Pharmaceutical Expenditure and Life Expectancy: An Analysis of OECD Countries

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Abstract. Increasing pressure has been placed on high-income countries to justify the increasing cost of health care, given the stagnant health outcomes. On this basis, the current analysis aims to assess whether a direct link exists between increasing pharmaceutical expenditures and increasing life expectancy in the 35 Organization for Economic Co-operation and Development (OECD) countries considering the systemic implications of COVID-19. A multivariate regression model using 2022 data from WHO and OECD was conducted in order to analyze the effect of pharmaceutical expenditure per capita while controlling for the potential effects of other independent variables such as GDP, urbanization, and gender ratios. Although the pharmaceutical expenditure was shown to positively affect life expectancy with a regression coefficient (β) of 0.0029, the effect failed to achieve statistical significance (p) when controlling for global factors. In contrast, the relationship between COVID-19 mortality and life expectancy was significant and negative. This research indicates that additional investments in pharmaceuticals are unlikely to yield substantial benefits to high-income countries. The lack of return on investment in pharmaceuticals since COVID-19 has led to a conclusion that resources should be allocated more efficiently and with more emphasis placed on pandemic preparedness and risk mitigation as opposed to the total dollar figure spent on pharmaceuticals.

Keywords: Pharmaceutical Expenditure; Life Expectancy; Healthcare Efficiency; OECD; Health Economics.

1. Introduction

Advancements in technology have allowed individuals across the globe to become increasingly aware of their health and how they live, particularly in industrialized countries. As a result of this awareness, the expectations of the general public for healthcare services have increased, requiring increased amounts of government funding for healthcare. Healthcare spending is a pressing concern for all nations because it affects the well-being and quality of life of every citizen. The current academic literature on health economics suggests that the relationship between health expenditure and health outcomes is nonlinear [1].

Countries like the U.S. ($12,555) and Switzerland ($8,049) have some of the highest health expenditures per capita with the highest percentage of spending as a percent of GDP (16.6% and 11.3%) respectively [2]. Conversely, India ($212) and Indonesia ($405) spend much less on health per capita with a percentage of GDP spending in 2.9% and 3.4% respectively [2]. This could indicate that they are allocating funds elsewhere, such as in public infrastructure or education, rather than toward healthcare. In order to understand how and where these countries invest their allocated health spending dollars, one must evaluate effective health spending and the impact it has on overall health outcomes. Ineffective health spending can result in poor health outcomes and an increase in the disparity among socio-economic classes [3].

The cost associated with pharmaceuticals is one of the largest components of the overall amount being spent on healthcare, including direct costs associated with purchasing medications and their availability. This component of healthcare costs differs substantially across countries, predominantly due to factors such as drug pricing, governance, and market availability. The United States currently spends the most on pharmaceuticals ($1,432 per capita) due to both high drug costs and substantial usage. Many countries in Europe continue to spend significantly on healthcare while also maintaining lower amounts spent on pharmaceuticals through strict drug pricing regulations and negotiated

pricing agreements. Thus, it is vital for the decision makers in these countries to understand the importance of balancing drug cost reduction and ensuring access to essential medications.

This study empirically analyzes the connections between pharmaceutical spending and life expectancy. Unlike previous studies, this research specifically controls for the disruption of COVID-19 mortality to assess whether traditional spending patterns hold true in a post-pandemic context.

2. Literature Review

There continues to be an ongoing debate about how to utilize the most efficient allocation of limited resources in terms of healthcare financing. Healthcare policy also has a direct impact on pharmaceutical expenditures, through determining drug access, regulating drug prices, and providing general health coverage to its citizens. In general, government-run healthcare systems (e.g., Canada and the United Kingdom) tend to have lower drug prices, thereby providing better access to necessary medications while keeping costs down [7]. In contrast, in countries that utilize a large percentage of private insurance (e.g., the United States), pharmaceutical costs are generally much higher due to market-based pricing and limited government intervention [8].

Technological innovation is supported by profit motives; however, such innovation does not necessarily lead to higher life expectancies unless the technology is available for everyone. There are effective policies to improve health outcomes while not placing unduly burdensome financial responsibility on the people and governments that will ultimately provide life-saving drugs. The ethical issue around the pricing of drugs relates to balancing the access to life-saving medicines with pharmaceutical company profits [9]. The excessively high prices of drugs in countries with no price restrictions prevent the ability of the lower income population to access drugs. There is recent evidence consistent with the theory of diminishing marginal returns; this would suggest that once a certain level of development is reached, social determinants and lifestyle factors are more important than the amount of money spent [10].

Urbanization is recognized as a major contributor to increased life expectancy. Urban density allows for resources to be concentrated within a given area which reduces the risks of poverty and inequality through improved health facilities and increased employment opportunities [11]. Additionally, the rapid and unplanned nature of urbanization can lead to increased health risks; thus, creating a dual burden of disease [12].

3. Methodology

In this study, life expectancy data were sourced from the official World Health Organization (WHO) website [13]. From the official WHO website, the life expectancy data were obtained to show the mean life expectancy in 35 OECD nations. Pharmaceutical spending per capita and GDP per capita for 2022 were retrieved from the Organization for Economic Cooperation and Development (OECD), which offers economic indicators for member nations [2].

3.1. Data Processing and Sample Selection

The initial stage of this study is to locate and delimit potential data relevant to the research question, in order to obtain data that can be compared through a socioeconomic lens, and to maximize data reliability. Low reliability data (countries with missing records) were removed from the dataset, leaving only countries with complete records available for analysis (a total of 35 countries, most of them located in Europe (e.g. Germany, Switzerland) or North America (e.g. USA and Canada), as well as some from Oceania (Australia)). Countries in far away regions such as the majority of Africa and parts of Asia were excluded to minimize the potential confounding influence caused by extreme differences in levels of development.

3.2. Statistical Analysis

Quantitative data analysis and the identification of trends and correlation are both part of this study. To evaluate the hypothesis of this study, a multivariate linear regression model was created. Microsoft Excel is utilized to generate scatter plots that visually represent the relationship between pharmaceutical spending and life expectancy (on the x-axis and y-axis respectively). In addition to determining the magnitude of pharmaceutical spending on life expectancy, the regression model controls for GDP per capita (2022), urbanization rate, gender distribution (female %), and the number of COVID-19 deaths. The use of a linear regression model was chosen due to its effectiveness in demonstrating an association with multiple variables, although it does have some limitations, such as being vulnerable to the effects of outliers [14].

4. Results

To investigate the relationship between pharmaceutical spending and life expectancy across different countries, exploratory data analysis was done by generating sample statistics. Table 1 presents the descriptive statistics for the sampled nations.

Table 1. Descriptive Statistics of Variables

Variable	Mean	Min	Max
Life Expectancy (Years)	79.0	70.0	84.0
Pharmaceutical Spending per Capita ($)	609.0	142.4	1,300.0
GDP per Capita ($)	43,591	11,497	125,006
COVID-19 Deaths (per million)	2,822	499	5,706
Urbanization Rate (%)	76.0	53.9	98.1
Female Population (%)	51.0	48.7	53.6

The focus of this research is on the correlation between pharmaceutical expenditures (hereinafter referred to as Rx) and longevity. The variable for life expectancy had a mean value of approximately 79 years across all the sampled nations. Pharmaceutical spending per capita was utilized as the main predictor, and had a mean value of approximately $609 across all nations sampled, with an approximate range of $142.4 up to $1,300 dollars per capita. As shown in Figure 1, the majority of the data points follow a positive trend; however, the data points for the United States are outliers with regard to life expectancy given the high amounts of money that are expended on pharmaceuticals.

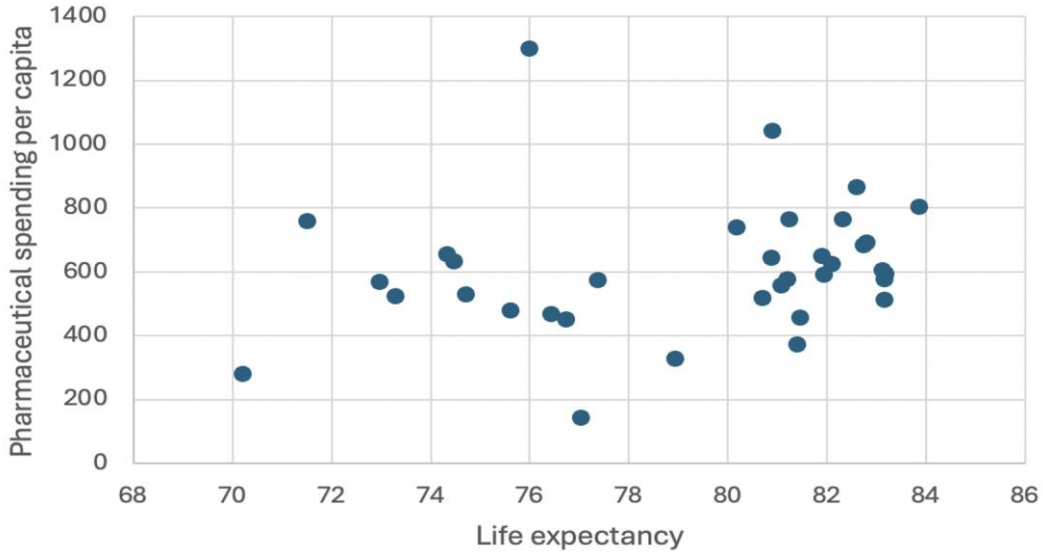

Figure 1. Relationship between Pharmaceutical Spending and Life Expectancy

The regression coefficients are presented in Table 2. The coefficient of Rx per capita was found to be 0.0029, indicating that there is a positive relationship between pharmaceutical (Rx) expenditures and life expectancy; however, this relationship was not statistically significant (p=0.29). Therefore, Rx expenditures are expected to have a very small increase in life expectancy with each additional dollar spent on pharmaceuticals after accounting for the impact of other variables. Additionally, GDP for 2022 shows a positive relationship to life expectancy, but this coefficient was also not statistically significant (coefficient=0.000024, p=0.37). In contrast, COVID-19 deaths present a statistically significant negative coefficient (-0.0012, p<0.05). This indicates that increased COVID-19 related deaths resulted in decreased life expectancy. Urbanization has a positive relationship (coefficient=0.015), whereas the female population percentage showed an unexpected negative coefficient (-0.99), which could be attributed to issues surrounding migration from less developed nations to more developed nations for employment.

Table 2. Regression Analysis Results.

Predictor	Coefficient (β)	P-value	Significance
Rx per Capita	0.0029	0.29	Not Significant
GDP (2022)	0.00002	0.37	Not Significant
COVID-19 Deaths	-0.0012	< 0.05*	**Significant**
Urbanization	0.015	0.76	Not Significant
Female %	-0.99	0.11	Not Significant

Note: Significance level set at $p < 0.05$.

5. Discussion

The data indicates an association between higher levels of pharmaceutical expenditure and longer average lifespans; however, the statistical evidence suggests that the relationship is not as strong as one might expect based upon commonly held beliefs regarding the relationship between the two (higher levels of pharmaceutical expenditure produce better population health outcomes). These data

provide no statistically significant (p = 0.29) evidence, which also supports the theory that there are diminishing returns on health (finance) investment [15].

As an example, at a per capita pharmaceutical expenditure of $5250.6, Japan has the highest average life expectancy at 84 years. At the other end of the scale, with only $279 per capita spent on pharmaceuticals, Mexico has the lowest average life expectancy of only 70 years. A paradox of the United States is that it is one of the nations with the highest expenditures on pharmaceuticals but also has the lowest average life expectancy, indicating that the amount spent on pharmaceuticals is not the only determinant of the health and well-being of a population; rather, the overall efficiency of the healthcare delivery system appears to play a larger role.

The COVID-19 pandemic has impacted the world in a way that is unprecedented in modern history, and the model indicates that the main cause of international differences in life expectancy in 2022 is the number of people who died as a result of COVID-19. For example, Bulgaria has an extremely high death rate from the virus (5,706 deaths per million) and, as a consequence, an extremely low average life expectancy in spite of their substantial spending on pharmaceuticals. Conversely, the country with the lowest death rate from the virus, Iceland, (499 deaths per million) has an average life expectancy of 83 years. The findings demonstrate that spending on pharmaceuticals does not equate to increased average life expectancy. Adequate public health systems are critical for reducing the number of deaths due to mortality shocks associated with pandemics.

Urbanization is another factor for life expectancy. The Netherlands, a highly urbanized nation, has a 92.8% urbanization rate and has access to concentrated healthcare resources. In contrast, Romania, which has a lower level of Urbanization (54.4%) has shown relatively higher levels of disparity where it can be attributed to unequal distribution of resources. While urbanization was not found to be statistically significant (p=0.76) in the regression analysis, literature has indicated that urbanization's impact is likely mediated through the infrastructure quality rather than the amount of urbanization itself [11].

Policymakers can maximize the potential impact of pharmaceuticals on human life expectancy by ensuring that all health-related expenditures are optimized for both efficiency and equitable accessibility to all people. Investments in preventive health services (such as vaccines) and disease screening programs produce more positive health outcomes than the traditional treatment of illnesses with reactive drug therapies. In addition, technological innovations in the development of new medications allow healthcare practitioners to prescribe these drugs at a much lower cost than they were produced for; thus, it is imperative for governments to create a level playing field among new drug manufacturers and offer incentives for practitioners to prescribe from the lower-priced drug list. Global collaboration is necessary to create equitable access to the health benefits associated with the scientific and technological advancements in the field of medicine.

6. Limitations and Conclusion

There are several disadvantages to this study that must be considered. First, the database mostly examines North America, Latin America and Europe; thus, it does not consider any countries in Asia, Africa, or South America. Furthermore, this type of sampling bias is likely due to the finding being focused primarily on developed economies, as opposed to developing nations where marginal utility associated with pharmaceutical purchasing would be expected to be higher than in developed nations. Another disadvantage is that this study does not attempt to address all of the various factors that contribute to one's life span. For example, only analyzing pharmaceutical expenditures, COVID-19 deaths, and urbanization has been performed by the researcher thus far. There is much research remaining to be conducted on lifestyle elements such as diet and smoking rates.

The developing connection between the financial investment from the pharmaceutical industry and the increase in human life expectancy will continue to expand and be explained through the results of this research. Further studies can incorporate many more data sources to arrive at a global conclusion regarding the relationship between pharmaceutical industry investment and human

longevity. Moreover, while the findings of this study support the notion that increasing financial resources supports more years of life, the key component of longevity is found in the efficiency by which the increased financial resources are converted into products and services.

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