

Data Analysis and Result

1.1 Data Analysis

1.1.1 Regression Analysis - Linear Regression

Linear regression can be used to determine the relationship between a dependent variable (denoted by y) and one or more independent variables (denoted by x). The relationship between a dependent variable (denoted by y) and one or more independent variables (denoted by x), where its formula generates a straight line. In this study, it is used to show the relationship between life expectancy and immunisation factors in the Rest of Europe region over the period 2000-2015. An example is as follows: ' $y = mx + b$ ' represents a linear regression model.

1.1.2 Statistical Analysis

Hypothesis testing is very important when selecting a dataset and this analysis was conducted using Tableau. The null hypothesis (H_0) and alternative hypotheses (H_1) chosen for this study were

- H_0 : There is no statistically significant linear relationship between immunological factors (e.g. hepatitis B) and life expectancy.
- H_1 : There is a statistically significant linear relationship between immunological factors (e.g. hepatitis B) and life expectancy.

Table 4.1 shows the p-values for each group used to derive the results. All p-values are less than 0.05. Therefore, the null hypothesis can be rejected.

Table 4.1 p-Values among Groups Used for the Test

Type	P-Value of Life expectancy
Hepatitis B	0.0111368
Measles	0.0077927
Polio	0.0030749
Diphtheria	0.0011984

The focus of the study was to analyse whether there is a relationship between economy status and life expectancy across the Rest of Europe region. Descriptive statistical analysis was used to measure life expectancy and regression models were developed to analyse the data.

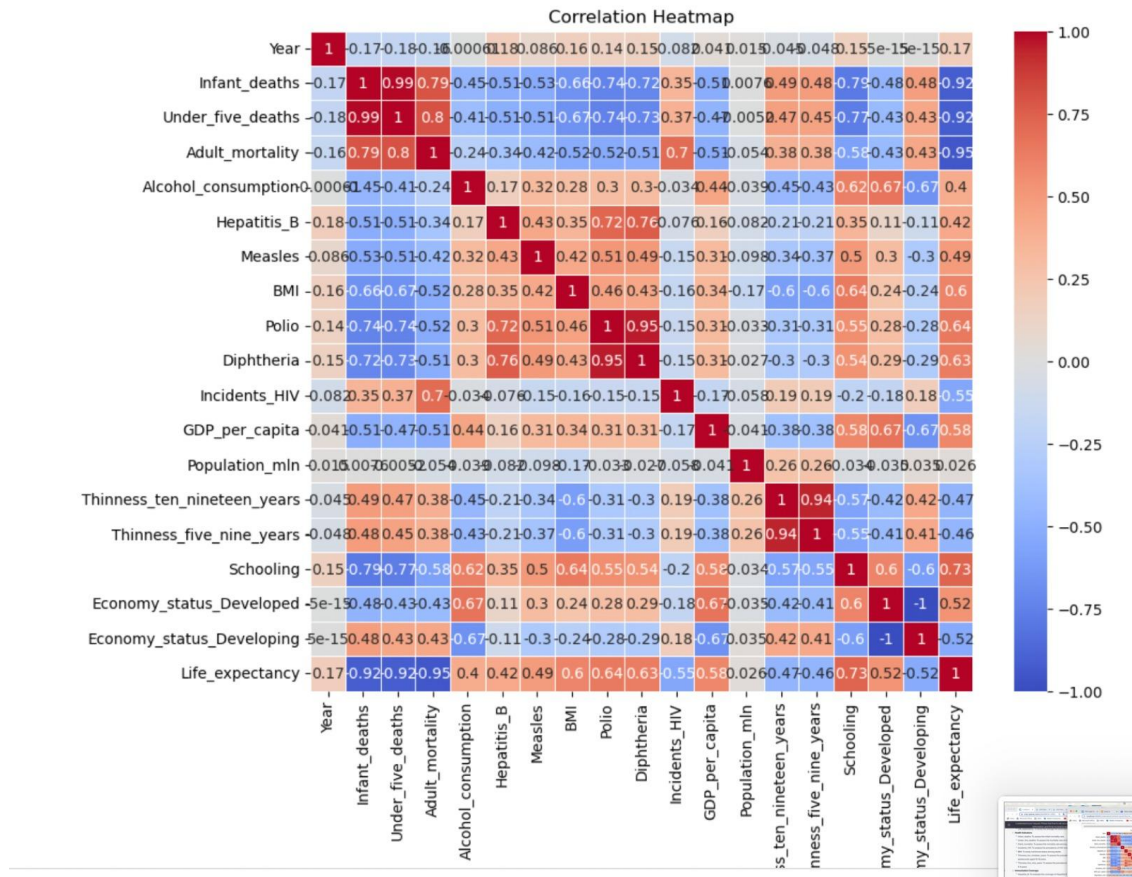


Figure 4.1 Correlation of dataset

Rest of Europe	Albania
	Armenia
	Belarus
	Bosnia and Herzego..
	Georgia
	Iceland
	Moldova
	Montenegro
	North Macedonia
	Norway
	Russian Federation
	Serbia
	Switzerland
	Ukraine
	United Kingdom

Figure 4.2 List of the Rest of Europe region countries

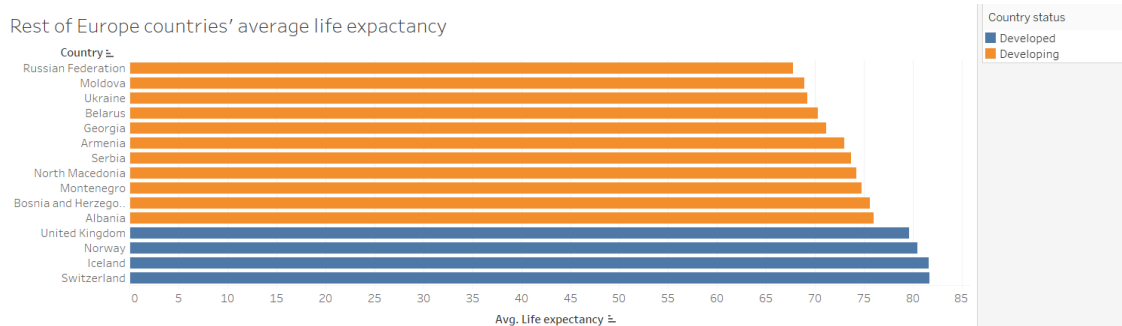


Figure 4.3 15 countries of Rest of Europe region average life expectancy

1.2 Result

1.2.1 The reason GDP affect country status

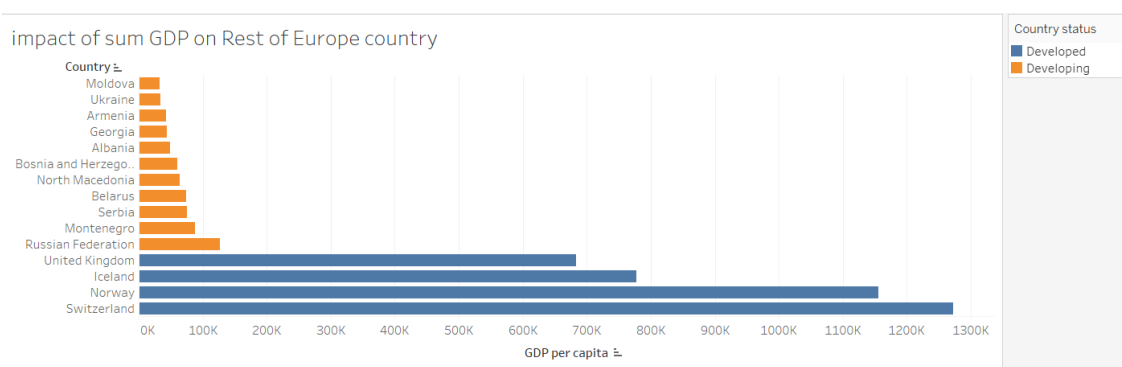


Figure 4.4 Impact of sum GDP on rest of Europe countries' in bar graph

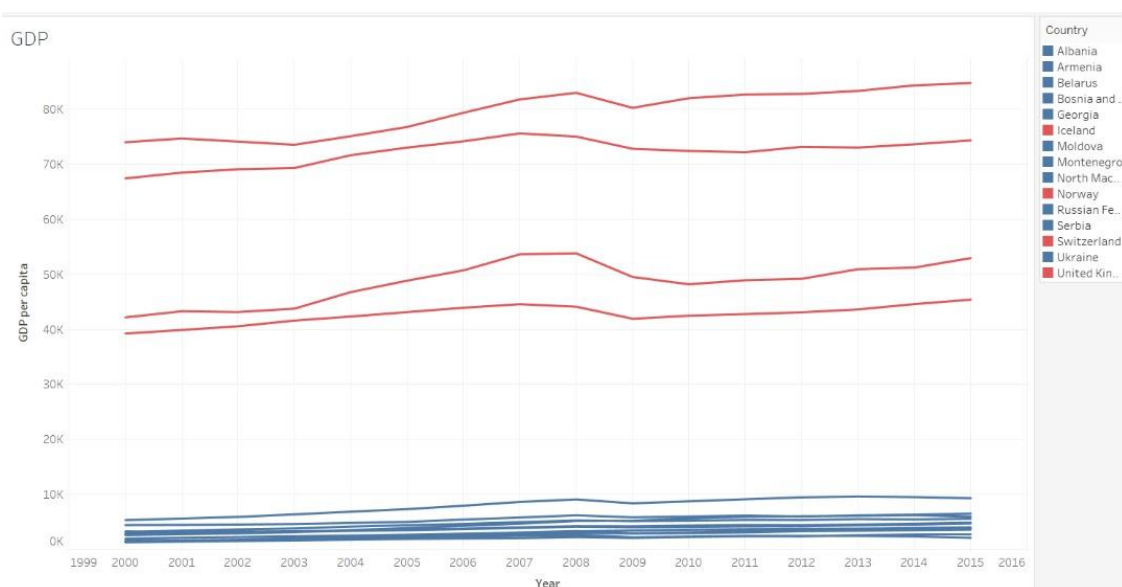


Figure 4.5 Impact of sum GDP on rest of Europe countries' in line charts

This graph shows the relationship between GDP per capita and economic status of countries. In this bar graph, the orange bar represents the developing country while the blue bar represents the developed country. From this bar, the top 4 GDP per capita belongs to the United Kingdom, Norway, Iceland and Switzerland which are developed countries, the sum is streets ahead of the developing countries.

GDP per capita is the measurement of the output per person which indirectly acts as an indirect indicator of per capita income. A high GDP per capita is usually associated with positive outcomes in a wide range of areas including better health, greater life satisfaction and higher education. As a result, health awareness in developed countries is relatively higher compared to developing countries in addition to that they have the financial ability to afford the vaccines.

In short, when the GDP per capita increases, the growth of the economy of the country increases. Therefore, the higher the GDP per capita, the higher the possibility of being a developed country.

1.2.2 The relationship between country status and immunization coverage.

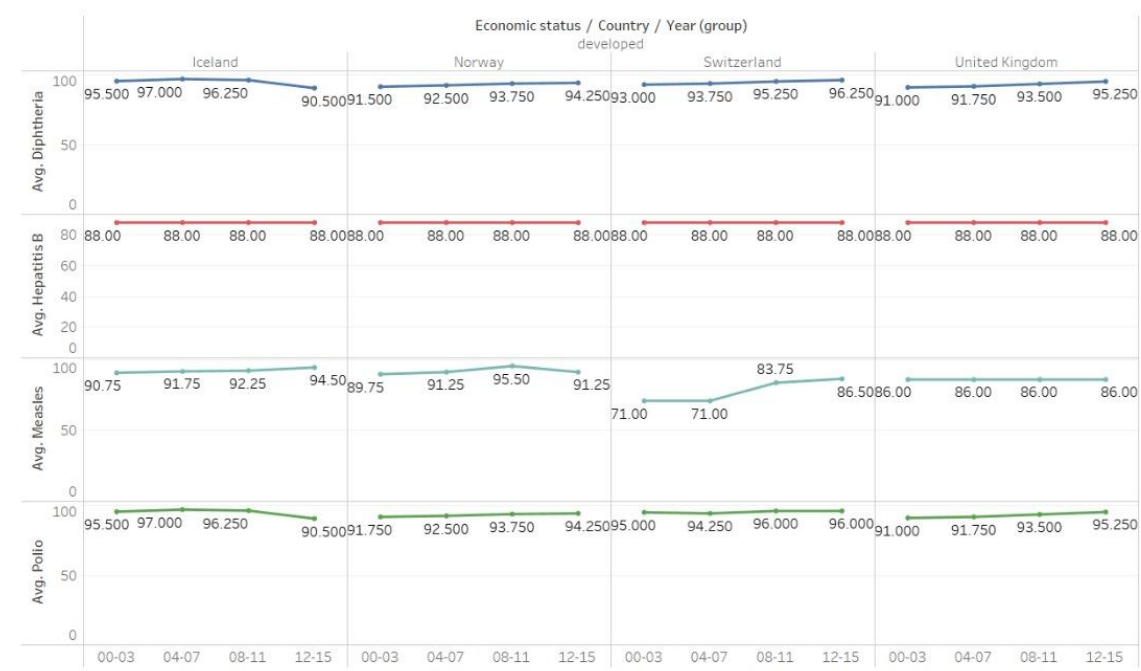


Figure 4.6 The immunization coverage in developed countries of R.O.E region from 2000-2015

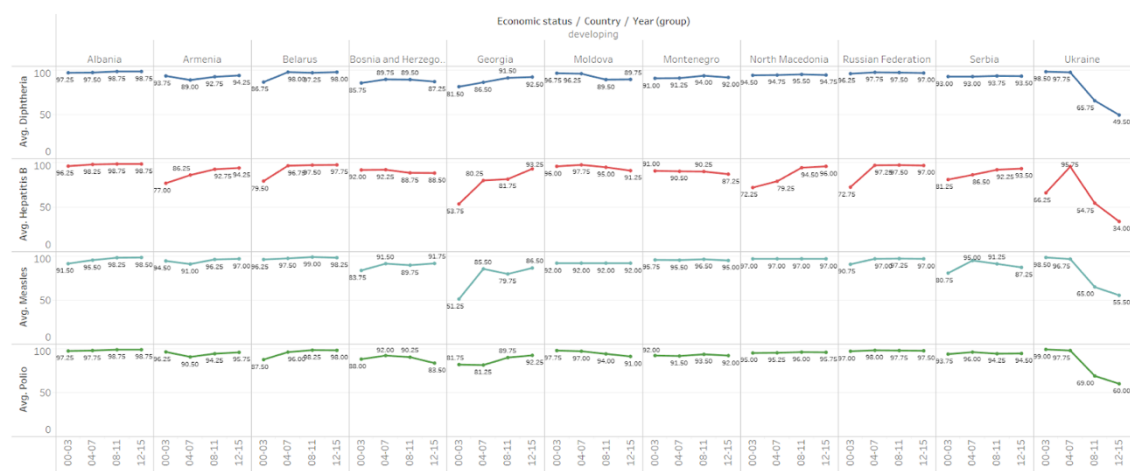


Figure 4.7 The immunization coverage in developing countries of R.O.E region from 2000-2015

The graph shows the relationship between country status and immunisation coverage on diseases in countries across the Rest of Europe region. Years in this graph are grouped by 4 years, which means 2000-2003 is grouped as one year, 2004-2007 is grouped as one year, and so on. Therefore, there would be a total of 4 groups of years for each of the country at the x-axis.

The graphs have clearly shown that the immunisation coverage of developed countries is more stable and constant compared to developing countries. This is due to the fact that the developed countries which have higher GDP per capita can make it easier for individuals to afford vaccines and healthcare services. Besides, developed countries also have comprehensive healthcare coverage or insurance systems that include vaccines as part of preventive care. In contrast, inconsistent and unstable immunisation in developing countries is stemmed from the possibility of upheaval and therefore result in the difficulties to get the vaccines. For instance, the plunge of immunisation coverage in Ukraine is because of political conflicts, subsequent delays in supplying healthcare units with a sufficient number of vaccines doses, and increasing vaccine hesitancy (Rzymiski.P& Falfushynska.H, 2022).

1.2.3 The immunisation which is Hepatitis B, Polio, Measles and Diphtheria coverage on life Expectancy across the Rest of Europe from 2000-2015 year?

Relationship between Percentage of Immunization Coverage of Diphtheria and Life expectancy of all countries in Rest of Europe region across years



Figure 4.8 Diphtheria coverage on life Expectancy across the Rest of Europe from 2000-2015 year

This combination of line graph and scatter graph clearly shows the immunisation coverage of Diphtheria and life expectancy of developed countries and developing countries from year 2000 to year 2015. In this graph, years are grouped by 4 years, which means 2000-2004 is grouped as one year, 2005-2009 is grouped as one year, and so on. There would be a total of 4 groups of years. There are four red plots for every country that represents the immunisation coverage for each group of years while the blue line shows the life expectancy of every country. Apparently, the life expectancy of developed countries is higher than the life expectancy of developing countries and all of them show a steady increase of life expectancy. Compared to developed countries, developing countries have a fluctuation in the immunisation coverage of Diphtheria. This may be caused by the economic status of developing countries due to the GDP per capita that have been mentioned above. These factors affect the immunisation of Diphtheria as there is lack of ability to afford the vaccine and the lack of awareness on immunisation. For example, limited supply chain and logistics are the barriers of transporting the vaccines to the developing country and people resists injecting an unknown foreign substance into their body without having knowledge on it. The graph shows that even though there is a sudden decrease in the immunisation coverage of Diphtheria, the life expectancy still increases steadily because the vaccines protect nearly everyone (97%) against diphtheria for approximately 10 years. A great comparison between developed countries and

developing countries can be shown by observing life expectancy. In developed countries, the life expectancy is above the immunisation coverage but the life expectancy of developing countries is below the immunisation coverage. This happens because immunisation coverage is not the sole factor of life expectancy. Developed countries have a higher living standard that causes them to have less exposure to Diphtheria.

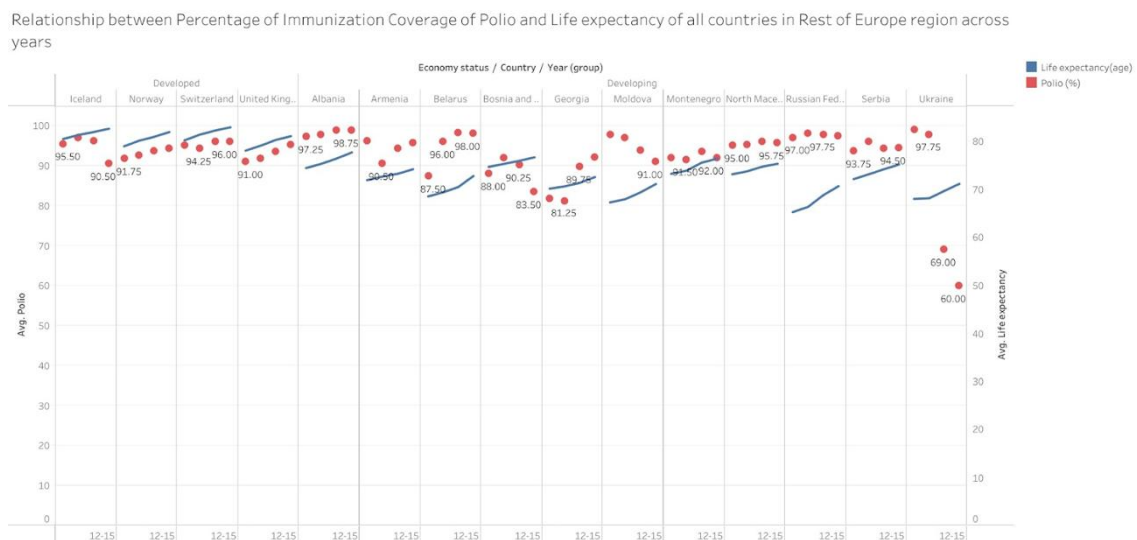


Figure 4.9 Polio coverage on life Expectancy across the R.O.E region from 2000-2015 year

There are similarities between the graph of percentage of immunisation coverage of Polio and the graph of percentage of immunisation coverage of Diphtheria. For example, the relationship of percentage of immunisation coverage and life expectancy, the trend and pattern of percentage of immunisation coverage of polio and the life expectancy. Although the diseases are different, they are indeed related in some aspects. They are both preventable and their vaccines are often administered together as part of a combination vaccine, such as DTaP or DTP for diphtheria, tetanus, and pertussis, or the polio vaccine in the Rest of Europe region. So, when the immunisation coverage of Diphtheria increases, the immunisation coverage of Polio will increase.

Relationship between Percentage of Immunization Coverage of Measles and Life expectancy of all countries in Rest of Europe region across years

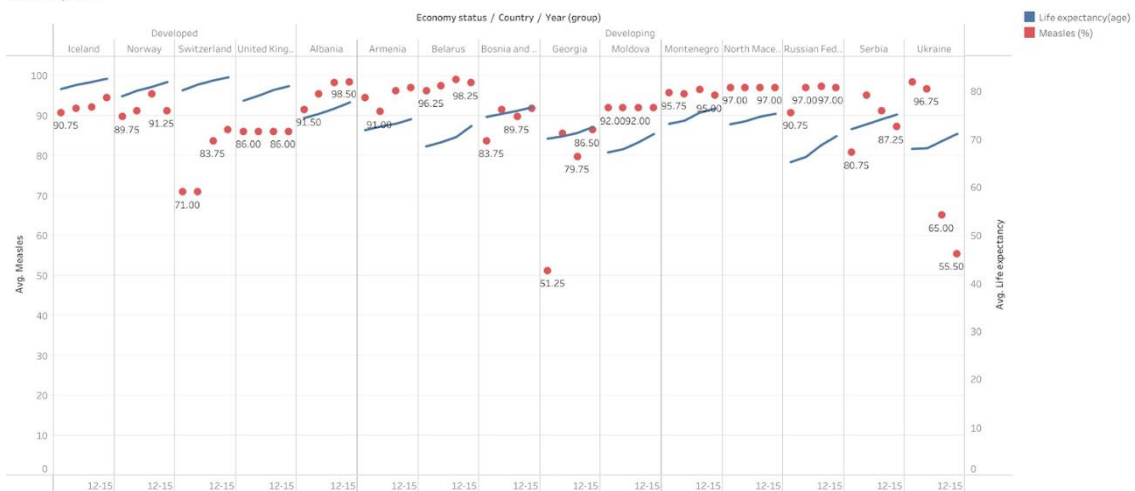


Figure 4.10 Measles coverage on life Expectancy across the R.O.E region from 2000-2015 year

This graph shows the percentage of immunisation coverage of Measles for developed countries is lower compared to developing countries and the immunisation coverage of diseases mentioned above. This is caused by the immunogenicity and vaccine efficacy. Approximately 5% of children with the first dose of MMR vaccine fail to respond to the vaccine due to immaturity of the immune system, destroying vaccine and passive antibody in the recipients. Therefore, people in developed countries that get more exposure to news and knowledge resists getting the vaccine in order to protect their children from getting the symptoms. However, there is an obvious low immunisation coverage in Switzerland. In Switzerland, Year 2000 to year 2006 is pre-epidemic period while there is an outbreak of cases in 2008, therefore, after year 2008, the immunisation coverage shoot up as the government and residents started to realise the importance of immunisation of Measles and the immunisation of Measles from year 2008 onwards is effective, considering that before the outbreak in Switzerland, the Measles vaccine has been modified and improved. Except Switzerland, Georgia and Ukraine, the immunisation of other countries have the same immunisation coverage as the other diseases.

Relationship between Percentage of Immunization Coverage of Hepatitis B and Life expectancy of all countries in Rest of Europe region across years

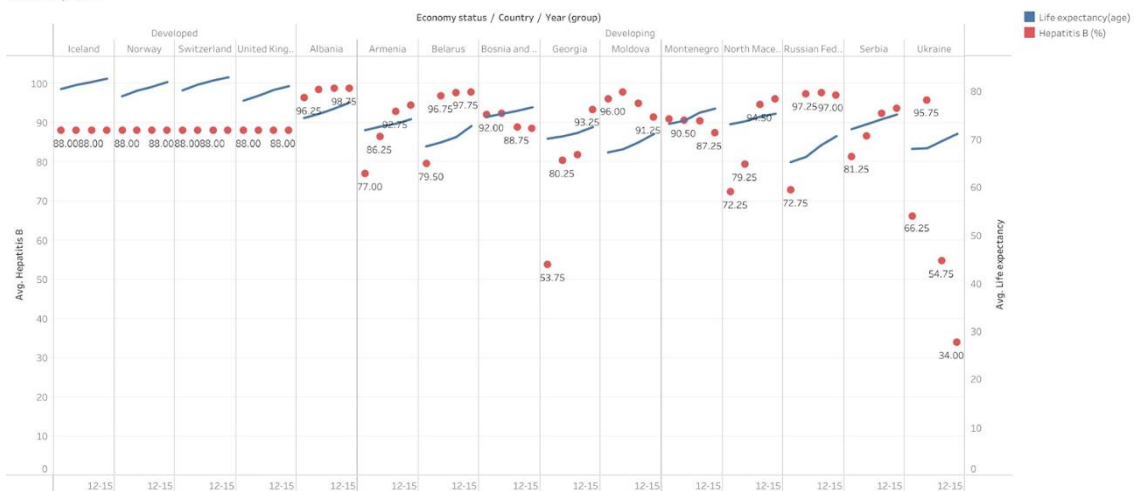


Figure 4.11 Hepatitis B coverage on life Expectancy across the R.O.E region from 2000-2015 year

Compared among four diseases, immunisation coverage of Hepatitis B is the lowest because there is still a lack of knowledge and awareness of hepatitis B. The immunisation coverage for developed countries is consistent and is lower than some developing countries. According to the research paper, in poorer countries, an infant dose of hepatitis B virus costs only \$0.75 but in the UK, it costs \$15. Although the United Kingdom is categorised as a developed country, some parents may not afford to pay for it. This fact clarifies that some developing countries have high immunisation coverage as the price is affordable. To explain the inconsistent immunisation coverage for developing countries, economic status is the most appropriate to make an inference as unstable economic status determines their ability to get vaccinated. No matter the fluctuating immunisation coverage for developing countries and the consistent immunisation coverage for developed countries, the graph shows a steady increase in life expectancy because the vaccine against hepatitis B lasts for 20 years and above.

Ukraine immunisation in every year

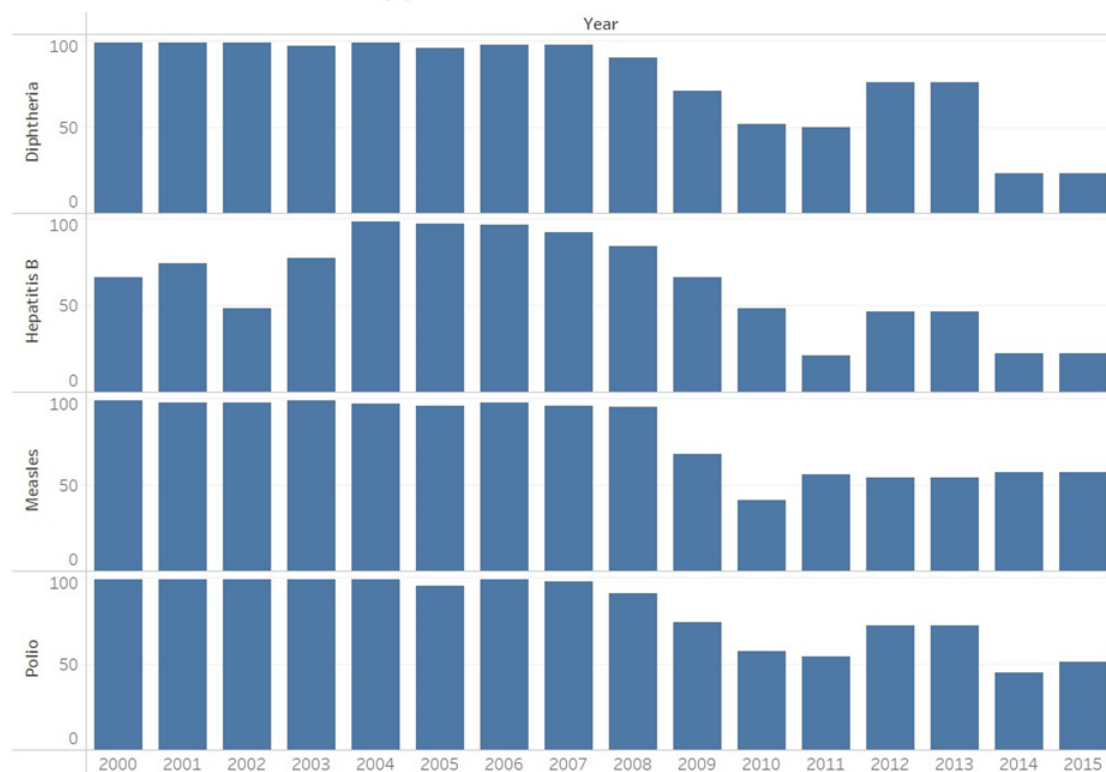


Figure 4.12 Ukraine immunisation coverage in every year

From the graph, the result shows Ukraine has a low immunisation coverage in four diseases. Worse than worst, there is a sudden collapse in immunisation coverage of four diseases. Let's take immunisation coverage of Measles as an example. For the first 10 years of the 2000s, the immunisation coverage of the first and second doses against Measles is in the range of 94% to 99%. Nevertheless, in 2010, the immunisation coverage plummeted and fell in the range of 56% to 41%, on account of failed measles immunisation campaigns in Ukraine. The residents in Ukraine are navigated by media scares about vaccines and therefore contributing to parents' anxieties in order to protect their children (Bazylevych.M, 2011). The parents are also worrying about the outdated health system of Ukraine.

impact of immunisation coverage on life expectancy in Rest of Europe region

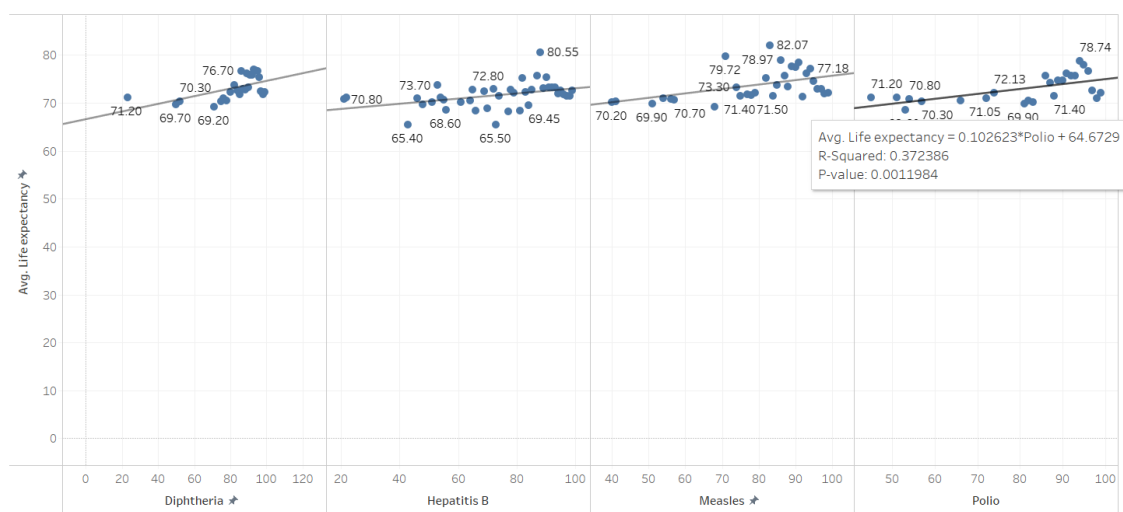


Figure 4.13 Average of all disease immunisation coverage in every country in Rest of Europe region

Table 4.2 Avg. Hepatitis B

	Unstandardized Coefficients		Sig	Model Summary	
	Coefficient Value	Std. Error		R Square	Std. Error of the Estimate
a	67.6431	1.52708	< 0.0001	0.157831	2.53264
b	0.0538529	0.02018	0.0111368		

Table 4.3 Avg. Measles

	Unstandardized Coefficients		Sig	Model Summary	
	Coefficient Value	Std. Error		R Square	Std. Error of the Estimate
a	66.4396	2.60131	< 0.0001	0.219882	2.96723
b	0.0921067	0.0322164	0.0077927		

Table 4.4 Avg. Diphtheria

	Unstandardized Coefficients		Sig	Model Summary	
	Coefficient Value	Std. Error		R Square	Std. Error of the Estimate
a	66.5794	2.02615	< 0.0001	0.322312	2.08131
b	0.079941	0.0241703	0.0030749		

Table 4.5 Avg. Polio

	Unstandardized Coefficients		Sig	Model Summary	
	Coefficient Value	Std. Error		R Square	Std. Error of the Estimate
a	64.6729	2.28273	< 0.0001	0.372386	2.27698
b	0.102623	0.0277799	0.0011984		

A regression analysis was carried out to determine the effect of the average of four diseases such as Hepatitis B, Measles, Diphtheria and Polio on average life expectancy. A linear regression is created. Dependent variable is average life expectancy while the independent variable is immunisation coverage of Hepatitis B, Measles, Diphtheria and Polio. The r-squared value is 0.3724, indicating a weak positive R-squared graph. The trend indicates that the immunisation coverage of Polio still provides information about life expectancy even though some data points fall further from the regression line. Although the r-squared value leads to a small effect size, it does not mean that it is unworthy to be interpreted. This is because according to a research conducted by Rappuoli.R (2014), vaccines have dramatically reduced the incidence of infectious diseases that historically killed hundreds of millions, and made a substantial contribution to life expectancy during the last century in developed countries. Although the r-squared value is 0.3724, we are only explaining the 37% of variation. We know that immunisation coverage of the four diseases mentioned above is not the sole factor of life

expectancy, but our point is just wanting to know if there was a small but reliable relationship.
Guess what? There is.

Conclusion

Using this dataset, we get a conclusion that, economic status is affected by GDP per capita, there is a relationship between economic status and immunisation coverage of countries, and immunisation coverage has an impact on life expectancy of countries in the Rest of Europe region. Hence, our data has answered our big question, which is, there is a relationship between economic status and life expectancy.

This analysis is useful for the stakeholders, including governments, international organisations, vaccine manufacturers, and healthcare providers as it navigates the right path for them to plan strategies in each field. To illustrate this, pharmaceutical companies can emphasise on the countries that have lower immunisation coverage such as Ukraine to manufacture and supply the sufficient amount of vaccines. Besides, logistic experts can improve vaccine supply chains by upgrading cold chain infrastructure, including refrigeration and storage facilities, to maintain the integrity of vaccines.

In addition, big data analysis is different from hypothesis, big data refers to real information that is collected in the real world, so the data are more reliable and conducive to facilitating informed decision-making. Consequently, the information applied in this research and analysis such as dataset and methodologies also can be applied to different areas in order to carry out different analyses in order to address societal issues.