

Discerning Hygiene Behavior amidst Bottom of Pyramid Segment: A CHAID Analysis

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Abstract

Hygiene status of the people along with other measures of environmental sanitization promotes health of the community by providing clean environment and breaking the cycle of disease. Establishing routine hygiene behavior and adopting hygiene norms by the community at large and in particular the bottom of pyramid segment is of critical importance for long term welfare and health benefits. This study aims to firstly assess the hygiene behavior adopted by bottom of pyramid segment across several aspects of hygiene behavior. Secondly, to employ various demographic and behavioral factors to predict, model and classify hygiene behavior and thirdly to explore the differences across various aspects of hygiene behavior in the identified groups. This study surveyed the hygiene behavior across 272 respondents from the bottom of pyramid segment. Descriptive data analysis, CHAID analysis and one way ANOVA was employed to address the research objectives. The findings indicate an evident gap in adoption of hygiene (score less than 2.5 on a four point scale) across all aspects such as hand hygiene food hygiene etc. Pre covid hand hygiene behavior, positive influence of family on adopting hygiene behavior and residential status (native or migrant) emerged as key predictors of hygiene behavior. Five heterogeneous groups emerged as an outcome of CHAID analysis and significant differences were found across several aspects of hygiene behavior in these groups. The study provides a typology of citizens from bottom of pyramid that will facilitate policy makers and local authorities and agencies to design campaigns and intervention programs that promote long term adoption of hygiene effectively.

Key words: Bottom of Pyramid, CHAID, Hygiene

Introduction

The COVID-19 outbreak has brought health and hygiene to the forefront. All experts recognize and emphasize that practices regarding sanitization, hygiene and social distancing are our best weapon to stay safe from the virus. In fact, even prior to the COVID 19 pandemic poor hand and household hygiene has been associated with an increased risk of contracting infectious disease [1]. Recognition of the importance of hygiene in the control of the spread of infectious diseases is reflected in the increased number of publications in the medical literature during the last few years, including major articles on hygiene in prominent general medical journals [2]. In a clean, well-maintained environment the risk of transmission of pathogens is minimized considerably. Surfaces are no longer a breeding ground for germs, bacteria or viruses. Even in places that are difficult to access, the pathogens are eliminated more thoroughly [3]. Hygiene status of the people along with other measures of environmental sanitization promotes health of the community by providing clean environment and breaking the cycle of disease. There have been many public health campaigns worldwide to encourage adoption of hygienic behavior. WHO with support of international health partners like UNICEF, UNIDO, UNFPA, IOM, OCHA and UNHCR, has been supporting Government(s) world over in raising awareness on the importance of hygiene and integrated waste management [2]. In India, the Government of India's flagship programmes include the Swachh Bharat Mission, the National Rural Drinking Water Programme (NRDWP), WASH (water, sanitation and hygiene) in Schools (including preschools called '*anganwadis*'), WASH in health facilities, and district-wide WASH interventions supporting planning and implementation and incorporating behavior change into state and national guidelines [4]. In spite of the increased attention directed at adoption of hygienic behavior and in particular hand hygiene much remains to be done. Although hand hygiene prevents cross-infection, successful adherence is unacceptably low (Institute for Healthcare Improvement, 2006). Establishing routine hygiene behavior and adopting hygiene norms by the community at large is a herculean task. Knowledge needs to be enhanced and changed to improve compliance [5]. Improving compliance is about altering human behavior and therefore studying compliance with hygiene recommendations includes input

from a wide range of disciplines, including behavioral and social sciences [2]. To plan campaigns, policies and interventions that are most likely to succeed in a large and diverse country like India it is vital to explore patterns of hygiene behavior across various segments of society. Bottom of pyramid (BoP) is one such segment. The bottom of the pyramid is the largest, but poorest socio-economic group. BoP comprise about 1.05 billion people in India (5 out of 6 Indians) who are living in poverty, less educated, have limited access to basic facilities and benefit from government welfare interventions. Given that education is an integral part of hygiene improvement strategies it is imperative to focus on this segment whose being less educated also compounds the problem. An exploration of factors that help classify hygiene conscious citizens versus those who are not can help formulate precision based strategies by policy makers who struggle with limited resources most of the time. These strategies can help strengthen the behavior of those who are hygiene conscious and target those who are likely to be less compliant with behavior modification strategies and interventions. It is evident that the area demands scholastic attention and this research endeavors for the same. The purpose of this research is threefold – Research Objective (1) to assess the hygiene behavior adopted by BoP across several aspects of hygiene behavior (detailed in the next section); Research Objective (2) to employ factors such as – gender, age group, resident status, awareness on media campaign about hygiene and sanitation, positive influence of family on hygiene behavior, positive influence of community members on hygiene behavior, interaction with ASHA workers, pre covid responsible hand hygiene behavior - to predict, model and classify hygiene behavior and; Research Objective (3) to explore the differences across various aspects of hygiene behavior in the identified groups. It is expected that the results of this research would help policy makers (and agencies involved in promoting hygiene) to design segment specific strategies and facilitate their understanding on the primary influences in adoption of hygiene behavior. The following sections present the methodology, results and conclusions of the study.

Material and Methods

Hygiene aspects and variables of importance

In modern usage hygiene usually refers to cleanliness and especially to any practice which leads to the absence or reduction of harmful infectious agents [2]. Hygiene behavior includes hand hygiene, personal grooming/hygiene, household cleanliness, and food-related hygiene [1]. Past researchers such as Stevenson et al.¹ observed that there is a lack of research in exploring the factors accounting for their variability and identifying such factors is important to provide possible clues as to how hygiene behavior can be improved. Previous research suggests that several factors such as- demographic, socio-economic, psychological and situational may influence hygiene behavior. In this study factors such as- age, gender, resident status (native or migrant) were employed. Further, influences of family members and of community, awareness on media campaigns for sanitation and hygiene, interaction with ASHA workers was also considered. Government of India launched the accredited social health activist (ASHA) program, with the goal to connect marginalized communities to the health care system [6]. Also pre-covid hand hygiene behavior was considered to see whether the innate disposition of people towards hygiene exudes influence on hygiene behavior amidst contemporary times.

Data collection and Sample profile

An on-site personally administered survey was conducted amidst workers at the campus of three private universities in Solan district, Himachal Pradesh. The workers and their family reside at the campus and are engaged in variety of work such as cleanliness, gardening, food preparation and security. They can be understood as belonging to the bottom of pyramid segment. This segment was chosen to facilitate data collection in a relatively safer environment and in a large number at a time. Data was collected in the period of October to December 2020, a time when Covid 19 cases were on decline in India and most restrictions were eased at centre and state level by Government of India. The field researcher approached the respondents who were educated at least up to standard eighth at their residential quarters, briefly explained the purpose of the research and invited them to participate in the survey. A total of 272 usable questionnaires were collected. Table 1 presents the sample profile.

Table 1 : Sample profile and Descriptive data

Gender	Male	124
	Female	148
	Total	272
Age group (yrs)	18-25	109
	26-45	86
	46 and above	77
Resident status	Native	141
	Migrant	131
Awareness on media campaign about hygiene and sanitization	Yes	162
	No	110
Positive influence of family on hygiene behavior	Yes	140
	No	132
Positive influence of community members on hygiene behavior	Yes	96
	No	176
Interaction with ASHA workers	Yes	108
	No	164
Pre covid responsible hand hygiene behavior	Yes	105
	No	167
Hygiene related variables	Mean (S.D.)	
<i>General hygiene</i>	2.48(.85)	
<i>Household hygiene</i>	2.37(.85)	
<i>Food related hygiene</i>	2.38(.84)	
<i>Hand hygiene</i>	2.39(.84)	
<i>Personal hygiene</i>	2.36(.75)	
<i>Cumulative score on hygiene behavior</i>	2.40 (.71)	
Hygiene conscious	128	
Non- hygiene conscious	144	

Research Instrument

A set of structured questions (translated in Hindi language) comprising of an enquiry about demographic variables such as age group and gender and statements related to awareness on media campaigns promoting hygiene, positive influence of family, community and ASHA workers and pre covid hand hygiene behavior were the first part of the questionnaire. Two statements for each of these (for example positive influence of family on hygiene behavior - *Do your family members insist on following hand hygiene most of the times? Do you correct each other's behavior with respect to hand, household and food hygiene?*) to be answered as yes or no were employed. If both statements were answered in affirmative they were classified as having positive influence/behavior and vice versa. In the next part of the questionnaire statements related to hygiene behavior were included. The scale was adopted from a previous study by Stevenson et al.[1] in 2009. This scale identified all aspects of routine hygiene behavior such as- *general hygiene* (10 items), *household hygiene* (4 items), *food related hygiene* (4 items), *hand hygiene* (5 items) and *personal hygiene* (4 items) was employed.

Responses were coded from 1 to 4 so that higher scores reflect greater reported hygiene behavior. For example - *When soap is available, do you wash your hands with soap*, response was recorded as - ‘always’ (scored as 4), ‘usually’ (3), ‘occasionally’ (2), and ‘never’ (1).

Statistical Methods

Data from the survey was recorded and analyzed using SPSS 24 and IBM SPSS Modeler 18. Frequency and descriptive analysis (presented in table 1) was followed by establishing reliability of the constructs (general hygiene, household hygiene etc.) used to capture different aspects of hygiene behavior. All constructs demonstrated adequate reliability with cronbach alpha exceeding the threshold value of .7 [7]. Next the chi-square automatic interaction detection (CHAID) method of decision tree is employed to meet the research objectives. Decision tree analysis is an exploratory technique used to investigate the relationship between a dependent variable and independent variables [8]. These relationships then can be used to classify or predict variables in a visual and easily interpretable manner. CHAID technique uses predicative algorithms use “data patterns” to “understand and predict behaviors” based on input variables (predictors) that have a “significant effect” on the output, or target attribute [9] (which can be interpreted as - if-then conditions [10]). The tree-like diagram where a root node is split into branches (“child” nodes result from splits produced by “parent” nodes) resulting in homogenous segments, referred to as terminal leaf nodes, that cannot be split further[11]. During the process, the algorithm splits the data several times, with child nodes containing cases with a similar characteristic, and the first division made based on “the most significant predictor.” [9]. In the present study, CHAID has been used for predicting the respondent as hygiene conscious (or not) on predictor variables such as- gender, age group, resident status, awareness on media campaign about hygiene and sanitation, positive influence of family on hygiene behavior, positive influence of community members on hygiene behavior, interaction with ASHA workers, pre covid responsible hand hygiene behavior. This is expected to provide heterogeneous segments that significantly differ with each other on dependent and independent variables. The resulting segments are compared through an ANOVA on the specific aspects of hygiene behavior. In this way, it helps determining if the subjects belonging to each group behave in a significantly different way with specific aspects of hygiene behavior.

Results

Table 1 presents the sample profile and the distribution of predictor variables amongst the data set of 272 respondents. The mean score of each dimension of hygiene related behavior is also presented. A cumulative score was computed across the various aspects of hygiene behavior. The median split (2.25) of this score was used to classify respondents in two categories hygiene conscious (128) and non hygiene conscious (144). These results address research objective (RO) 1. Respondent score on various aspects of hygiene reflects somewhat adoption of hygiene behavior (score above the mid value of 2) with almost a near equal score on all aspects. Furthermore, in spite of a self reported measure where the participant may be driven to project socially desirable hygiene standards these scores are an obvious concern. There is an evident need to promote adoption of hygiene standards and a policy intervention is the need of the hour.

Next the CHAID analysis was undertaken to address RO (2). As a part of this analysis the entire data is split in to a training (75%) and testing (25%) data. The decision tree model (figure 1) is built on the training data set and later model comparison is done between training and testing data sets to judge the efficacy of the model (table 2). Hygiene category acts as the dependent variable and gender, age group, resident status, awareness on media campaign about hygiene and sanitization, positive influence of family on hygiene behavior, positive influence of community members on hygiene behavior, interaction with ASHA workers, pre covid hand hygiene behavior are the predictor variables. By analyzing the decision tree one can see that the most important variables in splitting between hygiene conscious respondents and non-hygiene conscious respondents are pre -covid 19 hand hygiene behavior ($\chi^2 = 16.22$), residential status ($\chi^2 = 9.98$) and influence of family members ($\chi^2 = 4.86$). It should be noted that this decision tree possesses five terminal nodes- 4, 7,8,5,6 that can not be split further. By following the paths (branches in the decision tree), one can generate the classification rules. Since there are five terminal nodes in the decision tree, there are also five classification rules. They are presented below

Rule 1 IF (Pre-Covid 19 hand hygiene = yes) AND (Positive influence of family on hygiene behavior = yes) AND (residential status = native) THEN prediction = Hygiene Conscious (probability =100%)

Rule 2 IF (Pre-Covid 19 hand hygiene = yes) AND (Positive influence of family on hygiene behavior = yes) AND (residential status = migrant) THEN prediction = Hygiene Conscious (probability =86%)

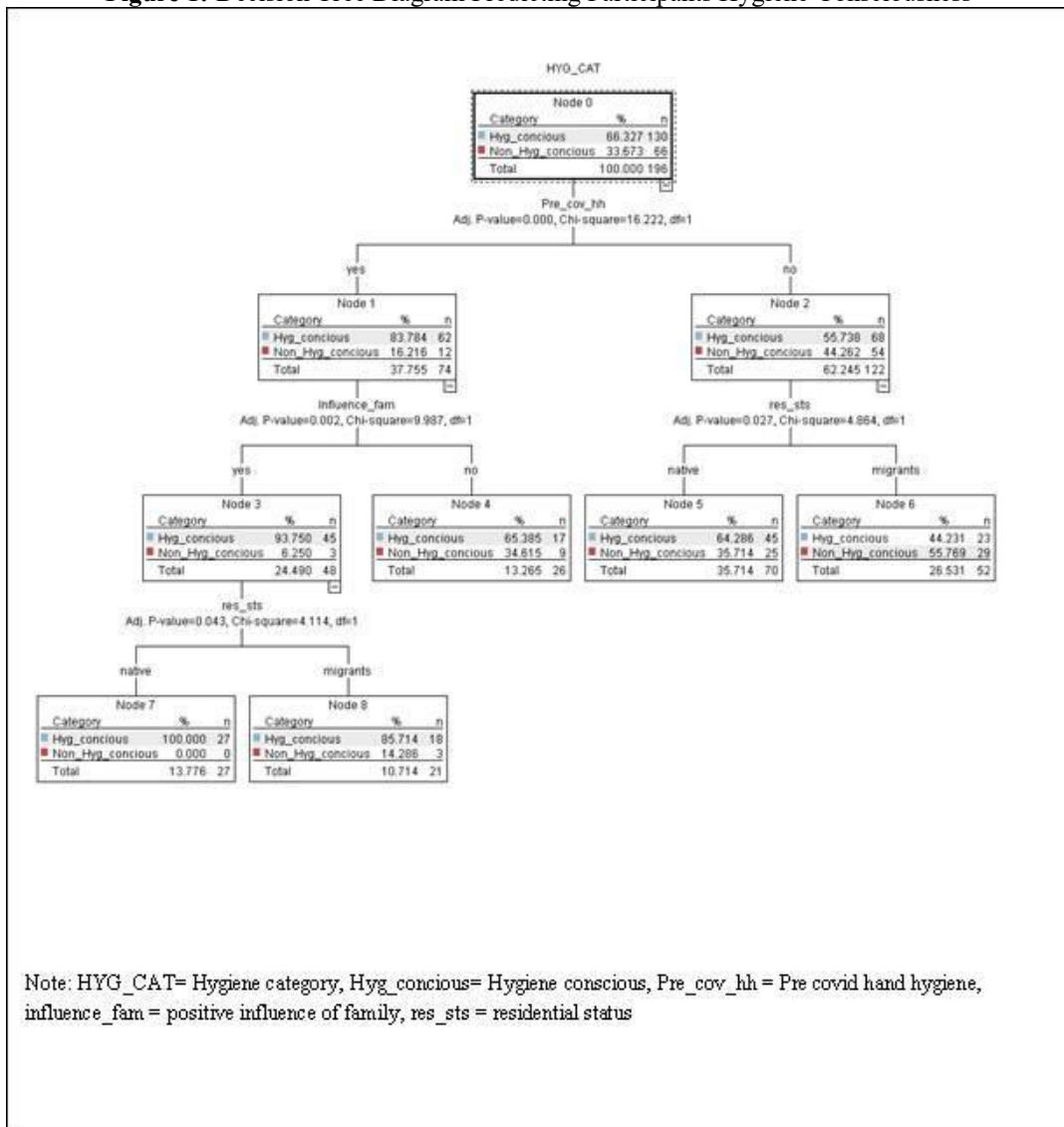
Rule 3 IF (Pre-Covid 19 hand hygiene = yes) AND (Positive influence of family on hygiene behavior = no) THEN prediction = Hygiene Conscious (probability =65%)

Rule 4 IF (Pre-Covid 19 hand hygiene = no) AND ((residential status = native) THEN prediction = Hygiene Conscious (probability =64%)

Rule 5 IF (Pre-Covid 19 hand hygiene = no) AND (residential status = migrant) THEN prediction = Non Hygiene Conscious (probability =55%)

Table 2 presents the classification of cases amongst training and testing data sets. Overall 70% of the cases are rightly qualified in the training data and 57% in the testing data. Further reflecting upon the category wise prediction then the model predicts hygiene conscious respondents better than non-hygiene conscious respondents. In the next stage of analysis the respondents were classified in five groups according to classification rules mentioned above. Rule1 for group 1, Rule 2 for group 2 and so on. A one way ANOVA analysis was undertaken across these groups and specific dimensions of hygiene behavior and results are presented in table 3. The results are found to be significant across all dimensions related to hygiene and cumulative score. Notably group 1 was found to be most hygiene conscious and group five the least.

Figure 1: Decision Tree Diagram Predicting Participants Hygiene Consciousness



Discussion

This study provides important information regarding hygiene behavior at the BoP. The results of this study highlight that despite the prevalence of COVID 19 pandemic, compliance on various aspects of

Table 2: Classification Data (training and testing)

Overall		Training	Testing
	Correct	136(69.39%)	43 (56.58%)
	Wrong	60 (30.61%)	23 (43.42%)
	Total	196	76
<i>(rows show actual)</i>			
Training	Hygiene Conscious	107	Non Hygiene Conscious 23
	Non Hygiene Conscious	37	29
Testing	Hygiene Conscious	37	16
	Non Hygiene Conscious	17	6

Table 3: Participant level of hygiene behavior across five groups

	N	Mean	Std. Dev	ANOVA F	Sig.
<i>General hygiene</i>					
Group 1	40	3.17	0.72	20.308	.000
Group 2	31	3.17	0.51		
Group 3	34	2.38	0.78		
Group 4	93	2.23	0.74		
Group 5	74	2.19	0.85		
<i>Household hygiene</i>					
Group 1	40	3.15	0.77	15.327	.000
Group 2	31	2.54	0.96		
Group 3	34	2.24	0.69		
Group 4	93	2.35	0.78		
Group 5	74	1.98	0.73		
<i>Food related hygiene</i>					
Group 1	40	3.34	0.68	24.801	.000
Group 2	31	2.58	0.94		
Group 3	34	2.15	0.67		
Group 4	93	2.32	0.73		
Group 5	74	1.97	0.67		
<i>Hand hygiene</i>					
Group 1	40	3.16	0.89	14.179	.000
Group 2	31	2.54	0.99		

Group 3	34	2.12	0.65		
Group 4	93	2.37	0.69		
Group 5	74	2.08	0.76		
<i>Personal hygiene</i>					
Group 1	40	3.27	0.67	21.450	.000
Group 2	31	2.53	0.93		
Group 3	34	2.36	0.72		
Group 4	93	2.30	0.81		
Group 5	74	1.91	0.67		
<i>Cumulative score on hygiene behavior</i>					
Group 1	40	3.22	0.67	27.354	.000
Group 2	31	2.67	0.76		
Group 3	34	2.25	0.49		
Group 4	93	2.31	0.61		
Group 5	74	2.03	0.55		

(Rule 1= Group1, Rule 2= Group2, Rule 3= Group3, Rule 4= Group4, Rule 5= Group5).

hygiene behavior remains questionable. The results of CHAID analysis illustrate that the most dominant variables in identifying hygiene conscious customers were- pre covid hand hygiene behavior, residential status and positive influence of family members and presents for policy makers group classification rules (and probability) which can help identify hygiene conscious citizens and non-hygiene conscious citizens. Specific policies such as training ASHA workers to particularly focus on migrants (refer group 5) and promoting hand hygiene as the first step to promote hygienic practices and behavior could be helpful. Given that positive influence of family promotes hygiene it is vital to engage with them as a unit and not deal with just individual level. Often children and young adults are made aware on maintaining hygiene at educational institutions but perhaps the family engagement is critical as age group did not have any significant role in hygiene behavior in this study. Although the results demonstrate that interaction with ASHA workers may not be significant in discerning hygiene conscious citizens yet their role cannot be undermined and they may be motivated and trained for such programs. Similarly awareness creation through media campaign could be more specific and local than generic campaigns which are not creating much of impact. Although the study suffers from the limitation of relatively small sample size and in specific geographic location yet the results can be meaningful for all stakeholders and agencies who aim to promote a culture of hygiene and sanitation for a healthier and happier society.

Conclusion

Bottom of pyramid segment needs particular attention to cultivate a culture and behavior of being hygiene conscious. The results of this study as indicated by respondents score on various aspects of hygiene behavior highlight an evident gap. The decision tree model illustrates the prediction for the hygiene conscious citizens and those who are not. Amidst the raging covid 19 pandemic it was found that hygiene behavior is primarily influenced by pre covid hand hygiene behavior, residential status and positive influence of family members. The BoP segment is not homogenous and different groups emerge as a part of CHAID analysis which demonstrate a difference in adoption of hygiene behavior.

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