

# Application of Nudge Theory in Reducing the Prevalence of Diarrhea through Safe Hand Wash before Meals

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## Abstract

Safe hand wash behaviour is a target to be achieved under Sustainable Development Goal 6.2 by 2030. Safe hand washing can prevent many infections and hence it is the least expensive preventive healthcare intervention. Insufficient hand hygiene can cause different infections like diarrhea. In India diarrhea causes 10.65% deaths every year. Hand hygiene should be maintained at least after defecation and before eating. With an increase in the safe defecation and access to toilets, it is expected that the hand wash with soap and water should be increased. However, 75% of Indian households follow safe hand wash behaviour after defecation but just 40% of households follow safe hand wash behaviour before eating. The present paper is focused to analyze the impact of hand hygiene before eating and occurrence of diarrhea. Technological intervention can bring the positive behaviour change for hand washing before eating particularly at workplaces/hospitals/food courts. The overall behaviour can be positively changed with nudging through media campaign.

**Keywords:** Non-Parametric Regression, Statistics, Group Preference, Behaviour Science, 51912, 268361, 1094, 91C20

## 1.0 Introduction

In 2017, Richard Thaler won the Nobel Prize for his contribution in the form of Nudge theory. In 2008, Richard Thaler and Cass Sunstein have written a book titled Nudge: Improving Decisions About Health, Wealth, and Happiness. There they explained nudge theory and its impact in making choices. Authors explained that preferences of people can be effectively change in a predictable way just by giving continuous reinforcement, without aggression. Some positive reinforcement is needed to bring this predictable change. To increase the process of this nudge, the intervention must be easy and cheap so that its frequency can be increased many

times. These nudges should not be imposed as compulsion rather these may be some indirect suggestions on positive note. In this way freedom is given to consumer only but still his choices can be influenced. For example to promote healthy eating habits, fruit can be kept at eye level so to crave him about healthy food, if consumer is aware about the benefits of eating fruit, his choice may get influenced. While just banning junk creates negative reinforcement and this behaviour change will be temporary, so it cannot be treated as nudge. If people are guided by positive thoughts, this process of change can be started. In the initial stage, this reinforcement is needed at higher frequency, and then this motivation will change the perception of masses permanently. Hand wash before eating is not a new knowledge. It was an intergral part of most of the civilization and culture. With rapid

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urbanization, people forget the importance of hand wash before eating. To bring the attention of the world towards this common practice, hand hygiene is added in sustainable development goal. The hand hygiene part of SDG 6.2 has three components; hand wash with soap and water, menstrual-hygiene, and food hygiene, but till now only hand washing with soap is monitored by WHO/UNICEF. According to this goal, all member nations should focus to achieve 'Safely-managed Sanitation and Safely-practised Hygiene for all by 2030'.

Hand washing is a small habit which ensures safety from different bacteria/pathogens. It discourages the spreading of excreta-related diseases through the faecal-oral route or transmission of respiratory viruses or even reduces transmission of soil transmitted helminths infections. Faecal oral pathogens can arise directly or through contaminated food or water. In this way safe hand wash can prevent diarrheal disease, stomach infection. Safe hand wash also reduces the fungal skin infection like ringworm and scabies. It is a small habit and should be taught in basic food hygiene practises. However, hand wash before meals can be considered as a part of food hygiene. As per the estimates of JMP (2020), 2.3 billion people at global level do not have basic hygiene services (hand washing facility with soap and water). One gram of human faeces can contain one trillion germs (Prüss-Üstün et al., 2008). If the traces of faeces can stick in the nails, it can easily reach to the stomach. Not only to stomach but if hands are touched to eyes, nose or mouth, germs can get the easy way to enter the body of a healthy person. If a person cooks with unwashed hands, germs can contaminate the food and the disease can be passed to another person. It is important for lactating mothers to wash their hand with soap and water both before feeding to their children. Hand wash with soap and water can eliminate this flow of germs. Ideally, hand wash should be followed at five key times; after the direct contact of faecal matter (after defecation or cleaning faeces of a child/ill person), before cooking, before and after eating food or feeding the young children, after touching pets or animal waste or garbage. But with the limited data, it is difficult to track the household behaviour for hand wash at all of these key times. Hence out of these two has been tracked; before meals and after defecation. Insufficient hand hygiene can be proved as fatal particularly for young children.

## 2.0 Review of Literature

Diarrhea causes many deaths in children below five years of age, mostly in LMICs. The organism causing diarrhea is transmitted from person to person through food and water contaminated with faeces, or through person to person contact. Hand washing after defecation, or after cleaning a

baby's bottom, and before preparing and eating food, can therefore reduce the risk of diarrhea. Promotion of hand washing practices in child day care centers can reduce the diarrheal episodes both in high and middle income countries by about 30% (Ejemot RI, Ehiri JE, Meremikwu MM, 2008). This hygiene intervention can increase the attendance of elementary school children by reducing the gastrointestinal illness, hence the absenteeism among these school children have reduced by 29-57% (Wang Z, Lapinski M, Quilliam E, Jaykus LA, 2017). For adults also, safe hand wash behaviour can reduce the episodes of diarrhea by 40% (Regina I Ejemot Nwadiaro, John E Ehiri, Dachi Arikpo, Martin M Meremikwu, 2021). Along with reduction in gastrointestinal diseases, this simple hand-hygiene intervention creates a positive dent on respiratory illnesses. Different studies from past 50 years shows that with Improvements in hand hygiene, gastrointestinal illness reduces of 31% and respiratory diseases reduces by 21% (Curtis, 2006), (Aiello PhD et al., 2008). The country like India, where respiratory illnesses have major share in total mortality, it is worth investing in creating awareness and providing basic hand washing infrastructure. Regular and safe hand wash can reduce the episodes of diarrhea even among the patients with different comorbidities. A study is conducted to find the impact of hand wash after defecation, before cooking and eating meals, before and after sex. It is found that just a small hand wash can reduce the diarrheal illness among AIDS patients, although these patients have high probability to develop frequent diarrhea episodes. It is a randomized, controlled study with total 260 patients were observed for 1 year to understand the impact of this behaviour intervention in longer duration (Huang DB, 2007). Regular hand wash behaviour can provide a shield against different infection and bacteria so it will positively impact the immunity and reduce the intake of antibiotic sick. Adequate food safety and hygiene education/promotion particularly in schools with the provision of adequate sanitary and hand-washing facilities are essential. Food hygiene can be defined as all the measures taken to ensure the safety of food stuff for human consumption. Hence it include all measures necessary to ensure the wellbeing of human through food in all stages of the food chain (van der Velde & van der Meulen, 2011). Hence it is a vast area but in the context of food hygiene from the perspective of personal hygiene, hand wash before consuming food stuff can ensure food hygiene. Majority of the food borne disease are caused by poor hygiene and handling of the food. Adequate personal hygiene will reduce the risk of food borne illness. Hand washing is an effective and cheapest measure to prevent food borne diseases. A study was conducted in Vietnam to find the predictable factors for diarrhea among young children. It was a cross-sectional study with 206 mothers of the young children. The study found that improvement in food hygiene habits of

mothers during cooking like hand wash before cooking has significantly reduced the risk of diarrhea among children (Takanashi et al., 2009). Hand washing can be promoted through group or individual training on maintaining personal hygiene, germ health awareness. Different tools can be used to promote hygiene awareness like posters, public hoardings, media campaigns. Besides the direct health benefits, hand wash habit can also reduce the disease burden and thus the medical expenditure.

### 3.0 Objective

Hand wash with soap and water both is necessary at least before eating and after defecation. If water and soap arrangements are next to toilets, then it is creating a nudge to wash the hand by an individual so with increase in the use of toilet, a greater number of people wash their hands after defecation. According to National Sample Survey (NSS) 76th round (2018), 74 per cent household members in India wash their hands with soap and water both after defecation. Although one cannot ignore the importance of washing hand before eating meals and when however, the proportion of population who follow safe hand wash before eating is much lower as compared to hand wash behaviour after defecation. Total 35.8% of household members are washing their hands with soap and water before taking meals. Hence in the present study:

- To investigate the safe hand-washing behaviour before meals across rural/urban households and among different socio-economic groups.
- To provide a cost friendly and viable solution to provide nudging for promoting hand hygiene behaviour.

### 4.0 Importance of Hand Hygiene for India

India is tropical country with high density of population. Both factors make positive circumstances for different bacteria to communicate. The curative health care infrastructure is not sufficiently available for all. India has tremendous progress in controlling the diseases like small pox, leprosy, and polio (Gupta, 2012). The disease burden has shifted from communicable to non-communicable diseases. The new challenges are the diseases like pneumonia, respiratory diseases and diarrheal. So, there is a mix of communicable and non-communicable diseases in the total mortality of the country. The new challenges are lifestyle disorders, pollution and hygiene.

India is a country who has a high proportion of people suffering from chronic diseases like diabetes, high blood

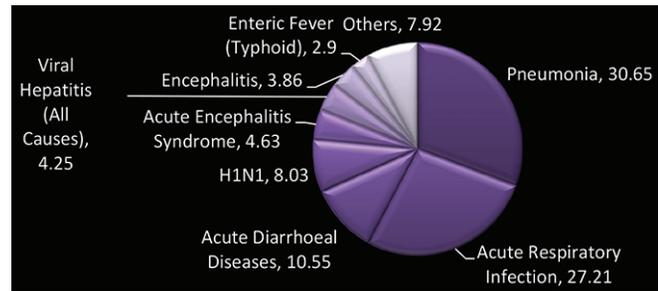


Figure 1: Reasons for mortality in India

Source: National Health Profile 2019, Central Bureau of Health Intelligence

pressure, heart disease, asthma/lung disease, cancer, immune deficiency, HIV, severe obesity and chronic liver or kidney disease. In the recent years, the burden of non-communicable<sup>3</sup> diseases in India has increased from 30 to 55 per cent. Pneumonia had taken the lives of 30 per cent of people, followed by acute respiratory infection (27%) and diarrhea (10.55%). For a highly populated country the role of public and personal hygiene both are important. Sufficient hand hygiene has positive correlation with respiratory infections and diarrheal both, so it is important for the country like India to create awareness for maintaining safe hand wash as a regular habit before eating meals and after defecation both. Another importance of hand hygiene before consuming food is the absorption of nutrients from the food. According to the estimates of World Health Organization (WHO) 50% of cases of child malnourishment is due to repeated diarrhea/stomach infection. The major reason behind this stomach infection is poor sanitation, hygiene and lack of safe water (Prüss-Üstün et al., 2008). Out of these three, safe hand wash with soap and water plays a vital role in determining good nutrition (Wixted, 2015). In India, with increase in per capita income, the malnourishment among children under 5 is increasing (International Institute for Population Sciences, 2020) so it is important to focus on the factors other than access to food.

### 5.0 Material and Methods

To understand the impact of hand hygiene on communicable disease like diarrhoea, the present study has employed a regression analysis. The model can be expressed as

$$\text{Log } D = \beta_0 + x_{\text{HW}} * \beta_1 + x_{\text{SG}} * \beta_2 + \epsilon$$

Where; D = Stomach Infection like diarrhea, dysentery and cholera (dependent variable); independent variables;  $x_{\text{HW}}$  =

<sup>3</sup>These are chronic diseases of long duration, and generally slow progression and are the result of a combination of genetic, physiological, environmental and behaviour factors.

Hand wash behaviour before meals of the households,  $\beta_0$  = constant term,  $\beta_1$  = coefficient of independent variables while  $\varepsilon$  = the error or disturbance term.

Access to a hand washing place with available soap and water is defined safe according to the World Health Organization and United Nations Children's Fund Joint Monitoring Program for Water Supply, Sanitation and Hygiene (World Health Organization and UNICEF, 2021). The sanitation ladder has defined different levels for basic hygiene and safe hand wash is considered for those who are washing their hands with soap/any other disinfectant and water both. Hence in the present analysis, safe hand wash is considered for those households who are washing their hand with soap and water both.

To analyse the hand wash behaviour of Indian households and its impact, the study is using the secondary data (collected at all India level). NSS 76th round data set collected by Ministry of Statistics, Government of India was collected on the theme 'Drinking Water, Sanitation, Hygiene and Housing Condition' (NSS 76 round, 2018). The sample collection was done from July to December 2018. It is all India unit level data covering all states except the villages in Andaman and Nicobar Islands. The total sample size of the data is 1,06,838 households (63,736 in rural areas and 43,102 in urban areas). The information for hand wash is also provided in the recent data set like NFHS (National Family Healthcare Survey, 2019-21) but in this survey only information is provided about the availability of infrastructure. the behavioural aspect about hand washing is not provided, hence the present study is considering NSS 76 round-2018 data to understand the impact of hand washing behaviour.

## 5.1 Dependent variable

The objective of the current study is to find the impact of hand wash behaviour before meals of household on stomach infection like diarrhoea, dysentery and cholera. The hand hygiene has high linkage with different diseases; the knowledge about importance of hand wash is not new. the most common which has high occurrence among Indian households particularly children in under 5 years of age (Lakshminarayanan and Jayalakshmy, 2015) is diarrhea. it is a common infection which has simple low cost treatment, yet globally 1300 young children die every day just due to this

**Table 1: Households reported stomach problems like diarrhea/dysentery/cholera during last 365 days (%)**

1	Rural	15.6
2	Urban	8.7
3	All India	13.3

Source: NSS 76 round (2018)

common infection (Hogan, 2018). It is the most common reason among preventable death, particularly among children under five in developing countries (Keusch et al., 2006). Diarrhoea can be explained as, a person is getting five or more loose/watery Stoll in a day. It is caused by bacteria which can enter in the stomach through mouth. If the person touches any surface with pathogens and touch the same to mouth, the bacteria can enter the stomach. Dehydration is an outcome of diarrhoea, although it can be cured easily but has dangerous side effect on health. Hand washing with soap and water can reduce diarrhoea by 30% (approx.) (Ejemot RI, Ehiri JE, Meremikwu MM, 2008).

The information on people reported stomach infection/diarrhea been extracted from NSS 76 round data set where information has taken from the household is asked; this data was collected from July-Dec 2018 so this occurrence of disease information is for 2017-18.

The most occurring disease among Indian household is stomach problems like diarrhea or dysentery or cholera. 13.3% households suffered from these stomach problems in last one year. Diarrhea is more deadly disease for the children under the age of five. Among the Indian children, diarrhea has been a cause of concern.

**Table 2: Comparative occurrence of diarrhea among young children (under five) who reported diarrhea in the last two weeks preceding the survey (2005-06 and 2015-16)**

Survey and reference year	Residence	Percentage of children reported diarrhea	Total number of children, reported diarrhea
NFHS-III (2005-06)	Urban	8.9	13,665
	Rural	9.0	39,203
	Total (All India)	9.0	52,868
	NFHS-III (2015-16)	Urban	8.2
Rural		9.5	170,987
Total (All India)		9.2	238,945

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

Even with the increase in per capita income or increase in water and sanitation facilities through SBM (Swachh Bharat Mission), the occurrence of diarrhea among young children has not been positively affected. In the proportion of population as well as in absolute number, the occurrence of diarrhea is not decreasing. Hence it becomes necessary to find out the reasons behind this common cause.

## 5.2 Independent variables

India has declared open defecation free in the year 2019, there has been massive increase in the access to toilet hence the sanitation facilities has improved to a great extent both in villages as well as in the cities. Still if the related disease with hygiene is not decreasing, then it is necessary to find the other hygiene factors.

### 5.2.1 Hand wash behaviour before consuming food

For a health body, sufficient nutrition is required. Nutrition gets derived from the food and the way the food is consumed. Both factors are equally important. In fact, if the food is consumed in a hygienic manner, the body can absorb all the nutrients from the same food in a better way. Hand washing with soap and water before consuming food is an important reason for better absorption of nutrition from the food<sup>4</sup>. Different bacteria/virus stuck in the nails can easily enter the gut and reduce the ability of the stomach to absorb the nutrients of the food. it can also be the reason of serious diseases and infections. For the smaller children, this could be the cause of malnutrition and stunting. Therefore, it is very much necessary to wash the hands with soap/disinfectant and water both before consuming food. Safe hand wash is such a common hygiene factor which is neglected by many. According to National Sample Survey (NSS) 76th round, 74 per cent households in India wash their hands with soap or detergent after defecation. This means still one-fourth of the population is not washing their hand in a safe manner even after defecation. Still, it is easy to convince the people to wash their hand s after defecation but to control the cases of diarrhea, it is not sufficient to maintain hand hygiene after defecation only but before eating it is necessary to maintain hand hygiene. India has achieved the status of open defecation free that means the basic infrastructure to wash the hand should not be a problem. The next target should be to create enough awareness that people should wash their hands with soap and water ideally both before taking meals and after defecation both. The proxies for hand wash behaviour are taken from the variable in NSS 76 round, where a question is asked from the household members about their habit of hand wash before meals.

**Table 3: Hand wash behaviour of the households before meals (%)**

	Safe Hand wash with soap and water	Unsafe Hand wash
Rural	25.3	74.7
Urban	56.1	43.9
All India	35.8	64.2

Source: NSS 76 round (2018)

There are high disparities in the safe hand wash practice before meals among rural and urban households. Hand wash before eating is necessary as the bacteria/dust particles which are stuck in the nails cannot directly enter the stomach. This is a small habit which does not take much time if hand wash infrastructure is available. If 75% of the rural households are not washing their hands with soap and water, there is immediate need to create awareness and provide infrastructure so that the common infection can be eliminated. Villages have low curative health care infrastructure, so it become even more necessary to invest in such low-cost preventive health care measures. Among the cities as well, 44% of the households do not follow necessary hand hygiene as a part of food hygiene.

Inequalities are the major hurdle in achieving any health goal for the society. Inequalities in any form are the major hurdle in human development for a country and ultimately for achieving the 2030 Sustainable Development Goals. After regional inequalities, social inequalities are the barrier for equitable development. For public health, income and wealth disparities affects the entire area so a common public policy can be framed to develop the curative health care infrastructure but inequalities among the communities are most difficult to handle as these inequalities differ from area to area. Marginalized communities are forced to the margin or the edge of society. They are forced to feel of less important than other section of the society. Marginalization of certain communities or groups is common in most of the societies, but in low-middle income countries it is more pronounced. In the Indian context, caste may be taken broadly as a proxy for socio-economic conditions and poverty. Among these marginalized caste, scheduled caste and scheduled tribes are considered as socially disadvantaged groups. In some cases, the other backward castes can also be considered but there are huge regional variations in the socio-economic status of OBCs. to provide some safe guard and to ensure equal opportunities, their representations in all democratic institutions are guaranteed under the Constitution (Delhi Solidarity group, 2015). With all such efforts still the consequences of social marginalization are clearly visible on income distribution/poverty of these excluded groups. Other consequences are visible on occupations where some specific castes are reserved for manual scavenging or jobs which include high health hazards (Ravichandran, 2011). Their socio economic status and poverty also make a remarkable damage to their health status of these groups give an indication of their poverty and social exclusion (Nayar, 2007).

The concentration of marginalized communities is higher in rural India as compared to urban India. In the previous

<sup>4</sup>WHO (2008). *Safer water, better health: Costs, benefits and sustainability of interventions to protect and promote health*

**Table 4: Distribution of marginalized communities in rural and urban India**

	Social Communities	Per cent
Rural	SC, ST	34.2
	Others	65.8
Urban	SC, ST	18.0
	Others	82.0

Source: NSS 76 round (2018)

independent factor, it is observed that habit of safe hand wash in rural India is much lower as compared to urban India. Hence it is necessary to find the combined effect of these two factors on occurrence of diarrhea.

### 5.3 Testing of Econometric Model

Binary logistic regression is run on SPSS software to find the significance of these two independent variables. The dependent variable which is prevalence of diarrhea is a categorical variable with two categories; those who have reported diarrhea in last 365 days and other who do not reported diarrhea. In this case binary logistic regression can provide a comparative view of the impact of independent variable on these two different categories of groups.

Logit is the natural logarithm of these odds. Exponential beta ration is called as odds/odd value. It can be expressed as the likelihood of an event occurring relative to the likelihood of its failure. Exponential to the power Beta or  $e^{\beta}$  Odds =  $p/(1-p)$ . It explains if the value of predictor increases, the probability of outcome occurring decreases. In the above model, the value of odd is more than 0.5 for all explanatory variables. The highest value of log of odds is safe hand wash before eating in urban Indian households

**Table 5: Descriptive statistics of logistic regression based on location (Rural vs Urban)**

Explanatory variables	B	SE	Exp (B)
Rural India			
Safe Hand wash before meals	-0.388	.000	.678
Social Group (SC and STs)	-0.209	.000	.811
Constant	2.203	.000	9.053
Urban India			
Safe Hand wash before meals	-0.246	.000	.782
Social Group (SC and STs)	-0.298	.000	.742
Constant	2.522	.000	12.451

Source: Author's calculation based on NSSO 76 round (2018)

( $e^B$  or  $e^{-0.246}=0.782$ ) which means that, the probability of diarrhea among the group of people who don't follow safe hand wash increase by 0.782. Another important factor in the model is that all beta values are in negative which implies that there is negative relationship between cases of diarrhea and the explanatory variables of the model. The coefficient of safe hand wash in rural India is 0.38 implies that if there will be one unit change in safe hand wash, there is probability of reducing the occurrence of diarrhea by 0.62 units. In the urban India, one unit increase in safe hand wash has the probability of reducing the occurrence of diarrhea by -0.38 units. If a small change has such high impact on infection like diarrhea, which cause 10.55% of total mortality in India, this can be a fruitful investment. Socially marginalized communities which are already vulnerable have also an important role in explaining the disease like diarrhea. In fact, in the urban India, these communities are more vulnerable. The standard error of the model is zero which shows the reliability on the data and sample size.

### 6.0 How to Create Nudge to Encourage People to Maintain Hand Hygiene before Eating

It has been analyzed that there is high variation in maintain hand hygiene before eating among Indian households on the basis of location. Place for hand wash has been constructed next to the toilets, construction through SBM. After the construction of place for hand wash, it becomes important to find the reasons for this high deficit in maintaining hand hygiene before eating. Two basic prerequisite of safe hand wash are water and soap. Soap can only work if water is available, so it has become important to find the status of water availability for toilet use for the households. If sufficient water is available, then only safe hand wash can be ensured. In the areas where sufficient water is not available for hand wash, sanitizers can be used. Access to pipe water will increase the hand wash behaviour but, in the water, scare areas or at the workplace, there could be limitation. These all limitation must be provided some feasible solution. In the urban areas where access to pipe water is available, still people are not maintaining safe hand hygiene before eating. Therefore, it is more about behaviour. It has been observed that monitoring can improve the hand-hygiene behaviour of the masses. This monitoring can be direct or indirect. Direct monitoring can be possible at hospitals/canteen/office cafeteria/food court or even at markets. When the common behaviour is monitored and shown to the people, it encourages the positive behaviour change. "Hawthorne effect" is a behavioural theory which states that people will change their behaviour when they are been observed

(Wickström, Gustav, 2000). This effect can be created if some small device/chip can be inserted in the identity cards of the employees to read the number of time when they wash their hands (Carleton, 2020). Alternatively, sensor can be installed at hand washing area or sanitizer dispensers which can read the employee id. The chip or sensor can record the time duration and frequency of hand wash, later on this data can be shown to the employees/patients (in hospital), so that they become more conscious for maintaining sufficient hand hygiene. Another method to bring the positive behaviour change is through indirect monitoring or motivation. This theory is called nudge. It is a design-based public policy approach which can be used on mass scale to provide positive reinforcements to modify the hand hygiene behaviour of a population (Caris, Martine and Labuschagne, H.A. and Dekker, Mireille and Kramer, M.H.H. and Agtmael, Michiel and Vandenbroucke-Grauls, 2017). This theory has been used by government of India during Covid-19 pandemic. Announcement for maintaining hand hygiene is made at public places, frequent awareness campaigns are arranged at community level. Interpersonal communication can also motivate the masses particularly the rural households. Leadership and community awareness can be implemented through ASHA/anganwadi workers. Nudging can create conscious thoughts which can alter choices. To create nudge separate place for hand wash with all infrastructure should be provided to the people at household as well as at public places.

## 7.0 Conclusion

It is not a new knowledge that hand hygiene can control many infections. Hence it is a most cost friendly preventive healthcare intervention. Safe hand wash behaviour is in crisis among marginalized communities so immediate measures are required to promote hand hygiene behaviour among these communities. It is found in our analysis that probability of reducing in the cases of diarrhea with increase in safe hand wash before meals is 78% among urban households and 68% among rural households. Among the urban household, the impact is greater as the chances of food contamination is high. Moreover the culture of eating outside is frequent. The analysis is done for a common infection which is responsible for 10.5% of total mortality in India. Hand hygiene before eating is an integral part of food hygiene. If with some investment positive behaviour change can be attained, it is worth enough to get the return through positive health externalities.

## 8.0 Acknowledgements

The present paper is based on national level data set, collected by GOI organisation (NSSO).

## 9.0 Declaration of Interests

We, (Vishakha Goyal) and Dr. Prem.S.Vashishtha declare that we do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## 10.0 References

1. Aiello PhD, A. E., Coulborn BS, R. M., Perez MS, V., & Larson PhD RN, E. L. (2008): Effect of Hand Hygiene on Infectious Disease Risk in the Community Setting: A Meta-Analysis. *American Journal of Public Health*, 98(8), 1372–1381. [http://ezproxy.fiu.edu/login?url=https://search.proquest.com/docview/215090126?accountid=10901%0Ahttp://resolver.ebscohost.com/openurl?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ%3Asoecscijournals&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:jo](http://ezproxy.fiu.edu/login?url=https://search.proquest.com/docview/215090126?accountid=10901%0Ahttp://resolver.ebscohost.com/openurl?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ%3Asoecscijournals&rft_val_fmt=info:ofi/fmt:kev:mtx:jo)
2. Caris, Martine & Labuschagne, H.A. & Dekker, Mireille & Kramer, M.H.H. & Agtmael, Michiel & Vandenbroucke-Grauls, C. (2017): Nudging to Improve Hand Hygiene. *Journal of Hospital Infection.*, 98. <https://doi.org/98.10.1016/j.jhin.2017.09.023>.
3. Carleton, N. (2020): AI-Based Solution Monitors Hand Hygiene Behaviour. 3–5.
4. Curtis, T. R. and V. (2006): Handwashing and risk of respiratory infections: a quantitative systematic review. *Trop Med Int Health.*, 11(3), 258–267. <https://doi.org/10.1111/j.1365-3156.2006.01568.x>
5. Delhi Solidarity group. (2015): Fair representation of SCs/STs. *Economic and Political Weekly*, 50(46–47), 4.
6. Ejemot RI, Ehiri JE, Meremikwu MM, C. J. (2008): Hand washing for preventing diarrhoea. *Cochrane Database Syst Rev*, 9. <https://doi.org/10.1002/14651858>
7. Gerald T. Keusch, Olivier Fontaine, Alok Bhargava, Cynthia Boschi-Pinto, Zulfiqar A. Bhutta, Eduardo Gotuzzo, Juan A. Rivera, Jeffrey Chow, Sonbol A. Shahid-Salles, and R. L. (2006): Disease Control Priorities in Developing Countries. Oxford University Press and The World Bank, 371–389.

8. Gupta, I. (2012): The New Oxford Companion to Economics (A.M. Kaushik Basu (ed.)). Oxford University Press. <https://doi.org/10.1093/acref/9780198078555.001.0001>
9. Hogan, D. (2018): MCEE-WHO methods and data sources for child causes of death 2000-2016. Global Health Estimates Technical Paper WHO/HMM/IER/GHE/2018.1, February.
10. Huang DB, Z. J. (2007): Effect of intensive handwashing in the prevention of diarrhoeal illness among patients with AIDS: a randomized controlled study. *J Med Microbiol*, 56(5), 659–663. <https://doi.org/10.1099/jmm.0.46867-0>
11. International Institute for Population Sciences. (2020): National Family Health Survey - 5 2019-21. In Ministry of Health and Family Welfare National (Vol. 361).
12. Lakshminarayanan, S., & Jayalakshmy, R. (2015): Diarrheal diseases among children in India/ : Current scenario and future perspectives. *J Nat Sci Biol Med*. <https://doi.org/10.4103/0976-9668.149073>
13. Nayar, K. R. (2007): Social exclusion, caste & health: A review based on the social determinants framework. *Indian Journal of Medical Research*, 355.
14. NSS 76 round. (2018): Drinking water, Sanitation, Hygiene and Housing Condition in India.
15. Prüss-Üstün, A., Bos, R., Gore, F., & Bartram, J. (2008): Safer water, better health. In World Health Organization. [http://www.who.int/quantifying\\_ehimpacts/publications/saferwater/en/](http://www.who.int/quantifying_ehimpacts/publications/saferwater/en/)
16. Ravichandran, B. (2011): Scavenging profession: Between class and caste? *Economic and Political Weekly*, 46(13), 21–25.
17. Regina I Ejemot Nwadiaro, John E Ehiri, Dachí Arikpo, Martín M Meremikwu, J. A. C. (2021): Hand washing promotion for preventing diarrhoea. *Cochrane Database of Systematic Reviews*, 1. <https://doi.org/10.1002/14651858.CD004265>.
18. Takanashi, K., Chonan, Y., Quyen, D. T., Khan, N. C., Krishna, C., Chonan, Y., Quyen, D., & Khan, N. C. (2009): Survey of Food-hygiene Pr Childhood Diarrhoea in Hanoi , Viet Nam. *Journal of Health, Population and Nutrition*, 27(5), 602–611.
19. van der Velde, M., & van der Meulen, B. (2011): EU food hygiene law and implications for food factory design. In *Hygienic Design of Food Factories* (pp. 37–54). Woodhead Publishing. <https://doi.org/10.1533/9780857094933.1.37>
20. Wang Z, Lapinski M, Quilliam E, Jaykus LA, F. A. (2017): The effect of hand-hygiene interventions on infectious disease-associated absenteeism in elementary schools: A systematic literature review. *Am J Infect Control*, 45(6), 682–689. <https://doi.org/10.1016/j.ajic.2017.01.018>
21. Wickström, Gustav, and T. B. (2000): “The ‘Hawthorne Effect’ – What Did the Original Hawthorne Studies Actually Show?” *Scandinavian Journal of Work, Environment & Health*, 26(4), 363–367.
22. Wixted, C. (2015): WASH and Nutrition, Implementation Brief - January, 2015. In USAID (Issue January 2015). [https://www.usaid.gov/sites/default/files/documents/1865/WASH\\_Nutrition-Implementation\\_Brief\\_Jan\\_2015.pdf](https://www.usaid.gov/sites/default/files/documents/1865/WASH_Nutrition-Implementation_Brief_Jan_2015.pdf)
23. World Health Organization and Unicef. (2021): Hand Hygiene for all.