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Does healthcare coverage have positive impact on decreasing mortality rate in Uzbekistan?

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Abstract
Despite recent advancements in economic growth and healthcare performance, the mortality rate remains a persistent challenge. This study investigates the key factors influencing child mortality in Uzbekistan, focusing particularly on the impact of healthcare coverage. Using panel data from 2013 to 2022, the analysis examines how variations in healthcare facility coverage affect child mortality rates in both urban and rural areas. Our findings highlight that while healthcare coverage significantly reduces mortality rates in rural areas, its effect is less pronounced in urban settings. The study underscores the importance of not only increasing healthcare facility availability but also ensuring equitable distribution to address geographical disparities. Additionally, the results suggest that healthcare product prices and population welfare metrics also play critical roles. Policy recommendations include expanding healthcare access, improving facility distribution, and regulating healthcare product prices to mitigate mortality rates effectively. This research contributes valuable insights for decision-makers aiming to enhance child health outcomes in Uzbekistan.

Keywords: mortality rate, Uzbekistan, geographical disparities, child mortality

1. Introduction

Mortality rate has been under consideration for several years and it is still challenging to determine major factors affecting it. Despite long-term economic growth and better performance of health industry in recent years, mortality rate still exists even though it has declined considerably over time. This study is expected to analyze major factors affecting mortality rate of children in recent period in Uzbekistan. In fact, we will be analyzing the impact of household coverage on mortality rate of the children in this country. Basically, the main motivation for the selection and conduction of this research is to determine how effectively healthcare facilities have been performing in the and what their contribution has been in reducing this rate. Actually, potential benefits from this research could be applicable policy recommendations to extend the access of population to healthcare services available. Before conducting the analysis, research studies conducted by other scholars will be analyzed and relevant findings will be illustrated as examples supporting our estimations. Meanwhile, we will describe the elements of the dataset that will be used in empirical parts and build a model for estimating the impact of particular factors that might have significant effect on mortality rate in methodology part of the research and research limitations will also be analyzed. Based on outcomes, we might have some recommendations for the decision-makers in the country.

2. Literature review

It is actually hard to define and estimate the relationship between numbers of healthcare facilities on mortality rate, especially, from the perspectives of green economy as well as other studies in the field of environmental economy. In different studies, researchers used different proxy variables that might have effect on mortality rate in the country. According to Sustainable Development Goals proposed by the United Nations in 2015, it was mentioned to fully eliminate the child death that are preventable by 2030. State that almost 70 percent of child death are preventable at earlier stages by providing prenatal cares. For this matter, the population should have sufficient access to the healthcare services. Ryan A. Conducted a research using large dataset including the information on over 250 thousand children born during 20-year period in 7 different countries in order to measure the role of healthcare system on the mortality rate of children. As a result, the researchers found that the access of the population to the healthcare services has statistically significant impact on mortality rate rather than the quality of healthcare system. This fact also supports our choice of coverage with healthcare facilities as an explanatory variable for the mortality rate in the country [1].

On the other hand, facility distance also matters in the determination of child mortality rate as it measures the frequency of approach to prenatal care at healthcare facilities. In fact, geographical location of these facilities should be planned in a way to provide equal access to the population. Especially, M. Karra *et al*. (2016) [3] carried out their analysis to measure the impact of the distance to the nearest healthcare facility on child mortality rate using the data in DHS surveys for 21 low-income and middle-income countries. Apparently, in these countries, the unavoidable "compensation" for larger distance to the healthcare facility is associated with higher mortality rate [2]. This reasonable argument also supports the idea construction of healthcare facilities in huge quantities so that all parts of the population will have equal access.

In addition, M. Målqvist (2010) [4] estimated the potential impact of distance to healthcare service on the neonatal mortality using randomly selected data from the middle of 2008 to the end of 2009 in Vietnam. In the empirical parts of the study, the researchers found the significant impact of the distance to the healthcare service on the neonatal mortality. In other words, individuals that live in farter distances are supposed to have higher risk level of facing neonatal mortality occasions. In addition to the previous study reviewed in this part, this research study also examined the availability of healthcare facilities rather than their quality as a factor to decrease mortality rate. Furthermore, it has been pointed out that geographical dimensions should also be taken into account while planning the construction of healthcare centers [3].

3. Methodology and data description

3.1. Data

As we use historical time series data for each area of Uzbekistan, the dataset is structured in panel data form. In other words, we have gathered data for mortality rate of children and other variables from 2013 to 2022 for each area separately. Statistical description of the variables is expressed in the following table:

Table 1: Statistical description of variables

	e(count)	e(mean)	e(sd)	e(min)	e(max)	e(kurto~)	e(skewn~)
childmort_~n	140	13.97661	5.918176	5.860057	35.88749	5.273316	1.450021
childmort_~l	140	10.31494	4.975354	0	23.41419	3.116785	-.0534608
ln_pop_urb	140	6.919965	.5707551	5.784133	7.959416	1.993961	-.2326244
ln_pop_rur	130	7.014643	.4737839	6.053265	7.843103	2.389273	-.5542539
ln_percap_~p	140	9.139047	.6636897	7.83708	11.09522	3.215144	.5752578
health_cov~e	140	.0363837	.0104017	.0190616	.0594035	2.066878	.3277398
water	140	73.86224	15.9203	34.81801	100	2.880351	-.5056274
ln_schools~b	140	5.503392	.4711775	4.41884	6.104793	2.427165	-.7971262
ln_schools~r	130	6.07275	.3935075	5.342334	6.804615	2.359999	.0303346
pensioner_~o	140	11.09133	1.514192	8.27	14.74072	2.375256	.3549921
price_med	140	.08017	.0332743	.0309	.1247	1.491727	.0019755

This table provides the number of observations, mean and standard deviation as well as minimum and maximum values of each variable highlighting kurtosis and skewness. Brief definition of the variables will be explained in the empirical model. In addition to descriptive statistics, correlation matrix is illustrated on the table below:

Table 2: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) childmort_urban	1.000										
(2) childmort_rural	0.428	1.000									
(3) ln_pop_urb	0.804	0.525	1.000								
(4) ln_pop_rur	0.484	0.795	0.759	1.000							
(5) ln_percap_gdp	-0.131	-0.332	-0.186	-0.178	1.000						
(6) health_coverage	0.081	-0.429	-0.155	-0.449	0.139	1.000					
(7) water	0.303	-0.067	0.242	-0.103	-0.197	0.246	1.000				
(8) ln_schools_urb	0.738	0.662	0.962	0.879	-0.268	-0.292	0.181	1.000			
(9) ln_schools_rur	0.346	0.691	0.671	0.874	-0.206	-0.571	-0.113	0.773	1.000		
(10) pensioner_ratio	-0.005	-0.356	-0.052	-0.120	0.845	0.148	-0.122	-0.154	-0.269	1.000	
(11) price_med	0.138	-0.026	0.072	0.093	0.665	0.039	-0.266	0.019	0.040	0.545	1.000

3.2. Methodology

It is not unforeseen that mortality rate of children might be different in urban and rural areas and model estimation for urban and rural population might lead to biased outcome. In order to avoid potential bias or possible misconducting of the model, we can estimate the impact of healthcare coverage on

1 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8357794/#CR4
2 https://academic.oup.com/ije/article/46/3/817/2617178
3 https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-10-762

mortality rate in urban areas and rural areas separately. Based on this assumption, we can describe two preliminary models in the following way:

Model for urban

childmort_urban = β0 + β1 health_coverage + β2* ln_pop_urb + β3* ln_percap_gdp + β4* water + β5* ln_schools_urb + β6*pensioner_ratio + β7*price_med + e*

Model for rural

childmort_rural = β0 + β1 health_coverage + β2* ln_pop_rur + β3* ln_percap_gdp + β4* water + β5* ln_schools_rur + β6*pensioner_ratio + β7*price_med + e*

Where the dependent variable in both models refers to the mortality rate of children. In this situation, mortality rate expresses the number of infant children per 1000 people. In addition, the first explanatory variable, host_coverage represents the proportion of the population covered with healthcare facilities. Furthermore, population and number of schools by urban and rural status in different areas, their respective per capita GDP are expressed in logarithmic forms in order to decrease the dispersion effect in the values of these variables. Besides, water means the coverage level with sufficient valid water resources. In the models, additional two important variables, the share of population receiving pension and other forms of social benefits and percentage change in the prices of healthcare products are also added in order to detect their marginal impact on the mortality rate over years.

4. Results

4.1. Model estimation

Principally, we have conducted the estimation of two models separately for mortality rate in urban and rural areas so that we can obtain actual differences between these two dwelling areas in terms of healthcare provisions. Once we applied OLS regression using real-case dataset for the country, we have obtained the following results:

Table 3: Empirical estimations indicating the mortality rate in urban areas

Linear regression							
childmort_urban	**Coef.**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
health_coverage	74.704	45.751	1.63	.105	-15.796	165.204	
ln_pop_urb	15.857	2.854	5.56	0	10.212	21.503	***
ln_percap_gdp	-1.923	1.149	-1.67	.097	-4.196	.351	*
water	.066	.033	1.99	.049	0	.132	**
ln_schools_urb	-17.552	2.947	-5.96	0	-23.381	-11.722	***
pensioner_ratio	.448	.504	0.89	.376	-.549	1.445	
price_med	18.821	15.296	1.23	.221	-11.437	49.078	
Constant	4.314	8.604	0.50	.617	-12.705	21.333	
Mean dependent var	13.977	SD dependent var	5.918				
R-squared	0.561	Number of obs	140				
F-test	22.578	Prob > F	0.000				
Akaike crit. (AIC)	795.047	Bayesian crit. (BIC)	818.580				
**** p<.01, ** p<.05, * p<.1*							

Table 4: Emperical estimations indicating the mortality rate in rural areas

Linear regression							
childmort_rural	**Coef.**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
health_coverage	-144.181	40.225	-3.58	0	-223.81	-64.553	***
ln_pop_rur	6.894	1.205	5.72	0	4.509	9.28	***
ln_percap_gdp	1.616	.933	1.73	.086	-.23	3.463	*
water	-.066	.02	-3.27	.001	-.106	-.026	***
ln_schools_rur	-10.718	1.642	-6.53	0	-13.97	-7.467	***
pensioner_ratio	-2.785	.371	-7.51	0	-3.518	-2.051	***
price_med	12.109	11.481	1.05	.294	-10.62	34.837	
Constant	52.256	8.636	6.05	0	35.16	69.352	***
Mean dependent var	11.108	SD dependent var	4.218				
R-squared	0.483	Number of obs	130				
F-test	19.893	Prob > F	0.000				
Akaike crit. (AIC)	672.356	Bayesian crit. (BIC)	695.296				
**** p<.01, ** p<.05, * p<.1*							

As we observe in the second regression table, higher health coverage rate in rural areas is associated with lower mortality rate with statistically significant coefficient of the main explanatory variable. In fact, it means that the number of healthcare facilities plays an important role in decreasing the mortality rate in rural locations. On the contrary, this factor does not have any significant importance in urban areas. In addition, increase in the price of medical goods is positively associated with mortal rate in both areas but only rural areas are quite sensitive to this inflation in the price of these products. In other words, price increase in healthcare products is in line with increase in mortality rate in rural areas where average income of people is already lower. However, we have to conduct fixed effect model and random effect model as well in order to have more practical outcomes as we are using panel data. Once we conduct these estimations in new scenarios using the same dataset, we will have the following estimation results for fixed effect model areas:

Table 5: Fixed effect model estimations indicating the mortality rate in urban areas

Regression results							
childmort_urban	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
health_coverage	12.952	68.66	0.19	.851	-123.002	148.907	
ln_pop_urb	23.92	14.208	1.68	.095	-4.214	52.054	*
ln_percap_gdp	-3.95	1.481	-2.67	.009	-6.883	-1.017	***
water	.004	.031	0.13	.895	-.057	.066	
ln_schools_urb	.967	7.577	0.13	.899	-14.037	15.971	
pensioner_ratio	1.607	.597	2.69	.008	.424	2.79	***
price_med	-1.377	11.647	-0.12	.906	-24.439	21.685	
Constant	-139.254	91.281	-1.53	.13	-320	41.492	
Mean dependent var	13.977	SD dependent var	5.918				
R-squared	0.116	Number of obs	140				
F-test	2.235	Prob > F	0.004				
Akaike crit. (AIC)	664.913	Bayesian crit. (BIC)	688.446				
*** *p<.01*, ** *p<.05*, * *p<.1*							

Table 6: Fixed effect model estimations indicating the mortality rate in rural areas

childmort_rural	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
health_coverage	-187.774	52.403	-3.58	0	-290.482	-85.066	***
ln_pop_rur	9.605	3.406	2.82	.005	2.93	16.279	***
ln_percap_gdp	2.396	1.171	2.05	.041	.101	4.692	**
water	-.043	.024	-1.81	.07	-.09	.004	*
ln_schools_rur	-13.987	4.06	-3.45	.001	-21.944	-6.03	***
pensioner_ratio	-2.944	.587	-5.01	0	-4.094	-1.793	***
price_med	7.059	9.936	0.71	.477	-12.414	26.533	
Constant	48.039	15.038	3.19	.001	18.565	77.514	***
Mean dependent var	11.108	SD dependent var	4.218				
Overall r-squared	0.460	Number of obs	130				
Chi-square	87.391	Prob > chi2	0.000				
R-squared within	0.412	R-squared between	0.498				
*** *p<.01*, ** *p<.05*, * *p<.1*							

It is clear from the results that we have similar results under fixed effect model too. The impact of healthcare coverage in urban areas still does not have significance on mortality rate while increase in healthcare coverage is expected to lead to lower mortality rate. Nevertheless, per capita GDP in urban areas is supposed to be interrelated with mortality rate in inverse directions. We can conclude from this factor that higher per capita GDP might have potential benefits of reduction in mortality rate in urban areas while it does not indicate any relationship in rural areas. In similar way, the regression results for random effect model are summarized on two tables below:

Table 7: Random effect model estimations indicating the mortality rate in urban areas

Regression results							
childmort_urban	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
health_coverage	12.952	68.66	0.19	.851	-123.002	148.907	
ln_pop_urb	23.92	14.208	1.68	.095	-4.214	52.054	*
ln_percap_gdp	-3.95	1.481	-2.67	.009	-6.883	-1.017	***
water	.004	.031	0.13	.895	-.057	.066	
ln_schools_urb	.967	7.577	0.13	.899	-14.037	15.971	
pensioner_ratio	1.607	.597	2.69	.008	.424	2.79	***
price_med	-1.377	11.647	-0.12	.906	-24.439	21.685	
Constant	-139.254	91.281	-1.53	.13	-320	41.492	
Mean dependent var	13.977	SD dependent var	5.918				
R-squared	0.116	Number of obs	140				
F-test	2.235	Prob > F	0.004				
Akaike crit. (AIC)	664.913	Bayesian crit. (BIC)	688.446				
*** *p<.01*, ** *p<.05*, * *p<.1*							

Table 8: Random effect model estimations indicating the mortality rate in rural areas

Regression results							
childmort_rural	**Coef.**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
health_coverage	-187.774	52.403	-3.58	0	-290.482	-85.066	***
ln_pop_rur	9.605	3.406	2.82	.005	2.93	16.279	***
ln_percap_gdp	2.396	1.171	2.05	.041	.101	4.692	**
water	-.043	.024	-1.81	.07	-.09	.004	*
ln_schools_rur	-13.987	4.06	-3.45	.001	-21.944	-6.03	***
pensioner_ratio	-2.944	.587	-5.01	0	-4.094	-1.793	***
price_med	7.059	9.936	0.71	.477	-12.414	26.533	
Constant	48.039	15.038	3.19	.001	18.565	77.514	***

Mean dependent var	11.108	SD dependent var	4.218	4.218
Overall r-squared	0.460	Number of obs	130	130
Chi-square	87.391	Prob > chi2	0.000	0.000
R-squared within	0.412	R-squared between	0.498	0.498

**** p<.01, ** p<.05, * p<.1*

In this scenario, impact level of factors did not change sharply. Healthcare coverage is still considered as one of the main factors to achieve lower mortality rate as it indicates negative relationship with the dependent variable. In other words, expansion in healthcare facilities is expected to lead to fall in mortality rate in rural areas but this action may not be applicable in urban areas due to insignificant coefficients according to the regression outcome within the scope of this dataset. In addition, the increase in price levels of healthcare products does not have any impact on the mortality rate in both areas. In the regression results above, one can observe the level of impact of each factor by considering the coefficients of each variable and their corresponding p-values.

In the final stage, we have to make appropriate model selection that could practically highlight our best regression results. Once we check for Hausman test, we have observed that fixed effect model has performed better compared to random effect model and usual regressions.

4.2. Policy recommendations

The empirical results should have policy implications as well in order to ensure the further implementation of these findings. Once we estimate the possible impacts of each factor on the mortality rate, we can provide appropriate policy recommendations. First of all, the significance of the main explanatory variable supports the action to increase the coverage of healthcare facilities so that major portion of the population will have access. As we observed in review of previous studies in literature review part, the access to healthcare possibilities might play essential role in reducing the mortality rate at higher importance in comparison to their quality. In the first step, the government expected to increase the number of households to provide the access to more individuals. In addition, the action plan to widen the coverage of population with healthcare facilities should focus on the distance factor as well. That is, higher coverage ratio might not be as effective solution as we expected if particular portion of the population still suffers from matters regarding the far distance. Moreover, expansion of access to water resources should also be in annual investment programs of the government. Even though water supply factor does not all the time indicates statistically significant matters affecting the mortality rate, at least it might have indirect effect with other factors. Finally, our approach also proved the role of per capita GDP factor on the healthcare matters as it exclusively defines the welfare of the public. As per capita GDP increases, it is expected that literacy level of individuals in different fields including healthcare and sanitation could be improved. However, policy actions towards increasing the per capita GDP might be challenging since it is high-level macroeconomic factor and it requires huge volume of economic cost as well. Additional to these policy recommendations, the government intervention is required to regulate the inflation rate in the prices of healthcare products as this factor also has indirect effects on the mortality rate which might have supplementary correlation with welfare of the population.

5. Research limitations

As the measurement of the impact of “green” factors on the mortality rate requires well-structured dataset including a number of factors, practically available data for the past 10-15 years in this country involves the use of proxy variables.

The main challenging situation with the methodology part is that it has been critical to measure the impact of independent variables on the mortality rate, specifically, in Tashkent. As we denote the dependent variable as the mortality rate in urban and rural areas, we do not actually observe rural areas in Tashkent and this fact could distort the final outcomes at marginal manner. Furthermore, we can refer to the degree at which the results can be implemented in the country. Actually, the decisions of the policy makers should be based on empirical studies rather than personal views so that our results would not be left behind the scope of action plans.

6. Conclusion

We aimed at measuring the impact of demographic and economic factors on the mortality rate in the country. In order to conduct this analysis, relevant academic papers have been discussed and the majority of them mentioned the importance of the availability and access to the healthcare facilities. In addition, a methodology for estimating the impact of different factors such as coverage of healthcare facilities and water resources as well as welfare indicators on the mortality. Within the framework of the methodology, summarized description of the data is also included. In the empirical part, true impact of explanatory factors on the dependent variable has been explained. Based on these, we can confidently sum up that the coverage of the healthcare facilities has direct effect on the mortality rate while water resources availability and welfare of the population do not have. Because they might indicate joint significance behind other major elements. According to the finding, appropriate policy recommendations are also included supporting the investment in healthcare system referring to the access and availability of healthcare services and government intervention in regulating the prices of medical products. However, there are many other factors that could have impact on the mortality rate and they are beyond our analysis.

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