>Cause of Mortality</th>
<th>1990</th>
<th>2010</th>
<th>Ch.YLL [%]</th>
<th>1990</th>
<th>2010</th>
<th>1990</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRT infection</td>
<td>36.02</td>
<td>32.24</td>
<td>32.80%</td>
<td>5.35</td>
<td>4.54</td>
<td>2</td>
<td>3</td>
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<td>Diarrheal diseases</td>
<td>38.60</td>
<td>45.13</td>
<td>41.27%</td>
<td>3.6</td>
<td>2.67</td>
<td>4</td>
<td>5</td>
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<td>Neglected tropical diseases</td>
<td>40.53</td>
<td>44.71</td>
<td>4.51%</td>
<td>2.4</td>
<td>2.95</td>
<td>5</td>
<td>4</td>
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<tr>
<td>Cardiovascular and circulatory dis</td>
<td>14.66</td>
<td>14.90</td>
<td>-50.60%</td>
<td>0.69</td>
<td>1.31</td>
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<tr>
<td>Tuberculosis</td>
<td>26.90</td>
<td>27.66</td>
<td>1.96%</td>
<td>1.19</td>
<td>1.47</td>
<td>7</td>
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<td>Nutritional deficiencies</td>
<td>30.15</td>
<td>33.62</td>
<td>-38.78%</td>
<td>0.91</td>
<td>1.59</td>
<td>8</td>
<td>6</td>
</tr>
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<td>Meningitis</td>
<td>45.05</td>
<td>48.65</td>
<td>26.46%</td>
<td>1.49</td>
<td>1.38</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Chronic respiratory diseases</td>
<td>27.56</td>
<td>23.93</td>
<td>25.13%</td>
<td>0.88</td>
<td>0.83</td>
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<td>Neoplasms</td>
<td>16.77</td>
<td>19.72</td>
<td>-82.41%</td>
<td>0.52</td>
<td>1.19</td>
<td>14</td>
<td>11</td>
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<td>Digestive diseases</td>
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<td>0.68</td>
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<tr>
<td>Diabetes.urogen.blood.endocrine</td>
<td>23.77</td>
<td>22.25</td>
<td>-27.78%</td>
<td>0.46</td>
<td>0.74</td>
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<td>14</td>
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<td>Maternal disorders</td>
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<td>38.37</td>
<td>21.77%</td>
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<td>0.57</td>
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<td>Transport injuries</td>
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<td>34.96</td>
<td>-46.69%</td>
<td>0.61</td>
<td>1.13</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>HIV/AIDS</td>
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<td>40.01</td>
<td>-391.03%</td>
<td>0.20</td>
<td>1.24</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>STI</td>
<td>48.31</td>
<td>61.38</td>
<td>16.51%</td>
<td>0.48</td>
<td>0.51</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Interp. Violence</td>
<td>33.11</td>
<td>38.71</td>
<td>-111.05%</td>
<td>0.196</td>
<td>0.52</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>Fire and Hot.subs</td>
<td>37.19</td>
<td>39.64</td>
<td>-5.30%</td>
<td>0.335</td>
<td>0.45</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Neonatal Disorders</td>
<td>49.10</td>
<td>63.36</td>
<td>-35.30%</td>
<td>4.058</td>
<td>5.14</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Congenital abn</td>
<td>48.66</td>
<td>59.54</td>
<td>44.18%</td>
<td>0.63</td>
<td>0.45</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Others</td>
<td>41.92</td>
<td>40.99</td>
<td>54.69%</td>
<td>11.03</td>
<td>6.31</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Legend (Table 1): This table shows the means years of potential life years lost (mYLL). mYLL is presented for both 1990 and 2010. The fourth column ch.YLL [%] shows the percent change in YLL from 1990 to 2010. The fifth and sixth columns shows the weighted YLL, calculated based on total YLL divided by mortality ratio, total mortality
assigned to be 100%. The Rank columns show the order of burden of disease based on weighted YLL. This helps to visualize the changes in shift of disease burden from 1990 to 2010.

Table 2: potential life years gained by cause elimination

<table>
<thead>
<tr>
<th>Cause of Mortality</th>
<th>1990</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRT infection</td>
<td>4.2</td>
<td>2.191</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>3.059</td>
<td>1.059</td>
</tr>
<tr>
<td>Neglected tropical diseases</td>
<td>2.243</td>
<td>1.385</td>
</tr>
<tr>
<td>Cardiovascular and circulatory diseases</td>
<td>1.889</td>
<td>1.714</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>1.995</td>
<td>1.304</td>
</tr>
<tr>
<td>Nutritional deficiencies</td>
<td>1.019</td>
<td>0.887</td>
</tr>
<tr>
<td>Meningitis</td>
<td>0.985</td>
<td>0.521</td>
</tr>
<tr>
<td>Chronic respiratory diseases</td>
<td>1.167</td>
<td>0.682</td>
</tr>
<tr>
<td>Neoplasms</td>
<td>1.421</td>
<td>1.455</td>
</tr>
<tr>
<td>Digestive diseases</td>
<td>1.051</td>
<td>0.776</td>
</tr>
<tr>
<td>Diabetes.urogen.blood.endocrine</td>
<td>0.769</td>
<td>0.691</td>
</tr>
<tr>
<td>Maternal disorders</td>
<td>0.927</td>
<td>0.37</td>
</tr>
<tr>
<td>Transport injuries</td>
<td>0.777</td>
<td>0.715</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>0.277</td>
<td>0.771</td>
</tr>
<tr>
<td>STI</td>
<td>0.174</td>
<td>0.088</td>
</tr>
<tr>
<td>Interp. Violence</td>
<td>0.268</td>
<td>0.312</td>
</tr>
<tr>
<td>Fire and Hot.subs</td>
<td>0.342</td>
<td>0.233</td>
</tr>
<tr>
<td>Neopatal Disorders</td>
<td>1.159</td>
<td>0.706</td>
</tr>
<tr>
<td>Congenital abn</td>
<td>0.224</td>
<td>0.086</td>
</tr>
<tr>
<td>Others</td>
<td>8.568</td>
<td>3.007</td>
</tr>
<tr>
<td>Residual (distributed among causes)</td>
<td>2.204</td>
<td>0.622</td>
</tr>
<tr>
<td>Total</td>
<td>32.95</td>
<td>18.954</td>
</tr>
<tr>
<td>Life expectancy to age 0</td>
<td>47.05</td>
<td>61.046</td>
</tr>
</tbody>
</table>

Legend (Table 2): This table shows the potential life years gained after cause elimination. Life expectancy before cause elimination and after cause elimination is calculated. The difference in life expectancy is expected to the potential life expectancy that will be gained if we eliminate that cause. Column one contains Causes of Mortality while Column 2 and 3 shows potential life years gained for the year 1990 and 2010 for each specific cause respectively.

Table 3: attribution of age structure to life expectancy gain

<table>
<thead>
<tr>
<th>Age</th>
<th>le_1990</th>
<th>le_2010</th>
<th>Attribution</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>47.74</td>
<td>62.985</td>
<td>2.70</td>
<td>17.29</td>
</tr>
<tr>
<td>1</td>
<td>50.45</td>
<td>63.732</td>
<td>5.60</td>
<td>35.78</td>
</tr>
<tr>
<td>5</td>
<td>53.58</td>
<td>61.704</td>
<td>0.36</td>
<td>2.31</td>
</tr>
<tr>
<td>10</td>
<td>49.22</td>
<td>57.011</td>
<td>0.31</td>
<td>2.00</td>
</tr>
<tr>
<td>15</td>
<td>44.77</td>
<td>52.263</td>
<td>0.37</td>
<td>2.37</td>
</tr>
<tr>
<td>20</td>
<td>40.58</td>
<td>47.749</td>
<td>0.53</td>
<td>3.41</td>
</tr>
<tr>
<td>25</td>
<td>36.79</td>
<td>43.484</td>
<td>0.61</td>
<td>3.91</td>
</tr>
<tr>
<td>30</td>
<td>33.13</td>
<td>39.272</td>
<td>0.54</td>
<td>3.47</td>
</tr>
<tr>
<td>35</td>
<td>29.48</td>
<td>35.147</td>
<td>0.65</td>
<td>4.13</td>
</tr>
<tr>
<td>40</td>
<td>26.14</td>
<td>31.216</td>
<td>0.52</td>
<td>3.32</td>
</tr>
<tr>
<td>45</td>
<td>22.74</td>
<td>27.373</td>
<td>0.49</td>
<td>3.16</td>
</tr>
<tr>
<td>Age</td>
<td>1990 Expectancy</td>
<td>2010 Expectancy</td>
<td>Difference</td>
<td>Percent Share</td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
<td>----------------</td>
<td>------------</td>
<td>---------------</td>
</tr>
<tr>
<td>50</td>
<td>19.49</td>
<td>23.711</td>
<td>0.60</td>
<td>3.85</td>
</tr>
<tr>
<td>55</td>
<td>16.54</td>
<td>20.2</td>
<td>0.47</td>
<td>3.00</td>
</tr>
<tr>
<td>60</td>
<td>13.67</td>
<td>16.937</td>
<td>0.64</td>
<td>4.08</td>
</tr>
<tr>
<td>65</td>
<td>11.5</td>
<td>14.064</td>
<td>0.42</td>
<td>2.68</td>
</tr>
<tr>
<td>70</td>
<td>9.476</td>
<td>11.626</td>
<td>0.32</td>
<td>2.02</td>
</tr>
<tr>
<td>75</td>
<td>7.938</td>
<td>9.811</td>
<td>0.20</td>
<td>1.25</td>
</tr>
<tr>
<td>80</td>
<td>6.474</td>
<td>8.281</td>
<td>0.31</td>
<td>1.97</td>
</tr>
</tbody>
</table>

Legend (Table 3): Table three shows the age contribution of life expectancy gain using the age and cause decomposition of life expectancy. Column one indicates age interval, column 2 and three indicate expected life expectancy in 1990 and 2010 respectively, column four indicate difference in life expectancy attributed to specific age interval and the last column represents the percent share of this difference to the total gain in life expectancy.

Legends of figures

Figure 1: Cause and age specific mortality rate in 2010 Ethiopia

Legend (Figure 1): This figure illustrates the mortality ratio for each specific cause of disease across a five year abridged age category in the horizontal axis, except for age under one and under five where age intervals are one year and four year respectively. The data is for 2010 estimate based on institute of health metrics and evaluation.

Figure 2: Age and cause decomposition of life expectancy for under five children

Legend (Figure 2): This figure shows the age and cause specific improvement in life expectancy from a reduction in burden of disease at each specific age and specific mortality. The orange line indicates the under-five life expectancy improvement and the blue line indicates the under one (key="1") improvement at each specific cause of mortality. The values in the horizontal axis indicate the causes of mortality and the values on the y axis indicate the additional years contributed to life expectancy gain from 1990 to 2010. The key which indicates 0 represents under one population and the “1” represents one to four years category.

Figure 3: age and cause decomposition of life expectancy, cause contribution

Legend (Figure 3): This graph shows the average life expectancy that is brought by reduction or shift in mortality from specific mortality causes. The values on the vertical radius represent the number of years that is gained from specific cause of mortality.
Reference


449

450

451
Casue and age specific mortality rate in 2010 Ethiopia

This figure illustrates the mortality ratio for each specific cause of disease across a five year abridged age category in the horizontal axis, except for age under one and under five where age intervals are one year and four year respectively.
Age and cause decomposition of life expectancy for under five children
3

age and cause decomposition of life expectancy, cause contribution mortality

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**Diagram: Radial Chart**

- LRT infection
- HIV/AIDS
- Diarrheal diseases
- Neonatal disorders
- Neglected tropical diseases and malaria
- Cardiovascular and circulatory diseases
- Tuberculosis
- Nutritional deficiencies
- Meningitis
- Neoplasms
- Chronic respiratory diseases
- Digestive diseases (except cirrhosis)
- Maternal disorders
- Transport injuries
- Diabetes, urogenital, blood, and endocrine...