Historical changes in health condition and its relation to government expenditure

Yanying Yu, Shufan Ming
IS597 Final Project

Project purposes

Finding patterns in changes:

> “It is important to know why people die to improve how people live.”

> “assess the effectiveness of our health systems help allocate resources based on needs”

Data curation:

deaths and causes of death; data on disability, disaggregated by age, sex and geographic location

Previous work

1.Global and regional causes of death

Dataset: World Health Organization

Research topic: global-, regional- and country-level estimates of mortality for a comprehensive set of causes (communicable, non-communicable, injuries) in 2004 (Mathers et al., 2009).

Finding 1: The contribution patterns of three death categories non-communicable dominant the cause of death

Finding 2: There is a *growing importance of non-communicable diseases* in most low- and middle-income countries since 2004

Finding 3: Cardiovascular diseases are the most killer in the world, Infectious and parasitic diseases are the next leading cause, followed by cancers in 2004

2. The Impact of Health Expenditures on Health Outcomes in Sub-Saharan Africa.

Dataset: annual data on 46 sub-Saharan African countries covering the period 2000–2015

Research topic: the effect of health expenditures on selected critical health outcomes in sub-Saharan Africa (Amponsah, 2019).

Main Finding: steady increases in health expenditures over time have the tendency to improve health outcomes in SSA

Our work

Paper 1:

- Data outdated
- No program code and not mention data preprocessing steps

  -> potentially biased picture of the patterns of global mortality.

Paper 2:

- sub-Saharan Africa only
- No program code and not mention data preprocessing steps

  -> would the conclusions hold for other countries.

Data collection and cleaning

1. Global cause of death

API: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death

Columns: country, Year, Population, Age_group (all age), Sex(Both_sex), Cause_code, Cause_title, Death_rateper100K, Death_number, etc.

2. Health expenditure:

API:GHO OData API

Columns: Life expectancy Maternal Mortality Ratio; Current health expenditure;

3.Country income group, Country Region, Mortality categories,

World Bank Country and Lending Groups

Global health estimates: Leading causes of death

https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html

Useful columns: country_code, country_name, Income group data for calendar year, country_region, disease_code, disease_categories, disease_name

Data set explanation

How many countries? 164 countries

Time span? 2000 - 2019

Seven regions — Provided by The World Bank
East Asia & Pacific; Europe & Central Asia; Latin America & Caribbean; Middle East & North Africa; Middle East & North Africa; South Asia; Sub-Saharan Africa

Four income group — Provided by The World Bank
1.High 2.Upper-middle 3.Lower-middle 4.Low

Three types of Mortality — Provided by World Health Organization (WHO)
1.communicable 2.noncommunicable 3.injuries.

Nearly 91 causes-of-death diseases —provided by WHO Global Health Estimates (GHE)

3 selected critical Health outcomes - under 5 mortality, maternal mortality, life expectancy

Idea of analysis

Worldwide

Income group/ Region

Mortality type /Age/ Sex

Specific disease

Hypothesis 1

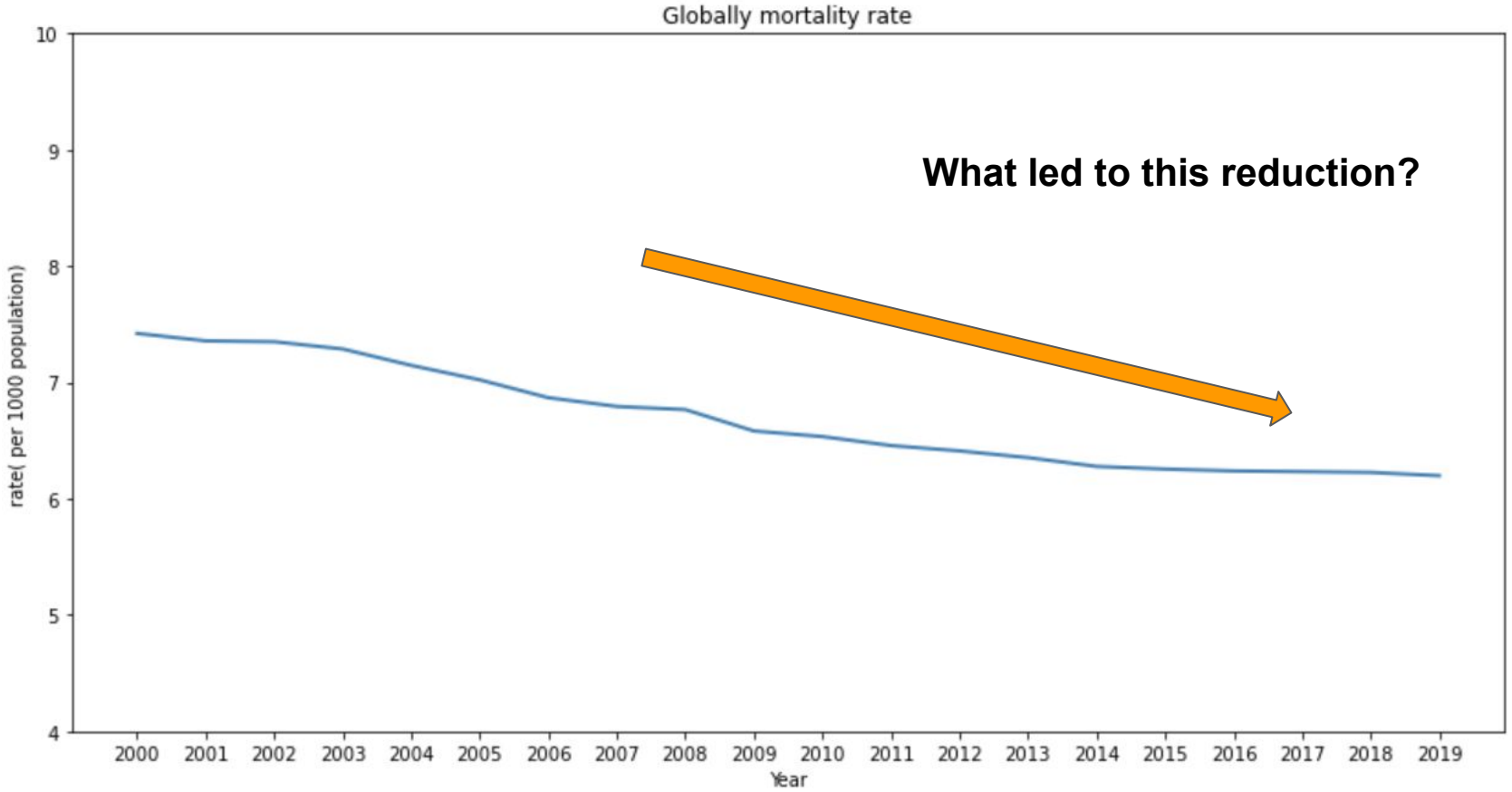
Do the Global patterns of mortality by income group all over the world aligned with the previous work?

Patterns : i.e., Trend of mortality

Cause Distribution

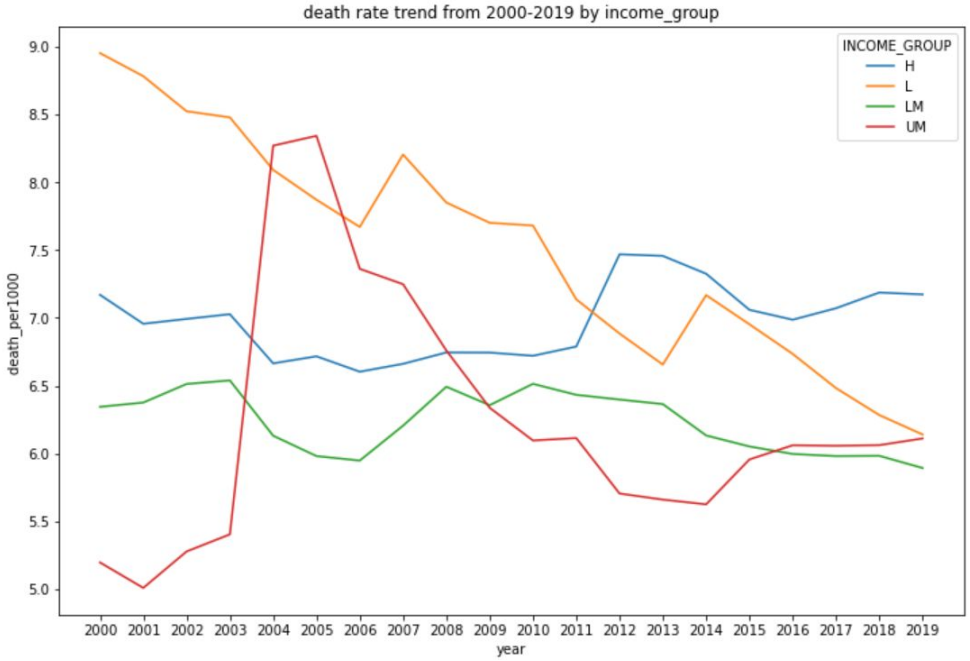
leading cause of death

Globally death rate trend during 2000-2019



Four income group

1:High 2:Upper middle 3:Lower middle 4:Low



Findings:

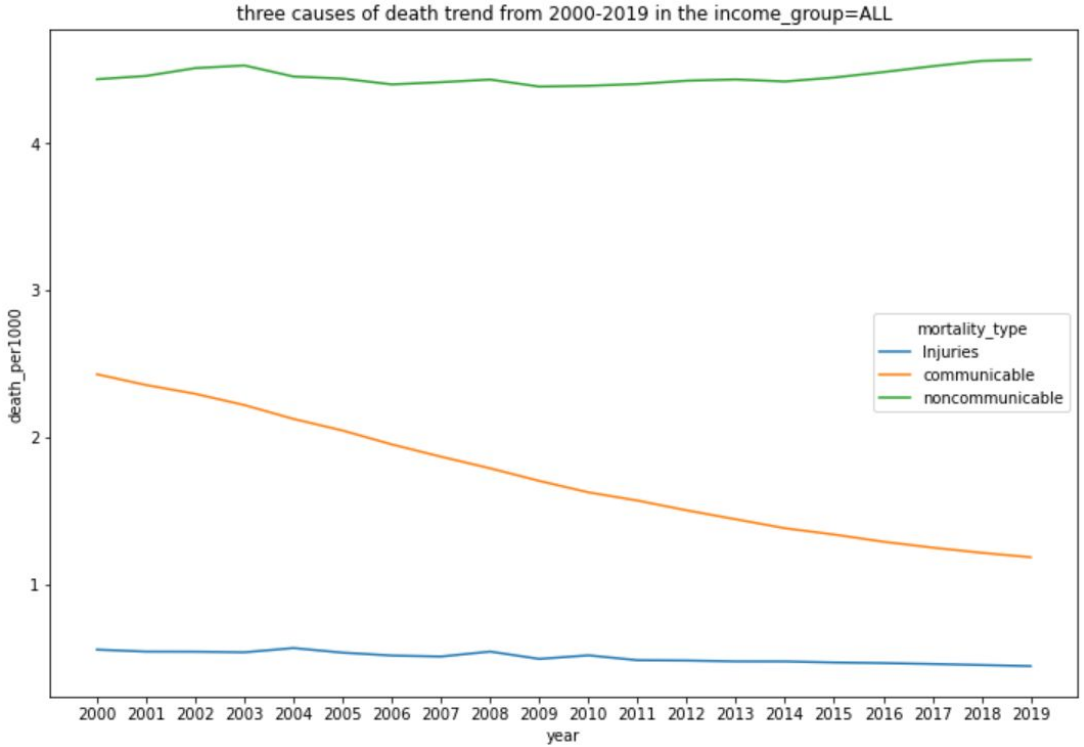
1.Low income group declined significantly

2. Something happened in Upper-middle countries during 2004-2005

3.Two peaks in Low income group around 2007 and 2014

Three mortality type:

1. Communicable 2:Noncommunicable. 3. Injuries



Test:

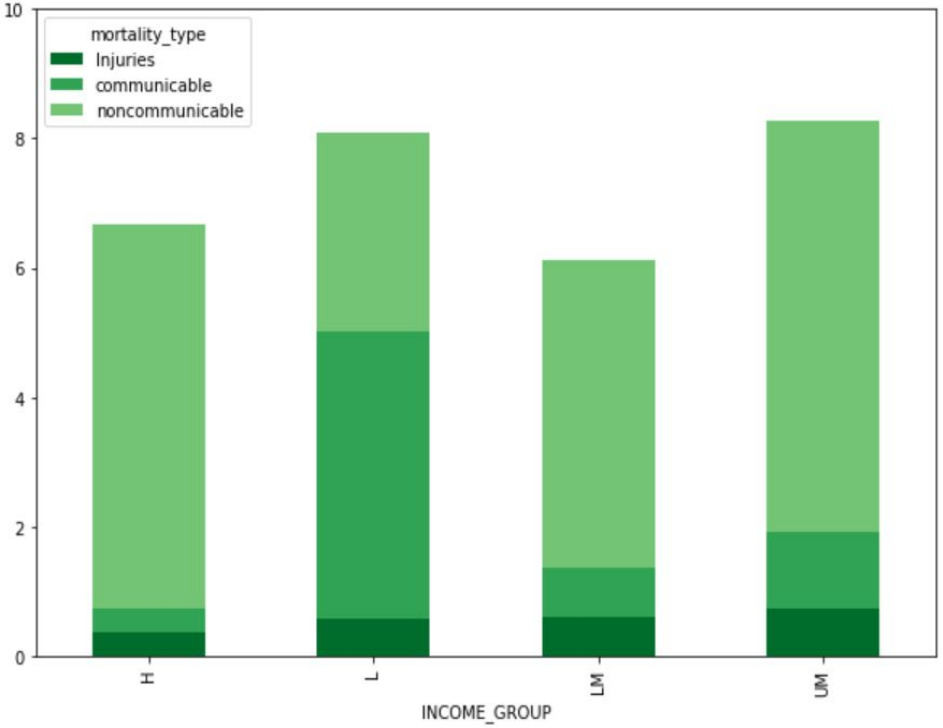
1.growing importance of noncommunicable diseases

2.The contribution of three type cause-of-death in 2004 globally

2004 globally	Article	Test
Non-Communicable	60%	62.4%
communicable	30%	29.7%
Injuries	10%	7.9%

Same pattern of cause-of-death type in different income group?

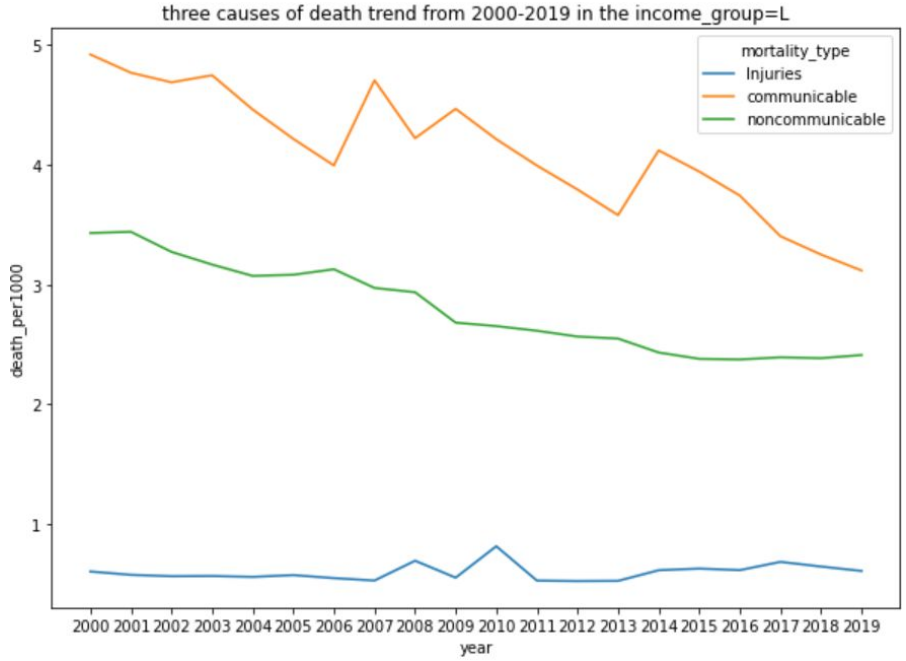
the distribution of Mortality type in different income group in 2004



Test:

communicable diseases remain an important cause of death in low income countries in 2004

How the cause-of-death type changed in low and low-middle income group?



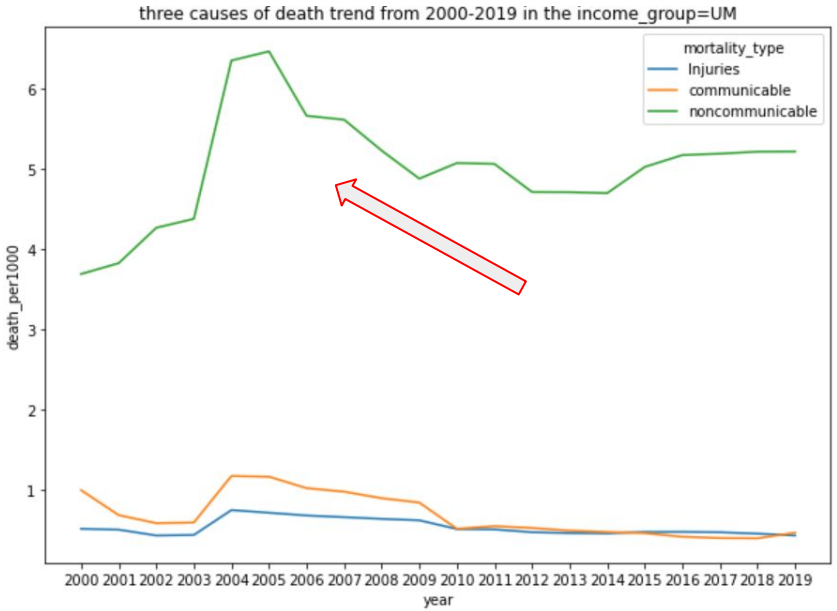
TEST:

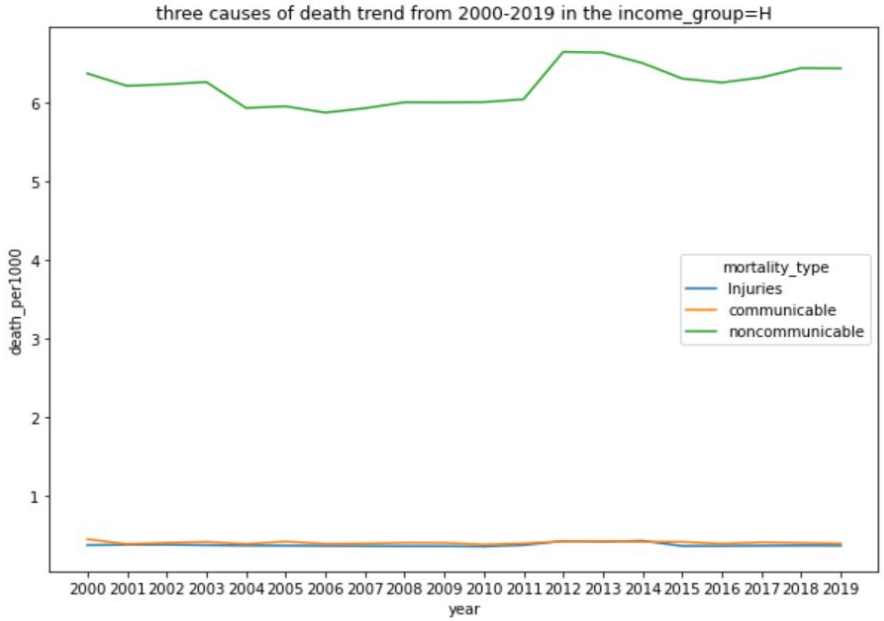
Low income group:True

Estimation: growing importance of noncommunicable diseases in most low- and middle-income countries since 2004

LM: During 2004-2010, non-communicable are getting less important(more communicable). But after 2010, the trend match the conclusion of the paper

How the cause-of-death type changed in High and Upper-middle income group?





TEST:

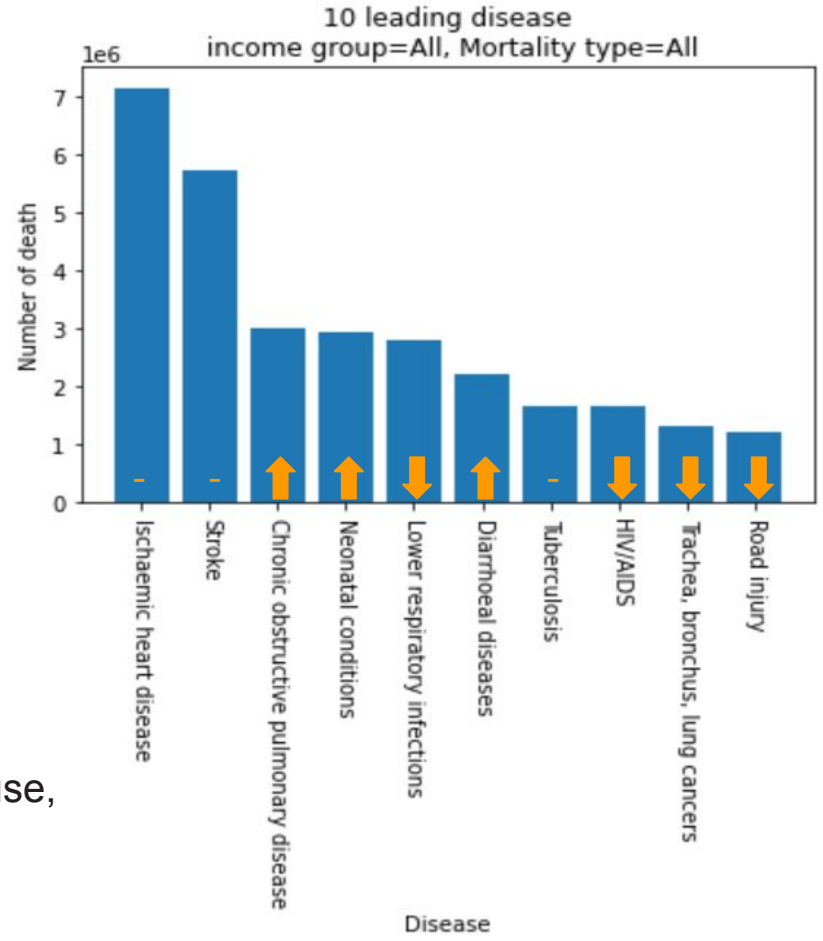
Estimation: growing importance of noncommunicable diseases in most low- and middle-income countries after 2004

UM: 2004-2010, non-communicable are getting less, after that , the portion keep the same level.

Global leading cause-of-death disease in 2004

Article's conclusion

	Disease or injury	Deaths (millions)	Per cent of total deaths
World			
1	IHD	7.2	12.2
2	Cerebrovascular disease	5.7	9.7
3	Lower respiratory infections	4.2	7.1
4	COPD	3.0	5.1
5	Diarrhoeal diseases	2.2	3.7
6	HIV/AIDS	2.0	3.5
7	TB	1.5	2.5
8	Trachea, bronchus, lung cancers	1.3	2.3
9	Road traffic accidents	1.3	2.2
10	Prematurity and low birth weight	1.2	2.0
	All causes	58.8	100



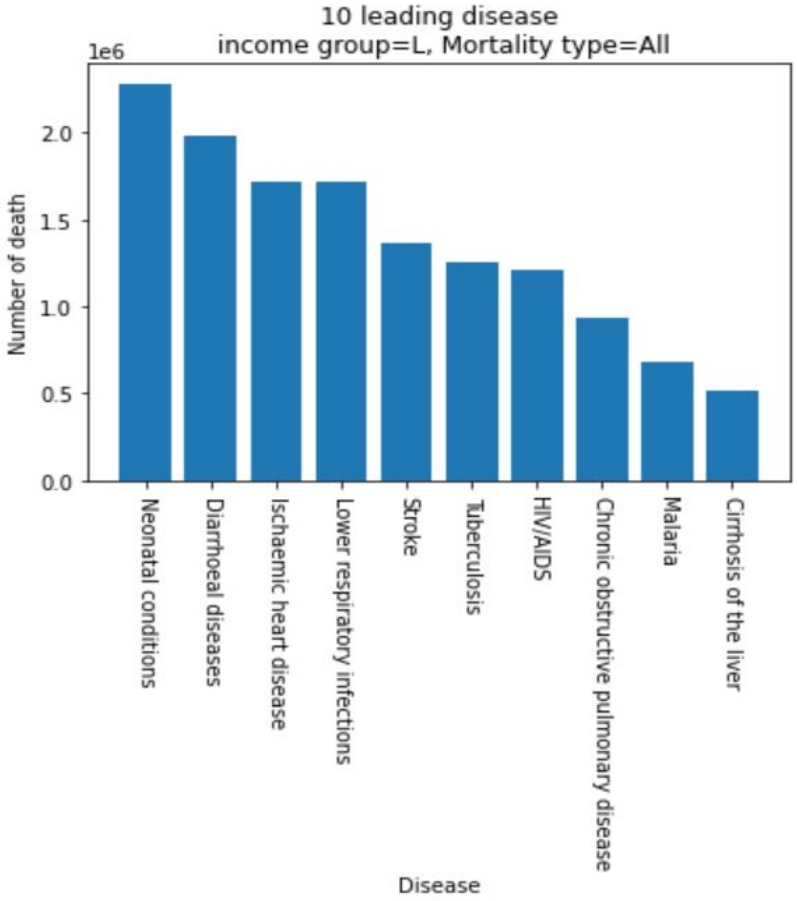
Test:

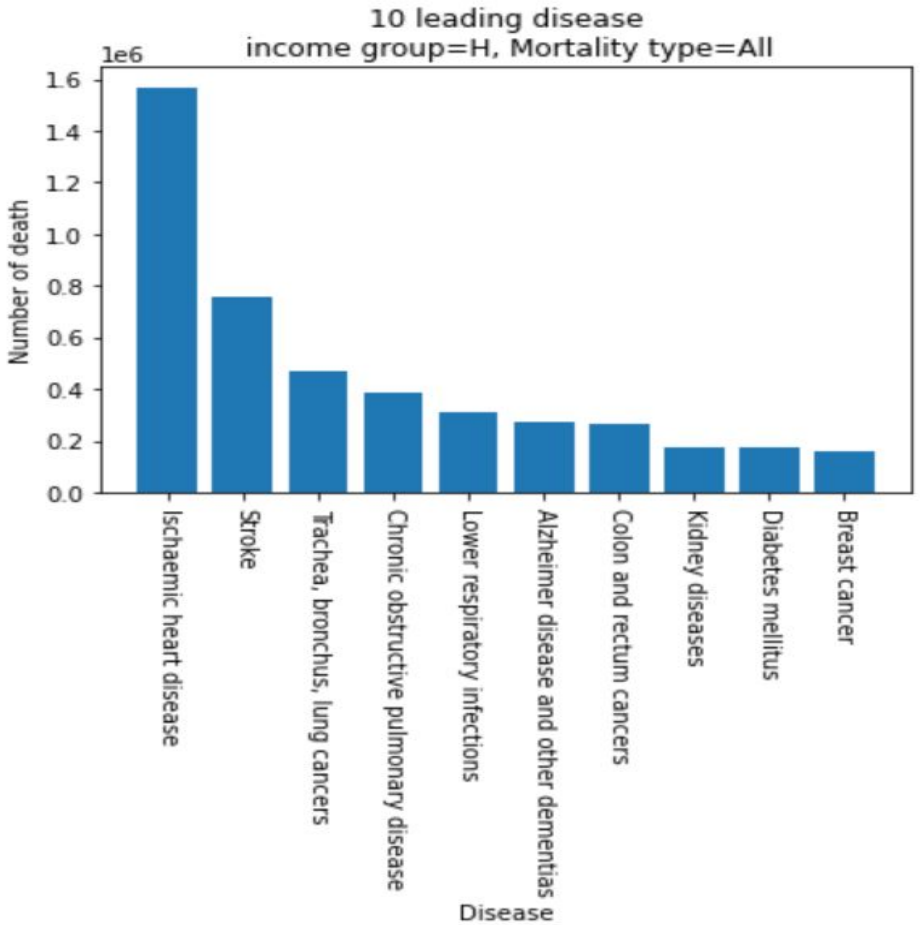
Cardiovascular diseases are the leading cause of death

Infectious and parasitic diseases are the next leading cause,

followed by cancers

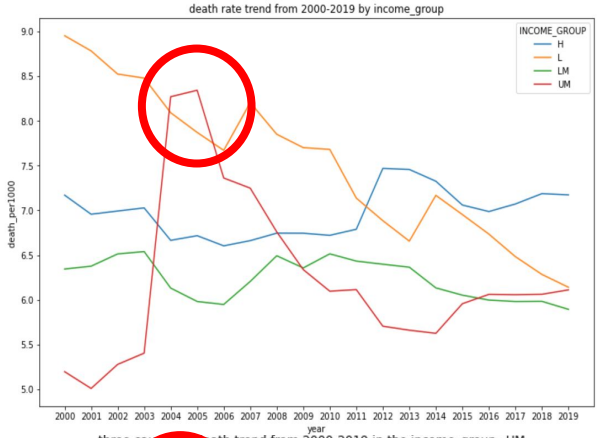
Compare leading disease between High and Low income group in 2004

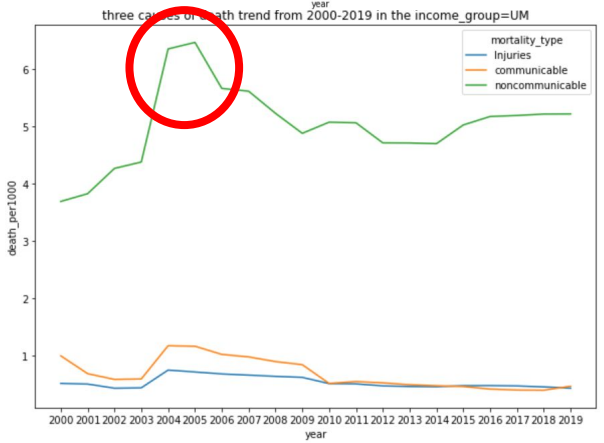




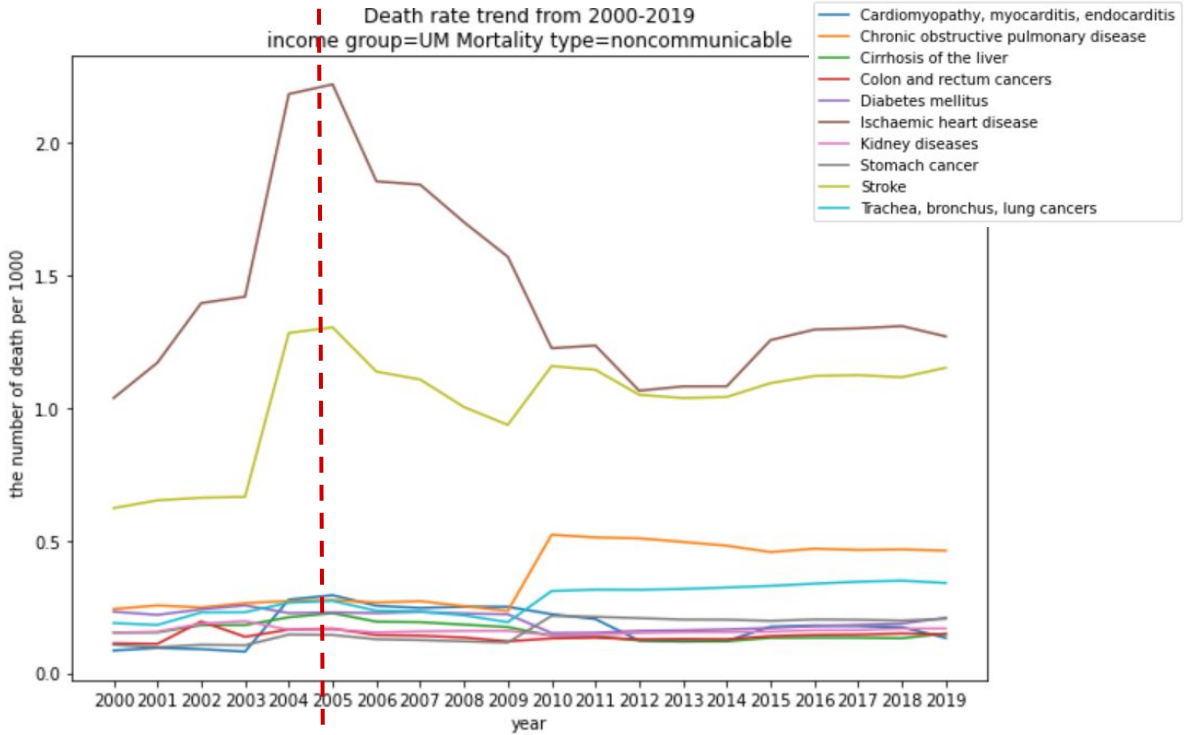
The trend of Leading non-communicable mortality diseases(2005) in Upper-middle income countries

Recap



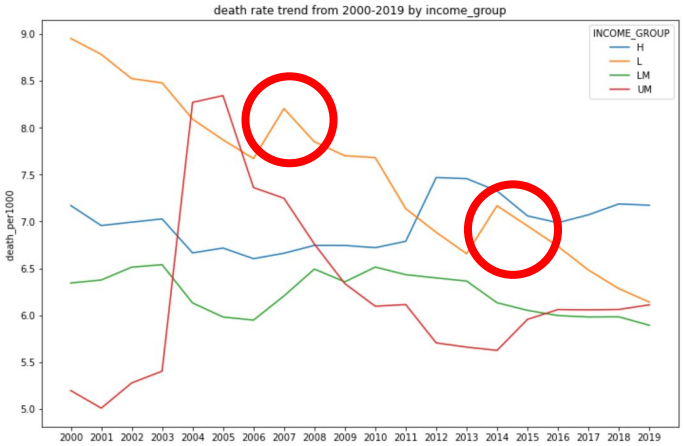


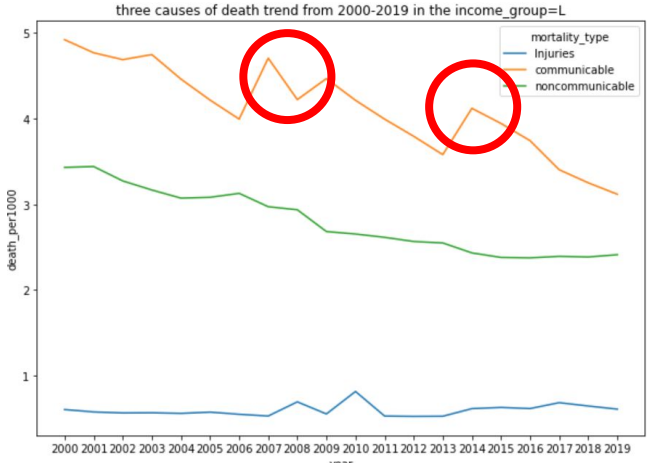
What led to the peak?



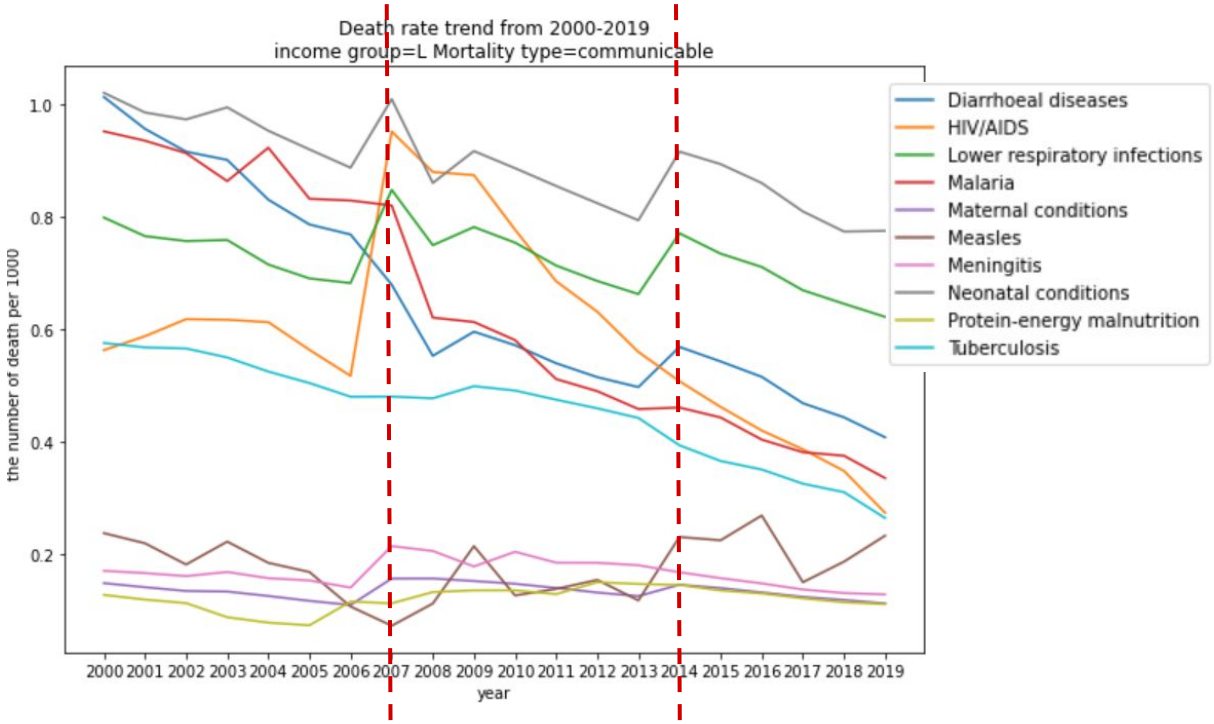
The trend of Leading communicable mortality diseases in Low income countries

Recap





What led to two peaks?



Findings

Do the Global patterns of mortality by income group all over the world aligned with the previous work?

Patterns : i.e., Trend of mortality Cause Distribution leading cause of death

1 Low income countries did a great job on communicable disease issue.

2. There are major differences in the ranking of causes between high- and low-income countries

3. An HIV pandemic occurred in 2007 in low-income countries with 7 years to come back to the normal level.

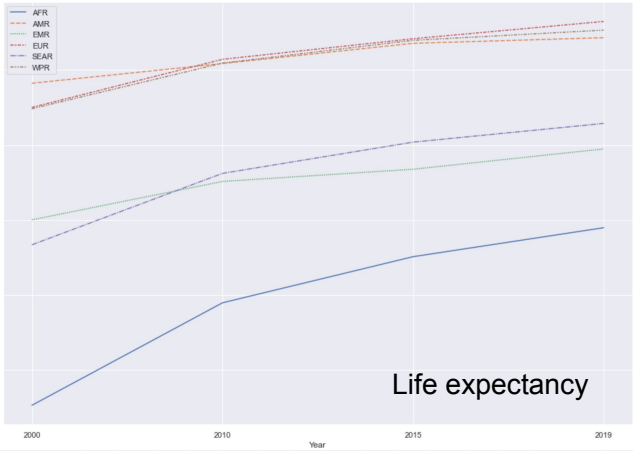
4. IHD and Stroke cases surged in 2004 in upper-middle countries, leading to a mortality spike in the whole Upper-middle income countries

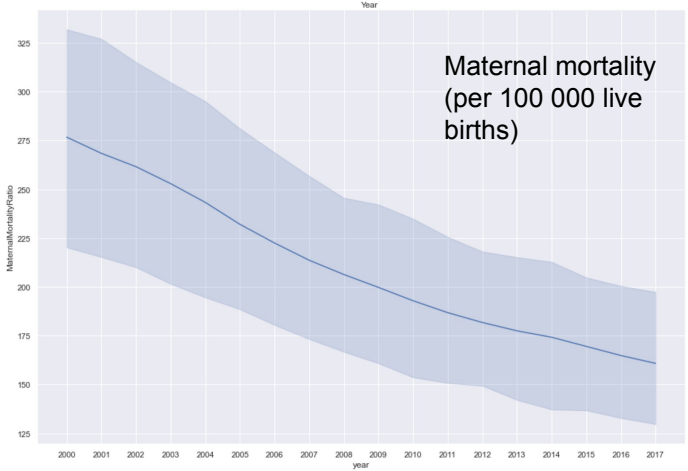
Hypothesis 2

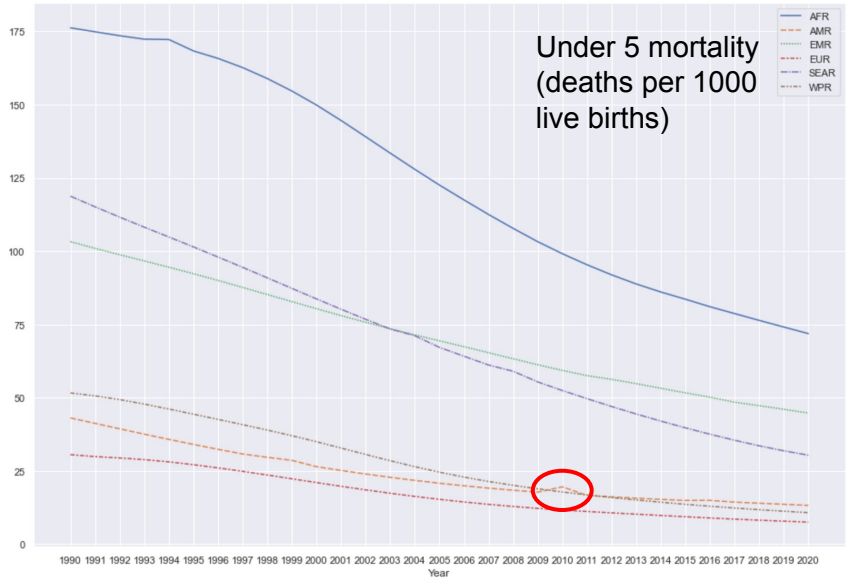
As in Sub-Saharan Africa, we expect health expenditure to exert a positive and significant impact on all three health outcomes (life expectancy, under-five mortality, and maternal mortality), for other regions globally. (1996-2015)

Tested Correlation: health expenditure and under-five mortality, maternal mortality, life expectancy.

Overview of health outcome over the years







203.58983	HTI
160.62904	SLE
157.39255	SOM

On 12 January 2010, at 4:53 pm local time, Haiti was struck by a magnitude-7.0 earthquake. This was the country's most severe earthquake in over 200 years.[191] The earthquake was reported to have left between 220,000 and 300,000 people dead and up to 1.6 million homeless.[192][193] The situation was exacerbated by a subsequent massive cholera outbreak that was triggered when cholera-infected waste from a United Nations peacekeeping station contaminated the country's main river, the Artibonite.[183][194][195] In 2017, it was reported that roughly 10,000 Haitians had died and nearly a million had been made ill. After years of denial the United Nations apologized in 2016, but as of 2017, they have refused to acknowledge fault, thus avoiding financial responsibility.[196]

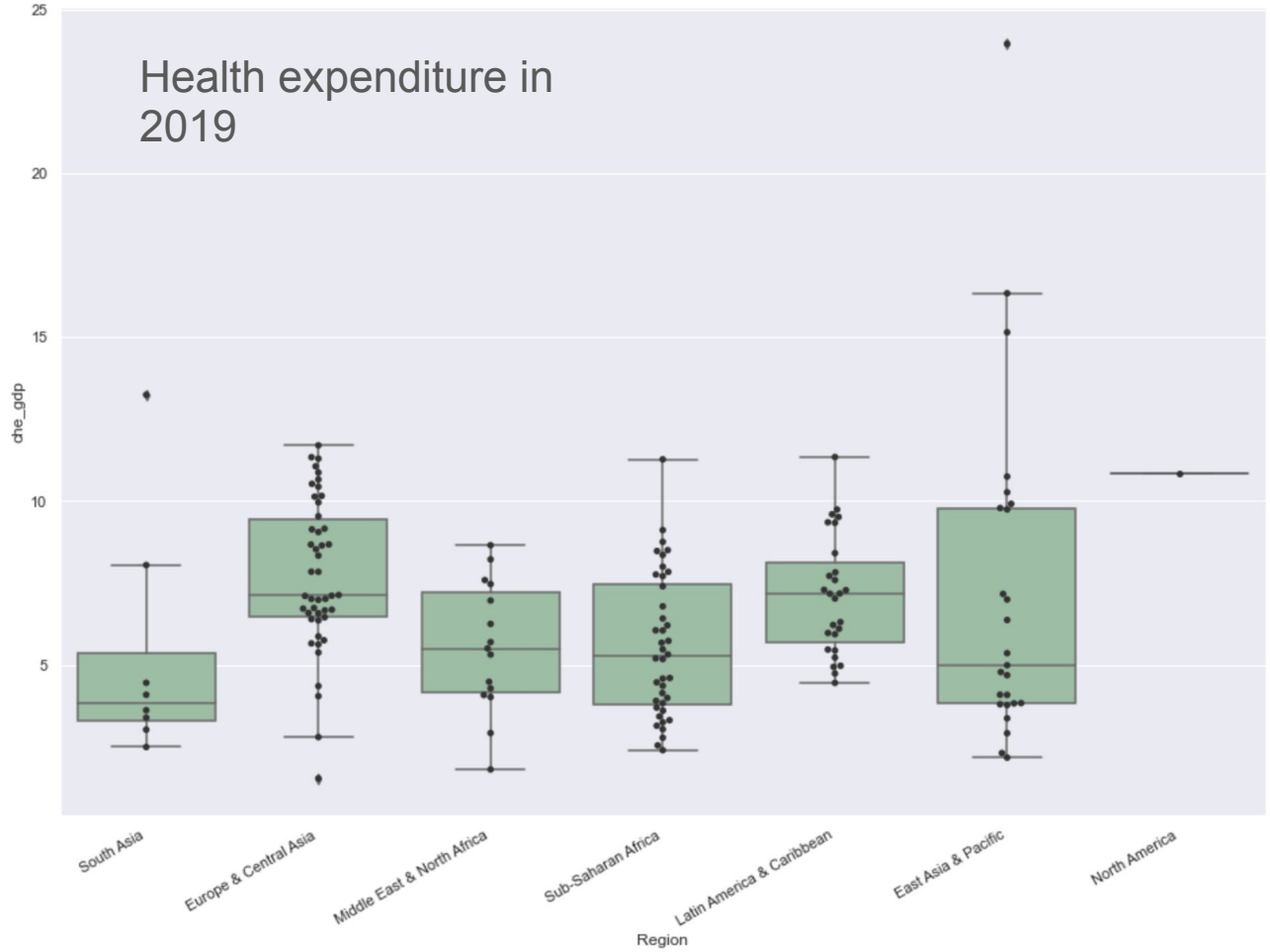
Overview of health expenditure 2015 - 2019

Year Region	2015	2016	2017	2018	2019
East Asia & Pacific	6.809137	6.669258	6.673334	6.739615	7.210822
Europe & Central Asia	7.628844	7.650285	7.588706	7.589544	7.735785
Latin America & Caribbean	6.853407	6.848583	6.876387	6.998009	7.110047
Middle East & North Africa	5.456460	5.490857	5.576039	5.565831	5.542898
North America	10.733205	11.022961	10.835383	10.806375	10.844478
South Asia	5.103873	5.479239	5.223773	5.265578	5.286553
Sub-Saharan Africa	5.960786	5.840205	5.684228	5.676715	5.551029

Health expenditure per region per year

	sum_sq	df	F	PR(>F)
Year	327.260740	19.0	2.784900	5.347052e-05
incomeGroup	393.647111	3.0	21.215592	1.326291e-13
Region	1545.575362	6.0	41.649355	4.028204e-49
Residual	19581.301987	3166.0	NaN	NaN

There are significant differences in health expenditure across Year, Income Group, Region.


Health expenditure in 2019
25
20
15
10
5
che_gdp
South Asia
Europe & Central Asia
Middle East & North Africa
Sub-Saharan Africa
Latin America & Caribbean
East Asia & Pacific
North America
Region

Effect of Health Expenditure on Selected Health Outcomes

Pearson correlation test:

- *Before 2015, a 1% increase in health expenditure resulted in a 0.5 percent reduction in under-five mortality in sub-saharan Africa; 9% reduction in North America. this happens to all other regions except for East Asia & Pacific*

- After 2015, the correlation between health expenditure and under-five mortality remains.

  Except for South Asia, East Asia & Pacific

- The results suggest that steady increases in health expenditures over time have the tendency to improve health outcomes in most regions/countries.

Reference

Mathers, C. D., Boerma, T., & Ma Fat, D. (2009, September 22). *Global and regional causes of death*. OUP Academic. Retrieved April 26, 2022, from https://academic.oup.com/bmb/article/92/1/7/332071?login=false

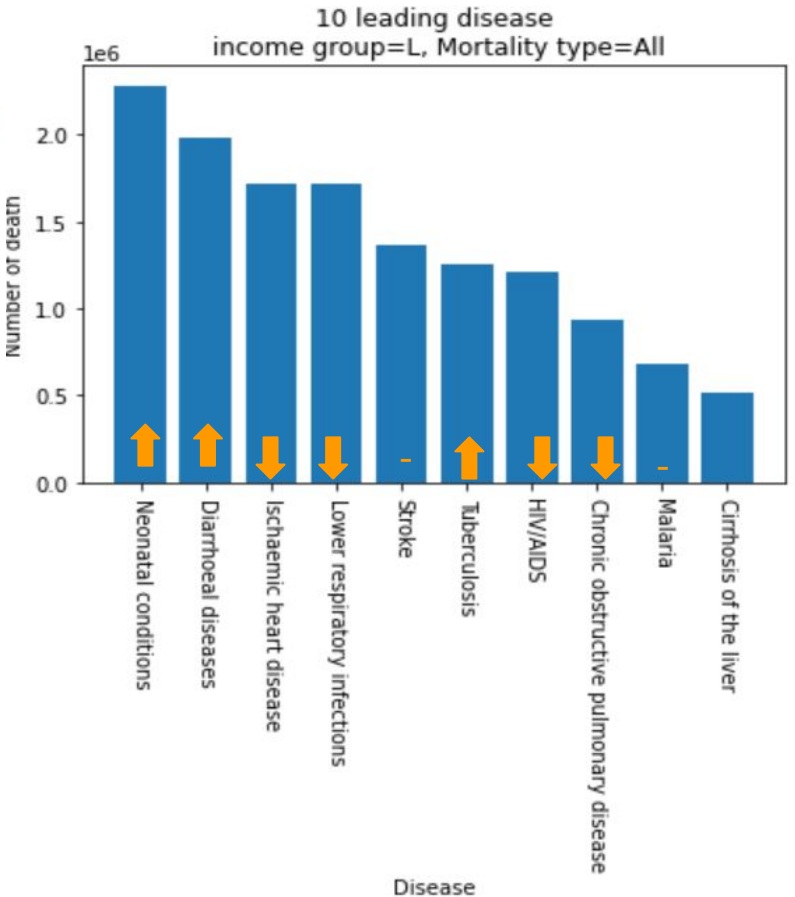
Amponsah, E. N. (2019). *The impact of health expenditures on Health Outcomes in ...* Retrieved April 27, 2022, from https://journals.sagepub.com/doi/full/10.1177/0169796X19826759

Thank you

Leading cause-of-death disease in Low income group in 2004

Article's conclusion

	Disease or injury	Deaths (millions)	Per cent of total deaths
Low-income countries*			
1	Lower respiratory infections	2.9	11.2
2	IHD	2.5	9.4
3	Diarrhoeal diseases	1.8	6.9
4	HIV/AIDS	1.5	5.7
5	Cerebrovascular disease	1.5	5.6
6	COPD	0.9	3.6
7	TB	0.9	3.5
8	Neonatal infections†	0.9	3.4
9	Malaria	0.9	3.3
10	Prematurity and low birth weight	0.8	3.2
	All causes	26.3	100



Limitations and Future work

- Empty record & NULL value
  - Data inspection: correlation test: outlier data
- Unified income group categorization

Leading cause-of-death disease in High income group in 2004

Article's conclusion

	Disease or injury	Deaths (millions)	Per cent of total deaths	
High-income countries				
1	IHD	1.3		16.3
2	Cerebrovascular disease	0.8		9.3
3	Trachea, bronchus, lung cancers	0.5		5.9
4	Lower respiratory infections	0.3		3.8
5	COPD	0.3		3.5
6	Alzheimer and other dementias	0.3		3.4
7	Colon and rectum cancers	0.3		3.3
8	Diabetes mellitus	0.2		2.8
9	Breast cancer	0.2		2.0
10	Stomach cancer	0.1		1.8
	All causes	8.1		100