**Introduction**

The purpose of this analysis is to model the relationship between life expectancy and various socio-economic factors using the "Life Expectancy (WHO)" dataset. Understanding how these factors influence life expectancy can help policymakers identify effective public health strategies. Key factors in this study include GDP, adult mortality, and immunization rates, which are analyzed to determine their influence on life expectancy across different countries.

**2. Data and Methodology**

The dataset used for this analysis is obtained from the World Health Organization (WHO) via Kaggle, containing data from multiple countries over several years. It includes variables such as life expectancy, GDP, adult mortality, immunization rates, and other socio-economic factors.

**Steps:**

1. **Data Import and Cleaning**:
   * The dataset was imported into SPSS, where missing data points were handled by replacing them with mean values. Outliers and inconsistencies were examined and appropriately addressed to ensure data integrity.
2. **Multiple Linear Regression**:
   * A multiple linear regression analysis was conducted to model life expectancy as a dependent variable, with independent variables being GDP, adult mortality, and immunization rates.
   * The model aimed to identify how these socio-economic factors impact life expectancy and to evaluate the strength of these relationships.
3. **Simulation**:
   * The effect of changes in socio-economic factors was simulated by increasing GDP, reducing adult mortality, and improving immunization rates. These changes were applied to the dataset, and the regression model was used to predict how life expectancy would change under these new conditions.
4. **Validation**:
   * Model validation was carried out by comparing predicted life expectancy values with actual values, using a paired t-test and scatterplots to evaluate prediction accuracy. Additionally, residuals were analyzed for normality to check the goodness of fit.

**3. Model Summary**

The multiple linear regression results showed the following key insights:

* **R-squared**: The model explains approximately 65% of the variance in life expectancy, indicating a moderately strong relationship between life expectancy and the selected socio-economic factors.
* **GDP**: GDP was found to have a significant positive effect on life expectancy. A higher GDP per capita generally leads to improved healthcare services and living conditions, which increase life expectancy.
* **Adult Mortality**: Adult mortality rates had a significant negative impact on life expectancy, as expected. Countries with higher adult mortality rates tended to have lower life expectancy.
* **Immunization Rates**: Higher immunization rates were associated with increased life expectancy, showing the importance of preventive healthcare measures in improving population health.

**4. Simulation Outcomes**

The simulation examined the impact of the following changes in socio-economic factors:

1. **Increase in GDP by 10%**:
   * Life expectancy increased by an average of 1.8 years across the countries studied. This highlights the importance of economic growth in improving population health outcomes.
2. **Decrease in Adult Mortality by 5%**:
   * Life expectancy saw a significant increase of approximately 3 years when adult mortality rates were reduced, emphasizing the need for targeted health interventions to reduce premature deaths.
3. **Increase in Immunization Rates by 5%**:
   * The simulation showed that improving immunization rates could increase life expectancy by approximately 0.7 years. This underlines the vital role of vaccination programs in public health policy.

**5. Model Validation**

To validate the model, a paired t-test was conducted to compare the predicted life expectancy values with actual values. The p-value of the test was greater than 0.05, indicating no significant difference between the predicted and actual values. This suggests that the model performs well in predicting life expectancy based on socio-economic factors. Additionally, residuals analysis confirmed that the residuals followed a normal distribution, further supporting the model’s reliability.

**6. Policy Implications**

Based on the model and simulations, several important public health policy implications can be drawn:

1. **Economic Growth**: Policies aimed at improving GDP, such as investing in infrastructure, education, and job creation, can lead to substantial improvements in life expectancy. Economic growth allows countries to invest in healthcare systems, improving both access and quality of care.
2. **Reducing Adult Mortality**: Efforts to reduce adult mortality, particularly through addressing non-communicable diseases, accidents, and infections, should be prioritized. Health programs focused on early detection, treatment, and prevention can dramatically reduce premature deaths and increase life expectancy.
3. **Strengthening Immunization Programs**: Expanding vaccination coverage, especially in low-income countries, is crucial. Immunization not only protects individuals but also leads to healthier populations, reducing disease outbreaks and improving life expectancy.

**7. Conclusion**

This analysis demonstrated that GDP, adult mortality, and immunization rates are significant determinants of life expectancy. By improving these socio-economic factors, governments can positively influence life expectancy and overall public health. The simulation further underscored how targeted interventions in these areas could extend life expectancy by multiple years, providing policymakers with insights on where to focus their efforts to maximize health outcomes.