

## Difference-in-Difference Approach in Estimating the OOPE for Non-Pandemic Diseases during Pandemic Period

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### Abstract

**Background:** Despite its branding as the “world’s pharmacy”, India’s population has limited access to medications with households paying over 65% of total health spending on out-of-pocket expenditure, with two-thirds of that on drugs [1]. As per World Health Organisation (WHO) research, household OOP spends on health services, particularly medications continue to force over 55 million Indians into poverty, with over 18% of households facing catastrophic levels of health expenditures annually [2]. In UDCs, the OOPE on healthcare is substantial compared to household income due to the lack of a social science system, low income levels and insurance coverage, growing longevity and non-communicable diseases [3]. The WHO has also recognized the issue and urged government to guarantee the basic healthcare services were available during pandemic [4]. Despite global guidance to maintain essential non-COVID health services, the number of people receiving healthcare for a variety of reasons, including maternal and neonatal care, child illnesses, communicable diseases, NCDs and injuries and emergencies requiring critical care has decreased [4]. Hence during the time of pandemic there was disturbance for accessing and utilizing the healthcare activities for the people those who have been suffering from chronic diseases [5]. This may cause to decrease in healthcare expenditure of the individual health seekers [6].

**Keywords:** Out-of-pocket expenses; Non-pandemic diseases; Difference-in-Difference (DiD) Approach; Chronic and acute diseases

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### Introduction

The individual payments for healthcare services or goods are referred to as expenditures on healthcare (OOPE) [7]. If a person becomes unwell and attends a doctor’s clinic, he/she pays for the consultation fee as well as additional services (injection, wound dressing etc), supplied by the doctor [8]. He/she also pays for drugs at the pharmacy and diagnostic tests (X-ray, blood test etc) at the laboratory individually [9]. OOPE refers to all payments made at the time of getting a health treatment, when an individual visit to a healthcare provider (clinic, hospital, pharmacy, laboratory etc) is not supplied “free” through government health facility or a facility run by a non-for-profit organization or if this individual is not insured OOPE is frequently charged [10].

Despite its branding as the “world’s pharmacy”, India’s population has limited access to medications with households paying over 65% of total health spending on out-of-pocket expenditure, with two-thirds of that on drugs [11]. The findings of National Health Accounts (NHA) estimates for India 2017-18, both OOPE as a share of overall health spending and foreign aid for healthcare decreased. OOPE has decreased from 64.2% (Rs.2336) in 2013-14 to 48.8% (Rs.2097) in 2017-18 as a percentage of an overall health spending [12]. An increase in utilization and a reduction in the cost of services in government health institutions are two variables contributing to OOPE for government hospitals [13].

The NHA estimates for 2017-18 clearly demonstrated arise in the share of government health expenditure in the country’ total GDP from 1.15% in 2013-14 to 1.35% in 2017-18, it has risen [14].

Furthermore, the proportion of government health spending in total health spending has risen over time [15]. In 2017-18, the government's share of expenditure was 40.8% up from 28.6% in 2013-14. According to the data, between 2013-14 and 2017-18, the government's health spending climbed from \$1042 to \$1753 percapita [16]. As per World Health Organisation (WHO) research, household OOP spends on health services, particularly medications continue to force over 55 million Indians into poverty, with over 18% of households facing catastrophic levels of health expenditures annually [17].

### Effects of OOPE on households

OOPE are a financial hardship for all households since they occur during a health event when the family is already in trouble [18]. When a household income is low or the amount of OOPE incurred is large, specifically the inpatient treatment or serious illness the impact of OOPE is significantly greater [19]. OOPE reduces expenditure on other necessary and fundamental requirements such as food, shelter, clothes, education and so on, especially among low-income households [20]. It also forces households to borrow money from friends, family or money lenders, pushing them deeper into debt [21]. The OOPE of a household which is often greater than 10% of the total household consumption expenditure is disastrous and it put the home below the poverty line, resulting in impoverished [22]. Medical OOPE is the total of all payments made in the previous 365 days for inpatient, outpatient and pregnancy/childbirth treatment [23]. A low overall OOPE value combined with high consumption of healthcare services in both public and private sectors indicates a well-functioning government health system, health insurance, and/or social health protection programme [24]. OOPE is the principal source of healthcare funding in underdeveloped countries [25]. In India, health spending accounts for 69.5% to overall health spending [26]. Because the services of a primary healthcare centres are not accessible to the majority of the population in some sections of the country due to inconvenient distance, person in these areas are more likely to use private sector facilities, which may result in greater percapita OOP health expenditure. OOPE exacerbates poverty, has a detrimental influence on equity and can put disadvantaged populations at danger of falling into poverty [27].

In UDCs, the OOPE on healthcare is substantial compared to household income due to the lack of a social science system, low income levels and insurance coverage, growing longevity and non-communicable diseases [28]. The high OOPE limits household consumption of non-health products and services, disturbs household living standards and drives many families into medical poverty and financial misery [29]. OOPE involve financial payments recorded in surveys and were made by households at the time of receiving health services [30]. Catastrophic health spending happens when a family must cut back fundamental needs for a period of time to cover healthcare costs for one or more of its members. If healthcare costs 5.2% of total household income, it is considered catastrophic [31].

There are different indicators related to the healthcare expenditures (THE) given by NHAs which includes total expenditure as percentage of GDP, THE percapita at current prices, THE percapita at constant prices, current health

expenditure (CHE) as percentage of THE, government health expenditure (GHE) as percentage of THE, OOPE as percent of THE, social security expenditure on health as percent of THE, private health insurance expenditure as percent of THE [32]. As per the various NHA estimates, it is bad sign that there is a decrease in the percent of NHA 2004-05 is 4.2% to 3.3% during the NHA 2017-18 [33]. Similarly, THE percapita at constant prices (Rs.2066 to Rs.3333), CHE as percent of THE from 98.9% to 88.5%, OOPE as percent of THE is from 69.4% to 48.8% and the donor funding for health as percent of THE from 2.3% to 0.5% are the different indicators, such as THE percapita at current prices (Rs.1201 to 4297), government health expenditure (GHE) as percent of THE (22.5% to 40.8%), social security expenditure on health as percent of THE ranges from 4.2 % to 9%, and private health insurance expenditure as percent of THE (1.6% to 5.8%) has increased between the time period of 2004-05 to 2017-18 [34]. The ultimate inference from these facts is that, there is good symptom of distribution of government expenditure on health has increased double time. Simultaneously it should be noticed on OOPE, which shows decreasing trend from 2004-05 to 2017-18. If it is so, it is a researchable issue on how was the OOPE during pandemic period for the non-pandemic diseases. It is fact finding issue in this research paper [35].

### Research problem

The COVID-19 epidemic has inflicted havoc on the variety of industries, including healthcare. Researcher has focused their emphasis on gaps in healthcare availability for COVID-19, infections poor nations. During the epidemic, most established healthcare services are disrupted. The WHO has also recognized the issue and urged government to guarantee the basic healthcare services were available during pandemic<sup>(42)</sup>. Despite global guidance to maintain essential non-COVID health services, the number of people receiving healthcare for a variety of reasons, including maternal and neonatal care, child illnesses, communicable diseases, NCDs and injuries and emergencies requiring critical care has decreased. Hence during the time of pandemic there was disturbance for accessing and utilizing the healthcare activities for the people those who have been suffering from chronic diseases. This may cause to decrease in healthcare expenditure of the individual health seekers. An attempt has been made to study the healthcare seeking behavior of people along with health treatment expenditure and determinants of OOPE for the chronic diseases. Hence during the time of pandemic there was a disturbance for accessing and utilizing the healthcare facilities for the people whose who have been suffering from chronic diseases. This may cause to decrease in healthcare expenditure of the individual health seekers. Attempt has been made to study the healthcare seeking behavior of people along with healthcare treatment expenditure and determinants of OOPE for the chronic diseases.

### Methods & Materials

The study looked on the healthcare utilization pattern and study participants who had atleast one chronic illness. As a result, the overall sample size interms of healthcare consumption was 2169 (1813 – non-pandemic chronic diseases and 356 – non-pandemic

acute diseases) by using mailing (online data collection) on system of medicine, kind of hospital, type of services, type of government hospital, medical insurances available were also investigated during January to May 2022. The research participants OOPE for chronic morbidity in 30 days before to data collection were gathered. To study the above said issues simple statistical and econometric tools have applied along with regression analysis in order to study the determinants of OOPE for chronic diseases. The percentage distribution, mean and standard deviation were calculated and presented in the name of descriptive statistics. The various socio-economic indicators also extracted from the respondents to find out the determinants of OOPE of the respondents.

On the different time period, the expenditure made during pre, during and post COVID were also been collected from the respondents to find “Is there any change in OOPE?”. The difference-in-difference (DiD) estimation attempts to measure the effects of sudden change in economic environment or general treatment on a group of individuals. Based on a combination of “before”, “after” and “treatment”, “control” group comparisons, the method has an intuitive appeal and has been widely used in economics. The DiD technique has been employed to assess the differential impact of covid pandemic on the healthcare expenditure. The “pre”, “during” and “post” criteria were used to understand the impact of covid on healthcare expenditure (Table 1).

Therefore,

$$Expt_{it} = \beta_0 + \beta_1 Y_i + \beta_2 Situation_t + \beta_3 Y_i * Situation_t + \beta_4 X_{it} + \epsilon_{it}$$

Where,

$Expt_{it}$  - healthcare expenditure for non-pandemic diseases at the time “t”

$Situation_t$  - multinomial variable with a value 0-pre-covid; 1-during covid and 2-

Table 1. Distribution of respondents with different diseases

Non-pandemic chronic diseases	OOPE of the respondents			
	Pre-COVID	During COVID	Post-COVID	Total
Diabetes	267 (43.06%)	142 (22.90%)	211 (34.03%)	620
BP (High/Low)	133 (48.01%)	58 (20.94%)	86 (31.05%)	277
Asthma / Breathing problem	62 (29.81%)	88 (42.31%)	58 (27.88%)	208
Ulcer / Stomach problem	73 (41.24%)	47 (26.58%)	57 (32.20%)	177
CVD	153 (44.22%)	89 (25.72%)	104 (30.06%)	346
Liver problem	67 (60.36%)	25 (22.52%)	19 (17.12%)	111
Others	36 (94.68%)	15 (2027%)	23 (31.08%)	74
<b>Total no. of non-pandemic chronic diseases</b>	<b>791</b>	<b>464</b>	<b>558</b>	<b>1813</b>
	<b>-43.63%</b>	<b>-25.59%</b>	<b>-30.78%</b>	<b>-100%</b>
<b>Total no. of non-pandemic common acute diseases</b>	<b>181</b>	<b>57</b>	<b>118</b>	<b>356</b>
	<b>-50.84%</b>	<b>-16.01%</b>	<b>-33.15%</b>	<b>-100%</b>

Source: Estimation based on survey data  
Note: Figures in parentheses are percent.

post covid

$\beta_1$  - co-efficient of marginal efficiency of income

$\beta_2$  - marginal effect of covid

$\beta_3$  - co-efficient of interactive term between income and different situations

$X_{it}$  - vector of other control variables

$\epsilon_{it}$  - error term

## Results and Discussion

The respondent’s socio-economic background has a significant impact on how they use healthcare and how much money they spend on it. Interms of sample responses, males account for the biggest age, followed by females all of whom are affected by chronic and acute or non-pandemic disorders (Table 2). The age category for both male and female members is the same and they are in the 35+ year range. As a result, chronic illnesses appear to affect people of all ages (Table 3). In addition the majority of the respondents (82.5%) are married (Table 3). Aside from that,

Table 2. Descriptive statistics on OOPE

Descriptive statistics on OOPE in different periods for different diseases (in Rs.)			
Diabetes	856	7.22	620
BP (High/Low)	732	9.23	277
Asthma / Breathing problem	531	4.71	208
Ulcer / Stomach problem	339	3.9	177
CVD	1672	4.92	346
Liver problem	451	5.05	111
Others	383	2.92	74
Common acute non-pandemic diseases	75.02	3.65	356
During covid			
Diabetes	591	9.1	620
BP (High/Low)	536	7.41	277
Asthma / Breathing problem	694	4.51	208
Ulcer / Stomach problem	253	3.98	177
CVD	1329	5.7	346
Liver problem	254	9.78	111
Others	213	3.9	74
Common acute non-pandemic diseases	28.13	1.92	356
Post-covid			
Diabetes	763	9.6	620
BP (High/Low)	693	8.46	277
Asthma / Breathing problem	607	6.14	208
Ulcer / Stomach problem	317	6.03	177
CVD	1425	7.89	346
Liver problem	214	6.2	111
Others	286	5.41	74
Common acute non-pandemic diseases	49.83	2.86	356

Source: Estimation based on survey data

Note: Column (1) shows the average OOPE for each disease

Column (2) indicates the standard deviation

Column (3) indicates no. of respondents in each category of disease.

**Table 3.** Multivariate test on OOPE

Multivariate test						
Effect	Value	F	Hypothesis df	Error df	Sig.	Partial eta square
Intercept						
➤ Pillai's Trace	0.878	1324.078	2	55	0	0.888
➤ Wilk's lamda	0.001	1324.078	2	55	0	0.888
➤ Hoteeling's Trace	85.856	1324.078	2	55	0	0.888
➤ Roy's largest Root						
	85.856	1324.078	2	55	0	0.888
Diseases						
➤ Pillai's Trace	0.505	11.57	4	113	0	0.208
➤ Wilk's lamda	0.45	12.624	4	112	.000***	0.218
➤ Hoteeling's Trace	1.064	13.671	4	100	0	0.24
➤ Roy's largest Root						
	0.804	25.061	2	46	0	0.367

Note: \*\*\*, \*\* & \* are significant at 1%, 5% & 10%.

**Table 4.** Tests between time period effects

Source	Dependent variable	Type III sum of squares	df	Mean squares	F	Sig.	Partial eta squared
<b>Corrected mode</b>	<b>Pre</b>						
	During	1323.122	2	1106.006	17.004	0	0.278
	Post	775.522	2	831.706	13.184	.000***	0.224
		943.121	2	432.009			
<b>Intercept</b>	<b>Pre</b>						
	During	155155.71	1	155155.71	2851.658	0	0.876
	Post	77670.056	1	77670.056	1225.024	0	0.848
		92486.146	1	92486.146			
<b>Disease</b>	<b>Pre</b>						
	During	1323.122	2	1106.006	17.002	0	0.278
	Post	775.522	2	831.706	13.184	.000***	0.223
		943.121	1	432.009			
<b>Error</b>	<b>Pre</b>						
	During	2718.84	1810	56.081			
	Post	2648.2	1810	54.842			
		2075.038	1810	51.064			
<b>Total</b>	<b>Pre</b>						
	During	171420	1813				
	Post	83316	1813				
		69714.01	1813				
<b>Corrected total</b>	<b>Pre</b>						
	During	5154.072	1812				
	Post	4533.822	1812				
		2983.901	1812				

Note: \*\*\*, \*\* & \* are significant at 1%, 5% & 10%

the sample responses are evenly split between working and non-working. The majority of them work in white collar positions, earning a minimum of Rs.14, 320/month and maximum of Rs.97500/month. With an average monthly income earning capability of respondent is Rs.32, 560/month. Along with this, the respondents, household spending is indeed collected and it actually serves as a proxy variable for the respondent's income. The monthly household expenditure ranges between Rs.12900 to 25000 per month. The monthly household expenditure is Rs.22, 345 for the same. The overall healthcare expenditure is also a

part of this household expenditure data.

With regard to the majority of people choose modern medicinal (Allopathy) as their medical system (86%). Homeopathy is the least popular medical system and 13% of the people are using a mix of different systems. While 1001 (46.15%) of individuals seek care at government hospital and 1168 (53.85%) seek treatment at private hospitals. In this survey, the majority of people 1696 (78.2%) utilize solely, outpatient care for chronic conditions, whereas just 21.8% (473) use inpatient services. Among the 1001

**Table 5.** Impact of pandemic on OOPE for non-pandemic diseases

Variable	Specification – 1 (without covariates)	Specification – 2 (with covariates)
Constant	2.801 (0.117)	3.046 (0.113)
Income	4.024 (0.11)	1.012 (0.21)***
Situation (Ref: During covid)	Pre-covid – 0.029 (0.20) Post-covid – 0.706 (0.28)	-1.867 (0.26) -0.814 (0.262)
Y * Situation	0.807 (0.613)	0.941 (0.664)
Age	0.699 (0.220)	0.781 (0.048)
Type of hospital (ref: government hospital) Private hospital	8.727** (0.004)	8.321 (0.021)**
Gender (Ref: Male) Female	----	0.912 (0.003)***
Region (ref: rural) Urban	----	2.568 (7.106)
Household size	----	-1.64 (0.045)**
No. of observations	2169	2169
F statistic	49.87	52.15
Prob>F	0	0
R <sup>2</sup>	0.43	0.39

Note: \*\*\*, \*\* & \* 1%, 5% & 10% levels of significant  
Dependent variable – Logarithm of OOPE respondents  
Source: Estimation based on survey data.

(69.7%) patients who use private healthcare services, while the remaining 31.3% individuals who use medical college hospital services and community healthcare centres (CHC),

A self-reported non-pandemic disease (chronic and non-chronic/acute diseases) during pandemic period was received. With regard to two categories of diseases such as chronic and acute non-pandemic diseases, 84% (1813 numbers) of the respondents were affected by common acute non-pandemic diseases such as cold & fever, diarrhea, pneumonia and different aches like leg, knee and back pain. Among the total chronic respondents more than 50% one third of the respondents (917) have infected with chronic diabetes when compared with other non-pandemic diseases such as cardio-vascular disease (CVD)(19.09% -346 patients), blood pressure – high/low (15.3% - 277 patients), asthma/breathing problem (11.5% - 208 patients) and other non-pandemic diseases include cancer (1.71% - 31 patients), tuberculosis (– 0.89% - 16 patients), stroke (1.03% - 18 patients). With this, it may be inferred that most of the patients are infected with chronic non-pandemic diseases are diabetes, CVD and blood pressure.

Along with the disease infected by respondents, further attempt has been made on the healthcare expenditure incurred by them during different time period viz., pre-pandemic, pandemic and post-pandemic. As it was justified in the problem formation a real picture should be derived on the same subject of healthcare expenditure or OOPE. Is there any change in OOPE on different time period? shall be examined by an economics student. The major researchable issue is that, in different time periods how far the healthcare expenditure has been varied from one disease to another. The inference received from the analysis is that except the disease asthma, all other diseases, the patients have incurred less expenditure during covid period comparatively pre and post covid period within the different diseases also expenditure

made during three different situations also varies. From the bivariate analysis between different covid time periods (pre, during and post covid) except two different major diseases like asthma or breathing problem and liver problem the percentage of healthcare expenditure incurred by them were less. The expenditure incurred on healthcare treatment was more during pre covid and had increased at the time of covid and further it was reduced during post-covid period. This shows that healthcare seekers may understood about their health status and moreover they used to take healthy food items during the covid that itself improved their health status.

The descriptive statistics is useful as it provided the mean and standard deviation for three different periodical dependent variables which has been split by different independent variables. The table provides total rows which allows mean and standard deviation for groups only split by the dependent variables was known. It is a mean expenditure incurred by both groups in different periodical situation.

### Multivariate test

Multivariate test helps to look at the second effect as type of diseases and the Wilk's lambda row. It can be seen from the table that it has significant value of 0.000, which means  $p < 0.005$ . It may be concluded that patients suffered from different diseases was significantly dependent on which different time period ( $p < 0.005$ ).

There was a statistically significant difference in healthcare expenditure during and pre-covid. To determine how the dependent variables differ for the independent variable it is needed to look at the tests of between time periods effect is shown in (Table 4).

The regression model with different control variables was estimated to ensure the robustness of DiD estimates. This research

observed that effect of age, income and type of hospital on OOPE for non-pandemic disease (including chronic and common acute diseases). The sign and statistical significance level of interaction term is compatible even after controlling for socio-economic variables. The co-efficient for income, situation and age are found to be positive and statistically significant implying that the OOPE increase with increase in income. Likewise the increase in age also had an increase in OOPE of the respondent. In otherwords, the co-efficient of marginal efficiency of income has increased based on the level of earnings of the respondents. Similarly, with reference to time period or the situation/during covid, the marginal effect of pre-covid situation had positive significant impact on OOPE and the post covid situation had negative significant impact on OOPE. This is more at pre-covid period when compared with post covid. Furthermore, the co-efficient of the interacting term between income and OOPE differentiation is statistically significant (Table 5).

In fact the impact of different period on OOPE clearly revealed in Table-6. DiD based on the decomposition of OOPE for non-pandemic diseases during post covid situation of respondents is less than that of pre-covid OOPE and which account for statistically significant based on the DiD analysis of both with and without covariates. For instance, the model with covariates the difference in the co-efficient associated with control and treated groups is 0.615 for the pre-covid period, where for the post-covid, the

difference without covariation, difference had decreased during pre-covid to post-covid (0.417 to 0.313). Hence the difference-in-difference co-efficient between periods is also negative (-0.104 & -0.157) and statistically significant for both models such as with and without covariates (Table 6).

## Conclusion

Medical pharmacies are also frequently used, according to several research. According to household income and expenditure survey data, a large amount of money, almost 60%, was spent on procuring medicine. Individuals who sought care in private institutions spent significantly more money than those who sought care in public facilities, according to the poll. Because the government significantly subsidizes public institutions, treatment expenses are usually shared by households and public hospitals. Private facilities, on the other hand, must pay all expenses and profits since they are profit-maximizing. Despite the fact that the study revealed a significant association between OOP expenses and various economic situations associated with pandemics. These findings might be a useful source of information for respondents' disease-specific out-of-pocket expenses. As a result, governmental initiatives should focus on low-income households to alleviate economic constraints during illness. As a result, a pro-poor policy initiative, as well as an urban health protection programme, may be necessary to assure healthcare service accessibility and affordability in compliance with various national level healthcare laws.

## Results & Conclusion

Despite the fact that the study revealed a significant association between OOP expenses and various economic situations associated with pandemics. These findings might be a useful source of information for respondents' disease-specific out-of-pocket expenses. As a result, governmental initiatives should focus on low-income households to alleviate economic constraints during illness. As a result, a pro-poor policy initiative, as well as an urban health protection programme, may be necessary to assure healthcare service accessibility and affordability in compliance with various national level healthcare laws.

Table 6. Did estimation results

	Pre covid	Post covid	Sig.
Model – 1	C T D	C T D	-0.104***
(without covariates)	2.081 2.498 0.417	1.361 1.674 -0.313	
Model – 2			
(with covariates)	3.046 3.661 0.615	1.493 1.951 0.458	-0.157***

Source: Estimation based on survey data

Note: \*\*\*, \*\* & \* 1%, 5% & 10% levels of significant.

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