Awareness and the demand of safe drinking water practices

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Introduction

- It is believed that income (poverty) is one of the causes of low demand for quality of environmental goods in developing countries.

- Due to lack of necessary information about health and environmental hazards, people can not make good decisions about their health.

- In developing countries, most of the fatal diseases are associated with contaminated drinking water especially among those children who belong to the poor and the vulnerable classes.

- WHO (2004) estimates that 1.8 million people die every year from diarrhea (including cholera) and 90 percent of them are children under the age of five years.

- It is also estimated that 88 percent of the cases of diarrhoeal disease are attributed to unsafe water supply, inadequate sanitation and hygiene.

- In Pakistan, every year 200,000 children die due to diarrheoal disease (Rosemann 2005)

- WHO (2004), if improved water supply were achieved worldwide then 6 to 25 percent diarrhea morbidity could be reduced annually

- WHO (2004) estimates that intervention in drinking water quality through household water treatment such as chlorination at point of use can lead to a reduction of diarrhea episodes by 35 to 39 percent annually.

- Why has adoption of safe drinking water practices, especially low grade technologies, not been universal?

- Poverty is an important factor but it certainly cannot explain why people do not use even less costly methods like chlorination and boiling

- The answer certainly is that people are unaware of the links between water contamination and associated health risks
- This concludes that:

  awareness is a determinant of the demand for safe drinking water

Objective of the Study

To Estimate and analyze the magnitude of awareness for safe drinking water practices among households in Hyderabad district, Sindh, Pakistan.

For the measurement of awareness, the indicators used are formal education, informal education (Print and electronic media) and health shocks (occurrence of diarrhoeal disease among 0-5 year's old children).

Review of Literature

- In Pakistan no published work has been found on examining the effects of awareness on drinking water purification behavior.

- Dasgupta (2001), McConnell and Rosado (2000) estimate: education of household members is statistically significant for the household's decision to purify drinking water at homes

- Joyotsna, Somanathan and Choudhuri (2003) finds that wealth has a dominated effect on household water purification behavior. It also finds that the willingness to pay for safe drinking water is highest for the highest educational level of female household member.

- Bruce and Gnedenko (1998) finds that medium and high income levels significantly affect households' decisions to adopt home purifications measures.

- The existing literature did not incorporate educational levels and other important characteristics of different household members for adopting the safe measures for drinking water at the point of use.

- This paper incorporates the different levels of education of household heads, decision-makers and other members of household; sex and occupation of decision-makers and households heads are also included

Methodology

Theoretical Considerations

- Marshallian demand is a function of its own price, income and household preferences

- In the cross-sectional data, households face the identical prices, so we cannot use the price of water purification method in the demand estimation.

- The method of estimation of traditional models is OLS. but water purification methods are durable and usually purchased in a single unit. (categorical variable), so bi-variate and multi-variate methods of estimation will be used by maximum likelihood.

Bi-variate Probit Model

$$y^* = \beta_1' x_1 + \varepsilon_1 \qquad (3.1)$$

$$y^* = \beta_2' x_2 + \varepsilon_2 \qquad (3.2)$$

$$y^* = \beta_3' x_3 + \varepsilon_3 \qquad (3.3)$$

Where $y^* = 1$ if a household uses some water purification method

$= 0$, Otherwise

3.1 represents the different characteristic of household heads

3.2 represents the different characteristic of decision-makers

3.3 represents the different characteristic of other household members

It is expected that household's purification behavior could be affected by its past experience of diarrhoeal disease. (problem of endogenity).

The solution of this problem, we have estimated a bi-variate probit model as system of equations

$$y_1^* = \beta_1' x + \varepsilon_1 ,$$
$$y_2^* = \beta_2' x + \varepsilon_2 ,$$

$$Cov\ (\varepsilon_1 , \varepsilon_2) = \rho$$

Multinomial Logit Model

On the basis of likelihood values from the bi-variate probit models we will select one model having the largest likelihood value for multinomial logit specification.

$$y_{ij}^{*} = \beta_j' x_i + \varepsilon_{ij}$$

The dependent variable have five different categories: no purification, boiling, use of chlorine/alum tables, ordinary (candle) water filter and ultra radiation electric filter.

List of Explanatory Variables

Variable		Explanation
Educational Variables	Edu1	1-8 years of schooling
	Edu2	9-12 years of schooling
	Edu3	13-15 years of schooling
	Edu4	16 and above years of schooling
Media Exposure Variables	Radio	Radio listening habit at least once in a week
	TV	Television watching habit at least once in a week
	Newspaper	Newspaper reading habit at least once in a week
Wealth Variables	W_quartile2	Household belong to lower middle wealth class
	W_quartile3	Household belong to upper middle wealth class
	W_quartile4	Household belong to top wealth class
Other Variables	Diarrhea	Household member 0-5 years suffered form Diarrhea during the last month of survey
	Sex	Whether male or female
	Occupation	Whether belongs to medical profession or not

Data and Construction of Variables

Table 4.1: Sample Profile

Name of Area (*Tehsils*)	Population of Area (million)	Number of Union Councils	Average Population of Union Councils	Number of Households Chosen from the Area	Household Members	Average household size of sample
City	0.518	20	0.0259	180	1,404	7.8
Latifabad	0.556	20	0.0278	200	1,424	7.12
Qasimabad	0.114	4	0.0285	40	282	7.05
Cantonment	0.085	3*	0.0283	30	181	6.03
Remaining Parts of City	0.200	7*	0.0286	64	505	7.89
Total	1.473			514	3,796	7.39

* *District Census Report* does not classify these areas in Union Councils. The numbers given above are the most probable ones if the areas were classified into union councils.

Data and Construction of Variables

The correct information on income cannot be collected accurately. However, the survey collect information on households ownership of various assets and characteristics of household dwelling

From the given information we calculate a wealth index by using first principle component analysis

$$W_i = \sum_{j=1}^{22} f_j \left[\frac{a_{ij} - m(a_j)}{S_j} \right]$$

This is the formula for the wealth index.

For the ease of interpretation, we create and use wealth quartile from the wealth index

Table 4.1: Distribution of Purification Adoption Rates by Education Levels

	No Purification	Purification				Total
		Boiling	Chlorine Tablets	Candle Filter	Electric Filter	
Education level of decision maker						
No Education	25.56	6.55	17.24	3.28	1.32	12.65
1-8 years	17.78	11.31	17.25	1.64	2.63	11.48
9-12 years	30.54	39.29	34.48	22.95	17.11	30.74
13-15 years	15.56	19.64	13.79	31.15	30.26	20.81
16 or above years	10.56	23.21	17.24	40.98	48.68	24.32
Education level of household head						
No Education	24.45	5.95	10.34	1.64	5.26	12.06
1-8 years	17.22	11.31	20.69	6.56	2.63	12.06
9-12 years	31.11	27.98	31.03	31.15	10.53	27.05
13-15 years	17.78	24.40	20.69	22.95	31.58	22.76
16 or above years	9.44	30.36	17.25	37.70	50.00	26.07
Highest education level among female household members						
No Education	30.00	7.74	31.03	3.28	7.89	16.34
1-8 years	7.78	4.17	6.90	0.00	0.00	4.47
9-12 years	41.67	31.55	34.49	31.15	13.16	32.49
13-15 years	14.99	35.12	17.24	29.51	36.84	26.65
16 or above years	5.56	21.42	10.34	36.06	42.11	20.05
Highest education level among male household members						
No Education	7.22	0.60	3.45	0.00	0.00	2.93
1-8 years	11.11	1.19	6.90	0.00	0.00	4.67
9-12 years	42.23	24.40	34.48	24.59	5.26	28.4
13-15 years	24.44	28.57	34.48	24.59	28.95	27.04
16 or above years	15.00	45.24	20.69	50.82	65.79	36.96
All households (%)	35.02	32.68	5.64	11.87	14.79	100
All households (Number)	180	168	29	61	76	514

Table 4.2: Distribution of Purification Adoption Rates by Other Household Characteristics

	No Purification	Purification				Total
		Boiling	Chlorine tablets	Candle filter	Electric filter	
Media exposures of decision maker						
Radio listening habit						
Almost Never	66.67	70.83	79.31	62.30	65.79	68.09
Once a week	33.33	29.17	20.69	37.70	34.21	31.91
TV habit						
Almost Never	18.33	4.76	0.00	3.28	2.63	8.75
Once a week	81.67	95.24	100.00	96.72	97.37	91.25
Newspaper						
Almost Never	51.11	32.74	37.93	14.75	15.79	34.82
Once a week	48.89	67.26	62.07	85.25	84.21	65.18
Household wealth						
Least Wealth Quartile	23.89	30.95	24.14	24.59	15.79	25.10
Lower Middle Quartile	17.22	32.74	37.93	36.07	13.16	25.10
Upper Middle Quartile	22.78	26.79	17.24	21.31	34.21	25.29
Top Wealth Quartile	36.11	9.52	20.69	18.03	36.84	24.51
Children aged 0-5 years suffered from Diarrhea						
No	36.67	30.36	27.59	34.43	50.00	35.80
Yes	63.33	69.64	72.41	65.57	50.00	64.20
Sex of decision maker						
Male	81.11	42.86	62.07	45.90	61.84	60.51
Female	18.89	57.14	37.93	54.10	38.16	39.49
Occupation of decision maker						
Non medical professional	97.78	95.24	100.00	90.16	81.58	93.77
Medical Professional	2.22	4.76	0.00	9.84	18.42	6.23
All households (%)	35.02	32.68	5.64	11.87	14.79	100.00
All households (Number)	180	168	29	61	76	514

Results and Discussion

We checked the endogeniety of the given probit equations by Seemingly Unrelated Bivariate Probit Model

The p-values of correlation coefficient between the errors of two equations by likelihood ratio test are 0.106, 0.200 and 0.125 for equations 3.1, 3.2 and 3.3 respectively.

Table 5.1: Marginal Effects in Bivariate Probit Regression Equations

Explanatory Variables	Probability of Purification Model 1	Model 2	Model 3
Educational Variables			
Education of decision maker; 1-8 years	0.188*		
	(0.013)		
Education of decision maker; 9-12 years	0.210*		
	(0.003)		
Education of decision maker; 13-15 years	0.282*		
	(0.000)		
Education of decision maker; 16 years or above	0.337*		
	(0.000)		
Education of household head; 1-8 years		0.150**	
		(0.055)	
Education of household head; 9-12 years		0.204*	
		(0.004)	
Education of household head; 13-15 years		0.277*	
		(0.000)	
Education of household head; 16 years or above		0.368*	
		(0.000)	

Highest education of female member of house; 1-8 years	-0.037
	(0.743)
Highest education of female member of house; 9-12 years	0.030
	(0.678)
Highest education of female member of house; 13-15 years	0.212*
	(0.005)
Highest education of female member of house; 16 years or above	0.288*
	(0.001)
Highest education of male: member of house; 1-8 years	0.077
	(0.645)
Highest education of male member of house; 9-12 years	0.241**
	(0.083)
Highest education of male member of house; 13-15 years	0.294*
	(0.034)
Highest education of male member of house; 16 years or above	0.426*
	(0.003)

(Continues)

Table 5.1 (Continued): Marginal Effects in Bivariate Probit Regression Equations

Explanatory Variables	Probability of Purification Model 1	Model 2	Model 3
Media Exposure Variables			
Radio habit of decision maker	0.014		
	(0.771)		
Television habit of decision maker	0.178*		
	(0.045)		
Newspaper habit of decision maker	0.194*		
	(0.002)		
Radio habit of household head		-0.004	
		(0.933)	
Television habit of household head		0.172*	
		(0.025)	
Newspaper habit of household head		0.094**	
		(0.098)	
Radio habit of female member in house			0.024
			(0.292)
Television habit of female member in house			-0.027
			(0.157)
Newspaper habit of female member in house			0.015
			(0.500)
Radio habit of male member in house			-0.020
			(0.339)
Television habit of male member in house			-0.007
			(0.676)
Newspaper habit of male member in house			-0.003
			(0.866)

Other Variables

Second wealth quartile	0.087	0.075	0.111
	(0.142)	(0.213)	(0.065)**
3rd wealth quartile	0.100	0.089	0.085
	(0.104)	(0.148)	(0.159)
Top wealth quartile	-0.016	-0.082	-0.083
	(0.798)	(0.201)	(0.221)
Diarrhea	0.078	0.061	0.078
	(0.104)	(0.193)	(0.104)
Sex of decision maker	0.414*		
	(0.000)		
Sex of household head		0.238	
		(0.114)	
Occupation of decision maker	0.083		
	(0.446)		
Occupation of household head		0.094	
		(0.475)	
Log likelihood	-242.718	-272.107	-254.660
Number of observations	514	514	514

Probability of critical values are reported in parentheses
* Indicates significance at 5% level
** Indicates significance at 10% level

- The results show that awareness has the most significant effect on adopting any method of purification and wealth has no significant effect.

- Based on the data set we may say that poverty is not a cause of lower quality of environmental goods; what is more important is how informed are households regarding the importance of those good in their lives.

Table 5.2 Marginal Effects of Multinomial Logit Regression

Explanatory Variables	Probabilities of purification methods			
	Boiling	Chlorine/Alum Tablets	Candle Filter	Electric Filter
Education of decision maker; 1-8 years	0.230*	-0.001	-0.085	0.087
	(0.006)	(0.351)	(0.903)	(0.215)
Education of decision maker; 9-12 years	0.107*	-0.001	0.003	0.173*
	(0.005)	(0.725)	(0.207)	(0.046)
Education of decision maker; 13-15 years	-0.046*	-0.002	0.037*	0.369*
	(0.002)	(0.821)	(0.018)	(0.002)
Education of decision maker; 16 years or above	-0.031*	-0.002	0.045*	0.396*
	(0.000)	(0.562)	(0.007)	(0.000)
Radio habit of decision maker	0.009	-0.001	0.036	-0.017
	(0.708)	(0.295)	(0.288)	(0.862)
TV habit of decision maker	0.010	0.012*	0.038	0.074
	(0.417)	(0.000)	(0.360)	(0.135)
Newspaper habit of decision maker	0.087**	0.000	0.101*	0.042*

Second wealth quartile	0.055	0.001	0.021	0.036
	(0.147)	(0.220)	(0.218)	(0.234)
3rd wealth quartile	-0.057	0.000	-0.019	0.211*
	(0.366)	(0.583)	(0.551)	(0.001)
Top wealth quartile	-0.205	-0.001	-0.032	0.258*
	(0.175)	(0.641)	(0.631)	(0.004)
Diarrhea	0.108*	0.000	0.017	-0.032
	(0.047)	(0.283)	(0.229)	(0.963)
Sex of decision maker	0.357*	-0.001*	0.117*	0.029*
	(0.000)	(0.019)	(0.000)	(0.000)
Occupation decision maker	-0.026	-0.015	0.030	0.069
	(0.854)	(0.780)	(0.568)	(0.327)

- The results lead us to conclude that besides other awareness variables, wealth influences the purification behavior only for expensive method of treatment, while the inexpensive methods of treatment like boiling and use of chlorine tablets are highly influenced by awareness variables only.

Conclusion

- Government and civil society can make an effective difference in lives of the people by making them aware about the methods of safe drinking water

- Education and awareness campaigns about clean water are powerful tools for public health interventions.

- Planned awareness of safety measures especially to uneducated and rural women along with relative empowerment of women in household affairs would be the key tools of success.

- Print and electronic media can be used to play a role in sensitizing and informing people about health hazards from unsafe drinking water.

These policies do not negate the need for increased supply of regulated clean pipe water; every possible policy to make the water safe needs to be considered and adopted.

Thank you for your attention