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Understanding the Reasons of Diarrhea among Children in India: Cross Sectional Study using National Family Health Survey

[1]Vishakha Jain, [2]Dr. Mridul Dharwal, [3]Dr. Prem.S. Vashishtha, [4]Dr. Nimmi Agarwal

[1]Research Scholar , Sharda School of Business Studies, Sharda University, Greater Noida U.P
[2]Professor, Sharda School of Business Studies , Sharda University, Greater Noida U.P
[3]Professor, Sharda School of Business Studies , Sharda University, Greater Noida U.P
[4]Assistant Professor, Sharda School of Business Studies, Sharda University, Greater Noida U.P

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Abstract

Safe sanitation is a global commitment under Sustainable development goal 6. The objective of safe sanitation is to eliminate direct/indirect human contact with human feces. The feces of the young children are equally infectious as of an adult. The young children who require constant care, depends on their mother/caregivers for their hygiene. If the mothers of these young children are disposing their feces in unsafe manner, it will create high health and environment negative externalities. An outcome of these unhygienic sanitation practices is diarrhea which is a common infection that can be cured easily. With the increase in health care facilities, India has controlled mortality due to diarrhea among under-5 children. But it is also important to reduce the prevalence of diarrhea as it may cause malnutrition among young children. This paper is focused on finding out linkages of prevalence of diarrhea among children under 5 years of age and the mother's behavior for disposing the stool of their children.

Keywords: Diarrhea among children under five, Health Inequalities, SDG-3, SDG-6, Disposal of child's stool by their mothers.

1. Introduction

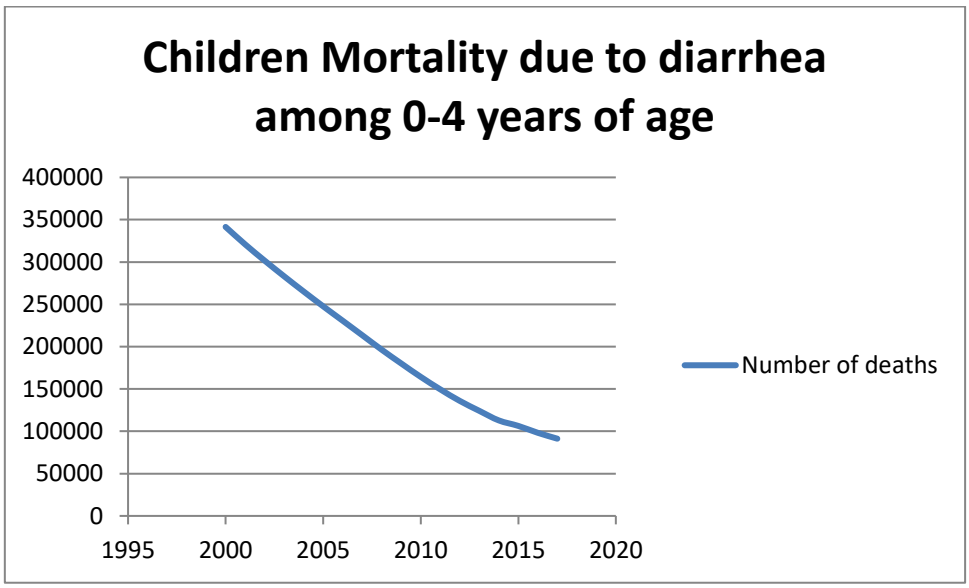
Despite the fact that diarrhoea is a common disease that can be easily treated at a low cost, Hogan (2018) reports that approximately 1300 young children all over the world pass away every day due to this common infection. It is the leading cause of death among those that can be avoided, especially among children under the age of five in developing countries (Keusch, Fontaine, Bhargava et al., 2006). Diarrhea can be defined a condition when three or more loose stools passed per day. Here it is mentioned if a person is passing of three or more formed (Not loose) stools, it is not considered as diarrhea. Diarrhea is a reflex action of parasitic growth in the intestinal tract(National Institute of Diabetes and Digestive and Kidney Diseases, 2016). Mostly these germs spread through the feces of one person to food through flies and thus enter into the mouth of another person. This means any visible traces of human/animal feces can become source of diarrhea. Unhygienic Sanitation, unsafe drinking water and in- sufficient personal hygiene accounts for 88 % of diarrheal cases (Robert E Black, Saul S Morris, 2003). Visible feces help these germs to contaminate surface water, nearby objects and ultimately moved to food through flies. If such parasitic growth gets cured within a few days of its occurrence, it cannot be termed as deadly disease it is a temporary dysfunction of the stomach to absorb nutrition from the food. But if it is not cured within few days and persists for longer duration without medical treatment, it leads to dehydration and become a deadly disease. Unavailability of safe defecation facilities increases the threat to catch other infections by such patients. According to the World Health Organization, 60 per cent of total diarrheal deaths are due to Poor sanitation. It affects rich and poor alike(Jamie Bartram, Sandy Cairncross, Thomas Clasenord, Jack Colford, Oliver Cumming, Valerie Curtis, Alan Dangour, Lorna Fewtrell, Matthew Freeman, Paul Hunter, Aurelie Jeandron, 2014). The only difference is among the mortality due to diarrhea. In the developing countries, rich can get the treatment but poor can't afford that. Therefore till now there is less attention to control the prevalence of diarrheal disease. There is focus on its treatment but there are very few efforts taken to reduce the occurrence of the disease. Diarrhea can be prevented with small efforts like

availability of Safe drinking water, better sanitation, and hygiene through hand washing. Still it is the second leading cause of under-five child mortality(Bartram, Cairncross, Clasenord *et al.*, 2014). Diarrhea can last for several days, it can drain the essential fluids and salt from the body so those children who are already Under-nourished, are the easiest target who gets dehydrated within few hours of diarrheal occurrence. Children in the age group of 0-5 years are the most vulnerable category who lost their life due to diarrhea. If such common infection can be reduced, life of 4,80, 000 children (under-5) globally can be saved each year globally(Hogan, 2018).

2. Background

The fourth Millennium Development Goal (MDG-4) was aimed to reduce the under-5 mortality by two-thirds. India has achieved an impressive reduction in under-5 child mortality in general. Still after twenty after the declaration of MDG, this concern is again taken and reframed while formulating Sustainable Development Goal. The SDG- 3 is focused for Good health and well-being(Food and Agriculture Organisation of the United Nations, 2020). Well-being can't be achieved without achieving successful control in the occurrence of common disease among small children like diarrhea. Although, it is appreciable effort by government of India that preventive and curative measures have improved to cure the common disease and this result in reduction in under-5 mortality due to diarrhea as well. It has reduced the mortality due to diarrhea. The mortality has reduced from 844 436 children (in the year 1980) to 117 285 children (in the year 2015) (Liu *et al.*, 2000). However, Diarrhea is still a major concern of child mortality.

Figure 1: Mortality due to diarrhea among the children under 4 years



Source: Global health observatory data repository, WHO

Temporal evidences shows that there has been only marginal improvement in reduction of mortality due to diarrheal (The data on mortality due to diarrheal disease is available only in the age group of 0-4 years).In the year 2017 total 91,270 under-four young children lost their life just due to diarrhea. Although this number has shown a reduction in the mortality but this could be due to contribution of health care facilities, increase in awareness through education and mass media campaign, but the country like India, which is already have crisis of health care infrastructure, it more important to reduce the incidence of disease. If a disease is easily preventable by maintaining hygiene then we should focus on the reduction of its occurrence and should not depend on the healthcare interventions to cure it after the infection. The country has achieved a significant success in reducing child mortality due to diarrhoea but all credit goes to curative measures like giving fluids like oral rehydration salt (ORS). The control of prevalence of the common disease like diarhhea is important

to increase the overall health parameters of the children. The most common reasons which trigger the disease to be spread are malnourishment, low socioeconomic status, low awareness/ literacy among mothers to provide lactation/ORS/other fluids, less weight at the time of birth, lesser duration of breastfeeding and poor hygiene conditions (Gupta and Murali, 1998) . In rural India almost all of these factors exist which trigger the disease incidence. Reducing inequalities in the human health and well-being is one of the main of SDG third goal. The rural-urban drift in India is very high. The spread of curative health care facilities is almost negligible in the villages of India. It's why to control the prevalence of such curable disease become even more important for rural India.

3. Objective

a) To examine the reasons for high prevalence of diarrhea among children under five.

b) Further the study will examine the impact of mother's behavior for disposal young child's stool, water and sanitation facilities and wealth index based on location; rural and urban households.

4. Hypothesis, Methodology and Data Used

The objective of the study is behavioral analysis qualitative analysis is required. To understand the impact in more logical manner, analysis is done through SPSS software version 24.

4.1 Hypothesis

$$InD= \alpha+\beta_1 DW+ \beta_2 DS+ \beta_3 W+ \beta_4 T+ \varepsilon$$

[Where, D= Mothers reported the case of diarrhea among their children (under-5) within two weeks of data collection; DW= Improved source of drinking water; DS= Method of disposal of young children stool by mothers and W= Wealth Index of mothers; T= Access to hygienic toilets; ε= error term]

To analyze the data, Logistic regression is used, as the dependent viable is of binary in nature. The logistic regression becomes more relevant as we have binary outcome measured repeatedly for each subject. Logistic regression assumes that the outcome variable is binary (i.e., coded as 0 and 1), in our case we have taken only two categories for dependent variables, the mother reported diarrhea among their children (under-5) within two weeks of data collection and mother who do not reported such issue. With a categorical dependent variable (incidence of diarrhea in this study), discriminant function analysis is generally applied when maximum of the predictors is well distributed. Here in this case, logit analysis is considered suitable as the predictor variables are a mix of continuous and categorical variables. An independent factor like Income is measured as a continuous variable in the survey. In our exercise, however, income is taken in dichotomous form. "Other independent factor is Improved source of drinking water includes Piped into dwelling/yard/plot, Public tap/standpipe, Tube well or borehole, Protected dug well, Protected spring, Rainwater and Community RO Plant". There are others source of water as well like Unprotected dug well, Unprotected spring, Tanker truck/cart with small tank, Surface water and Bottled water which are considered as unimproved source of drinking water. Bottled water is also taken as unimproved source because the source of bottled water is not known.

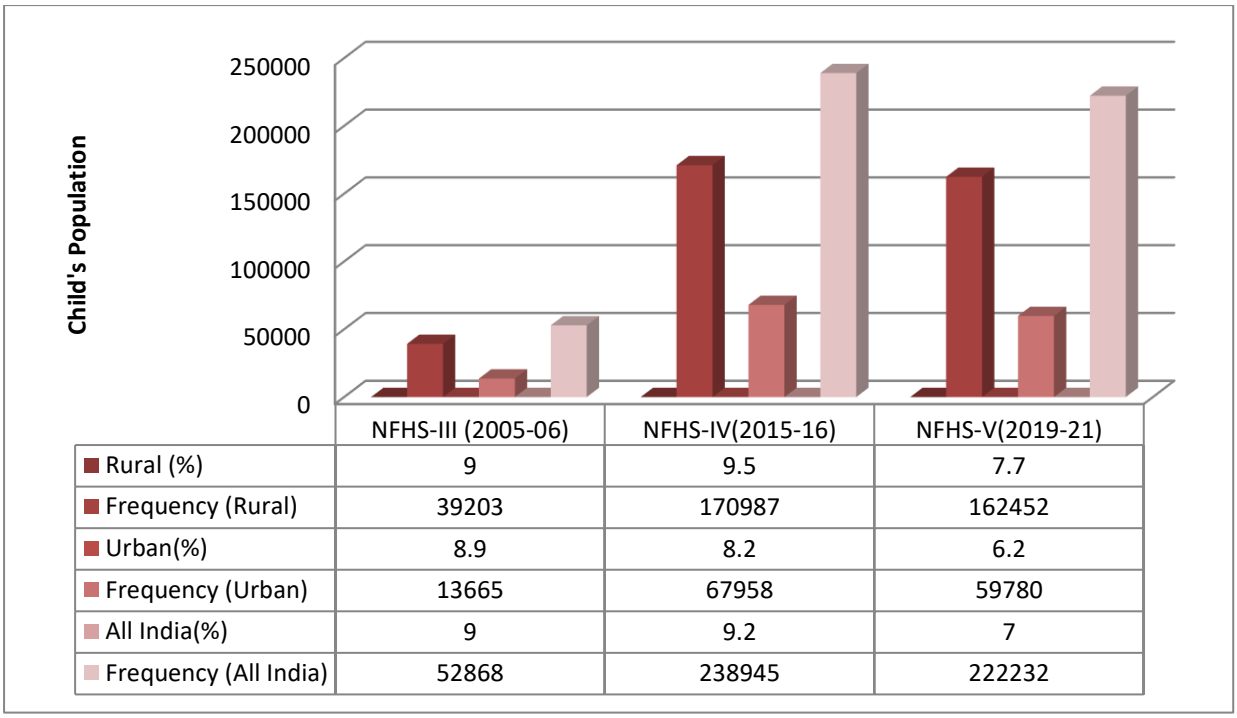
4.2 Data Used

The analysis is based on the unit level data on NFHS-IV round. NFHS data are large-scale surveys collected through representative samples of households. It is conducted by the Ministry of Health and Family Welfare, Government of India. GOI has nominated the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency for all the rounds of NFHS survey. The reference year for NFHS-IV is 2015-16 (collected from January 2015 to December 2016) published in 2017. It has covered 601 509 households including 699 686 women and 112 122 men. It's a multistage, stratified sample for which the estimates valid at the national and state levels. The information about occurrence of diarrheal disease among under-5 children is taken from the mothers.

4.3 Dependent Variable (Occurrence of diarrhea in rural and urban India)

India has achieved a significant reduction in the under-five child mortality. The total mortality has reduced from 2.5 million in 2001 to 1.5 million in 2012 (Bhan, 2015), though this does not mean that the incidence of common diseases has also reduced. As the infection drains the fluids from the body, it becomes a reason behind malnourishment among children. The decline in the prevalence of the disease is important to improve the nourishment level among the children. The mortality can further controlled by reducing the incidences of diarrhea. Let's understand the trend in occurrence of diarrhea among children under-5.

Figure 2: Trends of cases of Diarrhea among children (0-5 years) within two weeks before the survey



	NFHS-III (2005-06)	NFHS-IV(2015-16)	NFHS-V(2019-21)
Rural (%)	9	9.5	7.7
Frequency (Rural)	39203	170987	162452
Urban(%)	8.9	8.2	6.2
Frequency (Urban)	13665	67958	59780
All India(%)	9	9.2	7
Frequency (All India)	52868	238945	222232

Source: *National Family Health Survey (NFHS-3 & NFHS-4), India*

From the above figure, it is observed that incidence of diarrhea has increased from 2005-06 to 2015-16 and in 2019-21, it is stabilized. With improvement in sanitation and drinking water facilities, it is expected that incidence of common disease with high association with sanitation and hygiene should go down. India has declared 'Open defecation Free' in 2019 which means there should be significant reduction in the cases of diarrhea in the recent survey. In Rural India, health care facilities are poor so the occurrence of diarrhea results in high child mortality. Moreover low literacy level among mothers leads to low awareness about the treatment/ remedies and precautions. In such cases, a minor infection becomes deadly for a small child. The incidence of disease in urban has decreased a little in percentage but when checked in absolute numbers, the total number of cases have increased by more than five times. This number is shockingly increases in rural India. This number of children reported diarrhoea in the rural India has increased by just 0.5% (2015-16) and decreased to 7.7 % (2019-21) but in absolute numbers the cases of diarrheal reported among the children has changed to five times from 2005. India is the most populated country of the world. The growing population and proportion of children cannot be ignored.

4.4 Independent Variable

The common reasons behind diarrhea are the contaminated drinking water or unhygienic sanitation facilities. The children who belong to higher income families, can get better and quick curative health care facilities but the children who belong to lower income families are the most vulnerable. Children belonging to higher wealth

quintile have better sanitation and drinking water facilities as well. If the mother is disposing child stool in unsafe manner (throwing on the street/open), it should be considered as open defecation hence impact the overall sanitation of the residential locality. The study has taken four independent variables or four reasons behind high occurrence of diarrhea; Wealth quintile, access to safe Drinking water, Access to Improved toilets and mother's behaviour in disposing their child stool (if child is not using toilet)

4.4.1 Why is prevalence of diarrhea among children below 5 years not so markedly different across wealth quintiles?

With increase in the wealth index, there is high expectation to decrease the incidence of disease as the disease has the high correlation with hygiene/ safe drinking water and sanitation. With increase in income access to safe drinking water or safe sanitation is expected to be raised. High income would also lead to high awareness about hygiene and better living condition. Therefore such a common infection like diarrhea should be negligible as one is moving towards high in wealth quintile. Let's check the condition of India in case of prevalence of diarrhea with increase in the wealth status of the households "(The wealth index is a composite measure of a household's cumulative living standard. In NFHS, It is calculated using data on a household's ownership of selected assets, such as televisions and bicycles, materials used for housing construction and types of water access and sanitation facilities)".

Table 1: Wealth Index and prevalence of diarrhea among young children (under five) within two weeks before the survey (India)

Wealth index	Percentage of children reported diarrhea	Total Number of children, reported diarrhea
Lowest	10.2	59,416
Second	9.5	52,153
Middle	9.3	47,494
Fourth	8.5	43,896
Highest	7.8	35,986

Source: *National Family Health Survey -IV, India, (2015-16)*

From the above table, one can see that even the wealth index is not able to explain the incidence of diarrhea. Though the highest incidence of diarrhea is among the lowest quintile of wealth group but one should expect that it should get sharply decline when one moves from lowest to highest quintile. There is reduction too but the rate of reduction of not very high, which means even the household who fall in the richest quintile is not able to provide safeguard to his children (0-5 years of age) against diarrhea. There is decline of incidence of diarrhea with wealth status/quintile of the household but this decline is slow from one quintile to another. It is 10.2 percent in the lowest quintile and 7.8 percent in the highest quintile. There is fall of just 2.4 percent in the incidence of diarrhea from lowest to highest quintile. When this 2.4 percent is calculated in absolute term it comes the difference of 15,520 children out of total 35,986 children. In the highest wealth quintile, it is a matter of serious concern. Although there is less threat to the life of these children as the parents can afford to have curative health care facilities but the prevalence of the disease raise questions about health externalities in the vicinity of their residence. If the parents who can afford to provide good hygiene to their children and still the prevalence is high then one should look for other factor which are responsible for overall unhygienic conditions

in the environment.

4.4.2 Improved sources of sanitation and drinking water

If we assume that Open defecation or safe drinking water or waste management are the major reason behind diarrhea then there should be great difference between the prevalence rates of diarrhea from urban to rural India. If we compare the urban and rural areas, there is huge difference between the open defecation rates, availability of safe drinking water and coverage of sewer facilities (These three are the most obvious reasons for diarrhea), but the prevalence of diarrhea is not varying greatly. The Indian cities/towns have better condition on all these factors but still the prevalence of diarrhea is not hugely different from villages to towns.

Table 2: Children under five who suffered diarrhea in the past two weeks preceding the survey

Background characteristic	Percentage of children reported diarrhea	Total Number of children, reported diarrhea
Toilet facility		
Improved, not shared	8.2	97,505
Shared	9.9	21,981
Unimproved	9.8	119,459
Source of drinking water		
Improved	9.3	214,824
Not improved	8.1	23,781
Other	12.7	340

Source: *National Family Health Survey (NFHS-4), 2015-16: India*

Improved sanitation facilities are those which hygienically separate human excreta from human contact. These includes Flush or pour-flush/ piped sewer system/septic tank/pit ,Ventilated improved latrine, pit latrine with slab and - Composting toilet. Shared toilets are not considered as improved toilets. Other type of toilets like open pit, Bucket, hanging toilet are not considered as hygienic toilets (WHO & UNICEF, 2010.) Incidence of diarrhea is expected to come down with improved facilities of toilet, but the above evidence from NFHS-IV data set, incidence of diarrhea has not reduced substantially as one move from un-improved facilities of toilet to improved facilities. Therefore it is proven that access to toilet is only a necessary condition to lower the prevalence of diarrhea, but not a sufficient condition.

Another important reason for diarrhea is safe drinking water. But when we try to establish a linkage between improved sources of drinking water with the incidence of this disease, there is again weak linkage can be seen from above table.

If the visible feces in the neighborhood are present, it is equally or more harmful than open defecation. One common source of such visible feces both rural as well as in urban India is unsafe disposal of child's stool (under the age of 5) by their mothers. With massive urbanization, there is increase in the consumption of diapers particularly in urban areas but if the mother is not disposing diaper in the safe manner, it can become a reason for health externalities in the entire area.

4.4.3 Mothers behavior for the disposal of child's feces under five years

Feces of a child are equally infectious as the feces of the adult that means its disposal is equally important. Safe

child feces disposal is less prevalent in India than in any other country in South Central Asia (WSP, 2015). When a mother is disposing the child's stool in unsafe manner, it is more harmful than open defecation as a person who is practicing open defecation will go a little far from the social gathering/ house or village to ease himself/herself but when a mother is disposing child's feces, it is within the same vicinity so there are more chances to get human touch. Hence the negative externalities are much higher than the open defecation. In the NFHS survey, Mothers who are living with, less than 5 years old children are chosen for the interview. Their behavior of for disposal of excreta of children under-five has been taken. Safe disposal include when child's stools were put or rinsed into a toilet or latrine, buried, or the child used a toilet or latrine. Unsafe disposal includes when the feces are thrown in garbage or open drain or in the open place.

Table 3: Percentage distribution of mothers by the manner of disposing of the youngest child's stool (2015-16)

	Manner of disposal of child's stool				
	Put/rinsed into drain or ditch	Thrown in garbage	Left in the open	Total unsafe disposal	Safe disposal
Urban	5.5	10.4	22.6	38.5	61
Rural	5.2	15.8	52.5	73.5	25.5
Mother's schooling					
No schooling	4.8	16	59.6	81.6	18.4
Less than 5 years	6.3	17	50.0	74.5	25.5
5-7 years	6.4	15.3	45.8	68.9	31.7
8-9 years	5.5	14.8	42.2	63.2	36.8
10-11 years	5.5	12.3	34.9	53.4	46.6
More than 12 years	4.5	10.8	25.6	41.5	58.5
Wealth Index					
Lowest	4.4	17.6	66.6	88.6	10
Second	5.9	17.8	56.3	80	19
Middle	6.5	15.1	44.8	66.4	32.9
Fourth	5.7	10.6	27.2	43.5	56
Highest	4.0	7.9	12.8	24.7	75

Source: NFHS(2015-16), India published in December 2017, table 9.16

If we compare the way mother is disposing the stool of her small children from urban to rural areas, it is almost half. But still 38.5 percent of mothers in urban India are disposing the stool of her children in unsafe manner. Out of this 38.5 percent, 23 percent of mothers are just throwing in the open. In the urban areas, where density of population is already high and 23 percent of mothers who are disposing the child's feces in the open/ streets, it will affect all and become a root cause behind many diseases. There is another issue here, when a child is using diapers, there is very little awareness among the mothers to dispose these used diapers in safe manner. Diapers can't be disposed in the toilets; either it will be thrown in the trash or in the open. Diaper Industry in India is expanding its business at the very high pace. The diaper market in India has already reached a volume of 4.7 Billion Units in the year 2018 and it is expected to grow even more due to high demand (Market Publishers, 2019). But till now there is no provision for the safe disposal of used diapers. Even if one wishes to dispose safely, there is no popular option available within the reach of laymen. One should expect that with high level of formal education, the awareness level towards hygiene will also increase but from the above table we can see that safe disposal is not increasing highly when the mother's formal education has increased. This shows that either mother themselves don't consider child's feces as infectious or they don't have proper arrangements for its safe disposal. Similar trend can be observed with wealth quintile, the Safe disposal of child's feces by mothers' decreases as one move from lower to high wealth quintile group but still among the highest wealth quintile, 25 percent of mother still using unsafe methods to disposal of children feces. In such

case we have to go into more intricacies. One has to look the impact of Swachh Bharat Mission on mother's behavior for disposal of their young children stool.

Table 4: Comparison of Percentage distribution of mothers by the manner of disposing of the youngest child's stool (2005-06 and 2015-16)

Manner of disposal of child's stool								
	Unsafe disposal				Safe disposal			
	Put/rinsed into drain or ditch	Thrown in garbage	Left in the open	Total unsafe disposal	Child used toilet or latrine	Put/ rinsed into toilet or latrine	Buried	Total safe disposal
NFHS-III (2005-06)								
Urban	10.2	16.7	24.6	51.5	26.8	20.1	0.3	47.2
Rural	6.5	28.8	51.1	86.4	5.9	4.7	0.8	11.5
NFHS-IV (2015-16)								
Urban	5.5	10.4	22.6	38.5	38.8	21.4	0.8	61.0
Rural	5.2	15.8	52.5	73.3	14.8	9.0	1.7	25.5

Source: Table 9.17 of NFHS-III (2005-06) and table 9.16 of NFHS-IV (2015-16)

From the above table, one can see that there is improvement in safe disposal of child's feces by their respective mothers but still there is much more scope of improvement to reduce the health externalities of open defecation. The maximum improvement has taken place where the child either himself/herself is using toilet to defecate or when mother is putting child's feces in toilet, otherwise the behavior of a mother in disposal of child feces has not changed in a significant manner. This shows lack of awareness and require public policy to address this issue. According to Economic survey (2019), visible feces is considered to calculate overall open defecation rate. That means, If GOI/States want to retain the tag of open defecation free, they have to create awareness among the mothers for safe disposal of child's feces. They also have to develop provisions for the safe disposal of baby diapers so that neither the product will harm the environment not create health externalities. Let's understand this entire linkage between the above mentioned variables with incidence of diarrhea.

5. Testing of Hypothesis

To test the hypothesis, logistic regression will be used as the dependent variable is dichotomous in nature. The Wald test in the logistic regression can be understood as Z test in linear regression. It is the test of significance for individual regression coefficients. The value of Wald can inform about the significance of the explanatory variables. The exponential Beta value or logarithm of the odds is a linear function of the *X* variables (commonly known as log odds). This can be understood as logit transformation of the probability of success. Exp(B) value can be understood as the odds for an event is π / (1 - π) or in simple words it can be understood as the probability of the event.

Table 5: Discrete Statistics

		B	S.E.	Wald	Sig.	Exp(B)
Urban						
1	Improved Source of Drinking water	.006	.024	.071	.790	1.006
2	Safe Disposal of child stool by Mothers	-.063	.020	10.010	.002	.939

3	Wealth index (Mothers)	.003	.015	.054	.816	1.003
4	Access to hygienic toilets	.028	.025	1.268	.260	1.028
	Constant	-2.236	.049	2092.576	.000	.107
Rural Households						
1	Improved Source of Drinking water	-.069	.014	25.519	.000	.933
2	Safe disposal of child stool by Mothers	-.045	.009	23.182	.000	.956
3	Wealth index (Mothers)	-.083	.008	103.438	.000	.920
4	Access to hygienic toilets	.080	.014	32.634	.000	1.083
	Constant	-2.109	.018	14208.447	.000	.121

Source: Author's calculation from NFHS-IV (2015-16)

The above table shows a comparative analysis of the impact of different independent variables like Improved source of drinking water, safe disposal of under-5 children stool by their mothers, wealth index of mothers. Safe drinking water has proven relationship with diarrhoea (Bartram,Cairncross,Clasenord et,al.2014). Improved drinking water can reduce the incidence of diarrhoea, the same is applicable for India and hence in urban Indi, this factor is not very relevant but in rural India, improved drinking water has negative relationship with incidence of diarrhoea. A factor which is important in both rural and urban India is the way mothers of under-5 children dispose their stool. The probability of decreasing the occurrence of the diarrhoea becomes highest, if mothers will start using safe methods to dispose of their young children stool. There is negative relationship which shows that if mother will start using safe methods of disposing their child stool, less likely that their children will get diarrhoea. Although this can't be controlled by just few, the health externalities of throwing children stool in the open will impact all children living in an area equally.

6. Conclusion and Policy Implication

Disposal of used diapers is still a neglected area. Mothers who are aware that disposal of diaper in the garbage may lead to health and environmental externalities but lack of provisions for safe disposal of used diapers motivate them to follow the trend of unsafe disposal. This could be the reason that a large number of mothers in top 20 % of wealth quintile also follow unsafe disposal of child's stool. Unsafe disposal of child stool also contribute to visible faeces that means even the 100 % of ODF can't reduce the visible faeces. There is need to develop the innovative and cost friendly methods for safe disposal of diapers. Along with safe disposal of diapers, there is large number of mothers who dispose the child stool in the drain next to their house. This creates even the high externalities than open defecation. A person who is practising open defecation is moving out to find a solitaire place to defecate but when a mother is disposing the child stool in the drain just outside the house will create the very high health hazards. Hence there is need to create awareness among the mothers about disposal of young children stool.

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