Why Low Adult Immunization? An inquiry into the case of Hepatitis B Vaccine in the Peri-Urban Areas of Kathmandu Valley

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Abstract

We attempt to analyze the reasons to low adult immunization from the willingness to pay perspective in the peri-urban setting of Kathmandu Valley where some private health facilities had organized Hepatitis B Vaccine Health camps in the recent past. We reason the existence of regulated Hepatitis B Vaccine market in Nepal and thereby utilize an open ended question to assess the willingness to pay of an unimmunized adult. We justify the application of the two-part model in the study and further show that the socio-economic and demographic variables do not play significant role in explaining the low adult immunization except for age and employment. The result further reveals that people do not care to pay more for vaccination at present unless they apprehend the risk of suffering from disease with the disease specific symptoms or some history of chronic diseases. We argue that people exhibit time inconsistent - present biased preferences in immunization practices. The small preventive costs incurred to them on immunization today appear very large relative to the economic benefits realized tomorrow. There still exists asymmetric information so far as understanding the importance of the vaccine and its right/proper usage are concerned; a strong case of informing people to perceive vaccination as a preventive lifesaving shot thus becomes essential.

JEL Codes: I12, I15, I18

Key Words: Hepatitis B Vaccine, Adult Immunization

Background

Few people recognize the fact that immunization is a safe, effective and simple way to prevent life threatening illnesses not only in children but also in adults. Immunizations among adults, in many cases, are found to be more than 50 % effective (Finger and Francis, 1998). Reports show higher rate of underutilization of vaccines among adults. In the US alone, millions of adults go without routine and recommended vaccinations each year, which leads to an estimated 40,000 to 50,000 preventable deaths, thousands of preventable illnesses, and $10 billion in preventable health care costs each year (TFAH, IDSA & RWJF, 2010). The global policy environment and the contact with international agencies, type and quality of institutions, supply side dominance of vaccines (vs. demand side) are the major determining factors for the immunization coverage rates (Gauri and Khaleghian, 2002). Madhavi (2003) also substantiates this fact in the case of India reporting that the vaccine policy in India, rather than being determined by disease burden and demand, is increasingly driven by supply push, generated by industry and mediated by international organizations. Most vaccines, although affordable, do not induce people to take one unless persuaded at their doorsteps and that too at free of cost. Furthermore, less importance given to adult immunization; poor knowledge about safety and efficacy of vaccines; and lack of universal recommendations for all adults and financial constraints are other major causes of underutilization (Kishore et al, 2008).

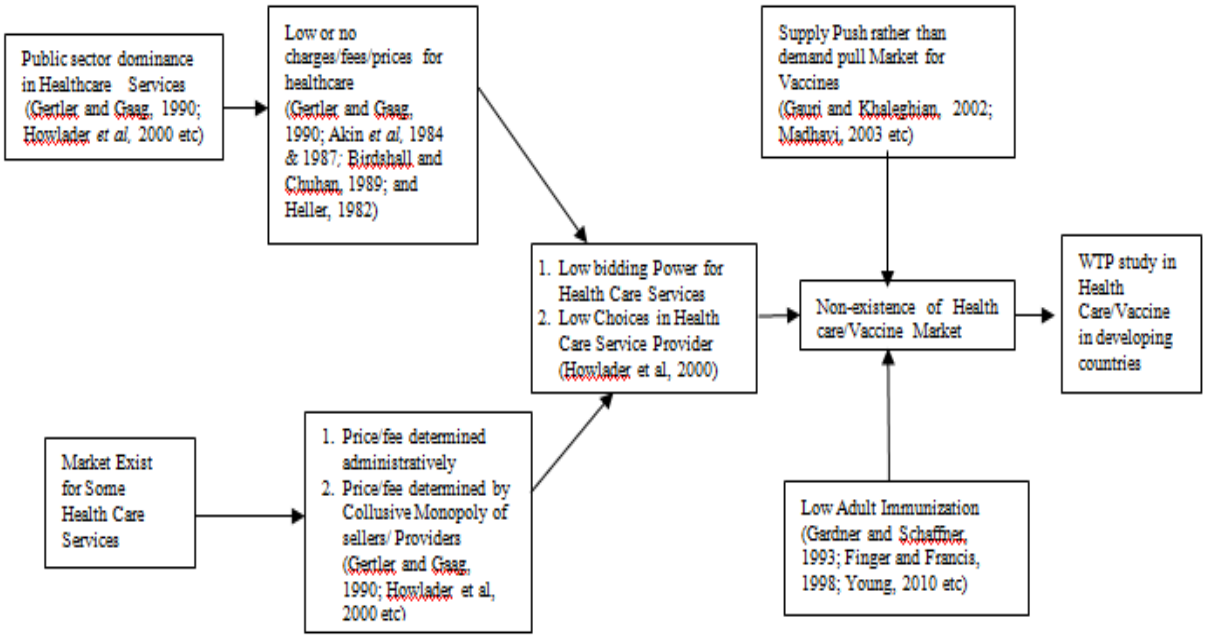
There are two strands of literature available relating adult immunization at micro level. The first one is related to assessing the willingness to pay (WTP) for a hypothetical vaccines such as HIV/AIDS and malaria in the economies with high prevalence of such

diseases. These studies utilize either OLS (Ordinary Least Squares) or the maximum likelihood estimation (MLE) basically to derive the standard demand function by asking dichotomous choice WTP questions [see for e.g. Whittington et. al (2002); Whittington et. al. (2008); Cropper et. al. (2004)]. The second one is straightforward and not much researched (particularly adult immunization). They assess the factors affecting the adult's decision to vaccinate and primarily utilise the logistic regression analysis to make their inferences. For e.g., Park et al (2013) assesses the determinants related to the lack of HB vaccine uptake in the general adult male population in Korea and find that lack of insurance, lower education and the lack of knowledge regarding the need for vaccination are the major determinants among others. Their study is the only available work that analyze the reasons behind the HB uptake in adult population at micro level. Other papers study other vaccines particularly influenza vaccines [See: Nagata et al., (2011); Zheng et al., (2013) etc].

To our knowledge, there are negligible papers which assess the adult immunization of actual vaccines (vs. hypothetical) from the WTP Perspective. Bloom et al. (2005) asserts that immunization has the potential to significantly boost economic growth by preventing millions of deaths every year and thereby reducing the costs of treatment and disability caused by infectious diseases. We believe that the analysis of immunization from WTP perspective is quite important in developing economies where the *actual vaccine* market are largely regulated; health insurance system is not developed; and the imperfect knowledge prevails in immunization practices. We therefore try to fulfill this gap in literature by utilizing WTP approach to adult immunization practices which we believe

will provide meaningful explanation to the low adult immunization in developing economies.

Figure 1: Rationale for WTP study in Developing Countries



Source: Author

From the microeconomic theory point of view, the poor demand of a vaccine poses a constraint to access the information on revealed preference of the consumers making the derivation of a standard demand function problematic. Therefore the researchers try to estimate the WTP based on stated preferences with hypothetical choices known as contingent valuation method in most of the public programmes especially in environmental and health care services (Blumenschein et al., 2008). Most of the healthcare and a substantial portion of curative care in poor economies are provided by the public sector and therefore market only partially exists for a few goods and services.

Moreover, the prices of such goods and services are determined administratively or by the collusive monopoly of sellers/providers thus strictly restricting the choice or bidding capacity of the consumer. Whether in a hypothetical or an administered vaccine market situation, the true preference of the individuals cannot be revealed (See: Figure 1).

HB and its Prevalence in Nepal

HB is a potentially life-threatening liver infection caused by HB Virus (HBV). HBV infection is a major global public health problem and is one of the most infectious agents causing acute and chronic morbidity worldwide. About 2 billion people worldwide have been infected, among whom more than 350 million are chronic carriers of HBV (Shah, 2005; Karki et. al. 2008; Ghimire et. al. 2007). WHO marked World Hepatitis Day on 28 July 2011 for the first time and warned that more than five million will die of the viral hepatitis in the next ten years in South East Asian region and has already killed more people in the region than malaria, dengue, and HIV/AIDs combined.

The incidence of acute HB in Nepal is low compared to other Afro-Asian countries (Shrestha, 2005). Karki et.al. (2008) found from the recent study conducted among Nepalese blood donors through the years 2001/2002-2006/2007 that the overall seroprevalence rates of HBV in a nationwide analysis were observed to be 0.82% with the prevalence rate of 0.92 % in Kathmandu alone. Similarly, Ghimire (2007) estimates 1 percent reported case of positive HBV out of the 1200 blood samples collected from three major cities (Kathmandu, Biratnagar and Nepalgunj). Each of Kathmandu and Nepalgunj accounted for 1.33% case of positive HBV from their respective blood

samples with Biratnagar no any case for the same. This indicates the higher prevalence of the HBV in urban centers of Nepal where proportionately larger number of people are at high risk to HBV.

The HBV is transmitted through contact with the blood or other body fluids of an infected person-not through casual contact. Originally known as “serum hepatitis”, the acute illness causes liver inflammation, vomiting, jaundice and-rarely-death. Chronic HB may eventually cause cirrhosis and liver cancer-a fatal disease with very poor response to current chemotherapy[1]. Normally, half of all people infected with the HBV have no symptoms. Symptoms develop within 30-180 days of exposure to the virus. The symptoms are often compared to flu. Some symptoms include appetite loss, nausea and vomiting, itching all over the body, pain over the liver etc. among others.

There is no specific treatment for acute HB. Care is aimed at maintaining comfort and adequate nutritional balance, including replacement of fluids that are lost from vomiting and diarrhea. Chronic HB can be treated with drugs, including interferon and anti-viral agents, which can help some patients. However, HB is preventable with a safe and effective vaccine. The vaccine can be given as either three or four separate doses, as part of existing routine immunization schedules. In areas where mother-to-infant spread of HBV is common, the first dose of vaccine should be given as soon as possible after birth (i.e. within 24 hours). The complete vaccine series induces protective antibody levels in more than 95% of infants, children and young adults. After age 40, protection following the primary vaccination series drops below 90%. At 60 years old, protective antibody

levels are achieved in only 65 to 75% of those vaccinated. Protection lasts at least 20 years and should be life- long.[2] People in high risks to HB include persons with high-risk sexual behavior; partners and household contacts of HBV infected persons; injecting drug users; persons who frequently require blood or blood products; recipients of solid organ transplantation; those at occupational risk of HBV infection, including health care workers; and international travelers to countries with high rates of HBV.

Context of the Regulated Vaccine Market in Nepal

Nepal started immunization service from the vaccination against small pox in the late 1960s and then stepped ahead with Expanded Program on Immunization (EPI) in 1979 (Acharya, 1988). In Nepal, six traditional antigens were in use till 2002, and HB came in existence in 2004 with the support of Global Alliance for Vaccines and Immunization (GAVI). The National Immunization program (NIP) of the Ministry of Health, the successor of the EPI, is primarily responsible for child immunization which is administered through local health institutions for free. On contrary, private health facilities cater to the demand for immunization of others who are ineligible under the NIP. These private institutions have to take prior approval from the Quality Control section at the Department of Health Services (DHS) of Ministry of Health. However, majority of these institutions are being operated without the approval. Moreover, they charge disproportionately higher prices for the HB vaccines despite the fact that the DHS has prescribed reasonably lower rates[3]. This indicates that the market for vaccine is very preliminary in Nepal further shrouded with Government Regulation (through price control) and unfair market practices by the private health facilities.

This study focuses on assessing the underlying factors responsible for low adult immunization in the peri-urban areas of Kathmandu Valley using the individual level information. We attempt to assess the same by applying the contingent valuation approach by asking an open ended WTP question for HB vaccine to the unimmunized adults. We further justify the application of two-part model in this study by showing that there are large numbers of zero responses to the maximum WTP question and that the problem of selection bias does not appear in making vaccine decisions. We show that age and status of employment are the only significant determinants among the socio-economic and demographic characteristics of the respondents. More importantly, we find that people are WTP significantly higher for immunization only when they self-report their poor health status evident in the form of some disease specific symptoms or some history of chronic disease. We attribute this phenomenon to a time - inconsistent, present biased preferences of individuals with self control problems wherein the small preventive costs on vaccine today appear quite large to them relative to its large economic benefits tomorrow.

Method

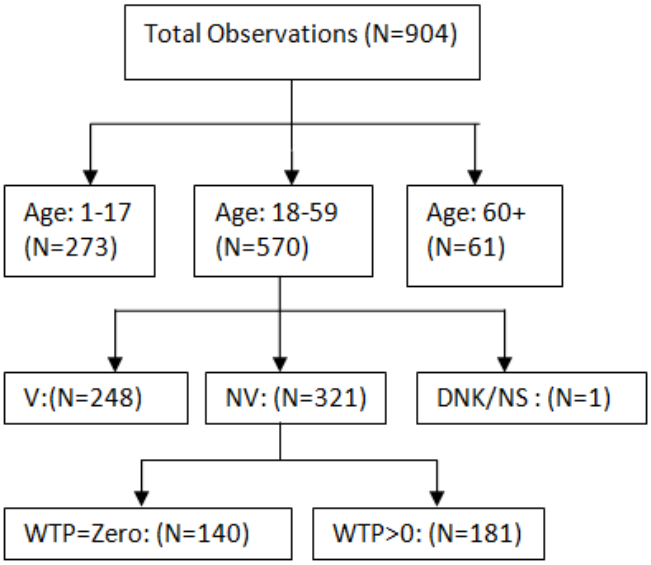
Sampling Method

A cross-sectional data was collected from January to February in 2011 from the peri-urban setting of Kathmandu Valley namely *Matatirtha* Village Development Committee (as a rural set up) and *Kirtipur* Municipality (as the urban set up).[4] Recently there has been a surge in HB vaccination health camps undertaken by some private health institutions in the peri-urban areas of the Kathmandu Valley. They organize such health

camps at regular intervals at some public place such as schools to ensure that the service is accessible to all those not covered under NIP but willing to vaccinate and that a complete dose of vaccine is received. Three wards from each of these set ups (rural and urban) where such heath camps were held in the recent past were randomly selected i.e. six wards in total[5]. This is interesting though - to see why the adult immunization is still lower - in spite of such frequently held health camps. We visited most of these private health facilities in Kathmandu and further inquired at local health facilities as well as few households to identify the wards where HB health camps were held recently[6]. Lastly, using proportionate sampling method, the desired number of samples was selected from the so selected wards separately.

We determine the sample size assuming that the vaccinated household in the *entire* population was approximately 50 percent and that the unvaccinated household conversely as 50 percent. This is a reasonable assumption to make since our sample population includes people of all ages and not only our samples of interest i.e. adults in18-59 age group. With such an assumption, our sample size will be the maximum and the sample will yield at least the desired precision with the most conservative sample size (Kothari, 1985).[7] We sampled a total of 184 of 615 households with 91 of 304 and 93 of 311 households from the rural and urban areas respectively. Our unit of analysis is an unimmunized adult household member of 18-59 ages. Therefore, the effective number of observations used in our preferred specification is 321 out of total of 904 observations from 615 households sampled.

Figure 2: Sample Chart



Note: N=No. of Observations; V = Vaccinated; NV= Not Vaccinated; DNK/NS=Do not know/Not sure

A sampling frame was constructed with the serial number, household number and name of the household head in order to select the households from each ward. Thereafter using simple random sampling, the required number of samples was drawn from each ward. In case of refusal to participate in the survey or ignorance, the next household not within the selected sample was interviewed. The interview with the structured questionnaire was conducted either in the morning hour or in evening hour to make sure that all the members of the household were present during the interview. If someone cannot respond especially children, his/her parent (either mother or daughter) was requested to respond on their behalf. The questionnaire had two parts: Part I with questions on socioeconomic and demographic characteristics asked to respondents of all ages and Part II with questions on HB experience asked only to 18-59 adult age- group. Our inferences are based primarily on responses from the latter set of questions asked to adult age group.

WTP Question

In our survey, we put the respondent in the role of a unitary decision-maker, asking him or her to maximize his own utility function (which may reflect altruistic preferences towards other family members), and subject to household income. This yields a stated demand for the vaccine that reflects the impact of the vaccine on the time spent ill by each family member and on his or her risk of dying, as well as the impact of the vaccine on the cost of treatment and productivity loss.

Our study further takes the administered vaccine market situation as a starting point where, unlike the hypothetical vaccine market case, asking the dichotomous choice WTP question may be counterintuitive. This is more so truer in the context of Nepal particularly with regards to HB vaccine market[8]. We, therefore, utilize the open ended WTP question since it does not require including bid value/ price as the explanatory variable in the model. Loomis et al (1997) finds no significant difference between the open-ended and dichotomous choice question formats irrespective of whether both are used to estimate either hypothetical or actual WTP.

The open ended WTP question, based on contingent valuation method, administered to the respondents was:

> Suppose that three doses (shot) of HB Vaccine provide protection from HBV throughout your lifetime. What is the maximum price you are willing to pay for one shot of the vaccine provided?

Selection of Econometric Model

Following Hammit and Zhou's (2006) suggestion, we decompose the responses to the maximum WTP question into two parts where the first part predicts whether an individual has a non-zero WTP (herein referred to as selection equation) represented in the form of dichotomous variable M_i taking the value of unity in that case and zero if otherwise, and the second part predicts the formers' magnitude, conditional on being positive (herein referred to as outcome equation) which is basically represented as logarithmic transformation of the revealed amount $(log)W_i$. Let us represent this bivariate model as follows:

$$M_i = X_{i1}^{'}\gamma + u_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1) \text{ (Selection Equation)}$$

$$M_i = \begin{cases} 1 \; if \; X_{i1}'\gamma + u_i \geq 0 \\ 0 \; if \; X_{i1}'\gamma + u_i < 0 \end{cases}$$

$$\ln W_i = X_{i2}^{'}\beta + v_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2) \text{ (Outcome equation)}$$

$$lnW_i = \begin{cases} X_{i2}'\beta + v_i \; if \; M_i = 1 \\ unobserved \; \; if \; M_i = 0 \end{cases}$$

X_{i1} and X_{i2} are the covariate vectors that determine M_i and lnW_i respectively. γ and β are vectors of unknown parameter. u and v are error terms with joint cumulative density functions and is assumed to have a bivariate normal distribution with mean zero, unit variance and correlation $'\rho'$ and $i = 1,2,3\ldots\ldots\ldots N$ represents the individuals. A sample selection problem arises when the selection is on unobservables i.e. $\rho \neq 0$ (Cameroon

and Trivedi, 2005)[9]. The conditional expectation of the lnW_i given that M_i=1 will thus be given by:

$$E(lnW_i|X_i, M_i = 1) = X'_{i2}\beta + \rho\sigma\lambda(X'_{i1}\gamma).....(3)$$

where $\lambda(X'_{i1}\gamma) = \frac{\emptyset(X'_{i1}\gamma)}{\Phi(X'_{i1}\gamma)}$ represents the inverse mills ratio which is the ratio of the probability density function $\emptyset(X'_{i1}\gamma)$ to the cumulative distribution function $\Phi(X'_{i1}\gamma)$ of a distribution. It follows from equation (3) that the sample selection bias will be introduced if it is estimated using only non-zero WTP for $M_i=1$ since we estimate without including the last part on the RHS of equation (3) as one of the explanatory variables. We test the presence of the sample selection bias by modeling the two choices simultaneously using Heckman's two-step MLE method (Calia and Strazzera, 2001 & Strazzera et al., 2003b).

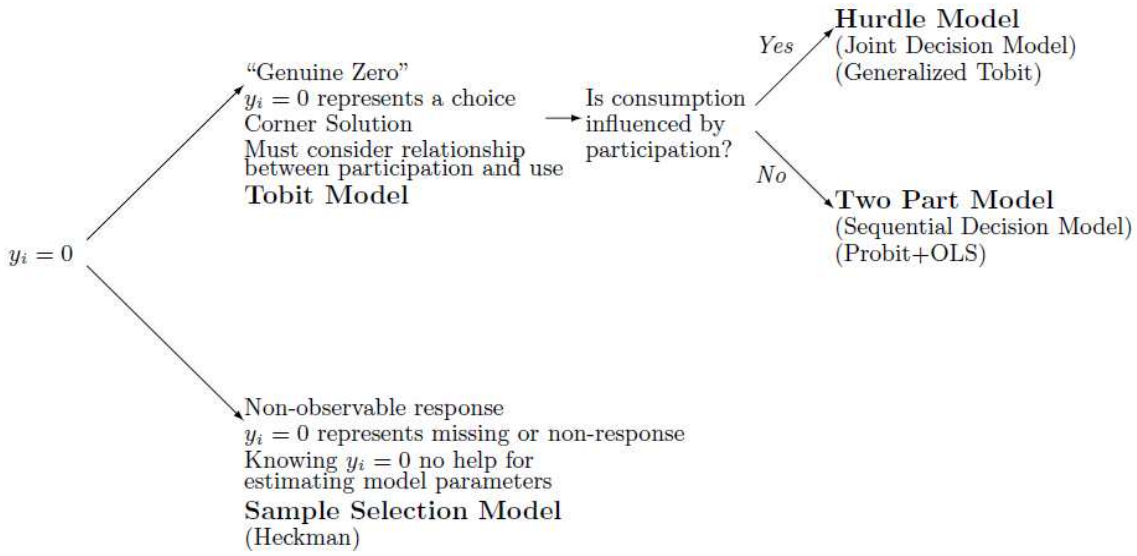
Following Strazzera et al (2003a), we set up a likelihood function for the Full information Likelihood estimation as follows:

$$lnL = \sum_{M_{i=0}} (1 - I_i) ln\,\Phi(-X'_{i1}\gamma) + \sum_{M_{i=1}} I_i ln\,\Phi\left(\frac{lnW_i - X'_i\beta}{\sigma}\right) + I_i ln\,\Phi\left(\frac{X'_{i1}\gamma + \rho((lnW_i - X'_i\beta)/\sigma}{\sqrt{1-\rho^2}}\right) - I_i ln\,\Phi$$

The maximization of the log-likelihood function provides sets of simultaneous equations of the parameters of both the outcome and the selection equations. If we fail to reject null hypotheses of independence between the error terms i.e. $\rho = 0$, then there is no

sample selection problem and we can use two-part model which is based on much weaker assumptions than the MLE since we relax the dependence of error term assumption.

Figure 3: Choice of appropriate estimation strategy



Source: Humphreys (2013)

Furthermore, the significant proportion of the people might be willing to pay nothing for it i.e. they choose to consume none of it which Humphreys (2013) describes as a "genuine zero" case. The two part model is the appropriate model when the participation and consumption (herein selection and outcome equations) are independent decisions and that there are relatively large number of genuine zero responses (Havet et al, 2012; Humphery, 2013) [See Figure 3]. Furthermore, while applying the two-part model we compare the results from the OLS and GLM (Generalized Linear Model) estimation in the selection equation. The two-part model suggests running probit model in the first part for whether the respondents report zero or positive WTP amount and then running OLS

or GLM in the second part using a log-normal model only for positive WTP. GLM accounts for the skewness in the distribution of dependent variable and the non-linear effect of the predictors on the dependent variable using variance-weighing rather than through transformation and retransformation. We assume gamma distribution while doing GLM estimation. Furthermore, we report robust standard errors clustered into households assuming that the observations may be correlated within households. Also we re-run the outcome equation in the two-part specification excluding variables that might be possibly correlated with each other to see if such a correlation may largely alter our inferences in baseline specification. Finally, in order to check the robustness of our results, we run alternative specifications of OLS and Tobit Model on full sample of unimmunized adults in 18-59 age category including zero WTP responses.

Selection of Covariates

Following Cropper et. al.(2004), the covariates used in our study include such factors like, household income, household size—respondent characteristics such as age, gender, marital status and literacy and a vector of HB related variables indicating the health status. We use consumption expenditure instead of household income as a measure of economic well-being of the household[10]. HB symptoms such as appetite loss, jaundice, liver pain etc. and HB causing activities such as blood transfusion, contact with infected person, sharing needles etc. were taken into account if they incurred in the last six months preceding the date of interview[11].In order to test if people spend on HB vaccines if they experienced poor health from some chronic disease unrelated to HB, we also

include the covariate representing the prevalence of chronic disease if it happened in the last one year preceding the interview date.

Table 1: Descriptive Statistics (N=321)

Variables	Definition	Mean
WTP value (log) (N=181)	Log of Positive WTP amounts	4.91 (0.95)
Household Size	Number of member s in the household (at household level)	4.67 (1.68)
Age	Completed Age in Years	37.39 (12.06)
Age Squared	Square of the completed Age in Years	1542.94 (955.39)
Male (=1)	Dummy indicating Male	0.48 (0.50)
Married (=1)	Dummy indicating married	0.80 (0.40)
Rural (=1)	Dummy indicating resident of a rural area	0.53(0.50)
Education		
No Education(=1)	Dummy indicating no schooling	0.10 (0.30)
Primary Education (=1)	Dummy indicating Primary level education completed	0.19 (0.39)
Secondary Education (=1)	Dummy indicating Secondary Level education completed	0.24 (0.43)
College Education (=1)	Dummy indicating College Level Education completed	0.47 (0.50)
Employed (=1)	Dummy indicating employed	0.71 (0.50)
HB related Variables		
HB Symptoms (=1)	Dummy indicating any or all HB symptoms in the last six months	0.02 (0.14)
HB Activities (=1)	Dummy indicating any or all activities in the last six months that may cause HB	0.20 (0.40)
Chronic Disease (=1)	Dummy indicating a chronic disease in the last one year	0.16 (0.32)
Consumption Expenditure	Expenditure incurred last month on consumption in Nepalese Rupees (at household level)	13865.98 (7282.44)

Note: Standard Deviations are in the Parenthesis

Source: Field Survey, 2011

Setting Hypothesis

The effect of *household size* on amount of WTP for the vaccine is unclear. *Age* is hypothesized as having positive relationship whereas the *age squared* with negative relationship with the amount of WTP for vaccine because people are WTP more when

they are younger since vaccines are effective during such ages but when they grow older they bother less about their health and also the effectiveness of vaccine declines with age i.e. vaccines work less effectively in old age people. This is also because older people probably feel less confident about their future income and have a lower opportunity cost of time.

We expect that married population (=*married)* is more likely to pay more for the vaccines than the unmarried population. The simple line of reasoning would be that married are more responsible towards their family and therefore more health conscious than unmarried. The effect of gender (=*male*) on the probability that a respondent will pay more for the vaccine is also uncertain. So far as consumption expenditure is concerned, most studies show that higher expenditure (=*consumption expenditure*) are associated with higher WTP for healthcare. We also hypothesize the same. The effect of formal education is unclear. It is commonly assumed that more years of schooling would have a positive effect on demand for improved health, perhaps because better-educated people should understand better the epidemiology of the disease and the benefits derived from the vaccine. Education also correlates with consumption expenditure. Employment (=*employed*) is also hypothesized to have a positive effect since it correlates with both consumption expenditure and education. The effect of area of residence (=*rural*) on the amount of WTP is also unclear.

We further hypothesize that the people with *HB symptoms* or those who have undertaken activities that might cause HB (=*HB activities*) are likely pay more to purchase the

vaccines than those who haven't such symptoms or undertaken such activities. To make it simple, we also hypothesize that people who had had some *chronic disease* in the last one year are WTP more to buy a vaccine.

Results

The status of vaccination shows that the NIP of the Government of Nepal for children has been a success with about 80 percent of the respondents from the age group 1-17 already vaccinated. This is not the same with the older age groups where majority of the respondents are not vaccinated (See Table 2). This further substantiates the rationale for excluding the young age category 1-17 and including the adult age category 18-59 in this study. We further exclude the oldest age category 60+ since the vaccines are least effective at these ages. The rationale for choosing 18-59 age category in the study is also further justified by the t-statistics for each category. This mean vaccination decline as people gets older i.e. people are less willing to vaccinate with the increase in their ages.

Table 2: Vaccination status by Age Category (t-test)[12]

	Mean Age			
	1-17	**18-59**	**60 & above**	**Total**
Vaccinated (A)	9.98 (82.12)	31.70 (43.58)	76 (6.56)	21.82
Not Vaccinated(B)	9.95 (16.79)	37.02 (56.42)	69.02 (93.44)	37.81
Difference (A-B)	0.03	-5.32***	0.98	-15.99***

Source*: Field Survey, 2011*

Figures in parenthesis are the percentage of respondents in the given categories.

Table 3: Amount of WTP (Between 18 to 59 years)

WTP amounts (in Nepalese Rs)	Frequency (%)
0	140 (43.6)
0-200	69 (21.5)
200-300	58 (18.06)
300 & above	54 (16.84)
Total	321 (100)

Source*: Field Survey, 2011*

Table 3 shows that the number of people willing to pay declines with the increase in amount of WTP i.e. more people are WTP lesser amounts and vice versa. Our unit of analysis for two-part model (WTP analysis) therefore boils down to 321 observations since we ignore the younger and older age groups as well those who are already vaccinated from the adult age group.

We fail to reject the null hypotheses of no dependence between the error terms in selection and the outcome equations. MLE Heckman result shows the likelihood- ratio test of independent equations with the chi-square value 1.17 and the p-value of 0.2793 (Result not shown). This means that the selection is on observables and that there is no problem of selectivity bias. This also shows that there is no problem of non-randomness induced from the self- selected samples of unimmunized adults from 18-59 age -category. Three observations from the young age group (1-17) were not used in Heckman analysis since they could not recall their vaccination status. We also observe that about 44 percent of the respondents replied zero amount to maximum WTP questions as a "genuine zero"

described above. As such, we use two-part model as the appropriate fit model in the study. We use log-linear model in the outcome equation to ensure the normal distribution of the positive values of WTP.

Table 4: Estimation Result: Two-Part Model[13]

Dep. Var.	Log of Positive WTP Amounts	
Exp. Vars.	**OLS**	**GLM**
Household Size	0.0583	0.0499
	(0.0433)	(0.0342)
Age	0.189***	0.167***
	(0.0687)	(0.0568)
Age Squared	-0.00237**	-0.00207***
	(0.000918)	(0.000759)
Employed	-0.271	-0.270*
	(0.196)	(0.149)
Chronic Disease	0.514***	0.440***
	(0.194)	(0.168)
HB Activities	-0.448*	-0.454*
	(0.255)	(0.239)
HB Symptoms	1.292***	0.937***
	(0.248)	(0.255)
Consumption Expenditure	-0.0000216	-0.0000145
	(0.000015)	(0.0000118)
Constant	1.810	2.504***
	(1.146)	(0.958)
Observations	181	181
R-squared	0.237	

Clustered Robust Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Both OLS and GLM result show that the maximum age after which the amount of WTP starts declining is 40 years. WHO (2012) also mentions that the levels of protection of the vaccines drops below 90% after the age of 40. This shows that the people perceive

this information strongly so that they show disinterest in immunization once they reach 40 and above. Prevalence of chronic disease and the symptoms of HB here represent the poor health status of the respondents which, according to our findings, means that they are willing to pay more when they perceive their health status as poor. However, this is much higher in the latter case with respondents reporting some HB symptoms - they are WTP about 100 percentage points more than the one without such symptoms. The explanation to this is obvious - the impending fear of the infection. Park et al (2013) also find the similar result stating that the individuals in poor health are more likely to receive vaccine.

Surprisingly, the respondents reporting HB activities have a negative coefficient of 0.45 but significant at only 10 percent level. One possible explanation to this phenomenon is that such activities do not directly reflect the poor health status of the people and therefore their wariness of being infected declines. Although this may be potentially linked to greater risk of infection, they do not perceive this riskiness as a *direct* threat to health. The alternative specifications, however, show this variable as insignificant although the sign is still negative (See Appendix II).

So far as employment is concerned, GLM specification shows that it is negatively associated with the WTP amount at 10 percent level of significance. The opportunity cost of attending vaccination series for the employed individuals might be higher. This means they either do not account for or simply ignore the expected economic benefits from immunization to be realized in the future.

Our estimates from two-part specifications are robust to alternative OLS and Tobit specifications in Appendix II. However, these specifications further show that the consumption expenditure has a significant negative impact on the WTP amount . We further checked if the possibly correlated terms in our preferred specification such as consumption expenditure, employment status and level of education might render our estimates inconsistent and biased. We find that the coefficients and level of significance for the main variables of interest does not change much from the baseline specification even after excluding possible correlated variables from the specification (See: Appendix III).

Discussion

Our results show that socio-economic and demographic factors do not in general determine the WTP for vaccines - age is shown to be the only significant predictor exhibiting a non-linear relationship with the amount of WTP. The inverted U shaped relationship imply that people are willing to pay more up to a certain years of age beyond which their WTP declines. We find that the maximum age at this turning point is 40 years. This is in line with the previous researches which find that the age matters the most of all in making vaccine decisions. This result also coincides with the WHO standard prescription for HB Vaccine that its effectiveness declines after the age of 40. In Nepal, preventive care is still not an essential part of the household health decisions as compared to curative treatment and therefore people are willing to spend disproportionately larger amounts on the latter than former. The tendency to spend more by a people with the history of chronic diseases and the HB symptoms may be more

related to their self-control problems properly described as time inconsistent - present biased preferences.

The time inconsistent preference lead people to perceive the small preventive costs on immunization today very large relative to the benefits typically realized far in the future. Dupas (2011) reasons this phenomenon for people spending huge amounts on remedial care whereas giving preventive tools and behaviors a far less priority at the same time. He , however, further substantiates that such procrastination in preventive health behavior becomes unlikely in the event of the health shock when suffering is immediate and risk of death imminent. This explains why the respondents in our study as well remain indifferent to immunization unless they have an impending fear of suffering - the suffering primarily instigated from the disease specific symptoms or some episodes of chronic disease not necessarily related with the vaccine preventable diseases. Several other papers provide an evidence of present bias justifying poor uptake of preventive care.

Formal education itself does not determine adult immunization. Dupas (2011) also puts forth several studies to justify that the information on health risk matter more to improve the preventive uptake and education is important only to help enhance information acquisition and learning. Our study area had seen some HB vaccination health camps in the recent past by private health facilities primarily targeted at the adult members. We expected a significant increase in adult immunization as a consequence of these camps but our result showed that there are still a significant number of adults unvaccinated in

the 18-59 age group (See Table 2). One possible explanation to this irony is the lack of flow of proper information about the importance of the vaccines and the health risk one is likely to suffer in case of adversities. The staffs from the health camps pre-visit each household and ask them to buy a 'coupon' for the vaccination to be held at a some pubic place such as schools at certain future date. Interestingly, neither of these parties bother to explain or ask about the rationale for taking vaccines to each other. Hence education without information is not sufficient to explain the WTP of an individual.

Above explanations on time-inconsistent preference and lack of flow of information indicates a huge information gap in understanding the importance of vaccination among adults. It is important to inform people about the health risk and the use of vaccines as a preventive treatment with the enormous potential to mitigate the substantial economic burden in the future.

Conclusion

HBV is now a major global health problem primarily unfolded by the low vaccine coverage among the adults. This is more problematic in poor and developing countries. Poor economies are not well placed to cater to the basic health needs of the population - immunization of adults is rather a distant concern for the Government. However a National Campaign for adult immunization or “Immunization for all” is necessary with the Public-Private Partnership and should be at least made compulsory among high risk groups such as Health Care Providers, Commercial Sex Workers, Intravenous Drug Users, and Migrant Workers etc. to begin with. A strong monitoring mechanism is

necessary to control the unfair practice so that all the private institutions are duly registered with the Government and provide safer vaccines at convenient locations without charging exorbitant price.

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[1] Chronic diseases are diseases of long duration and generally slow progression such as heart disease, stroke, cancer, chronic respiratory diseases, diabetes etc. (See: http://www.who.int/topics/chronic_diseases/en/)

[2] This represents the effectiveness of the vaccine. [http://www.wpro.who.int/mediacentre/factsheets/fs_20120219_hepb/en/]

[3] We visited some private health facilities in Kathmandu that were involved in Hepatitis B Vaccination. Most of these facilities target middle class consumers and use among the cheapest vaccines available for sale in Nepal which is priced by Government at Nepalese Rupees 41 and Rupees 25 for adults (1 milliliter) and child (0.5 milliliter) respectively for one dose. We found that that most of these facilities charged prices which are more than 100 percent higher than the Government approved rates. Government of Nepal has approved to import and sale HB Vaccine of following four manufacturers: Serum Institute; L.G. Life Science/Shanta Biotech; and Berna Biotech (mentioned here in increasing order of the Government approved prices). The details of Government approved prices were obtained from Quality Control Section of Department of Health Services, Ministry of Health.

[4] It might be confusing again to further divide the peri-urban setting of Kathmandu Valley into Urban and Rural Area (according to their administrative set up) but this will help us predict the heterogeneous effect of the spatial variation within the peri-urban setting on adult immunization practices.

[5]Nepal is nationally divided into 75 districts; each district further divided into Municipality and Village Development Committee (VDC); and each Municipality and VDC divided into wards. Ward is the lowest administrative level in Nepal.

[6] We could not cross check our self reported status of vaccination from the documents of these private health facilities because they were reluctant to provide such details - they were concerned about their as well as the clients privacy.

[7]Following formula is used to determine the sample size: $n = \frac{z^2.p.q.N}{e^2(N-1) + z^2.p.q}$

Where, p=sample proportion, q=1-p; Z= the value of the standard variate at a given confidence level and to be worked out from table showing area under normal curve; N=Population size; e = margin of error/acceptable error (Precision); n = sample size. Here, p=0.5 and q=1-p=0.05. Confidence interval assumed at 95% which gives z=1.96.

[8]See subsection ' Context of Regulated Vaccine Market in Nepal ' above for details on *regulated* Vaccine market in Nepal.

[9]Selection is on observables means that the error terms are dependent i.e. the outcome of interest is determined in part by individual choice of whether or not she participates in the activity of interest (Cameroon and Trivedi, 2005).

[10] See: Johnson and Shipp (1997), Haq (1998), Johnson et al (2005) etc.

[11]Symptoms develop within 30-180 days of exposure to the virus (See: http://www.emedicinehealth.com/hepatitis_b/)

[12] The categorization of age is made according to WHO prescription of the effectiveness (protection levels) of HB vaccine at various ages (For details see: http://www.who.int/mediacentre/factsheets/fs204/en/). Furthermore, by vaccinated population, we assume that they have taken a complete three doses of vaccine. This assumption was important since majority of the respondents could not recall it.

[13] Only estimation from second part (outcome equation) with relevant coefficients are reported. For complete result, see Appendix I.

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Appendix

Appendix I: Estimation of the Two Part Model

Dep. Var.	Log of Positive WTP Amounts		
Exp. Vars.	**First Part (Probit)**	**Second Part (OLS)**	**Second Part (GLM)**
Household Size	0.0571	0.0583	0.0499
	(0.0550)	(0.0433)	(0.0342)
Age	0.0760	0.189***	0.167***
	(0.0654)	(0.0687)	(0.0568)
Age Squared	-0.00144*	-0.00237**	-0.00207***
	(0.000787)	(0.000918)	(0.000759)
Male	0.0599	-0.00700	0.0824
	(0.169)	(0.142)	(0.122)
Married	0.0843	-0.168	-0.175
	(0.314)	(0.260)	(0.216)
Primary Education	0.203	-0.237	-0.362
	(0.312)	(0.340)	(0.266)
Secondary Education	0.361	0.246	0.0265
	(0.299)	(0.345)	(0.251)
College Education	0.298	0.370	0.152
	(0.364)	(0.368)	(0.292)
Employed	-0.208	-0.271	-0.270*
	(0.211)	(0.196)	(0.149)
Rural	-0.130	-0.426	-0.263
	(0.287)	(0.260)	(0.176)
Chronic Disease	0.247	0.514***	0.440***
	(0.274)	(0.194)	(0.168)
HB Activities	0.0405	-0.448*	-0.454*
	(0.270)	(0.255)	(0.239)
HB Symptoms	0.568	1.292***	0.937***
	(0.637)	(0.248)	(0.255)
Consumption Expenditure	-0.0000341***	-0.0000216	-0.0000145
	(0.0000116)	(0.000015)	(0.0000118)
Constant	-0.477	1.810	2.504***
	(1.294)	(1.146)	(0.958)
Observations	321	181	181
R-squared		0.237	

Cluster Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix II: Robustness Check with alternative Specifications

Dep. Var.	WTP Amounts	
Exp. Vars.	**OLS**	**Tobit**
Household Size	7.317	11.55
	(4.866)	(7.764)
Age	11.05**	28.19***
	(4.830)	(10.21)
Age Squared	-0.166***	-0.427***
	(0.0571)	(0.128)
Male	9.225	16.79
	(14.00)	(25.09)
Married	7.650	-1.117
	(31.05)	(49.63)
Primary Education	-3.834	12.35
	(27.96)	(56.05)
Secondary Education	28.99	66.40
	(28.26)	(50.81)
College Education	31.31	66.09
	(34.40)	(62.19)
Employed	-37.56*	-57.81*
	(19.15)	(34.58)
Rural	-22.92	-48.41
	(30.49)	(49.74)
Chronic Disease	49.50*	79.99*
	(25.98)	(45.20)
HB Activities	-39.45	-41.97
	(27.10)	(40.25)
HB Symptoms	123.9**	168.7**
	(51.85)	(70.40)
Consumption Expenditure	-0.00220***	-0.00609***
	(0.000653)	(0.00196)
Constant	-49.17	-329.6*
	(90.70)	(187.4)
Observations	321	321
R-squared	0.132	

Cluster Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix III: Check for Possible correlated Explanatory Variables (Two-part Model: Second Part only)

VARIABLES	(Scenario I:excluding education and employment status)	(Scenario II: excluding consumption and education)	(Scenario III: excluding consumption and employment)
Household Size	0.0691	0.0670	0.0569
	(0.0436)	(0.0435)	(0.0421)
Age	0.154**	0.139**	0.162**
	(0.0702)	(0.0652)	(0.0694)
Age Squared	-0.00203**	-0.00185**	-0.00204**
	(0.000940)	(0.000860)	(0.000931)
Male	0.0305	0.126	-0.0894
	(0.0855)	(0.132)	(0.109)
Married	-0.0988	-0.121	-0.111
	(0.258)	(0.265)	(0.260)
Rural	-0.514**	-0.389	-0.379
	(0.251)	(0.268)	(0.271)
Chronic Disease	0.552***	0.550***	0.491**
	(0.186)	(0.189)	(0.201)
HB Activities	-0.493*	-0.448*	-0.413
	(0.265)	(0.254)	(0.254)
HB Symptoms	1.374***	1.247***	1.357***
	(0.200)	(0.221)	(0.213)
Consumption Expenditure	-0.0000147		
	(0.0000154)		
Employed		-0.238	
		(0.177)	
Primary Education			-0.310
			(0.332)
Secondary Education			0.126
			(0.335)
College Education			0.161
			(0.357)
Constant		2.585**	1.946
	(1.094)	(1.090)	(1.198)
Observations	181	181	181
R-squared	0.194	0.194	0.210

Cluster Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1