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# Infectious Disease Risks In Developing Countries: A Non-market Valuation Exercise

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# INFECTIOUS DISEASE RISKS IN DEVELOPING COUNTRIES: A NON-MARKET VALUATION EXERCISE

by

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## ABSTRACT

This dissertation focuses on the non-market valuation of health-risks of malaria, an infectious disease that imposes a substantive public health burden across the globe, hitting particularly hard the tropical developing nations of Africa and Asia. The United Nations Millennium Development Goals include malaria control as a priority and large investments are underway to promote effective prevention and treatment. Despite such concerted supply-side efforts, malaria-related mortality and morbidity still abound due to a complex interface of factors like climate-change, poverty, inadequate control behavior, infection and prevention externalities, parasite resistance etc. This research project digs into the demand-side of the health problem, considers the "externality" dimension to prevention, and primarily asks the question: how do individuals in developing countries view competing disease-control (prevention) measures, viz. a publicly-administered community-level malaria control measure as against private preventive choices. A theoretical model is developed to help explore the public-private interplay of health risks of malaria. The malaria-endemic regions of Kolkata (India) and its rural fringes comprise the site for an empirical investigation. A field survey (Malaria Risk and Prevention Survey, October-December, 2011) incorporating a mix of stated and revealed preference techniques of health valuation is implemented. Risk-perceptions of respondents are elicited using a measurable visual-aid and individuals' perceived valuations of health-risk reductions, randomly offered with the public and private health treatments, are empirically ascertained. Using a Likelihood Ratio Test on the structural risk parameters, it is seen that individuals' valuations of health risk reductions are the same across the private and public treatments. The comparative valuation

exercise, thus, corroborates the externality dimension to malaria control, calling for greater public action to combat malaria. The viability of such a scaled-up public malaria program, in the context of Kolkata, is discussed by comparing the public treatment willingness to pay estimates with the annual estimated costs that the Kolkata Municipal Corporation, the civic body in the city of Kolkata, maintains on account of vector control. Results from the comparative valuation exercises also support the idea that private prevention is generally responsive to prevention costs, indicating the importance of price incentives to induce greater prevention. The issues of health valuation and price sensitivity are further explored across various split-samples differentiated on the basis of socio-economic attributes, disease exposure, actual prevention efforts and perceived malaria risks of survey respondents. Such auxiliary exercises help analyze the valuation question in greater depth, and generate policy insights into the potential factors that shape private prevention behavior.

To

Dearest

Soma Samajpati & Sukumar Samajpati,

my parents

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## 1.1 Introduction

This dissertation explores the health risks of infectious diseases, particularly in the context of developing countries, where such health problems abound. Despite improvements in the design of effective prevention and treatment technologies, infectious diseases are still an unfortunate reality, impacting more than two-thirds of the world's population. The "infectiousness" of such diseases makes the externality dimension explicit. This brings in the conspicuous role of public policy alongside private prevention efforts for an effective combat of the disease. Contemporary literature has explored the cost-effectiveness and valuation of various disease control tools, from the supply-side and demand-side respectively. But, seldom has a study empirically investigated how exactly does the externality dimension play out in the private demand for prevention in the context of disease-prone areas. Under the circumstances, the present study finds it inspiring to explore the externality dimension in the field, for knowing better, the need for, and the extent and viability of public disease control efforts. For analytical simplicity, private prevention spillovers are not attempted to be directly tested. Rather, alongside private prevention demand, a public/social dimension to prevention is brought into the framework by modeling government action. Given both private and public roles of disease control, the dissertation compares the perceived valuations of health-related benefits that individuals associate with different kinds of preventive options they have access to. Focusing on malaria, a vector-borne infectious disease, a non-market valuation framework is developed with regard to two kinds of health interventions - private and public. Stated preference methods (Contingent Valuation Method, CVM) are used to explore individuals' valuation of risk-reductions from using a privately obtainable new malaria-preventing product, as against the worth they attach to community-wide benefits of a new government-administered vector-control program. Such a comparative assessment, in turn, allows for indirectly testing the externality dimension to malaria prevention, thereby contributing to policy.

In contemporary policy dialogues, the issue of malaria control is treated with great urgency. Programs such as The Roll Back Malaria Program of the World Health Organization (WHO), The Global Fund to Fight AIDS, Tuberculosis and Malaria etc., are just a few instances of the immense global efforts that are currently underway to achieve a targeted eradication of malaria by 2015. But the road to accomplishing the aim is complex. Even when one abstracts away from the intricacies of malaria treatment and considers the prevention aspect in isolation, a multitude of issues seems intertwined. Despite international investments promoting the availability of preventive tools like insecticide-treated bed nets (ITNs) around the world, it is often seen that private demand for malaria control is inadequate. In this regard, contemporary research often affirms the critical role that price elasticity of demand plays in shaping private preventive choices (Dupas, 2010). It is further recognized that giving the correct price incentives for malaria control is important not only for generating private benefits but also for the larger social good, especially since malaria is infectious involving human hosts. Given such infectiousness, private prevention necessarily generates substantive positive spillovers. This externality dimension, in turn, indicates the possible sub-optimality of private demand and calls for greater government action in combating malaria. However, even as the government emboldens community-level malaria control efforts, further issues may arise. In the epidemiological literature often the issue of behavioral feedbacks across private prevention and community-level malaria programs has been talked about (Klein et al., 2007). However, the externality dimension to malaria control and the apprehension that private prevention is likely to be correlated with the government programs have rarely been tested in the field. Added to such a private-public dimension, the fact that private prevention may be prevalence elastic (Philipson, 2000) brings in even greater complexities to the way individual demand behaves. The cobweb of issues in the context of malaria, thus, makes it clear that despite the present policy thrusts on malaria control, more understanding is needed of the factors individuals' prevention decisions are influenced by, and of the latent externality dimension that lies underneath.

Given these lesser known facets of malaria control, this dissertation primarily explores the question if people value private preventive strategies in exactly the same manner as they assess the benefits of a community-level program. In a CVM field exercise carried out in Kolkata (India) a between-subject design is alluded to for empirically addressing the comparative valuation question. Respondents are randomly assigned to two fundamentally different prevention modes, private and public, and their decisions on monetary contributions for the same recorded. In course of the empirical exercise the externality dimension to malaria control is put to test. The delivery mechanisms and scope of benefits of the health interventions are deliberately kept divergent over private and community domains. Given such a survey design, it is of interest to investigate if empirical assessments of valuations emerge the same across the treatments or they diverge. In the case of the former (i.e., if valuations are observed to be the same), the latent externality dimension would be emphasized, indicating a greater role of government action in fighting the disease. Recalling from the literature that private and community-level malaria control efforts may potentially interact and generate feedbacks, such an equality of valuation results could also indicate that such private and public efforts may be potential substitutes for an individual decision-maker. Contrary to the result on equal valuations, if private and public treatment valuations are found to differ, the presence of a social preference component in private prevention could also be reflected upon.

The results of the empirical analysis[1] contribute to policy with regard to the following: (i) Demand-side assessments of both kinds of malaria control tools, private and public, offered simultaneously in the field, are obtained for the first time in the literature; (ii) Depending upon whether the cross-treatment valuation figures are equal or divergent, the public good dimension to malaria control (and also, the presence or absence of social preference) could be tested, hence informing policy on the extent of public action urgency; (iii) The valuation question and the issue of price-sensitivity when explored across various split-samples generate policy insights into the potential factors that shape private prevention behavior of respondents with varied socio-economic attributes, malaria histories , *actual* prevention levels, and perceived risk levels; and (iv) The viability of a scaled up public program is reflected upon by comparing the willingness to pay estimates with the estimated budget on vector control that the civic body in the city of Kolkata maintains.

[1] Results of all empirical exercises are presented in Chapter 6.

## 1.2 Background

Vector-borne infectious diseases like malaria[2] comprise a major public health burden across the globe with tropical developing nations particularly being the worst hit. In case of India, for instance, the challenges of combating malaria are overwhelming and pose formidable threats for the health of the population. Although the WHO estimates 15,000 malaria deaths per year in India, Dhingra et al. (2010) find in an extensive national-level survey that even the lower bound of the annual mortality figures well surpasses the WHO estimate[3]. Pattanayak and Pfaff (2009) explain the substantive morbidity dimension to malaria, thus, reiterating the health-threats that the disease poses[4]. Moreover, malaria is identified as a disease of poverty (UNICEF, 2005), thereby disproportionately affecting the world's poor. This justifies why policy initiatives on malaria control are envisaged as being intimately related to the potential success of sustainable development objectives like the United Nations Millennium Development Goals (MDGs). Although featuring prominently on the international development agenda, the issue of effective control and prevention of malaria assumes a complex dimension. Challenges emerge particularly since diverse factors interact in furthering disease spread and hence, in contributing to its control. Factors at play include risks of transmission, influences of climatic changes on vector biology,

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[2] In case of malaria, the vector or the disease carrier is the female variety of the Anopheles species of mosquitoes. The World Health Organization (WHO) reports that this parasitic disease causes over 300 million episodes of "acute illness" and more than one million deaths annually.(Reported on the "Roll Back Malaria" program website :http://mosquito.who.int/cmc_upload/0/000/015/372/RBMInfosheet_1.htm, January 30, 2005).

[3] Dhingra et al. (2010) find that the plausible lower and upper bounds (on the basis of only the initial coding) are 125000–277000.

[4] Malaria causes morbidity through fever, weakness, malnutrition, anemia, spleen diseases and vulnerability to other diseases. Malaria infection may lead to severe febrile episodes and chronic adverse effects, making its health consequences particularly dire for children and pregnant women (Breman, 2001).

access to public health infrastructure, individuals' attitudes towards prevention and treatment options, environmental management[5] etc. Addressing the threat of vector-borne infectious diseases, thus, calls for an effective management of issues that lie squarely at the intersection of environment, health and development.

Interaction between the mosquito (which carries the parasite and is, therefore, called the vector) and the human comprises the core biological phenomenon behind malaria transmission. Besides, the breeding, development and survival of the vector are in a large part influenced by climatic conditions like temperature, rainfall, humidity etc. This explains the conspicuous mention of malaria in climate-change debates as well. The Intergovernmental Panel on Climate Change (IPCC, 2007) apprehends that climatic variations, especially rising global temperatures, will considerably alter the geographical range of vector-borne infectious diseases like malaria. Contemporary epidemiological studies echo this concern. For instance, Chan et al. (1999) note that the current qualitative estimates in the epidemiological literature suggest a substantial likelihood of these diseases spreading into susceptible, previously uninfected populations as the global climate warms. In contrast to these apprehensions, Gething et al. (2010) argue that the climate-malaria correlation may not hold if the confounding effects of other factors like economic development, governmental interventions, improvement in prevention technologies and the like, are adequately incorporated into the analysis[6]. Along similar lines, calibration

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[5] Utzinger, Tozan, and Singer (2002) report the different measures of malaria control through environmental management viz. vegetation clearance, draining swamps, river boundary modification, and house screening.

[6] Gething et al. (2010) empirically prove that the data pertaining to the status of malaria range and intensity around the world and global surface temperatures over the time-period 1900-2007 fail to bolster a correlation between climate and malaria ; a finding that is striking enough for a century that has unequivocally witnessed temperature rises worldwide. The authors observe

exercises in Gollin and Zimmerman (2010 a) illustrate that preventive behavior will significantly mitigate the negative influences of climate-related malaria threats and, hence, future malaria prevalence is likely to be modest. Notwithstanding the debates on the extent of a climate-malaria association, the importance of human adaptive/preventive behavior in the fight against malaria transmission is explicit in the contemporary literature. It is argued that human exposure to diseases like malaria is not a mechanical function of environmental conditions only. Rather, given that the vector must spend at least a portion of its lifecycle in humans, behavioral choices that people make - in terms of prevention and treatment - influence the level of disease prevalence to a substantive extent. Philipson et al. (2000) additionally observe the prevalence-elastic nature of human behavior. The authors claim that there is a continued interaction between "the extent of disease, which is decreased by the demand for prevention, and the demand for prevention itself, which is increased by the extent of disease." Asserting this behavioral significance, Klein et al. (2007) contend that although epidemiological research has introduced greater biological realism into vector-borne disease models, principles of economic optimization, latent incentives, and the costs of disease control measures, have yet to be fully incorporated into theoretical frameworks of diseases.

Given the potential of prevention and treatment, public health policy procedures around the globe emphasize the need for strengthening the availability of effective disease control tools.

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that post-1900, when malaria control measures, urbanization and economic development have taken off considerably, the world has, in fact, experienced a remarkable decline in malaria endemicity compared to predictions that were put forth prior to 1900 (referred to as the pre-intervention era). Campbell-Lendrum et al. (2003) also reiterate the importance of factors besides climate but caution that, the degree to which humans will adapt to climate-change (through psychological, societal and behavioral changes) and hence absorb climate-driven disease risks, cannot be predicted accurately.

Strategies include expanding the coverage of mosquito nets (Sachs, 2006), insecticide-treated bed nets (ITN); indoor-residual spraying (IRS) of insecticides; and promotion of anti-malarial drugs like artemisinin combination therapies (ACT)[7]. Despite a strong international commitment on promoting access to malaria control options and generating awareness on the issue, often the purchase of the control options and a sustained commitment to using the same remain low. The WHO (2008) reflects that even as ITN coverage in the Sub-Saharan Africa gained good pace in the last decade, fewer than one in four children under the age of five sleep under an ITN. Contemporary research has, thus, dwelt on exploring how best to price the means to disease prevention for triggering the correct incentives to change behavior. For instance, Cohen and Dupas (2010) randomize the prices of bed nets to study its demand among women across different areas in Kenya. Focusing on the price-elasticity of bed net demand, the authors observe that free distribution of ITNs does not necessarily imply wastage. Compared to cost-sharing, which often dampens demand, free provision of nets is found to be more effective. Related to the issue of appropriate pricing of control options, another question of significance arises. How best to ensure continued usage of and hence, commitment to the preventive goods, once purchased?

The World Malaria Report (WHO, 2010) emphasizes this dimension by resolving to achieve sustained "use" of bed nets rather than its mere "coverage." Since cost is often cited as the obvious reason behind low usage of bed nets, Tarozzi et al. (2009) evaluate the role of financial commitment devices (e.g., consumer loan contracts aimed at increasing ITN ownership

[7] Laxminarayan et al. (2010) develop a conceptual and numerical framework on ACT and illustrate that large subsidies for artemisinin combinations, which help delay the emergence of resistant malaria strains, are justified on economic efficiency grounds across a wide range of plausible parameter scenarios.

and retreatment) in inducing health-protecting behavior in Orissa, a malaria-endemic state in India. Hoffman (2009) explores the implications of different modes of delivery of bed nets (free versus cash transfer mechanisms) for intra-household usage of the nets in Uganda, where children under the age of five are particularly vulnerable to the disease. Post-experiment follow-up visits to participants' homes revealed that despite the program's thrusts on the need to protect children, the adult subject group purchasing nets with cash, was, on the average, more likely to use nets for themselves rather than their children. Subjects in the free net delivery treatment behaved otherwise. Dupas (2009) strikes another interesting behavioral finding in an experiment in rural Kenya. Individuals who paid a higher price for bed nets did not quite use the bed nets more, as compared to those who paid less[8].

Alongside these behavioral complexities, the crucial aspect that makes the issue of effective malaria control particularly challenging, yet interesting, is the fact that the benefits of prevention and treatment of infectious diseases like malaria spill beyond private domains. Alternatively put, malaria-infected people can infect other people who in turn infect others, and so on, in conjunction with the role that the parasite-carrying mosquito plays. This explains a *pure infection externality* (Gersovitz and Hammer, 2004; 2005). Besides, a *pure prevention externality* exists. Thus, an individual spraying insecticides, may or may not be bitten and infected, but the killing of mosquitoes lessens the probability that others will be bitten and infected, something that the individual decision-maker may disregard. More generally, the technologies for malaria

[8] Dupas (2009) also finds no effects of different marketing and framing treatments of health-products (bed nets) on prevention behavior. Also, a verbal commitment to invest in nets did not quite affect the subjects' actual investment.

control, e.g., bed nets, IRS and anti-malarial drugs, can be conceived as mixed/ impure public goods, generating both private and public benefits. This externality dimension to malaria control makes it likely that private demand for prevention and/or treatment will fall below socially optimal levels (Hanson, 2004; Hammer, 1993). This, in turn, calls for public roles for disease control, alongside efforts to promote private prevention. Thus, community-level spraying drives, swamp clean-up exercises and indoor residual spraying programs are considered crucial government-level health and welfare interventions. But, the literature also apprehends private-public feedbacks, often when the both community-level and individual disease control actions are at play. All such dimensions to private prevention make a demand-side exercise intriguing.

### 1.3 Research Question and Relevance

Against the backdrop of such a contour of complexities – ranging across the nodes of biology, climate-change, economics, and public policy – this dissertation adopts a demand-side perspective to explore individuals' attitudes towards malaria prevention[9]. Three key observations picked from the contemporary literature help motivate the research goal: (i) the externality dimension to malaria control; (ii) the importance of both private and public roles of disease prevention; and (iii) the likely feedbacks across private and public actions. A set of relevant research questions emerges. Firstly, how exactly do individuals in developing countries perceive the health-related benefits of different preventive strategies, viz., private and

[9] Theoretical and empirical analysis of treatment behavior falls outside of the scope of this paper. See Laxminarayan et al. (2010) for details on modeling treatment behavior.

government-level control tools? Do valuations of private and public disease control options differ? What are the outcomes like when the externality/public good aspect of malaria control is empirically put to test? Are people essentially self-interested while taking protective actions, or do social preferences come into play?

Our interest in enquiring into private-level prevention behavior in the broader light of externality dimensions to disease risks aligns with Pattanayak and Pfaff (2009) who analyze the reasons behind recurrence of major environmental health challenges e.g., malaria, diarrhea and groundwater contamination, in the developing world. In Pattanayak and Pfaff (2009), the infectious nature of malaria (and hence, an externality element) is incorporated into a micro-model of disease avoidance, by making a household's disease exposure an explicit function of not only private prevention decisions, but governmental risk control efforts and community-level averting behavior as well. Their emphasis on the community-dimensions to disease risks motivates the private and public treatment of malaria control in our analysis. Thus, governmental actions, in our framework, are conceived as having a public or a community-wide impact. However, for analytical simplicity private spillovers (i.e., community averting behavior) fall outside the present scope. [10] Despite spillover dimensions (and hence, strategic interactions) being suppressed here[11], our analysis allows for a potential contribution. In the empirical exercises, individuals' assessments of preventive strategies with different levels of "publicness"

[10] Although in reality risks of infectious diseases like malaria are interdependent in a community, we do not model private spillovers, or in other words, the community-level risk interactions. In order to facilitate empirical tractability (See Chapter 3 and 5 for the empirical procedures), strategic elements and expectations about others' preventive choices are not explored. See Heal and Kunreuther (2007) for a game-theoretic treatment of interdependent risks in the context of infectious diseases.

[11] See Chapter 2 for the theoretical exposition of our analysis.

are investigated, which, in turn, allow for exploring aspects of externality and social preferences in greater depth. The importance of our approach gains support from the illustration in Crocker and Shogren (2002) who explain the need for policy makers to consider private choices in order to determine the optimal level of provision of public action such that costs of risk control are minimized. In the literature on economic epidemiology[12], Klein et al. (2007) point towards the importance of considering behavioral feedbacks across private malaria control measures (like use of bed nets) and community-level spraying programs. The authors argue that often in response to increased mass spraying efforts by the government, private actions in terms of bed net use may shrink. Thus, a failure to account for such interactions may exaggerate or underestimate the real benefits/ costs of a public malaria control policy. Note that although explicit measurement of the substitution possibilities between private and public malaria control options is not attempted for in this research, results of a public-private comparative valuation exercise may nevertheless, indicate towards potential substitution possibilities[13], if private-public valuations do not significantly differ.

Our demand-side approach to comparing valuations of private and public disease control measures bears a similarity of sorts to the comparative cost-effectiveness exercises, often viewed from the supply-side in resource-constrained malaria-endemic countries. For instance, Bhatia et

[12] See Philipson et al. (2000), Klein et al. (2007), Gersovitz and Hammer (2003, 2004, 2005), Berthelemy and Tuilliez (2010) for details on the principles of economic epidemiology.

[13] The issue of substitution between private and public actions is interesting and has been explored in other contexts of environmental risks. Mahmud and Barbier (2010) explore how private defensive expenditures against storm damages in a coastal area in Bangladesh interact with government programs on protective spending. It is found that the presence of public disaster relief policies incentivize private self-insurance but dampen private self-protection. Jakus (1994) finds that in the presence of publicly sponsored moth control programs in the neighborhood people substitute governmental program for private control.

al. (2004) performed comparative economic evaluations of two prominent malaria control devices in India, namely insecticide-treated bed nets and in-house residual spraying (IRS), and arrived at higher cost-effectiveness ratios for nets in comparison with IRS[14]. We assert that owing to public health budgets in developing countries being tight[15], additional information on demand-side perceived valuation of alternative disease control measures will serve complementary to such cost-effectiveness results[16,17], and hence, assume policy importance.

The CVM methodology we use finds relevance in the contemporary demand-side literature on malaria prevention. But, three potential extensions are envisaged. Firstly, existing works have mostly considered a single disease control tool as reference, (e.g., ITNs, IRS, and hypothetical vaccines), each time demand has been assessed (Onwujekwe et al., 2003; John et al., 1992; Whittington et al., 2003; Cropper et al., 2004)[18] . In contrast, given our focus on the public-

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14 The randomized controlled trial in Bhatia et al. (2004) was geared towards making recommendations to the national Anti-Malaria Programme (NAMP) within the Government of India (GOI).

15 Anderson et al. (2010) theoretically analyze optimal spending strategies by public health authorities in the context of infectious diseases when government budgets are constrained.

16 Onwujekwe et al. (2003) argue that understanding the feasibility of achieving large scale coverage of disease control tools (e.g. ITNs) has to be preceded by learning how people value the same and estimating its potential demand .

17 Usually costs considered in the cost-effectiveness approaches in randomized controlled trials include costs of implementing the interventions, resources saved by the government health sector and households from averting malarial morbidity.

18 Onwujekwe et al. (2003) investigate the determinants of the ownership of ITNs in Nigeria by adopting a CVM technique. Onwujekwe et al. (2001) explore hypothetical and actual WTP for ITNs and compare these in areas with and without free exposure to free ITNs. Chase et al. (2009) comprise an analysis of WTP for bed nets, their ownership, usage etc in an area of endemic malaria transmission in rural Mozambique. John et al. (1992) evaluate a public program of mosquito abatement in the Texas County (US) from a normative economic perspective, using CVM methodology and comparing the benefit estimates with those obtained from an indirect estimation method, namely the expenditure function approach. Cropper et al., 2004, estimate the household demand function for malaria prevention using hypothetical vaccines. When contrasted with traditional cost-of illness measures, the stated WTP measures yield values twice as large. Whittington et al. (2003) conduct a contingent valuation survey in a very low-income, malaria-endemic community in Mozambique to assess the perceived benefits of avoiding malaria. The average respondent's willingness to pay for a hypothetical malaria vaccine to avoid the (high) risk of contracting malaria for one year was approximately US$14, equivalent to about seven chickens in the local economy. Prabhu (2010) explores intra-

private interplay in disease control, the comparative valuation exercises analyze the perceived costs and benefits of individual decision-making when the nature of "publicness" of disease control tools differs. Secondly, in our framework, the benefits of preventive technologies are explicitly tied to health risk reductions, both theoretically and during empirical exercises, thereby, making the principles of non-market valuations of health risks apply (Dickie and Gerking, 1991; 1996; 2007). Finally, in the process of estimating the values for health-related outcomes using alternative malaria control strategies, perceptions on malaria risks are elicited. In the literature, studies concerning malaria-related awareness and knowledge are common (e.g., Karronamurthi and Kumera, 2010; Onwujekwe et al., 2000). But information on perceived malaria risks in the context of developing countries may facilitate a deeper behavioral analysis of a recurring public health challenge such as malaria[19]. In this regard, Mahajan et al. (2009), who explore a model of ITN adoption in rural Orissa (India), inspires our risk-elicitation plan. But, in addition to the elicitation of subjective beliefs on contracting malaria (as in Mahajan et al., 2009), our empirical methodology involves random assignments of proportionate risk-reductions and non-market valuation of the same.

household resource allocation for hypothetical malaria vaccines in Navi-Mumbai (India) by assessing husbands' and wives' individual and joint WTP for the product.

[19] On the importance of the risk dimension in economic epidemiological models of diseases, Fenichel (2010) explains that…. " people weigh the expected utility associated with decisions that include the possibility of becoming infected when choosing behaviors ……these decisions affect disease risks that, in turn, affect future decisions. Risk comprises two elements: the probability of an outcome and the value of that outcome where these elements generally are not additively separable; risk is therefore endogenous (Shogren and Crocker, 1999). This implies that risks simultaneously affect and are affected by decisions, creating a risk feedback."(p. 4; Fenichel, 2010; Working paper presented at the World Congress, Montreal, 2010). The argument in Klein et al. (2007) runs along similar lines. The authors contend that since individuals may alter their behavior responding to changes in their risk perceptions over the course of an epidemic, individuals' perceived risks and decisions are likely to have population-level consequences.

In the field exercise, a private-public between-subject randomized design allows an inquiry into the externality dimension, thus, leading to see if community-level social preferences exist. Onwujekwe et al. (2002) estimate altruistic WTP for ITNs in holo-endemic communities in south-eastern Nigeria, thus, providing evidence that other-regarding preferences might exist[20]. Moreover, the importance of a community's perspectives and practices are illustrated as being vital in propelling the success of any malaria control program (Anh et al., 2005). Outside the realm of malaria, a community-level approach to estimating WTP for others' benefits from a public risk-reducing program has gradually started to be explored (Bosworth et al., 2009)[21]. In the context of altruism in vaccination demand, Sheill and Rush (2003) explore Sen's (1974) notions of commitment and sympathy and examine if private WTP values for vaccination policies truly capture the community's values for such programs. Moreover, the emphasis on the community dimension is explicit in Whittington et al. (2000) who explore households' preferences towards a "neighborhood deal" of urban sewers in the urban center of Semarang in Indonesia. Arana and Leon (2002), although not specifying the community aspect in particular, investigate the private and public values for health risk reductions in the context of flu. Altruism emerges as an important component in their valuation exercise. Thus, our approach to exploring individuals' perceptions of community-level benefits from malaria-related public interventions and contrasting the same with perceptions of benefits from private health interventions has

[20] However, our treatment of community-level other-regarding preferences differs from the Onwujekwe et al.'s (2002) conceptualization of the same. See Chapter 2 for details on how community-level other-regarding preferences are defined in our theoretical framework.

[21] Bosworth et al. (2010) reflect that their risk-dollar tradeoff approach to estimating community-level WTP comprises the first of its kind.

contemporary relevance. In contrast to the notion of altruism, if results from our private-public comparative valuation exercise support that public and private values are non-divergent, the externality dimension to malaria control will be corroborated, calling for emboldened government-administered malaria control efforts to keep the disease in check.

## 1.4 Theory and Methods

In order to address the research questions posed, a non-market valuation framework is developed, theoretically modeling private and community-level malaria risks. The decision-maker's concern for the overall health improvement in her community is asserted, thereby incorporating other-regarding preferences in the model. Using the principles of health-risk valuation, the welfare analysis illustrates the theoretical measures of value for two kinds of health interventions – (i) a private-level health intervention product which solely benefits the decision-maker; and (ii) a community-level malaria control program that reduces health risks for both the decision-maker and her community.

Given the aim to empirically compare the benefit estimates across private and public disease control tools, a field survey titled "Malaria Risk and Prevention Survey" is designed and conducted in a malaria-endemic area in India over the period October-December, 2011. The survey elicits information on the prevention strategies that individuals already engage in, record malaria-related experiences that individuals faced in a certain recall period etc. The thrust of the fieldwork, however, lies in incorporating a CVM component, whereby individuals are offered a hypothetical scenario of malaria control and their decisions elicited with regard to financially contributing towards the health risk reductions that the control strategy brings forth. In order to explore the private-public interplay of risk-reductions, a between-subject survey instrument is implemented with two treatments, in keeping with the two kinds (private and public) of preventive measures that we theoretically model. In order to ensure the reliability of the risk-reductions that the hypothetical CVM scenarios offer, the survey is so designed that before presenting such scenarios, respondents' risk-perceptions are elicited. Using a certain visual aid (colored cards) as the risk-scale, perceptions on malaria risks are assessed, following which the CVM question is posed and associated risk-reductions are pictorially conveyed to the respondents.

## 1.5 Dissertation Organization

The rest of the dissertation is organized as follows. Chapter 2 develops the theoretical framework of individual optimization on malaria control. The illustrations include comparative statics results, derivations of the theoretical measures of value for different kinds of health interventions (and associated health risk reductions), and implications for policy. Chapter 3 documents the details of the survey. In this chapter, the sampling plan, survey design and different stages of the fieldwork through implementation of focus groups, pretests and the final survey are presented. Chapter 4 illustrates the descriptive statistics of the data collected. Chapter 5 lays out the econometric specification of the model. Primary and auxiliary hypotheses are specified and the empirical methodologies discussed. In Chapter 6 results of the valuation exercises are presented. Finally, Chapter 7 concludes by summarizing the findings and contemplating on policy relevance.

# CHAPTER 2:THE CONCEPTUAL FRAMEWORK

## 2.1 <u>The Model</u>

This chapter develops a theoretical framework fundamentally akin to Harrington and Portney (1987). Given the particular interest in health risks from malaria and prevention efforts, both at the individual and community levels, some key aspects are additionally incorporated. Firstly, household production of health risks, rather than “sick time”, is modeled as in Dickie and Gerking (2007). Secondly, the model attempts to test for the presence of social preferences that the decision-maker may have with regard to the community she lives in. In the present framework, community-level social preferences pertain to the satisfaction that the decision-maker derives from reduced malaria risks facing the other individuals living in her community. Thirdly, the role of public action, i.e., the government, is brought in, alongside private prevention efforts, to reduce health risks from malaria.

The decision-maker is rational and asserted to be one who: (i) is aware of the morbidity risks that malaria poses to her and the community, (ii) is in the know of the disease being preventable, and (iii) takes private risk-reducing measures as a necessary safeguard, alongside being informed of the community-level control measures. The individual’s perception of malaria risk that she herself faces is denoted as $R^S$. Perceived malaria risks can be reduced through the purchase of a marketed preventive good $a$ and the consumption of a malaria-specific public good, namely community-level malaria control measures, $g$, that the public health and civic authorities implement.

Thus, $R^S = r^S(a; g)$ (1)

In the context of health risks from malaria, examples of $a$ primarily include the purchase of bed nets, mosquito repellants or window-netting. The parameter, $g$, considered as given in the individual's optimization problem, may involve an array of community-level malaria-control measures such as vector-control programs or indoor residual spraying (IRS), swamp and canal cleaning drives, provision of health facilities for effective prevention, diagnosis and treatment or knowledge and awareness dissemination[22]. In equation (1), the technological or objective relationship between the consumption of the private good $a$ and that of $g$ is one of substitutes, as in Hori, 1975. Each of $a$ and $g$ results in reduced perceived risks that the individual faces. Thus, the marginal products of $a$ and $g$ are given as $\frac{\partial r^S}{\partial a} < 0$ and $\frac{\partial r^S}{\partial g} < 0$ respectively. It is also assumed that $\frac{\partial^2 r^S}{\partial a^2} > 0$, implying that for a given level of $g$, the marginal effectiveness of $a$ declines as additional units of $a$ are successively purchased[23]. Following the same logic, we additionally assume that $\frac{\partial^2 r^S}{\partial a \partial g} > 0$, i.e., successive increases in the level of public action, $g$, make the marginal product of $a$ fall. Herein, note that the purchase of $a$ does not affect utility directly. Also, if the decision-maker cares for the health (or malaria risks) of the other community members living in her proximity, $g$ assumes an additional importance, apart from its role in impacting the individual's own malaria risks, $R^S$. The individual perceives that the community-level malaria control measures contribute towards reducing the malaria risks facing

[22] Jalan et al. (2009) argue that awareness about a public good, say environmental quality, is itself a public good and is likely to be sub-optimally supplied in the market, resulting in a demand for environmental quality that is inefficiently low. This justifies our treatment of government-induced awareness as a public good.

[23] Although successive reductions in $R^S$ decline from buying each additional unit of $a$ successively, the algebraic sign of $\frac{\partial^2 r^S}{\partial a^2}$ is positive. For a diagrammatic representation of the $r^S$ function which is decreasing and concave up, see Appendix C.

the other community members, $R^C$ , as well. The social effect of $g$ with regard to influencing others' malaria risks is given as

$$R^C = r^C(g) \text{ ; where } \frac{\partial r^C}{\partial g} < 0. \quad (2)$$

The individual maximizes the utility function

$$\widetilde{U}(x, a) \stackrel{def}{=} U[x, r^S(a; g); r^C(g)] \quad (3)$$

subject to the risk production function in equation (1), the social effect function in equation (2), and the budget constraint

$$Y = x + p_a\, a \quad (4)$$

The partial derivatives underlying the utility function (3) are assumed as $\frac{\partial \widetilde{U}}{\partial x} = \frac{\partial U}{\partial x} > 0$ and $\frac{\partial^2 \widetilde{U}}{\partial x^2} = \frac{\partial^2 U}{\partial x^2} < 0$, with respect to the numeraire $x$. Besides, perceived malaria risks, $R^S$, impact the well-being/utility of the individual negatively, i.e., $\frac{\partial U}{\partial R^S} < 0$; and $\frac{\partial^2 U}{\partial {R^S}^2} < 0$ , implying that each additional unit of $R^S$ results in successive increases in the reductions in utility $U$[24]. Moreover, the assumptions specified so far, in conjunction with the properties of the utility function, imply that $\frac{\partial \widetilde{U}}{\partial a} = \frac{\partial U}{\partial R^S} \frac{\partial r^S}{\partial a} > 0$, and $\frac{\partial^2 \widetilde{U}}{\partial a^2} = \frac{\partial U}{\partial R^S} \frac{\partial^2 r^S}{\partial a^2} + \frac{\partial r^S}{\partial a} \frac{\partial^2 U}{\partial {R^S}^2} \frac{\partial r^S}{\partial a} < 0$. Alongside, $\frac{\partial^2 U}{\partial x \partial R^S} > 0$ , i.e., the marginal disutility from private malaria risks decreases with increased consumption of the numeraire good, which, in turn, implies that $\frac{\partial^2 \widetilde{U}}{\partial x \partial a} = \frac{\partial^2 U}{\partial x \partial R^S} \frac{\partial r^S}{\partial a} < 0$. Thus, it

[24] See Appendix C for a diagrammatic depiction of the utility function that is downward-sloping and concave down with respect to $R^S$.

follows that the utility function is increasing and concave with respect to the private preventive good $a$ and the numeraire good $x$.

Besides the above assumptions, if the decision-maker has social preferences pertaining to the community she resides in, then $\frac{\partial U}{\partial R^C} < 0$. In the utility function (3), $R^C$ constitutes the component representing social preferences with regard to the overall malaria exposure in the community. The illustration on caring externalities in the context of economic evaluation of health policies in Jacobsson et al. (2005) inspires our model specification in this regard. Note however, that here the decision-maker – even if having regard for others' well-being – lacks control in influencing the same. Thus, governmental risk-control measures are perceived to be of sole significance in bringing about an improvement in the community's overall health conditions. An alternative way of interpreting the social preference component in the utility function (3) is that the decision-maker has altruistic preferences towards the other community members facing malaria risks, where altruism is pure and outcome-oriented as in Francois and Vlassopoulos (2007)[25]. Herein, two assumptions need mention in order to theoretically specify the interaction between community-level malaria risks and the numeraire, and that between private and community risks: (i) $\frac{\partial}{\partial R^C}\left(\frac{\partial U}{\partial x}\right) < 0$, implying that the marginal utility from the numeraire declines with increasing levels of malaria risks in the community; and (ii) $\frac{\partial}{\partial R^C}\left(\frac{\partial U}{\partial R^S}\right) < 0$, i.e.,

[25] Francois and Vlassopoulos (2007) discuss alternative approaches taken in the literature to describe pure or outcome-oriented altruism. One of the recent papers cited is Francois (2007) where "agents" having such altruism derive a direct benefit when a good/service that is generally considered socially worthwhile (say similar to the public malaria control measures $g$ in our framework) is provided. Pure altruism of this nature also means that this direct benefit, which the agent enjoys, is "independent of whether the agent has a hand in producing the good or service or not, something which does not occur with action-oriented motivations".

the marginal disutility from private malaria risks increases as malaria threats in the community rise.

In the budget constraint that the decision-maker faces [i.e., equation (4)], $Y$ stands for the exogenous income and $p_a$ represents the price of the marketed risk-reducing good privately consumed by the individual to avoid malaria risks. $x$ is treated as the numeraire.

The Lagrangian of the optimization problem can be written as follows:

$$L(x, a;\ g, p_a, Y) = U[x, r^S(a; g); r^C\ (g)] + \lambda(Y - x - p_a a), \tag{5}$$

where $\lambda$ is the Lagrange multiplier associated with the budget constraint. The First Order Necessary Conditions (FONCs) are given by,

$$L_x = \frac{\partial U[x, r^S(a;g); r^C\ (g)]}{\partial x} - \lambda = 0, \tag{6}$$

$$L_a = \frac{\partial U[x, r^S(a;g); r^C\ (g)]}{\partial R^S}\frac{\partial r^S(a;g)}{\partial a} + \lambda[-p_a] = 0, \tag{7}$$

$$L_\lambda = Y - x - p_a a\ = 0. \tag{8}$$

Manipulations with equations (6) and (7) and substitution of $\lambda$ yield

$$\frac{\partial U}{\partial R^S}\frac{\partial r^S(a; g)}{\partial a} = \frac{\partial U[x, r^S(a; g); r^C\ (g)]}{\partial x} p_a$$

Or, $$\frac{\frac{\partial U}{\partial R^S}\frac{\partial r^S}{\partial a}}{\frac{\partial U}{\partial x}} = p_a \tag{9}$$

Equation (9) suggests, that at the optimum, the consumption of $a$ is such chosen that the monetized marginal benefit of private prevention is equal to the price $p_a$. Assuming the Second Order Sufficient Conditions hold at the optimum, the Implicit Function Theorem (IFT) is invoked and equations (6), (7) and (8) are used to solve for the optimal values of $x$, $a$ and $\lambda$, in principle, thus giving, $x = x^*(p_a, Y, g)$; $a = a^*(p_a, Y, g)$, and $\lambda = \lambda^*(p_a, Y, g)$.

### 2.2 Comparative Statics

Although the above model assumes that $a$ and $g$ are technological substitutes in the individual's risk production function, $r^S(a; g)$, it is of interest to explore how, at the optimum, external shocks to the system through changes in the parameter $g$ impact the optimal economic choice of $a$, i.e. $a^*$. Such a comparative statics exercise will also allow for studying if, theoretically, the presence (or absence) of the social preference component embodied in the utility function (3) has implications for the sign and /or magnitude of the comparative statics. This, in turn, may throw light on the nature and extent of the substitutability between private and public efforts of malaria control under different conditions. For the purpose, $x^*\,(p_a, \mathrm{Y}, \mathrm{g})$, $a^*(p_a, \mathrm{Y}, \mathrm{g})$ and $\lambda^*(p_a, \mathrm{Y}, \mathrm{g})$ are substituted in the FONCs to get the following comparative statics:

$$\frac{\partial a^*}{\partial g} = \frac{-[\frac{\partial^2 U}{\partial R^S \partial x} . \frac{\partial r^S}{\partial g} . p_a - \frac{\partial U}{\partial R^S} . \frac{\partial^2 r^S}{\partial g \partial a^*} - \frac{\partial r^S}{\partial a^*} \frac{\partial^2 U}{\partial {R^S}^2} \frac{\partial r^S}{\partial g}]}{|H|} + \frac{-p_a . \frac{\partial^2 U}{\partial R^C \partial x} . \frac{\partial r^C}{\partial g} + \frac{\partial r^S}{\partial a^*} \frac{\partial^2 U}{\partial R^C \partial R^S} \frac{\partial r^C}{\partial g}}{|H|}, \tag{10}$$

where $|H|$ is the Hessian matrix.

It follows from the assumptions that $\frac{\partial a^*}{\partial g} < 0$ , implying that the decision-maker chooses an increased amount of private preventive measures, $a^*$, when there is a decrease in the level of community-level malaria control efforts that the public health authorities implement. The comparative statics corroborates that private and public preventive measures are substitutes irrespective of whether social preferences are accounted for. Additionally, it emerges that the presence of concern for fellow community-member's health makes the substitution result even stronger[26,27].

## 2.3 Welfare Analysis and Policy Implications

The economic substitutability between $a$ and $g$ shown in Section 2.2 brings in some associated questions relevant for the welfare analysis of malaria-control policies. For instance, would the individual value two types of risk-reducing measures, viz. private and public health interventions, differently? In clearer terms, these two types may be conceived as: (i) new protective goods that generate only private benefits (hitherto non-marketed goods but otherwise similar to the nature of $a$) and (ii) community-wide malaria control measures that have both private and public/ community-wide dimensions of benefits (like $g$). Secondly, if economic valuations do differ across private and public goods, what implications, if at all, may emerge with regard to the social preferences of the decision-maker towards the community she lives in? These questions assume policy significance under a budget-constrained public spending scenario which is quite often the reality in malaria-endemic developing countries.

[26] For solely self-interested individuals without concern for the overall health conditions of the community, $\frac{\partial a^*}{\partial g} = \frac{-[\frac{\partial^2 U}{\partial R^S \partial x} \cdot \frac{\partial r^S}{\partial g} \cdot p_a - \frac{\partial U}{\partial R^S} \cdot \frac{\partial^2 r^S}{\partial g \partial a} - \frac{\partial r^S}{\partial a^*} \frac{\partial^2 U}{\partial {R^S}^2} \frac{\partial r^S}{\partial g}]}{|H|} < 0$ . Also, $\left|\frac{\partial a^*}{\partial g}\right|$| without social preferences < $\left|\frac{\partial a^*}{\partial g}\right|$ |with social preferences, implying the substitution result to be even stronger under social preferences towards the community.

[27] Recall that, in the present framework, the spillovers of private preventive actions $a$ on the community are not modeled. Rather, the decision-maker enjoys satisfaction from the increased well-being of her fellow community-residents, only brought about by government-administered community-wide malaria control measures.

### 2.3.1 Valuation of Marginal Changes in Community-Level Malaria Control Measures

Let the indirect utility function be denoted as $V(Y, p_a, g)$ which is defined as

$$V(Y, p_a, g) \stackrel{\text{def}}{=} U[x^*(p_a, Y, g), r^S\ (a^*(p_a, Y, g);\ g); r^C\ (g)] \tag{11}$$

A compensating surplus approach to valuing changes in the quantities of public goods is adopted (Freeman, 1993). For the purpose, WTP for changes in the community-wide risk control measures, when its quantity marginally increases from $\bar{g}$ to $g$ , is defined as the following:

$$V(Y - WTP, p_a, g) = V(Y, p_a, \bar{g}) \text{ ; where } g > \bar{g}. \tag{12}$$

Differentiating both sides of equation (12) with respect to $g$ (as in Harrington and Portney, 1987; Courant and Porter, 1981) we get,

$$V_Y(.)\left[-\frac{\partial WTP}{\partial g}\right] + V_g(.) = 0$$

Or, $\dfrac{\partial WTP}{\partial g} = \dfrac{V_g(.)}{V_Y(.)} = \dfrac{V_g(.)}{\lambda^*}$, where $\lambda^*$ is the marginal utility of income at the optimum. (13)

Also, $V_g = \left[\frac{\partial U(.)}{\partial R^S}\frac{\partial r^S}{\partial g}\right] + \left[\frac{\partial U(.)}{\partial R^C}\frac{\partial r^C}{\partial g}\right]$ (by the envelope theorem).

Substituting for the expression of $V_g$ in equation (13) we get,

$$\frac{\partial WTP}{\partial g} = \left[\frac{\frac{\partial U(.)\partial r^S}{\partial R^S\ \partial g}}{\lambda^*}\right] + \left[\frac{\frac{\partial U(.)\partial r^C}{\partial R^C\ \partial g}}{\lambda^*}\right] \tag{14}$$

The L.H.S. of equation (14) represents the change in the willingness to pay for an extra unit of the public risk control measures, $g$, and is made up of two components . The first bracketed expression on the R.H.S. reflects the monetized *private* benefits (reduced private health risks) that accrue to the decision-maker in consequence of a change in $g$[28,29]. The second bracketed expression in equation (14) denotes the valuation of the *social* benefits ensuing from the increased provision of the public health intervention, if the decision-maker cares for others' health in the community[30].

### 2.3.2 Valuation of Private-Level Risk-Control Measures

Now consider policy measures concerning introduction of a new advanced risk-control product, the benefits of which are largely private in nature, i.e., are enjoyed solely by the decision-maker who chooses to consume it. Thus, such a good, is essentially akin to $a$, albeit with the characteristic that it is hitherto non-marketed and possesses advanced effectiveness

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[28] For a better understanding of the valuation of the private benefits ensuing from $g$, recall that $g$ influences the private risks $R^{Self}$ . Besides, the marginal effectiveness of $g$ in terms of reducing private risks is given as $\frac{\partial r^S}{\partial g}$ . Let us now concentrate only on the first bracketed expression on the RHS of equation (14) and explore an alternative interpretation of the monetized private benefits from the $g$ change. In this regard, also recall that the FONCs indicate that at the optimum $\lambda^* = \frac{\frac{\partial U^*(.)\partial r^S}{\partial R^S \ \partial a}}{p_a}$ . Replacing $\lambda^*$ in $\left[\frac{\frac{\partial U^*(.)\partial r^S}{\partial R^S \ \partial g}}{\lambda^*}\right]$ we get, $\left[\frac{\frac{\partial U^*(.)\partial r^S}{\partial R^S \ \partial g}}{\lambda^*}\right] = \frac{\frac{\partial r^S}{\partial g}}{\frac{\partial r^S}{\partial a}} p_a$. Thus, solely for the private dimension of the publicly administered malaria control efforts, the decision-maker is willing to pay an amount equivalent to what she would have spent on the private preventive good, $a$, currently available on the market, to achieve the same amount o private risk reduction that one additional unit of $g$ brings forth.

[29] *An alternative interpretation of the valuation of the private dimension to the public health intervention:* Let $\frac{\partial r^S}{\partial a}$ units of risk are reduced by 1 unit of $a$. Recalling that the unit price of $a$ is $p_a$ , the cost of a unit reduction in the individual's risk, $R^{Self}$ through the use of the private preventive good, $a$ , is $\frac{p_a}{\frac{\partial r^S}{\partial a}}$ . Thus, the private cost that the individual would have incurred to achieve the same amount of risk reduction as what an additional unit of $g$ brings in (i.e., $\frac{\partial r^S}{\partial g}$) is given as $\frac{\frac{\partial r^S}{\partial g}}{\frac{\partial r^S}{\partial a}} p_a$ which denotes the maximum WTP for private benefits associated with a unit increase in $g$.

[30] As a special case, for solely self-interested individuals, the second component on the RHS reduces to zero and hence, equation (14) can be rewritten as $\frac{\partial WTP}{\partial g} = \frac{\frac{\partial U^*(.)\partial r^S}{\partial R^S \ \partial g}}{\lambda^*}$.

features. The decision-maker's valuation of such a good will assume significance in order to estimate the benefits of a new policy which may target to achieve increased private-level consumption of a preventive good for an effective combat of malaria threats in the society. As a related matter, note that in our framework, since a good is deemed private when it only impacts the private health risks of the decision-maker, $R^S$ [31], the valuation exercise pertaining to the new good essentially translates into the valuation of reduced private risks that the good brings forth.

Suppose $L$ is a new private risk-control product (say, a mosquito-repelling lotion) which may be potentially introduced under a new malaria control plan. Let $L$ be a new parameter into the private risk production function, $r^S(.)$, and is at an initial level, $\bar{L}$ . Then the decision-maker's optimal value of utility as determined in section 2.1 can be written as:

$$V(.) \stackrel{\text{def}}{=} \text{U}[x^*(p_a, Y, \bar{L}, g), r^S\ (a^*(p_a, Y, \bar{L}, g);\ g); r^C\ (g)]. \tag{15}$$

Note that the valuation procedure followed earlier for the public risk control program in equation (12) is now repeated for the new private good $L$. The WTP for an increase in the level of the new good from $\bar{L}$ to $L$ is denoted as $Z$, and is defined as the following:

$$V(Y - Z, p_a, g, L) = V(Y, p_a, g, \bar{L}) \text{ ; where } L > \bar{L}. \tag{16}$$

Differentiating equation (16) with respect to $L$ we get,

$$V_Y(.)\left[-\frac{\partial Z}{\partial L}\right] + V_L(.) = 0 .$$

Or, $\frac{\partial Z}{\partial L} = \frac{V_L(.)}{V_Y(.)} = \frac{V_L(.)}{\lambda^*}$, where $\lambda^*$ is the marginal utility of income at the optimum. (17)

[31] Although from a social-planner's perspective provision of such private goods does have a positive social bearing in an aggregate sense and also in the epidemiological sense, recall that for the individual decision-maker in our model, the perception that such private goods benefit others in the community is not felt. In our model, the only way the decision-maker perceives a social effect on the community is when the public good $g$ is provided.

Also, $V_L = \frac{\partial U(.)}{\partial R^S}\frac{\partial r^S}{\partial L}$ (by the envelope theorem).

Substituting for the expression of $V_L$ in equation (17) we get,

$$\frac{\partial Z}{\partial L} = \frac{\frac{\partial U(.)}{\partial R^S}\frac{\partial r^S}{\partial L}}{\lambda^*} > 0 \qquad (18)$$

The LHS of equation (18) represents the valuation, at the margin, of the private health intervention, i.e., provision of the new preventive good $L$, offered to the decision-maker. The RHS can be interpreted as the valuation of the change in the private health risks that the policy/good brings forth.

### 2.4 Policy Implications

The above exercises illustrate how measures of value pertaining to two broad classes of health interventions may be arrived at. More precisely, equations (14) and (18) indicate that the valuations of the benefits from a publicly administered community-level intervention and those from a private-level prevention strategy are theoretically divergent, if social preferences exist. Depending on whether the two measures of value are empirically divergent or not, the framework, thus, allows for examining the presence (or absence) of other-regarding preferences with regard to community-wide malaria-control efforts. In this regard, the theoretical assertion in our basic theoretical set-up, that people care for others' health, is actually put to test and the empirical findings potentially guide public health policy procedures on the demand-side perspectives towards community health enhancement programs. From the empirical results, the need for, and the level of urgency of public action in the context of malaria control are known better, hence informing policy meaningfully.

# CHAPTER 3:FIELD SURVEY

## 3.1 Introduction

This chapter presents the field research methods and the associated framework of sampling, design and implementation of the "Malaria Risk and Prevention Survey", conducted for addressing the empirical needs of the research questions outlined in this dissertation. Survey data were collected in India between October and December, 2011, to explore the WTP measures for two kinds of preventive strategies and associated health-risk reductions, as illustrated in Chapter 2. Moreover, the field research provided an opportunity to empirically test for the theoretical assertion of the presence of community-level social preferences. Besides, an associated interest lay in obtaining information on the actual prevention strategies that individuals undertake to combat malaria, and also on a gamut of socio-economic and community-specific characteristics. In particular, the survey had three main purposes: (i) To record individuals' beliefs about the annual risks of getting malaria in the context of a developing country where malaria comprises a major recurring public health threat; (ii) To elicit individuals' perceived valuations of health-related benefits (i.e., risk reductions) that are associated with two kinds of hypothetical prevention scenarios: use of a fictitious private malaria-preventing good, and monetary contributions towards a community-level malaria control drive; and (iii) To estimate and compare the willingness to pay to reduce risks under the above two scenarios, using contingent valuation method (CVM) instruments.

In the survey, a sample of 780 adults, above 18 years of age, was selected from Kolkata, India. Kolkata is the capital of West Bengal, a malaria-endemic state in the eastern part of India.

Using interviewer-administered questionnaires, face-to-face interviews in the setting of the homes of the respondents were implemented. Instruments involved (i) a visual physical device for eliciting malaria-related risk perceptions; (ii) a between-subject survey design comprising two health intervention treatments; (iii) random assignment of participants to one of the treatments; (iv) a CVM question; and (v) sections on revealed preference behavior, along with other background questions on family demographics, socio-economic status, community-specific characteristics, and malaria-related awareness and disease history.

## 3.2 Sampling Methodology

### 3.2.1 Study Site and Reasons of Choice

Households in the city of Kolkata (India) and in its neighboring sub-urban/rural district on the south, namely, the South 24 Parganas, comprised the universe or population. Kolkata, one of the 4 metropolitan cities of India and also the capital of state of West Bengal, amply qualifies as a suitable site for studies on malaria-related risk perceptions and prevention behavior. Each year the morbidity burden on account of vector-borne diseases in the city recurs substantively, making the issue of effective malaria control conspicuous in public health debates[32]. Considering the universe as the backdrop, our study selected a representative sample of 780 households (and

[32] See the Urban Health Strategy (2008) published by the Government of West Bengal for details on the policy emphasis on malaria in the city. Sur et al. (2006) report the results of a community-based study in an impoverished urban site in Kolkata to estimate the malaria burden and that of typhoid and explore the risk factors underlying the diseases. Biological research on mosquito breeding and other behavior of the vector galore (see Mandal et al., 2011, for the details). Although not in the area of Kolkata, Mazumdar (2011) study the prevalence of malaria and associated risk factors and treatment behavior in another region of the state of West Bengal, using a household survey in the manner we did.

subsequently picked, on a random basis, one respondent from each selected household) for the purpose of an empirical analysis of individuals' behavior towards malaria risks.

Apart from our interests in the city proper, the inclusion of the South 24 Parganas district in our empirical plan is motivated by the fact that the city (or the district) of Kolkata spills into the aforementioned southern district to a large extent. In fact, some of the administrative regions of the city are accounted for, under the jurisdiction of Greater Kolkata, which is made up of substantive chunks of this surrounding district. Herein, note that given the trends of rapid urbanization, the capital city is fast expanding. Hence, the development of new townships and extended business districts, along the city fringes (which are often not very distant from rural areas), offers us the motivation to study malaria not solely against the backdrop of a chiefly urban setting. Rather, we aim to assess individuals' behavior towards this recurring public health problem against an interesting geographical spectrum where both urban and rural traits exist and a steady economic transition is underway[33].

Given our between-subject design and randomized treatment plan, a sample size of 686 respondents (in other words, about 340 respondents in each of the private and community-level health intervention treatments) was estimated to be fairly sufficient to address the research questions posed in the study. Based on response rates for similar surveys conducted earlier, the survey was, thus, planned to be ultimately fielded to a total of 780 respondents, in order to sufficiently allow for chances of non-responses (generally about 12% as per instances from prior surveys in Kolkata), thereby generating the targeted number (i.e., 686) of completed surveys.

[33] Associations between malaria and economic conditions and poverty comprise a commonly researched area and policy topic of debate (See Sharma, 2003; UNICEF, 2005 etc).

Given our interest in a rural-urban mix in and around the city of Kolkata, the following sample-decomposition was planned: 350 respondents in the urban area (Kolkata), 350 respondents in the rural district (South 24 Parganas) and 80 respondents in a slum from within the urban site. The inclusion of the 80 surveys exclusively from the slum areas was inspired by the fact that the city of Kolkata is home to a fairly conspicuous slum population. Thus, for the purpose of our study, in addition to the urban-rural areas, it was envisaged as being interesting to explore the disease status, prevention behavior, valuation perspectives, socio-economic features and community dimensions that particularly characterize a slum area.

### 3.2.2 The Hierarchy of Administrative Structure and Subject Recruitment Protocol

In this sub-section, the subject recruitment protocols adhered to in the two sites (namely, Kolkata, with its constituent urban and slum areas, and the rural district) are illustrated. Alongside this illustration, brief references are made to the hierarchy of administrative structures of Kolkata and the surrounding rural district to facilitate understanding of the basis of the multi-stage sampling methodology adopted. The rungs of the administrative structure of the state of West Bengal defined the sampling units at each stage. A schematic diagram in Appendix A shows how the districts of the state can be divided into smaller administrative units, thus, leading us through successive stages, towards selecting the ultimate sampling units – namely, individual representatives of the households. A district is composed of several sub-divisions. Each subdivision consists of areas, both rural and urban. The urban regions in a sub-division fall under the jurisdictions of various municipalities and each of the municipalities, in turn, consists of wards, where a ward is defined as a cluster or collection of households. The rural areas in a sub-division form blocks, which have a classification as shown in Appendix A. Note here, that despite Kolkata being technically called a district, the nature of its constituent administrative divisions differs from that of the other districts, since Kolkata is chiefly a metropolitan area with only urban areas. Thus, the city falls directly under the jurisdiction of the Kolkata Municipal Corporation, KMC, (there is no intermediate stage of sub-division) which divides the city into a total of 141 Wards.

*Recruitment in Urban Area:*

Recruitment of survey respondents in the city of Kolkata was accomplished by following a three-stage sampling method. In the first stage of sampling, 1 Ward (namely Ward No. 72) out of a total of 141 Wards, under the jurisdiction of KMC, was systematically identified. Two primary reasons prompted the selection. Firstly, public health records indicate a substantive recurrence of the disease in Ward No.72 (see attached media report, Appendix A). Besides, Ward No. 72 is characterized by the presence of a socio-economic mix, thereby facilitating representation of different classes of respondents in the sample. Once Ward No. 72 comprised the first stage sampling unit, for the subsequent sampling units to be selected in order of hierarchy, assistance was sought from the online database of the updated electoral rolls of 2011 (i.e., voter list), that the Election Commission of India (ECI) maintains for each of the 19 districts in the state of West Bengal. In particular, from the website of the Chief Electoral Officer, West Bengal, (http://ceowestbengal.nic.in/), the complete rolls (Date of Final Publication: 01/05/2011) pertaining to Ward No.72, falling under the district of Kolkata, were saved. As an example, a snapshot of a constituent page of the list can be accessed on the link:

http://www.wb.nic.in/wbeco/EROLLS/PDF/English/A159/a1590135.pdf. Note here that the electoral rolls record the information pertaining to the names of the individuals living in a given ward, and their corresponding guardian (father/husband), gender, age and house number (i.e., address). Given our interest in the zooming in on households first, and then, randomly picking a representative of each household, we adopted the following procedure. From a total of 20887 individuals living in Ward No. 72, in the second stage of sampling, data were coalesced according to house numbers/ addresses to ultimately arrive at a list of 3167[34] addresses relevant for the Ward. It needs mention here that of these 3167 addresses, it might be so that in some of the addresses there were more than one family (i.e., household) residing. Two things prompted such a possibility: (i) While coalescing data as per house numbers, in some cases, under the same address a large number of individuals and also, more than one family name, were noted; and (ii) while pretest sessions (to be discussed in detail in Section 3.4.2 later in this chapter) were being administered, in a few instances, more than one family residing in a specific address (as renters, especially) were observed. Such observations led us to employ a weighted simple random sampling procedure, whereby 350 addresses (out of 3167 addresses) were selected in Ward No. 72, with the number of individuals residing in the respective addresses (or, house numbers) considered as the weight. Such a weighted sampling scheme ensured that addresses with large number of individuals (and/or families) had proportionately greater likelihood of being included in our sample than what addresses with lesser number of individuals did. For example, a house

[34] Note here in contrast to the 3167 figure we have arrived at, an aggregate of 5159 households (1991 Census of India) are recorded under Ward No:72, in the Kolkata Statistical Handbook, 2004; Govt. of West Bengal . The mismatch between the figures gets obscure, particularly since our figure is computed as per the most recent voter list (2011 Census of India), updated by the Election Commission of India in January 2011.

number, with 20 residing individuals, was assigned a weight of 20/20887=.00009 in contrast to a house number with fewer individuals, say 2, being assigned .000009. Once 350 house numbers were finalized, door-to-door visits were made to each of the selected addresses. When any adult respondent from a particular address agreed to participate in the research by giving his/her consent statement, the individual was interviewed in the privacy of his/her home using interviewer-administered questionnaires. As a related matter, it may be mentioned here that Whittington et al.(2009), who explore the private demands for cholera and typhoid vaccination policies for the poor in Kolkata (India), alluded to a similar sampling plan as ours where voter rolls were used, but used the electoral list to directly recruit individual respondents and not specific house numbers which we, in fact, did.

*Recruitment in Rural Area:*

In the district of South 24 Parganas, which surrounds the city of Kolkata on the south, a four-stage sampling procedure was followed. Through systematic sampling procedures, the Sonarpur block in the South 24 Parganas district was identified as the first-stage sampling unit, given its socio-economic heterogeneity. Also, the block comprises a semi-urban/ rural setting, thereby helping in accurate representation of the outskirts of a city like Kolkata that is fast expanding to its fringes under a rapid trend of urbanization and population growth. The block has a total of 34361 households (Source: District Statistical Handbook, South 24 Parganas; 2004; Govt. of West Bengal). In the second stage of sampling, 1 of the 11 constituent Gram Panchayats in the Sonarpur block was selected. Thus, Kalikapur-I Gram Panchayat was identified. The next stage of sampling involved selecting 1 of the 5 villages, namely, Kalikapur, Muragacha, Jardaha, Natagachi and Chakberia, constituting Kalikapur-I Gram Panchayat. Employing simple random sampling, the village Kalikapur was ultimately identified as the third stage sampling unit.

As per our sampling plan, in order to select the 350 households from within Kalikapur village, and to subsequently pick one representative, on a random basis, from each of such 350 households, a sampling procedure different from the one adopted in the urban area was followed. The electoral rolls for the South 24 Parganas district (and those pertaining to Kalikapur village, selected for our sample) maintained by the Chief Electoral Officer, West Bengal, were not considered unlike a similar list being taken help of, for the urban area subject recruitment. This is because, for the rural dwellings in the state of West Bengal, and in particular, for those located in the village concerned, the house numbers enlisted on the electoral rolls pertain to the identification criteria of the Election Commission of India only. On the actual rural site, house numbers (and also street names) for rural dwellings do not exist, thereby making it difficult, if not impossible, to identify a particular house number/address. Therefore, in order to prepare a sampling frame from where to select 350 households as our rural sample, a team of 4 professional interviewers over a 7-day period from October 9, 2011 to October 15, 2011, accomplished a complete enumeration of the households (individual families), living in the village. Information recorded in the enumeration exercise included for each household/ family: (i) Name of head of the household; (ii) Number of male and female household members; (iii) Number of children (below 1 year of age); (iv) Religion; and (v) Qualitative remarks on location of the household (to help locate the house on the next visit for the actual survey). Thus, interviewers computed an aggregate of 1384 households/families and a total of 5864 individuals living in the village.

In the fourth stage of sampling, a total of 350 households were selected from the aggregate number of households, i.e, 1384. Note here, that no weighting scheme (unlike what we did for the urban area) was followed. This is because, during the enumeration process, on the instances where more than a single family was found to be residing in a dwelling, each family was already entered as a separate household by the interviewers. To facilitate the ease of respondents' understanding of the question on the number of families residing under the same roof, respondents were plainly asked : "How many people are residing in this house? Do all of you have the same kitchen to make and have meals together?" If indicated about the presence of more than one family (i.e., separate household entities with distinct kitchens) in the same dwelling, each interviewer proceeded to look for a representative of the other family/families staying in the same house, and listed the other family/families as separate households, noting down the relevant set of information for them. This procedure made it possible that while employing the simple random sampling procedure to ultimately select the 350 households/families, a weighting scheme needed not to be employed additionally. Once our rural sample of 350 households was identified following the above 4-stage sampling method, at a later date (from November 2011- December 2011), interviewers paid door-to-door visits to each of the same. Conditional on the consent of any adult individual, representative of a particular household comprising our sample, he /she was recruited as a respondent in the survey and interviewer-administered questionnaires made use of to record answers.

*Recruitment in Slum Area:*

With a view to selecting the targeted number of 80 household units in the slum areas, we decided to choose the same from within our selected urban area only (i.e., Ward No. 72). Ward No.72, although not accounting for the presence of a large proportion (say, more than 15%) of slum dwellers, still comprises a substantive number of slum dwellings. In course of the pretest sessions in Ward No. 72, we minutely observed the slum clusters and their exact locations. Three slum clusters were identified (this identification was also backed by facts collected from key informants like, local community leaders, civic personnel of the KMC and health workers working in the area) on streets namely, Mallick Lane, Beltala Road and Bakulbagan Row. Of these, two clusters on Mallick Lane and Beltala Road were selected in the first stage of sampling procedure. In the second stage, interviewers paid visits to all the dwellings/households (roughly about 100) on the two streets/clusters and administered the survey to the 80 willing adult respondents subsequent to obtaining their verbal consents. Note here, that unlike the dwellings in the rural area (namely, Kalikapur village in the South 24 Parganas district), in the slum clusters, the issue of more than one family residing in the same house did not remain. This is because, in any slum cluster in a metropolitan city like Kolkata, the dwelling space is already limited; thereby meaning that on most cases, distinct doors opening to the main alley of the slum cluster coincided with a separate household/family living inside. So, the question, if more than one family resided under the same roof, was futile as all the constituent families did, in fact, live in a cluster.

In all of the three areas: rural, urban and slum clusters within an urban region, once an adult representative of a sampled household was willing to participate, the interviewer obtained information about the responding adult member concerned and his/her family. No screening criterion except for a respondent's age of adulthood (of or above 18 years of age) was implemented. Note here, that although the survey focused on the valuation of future malaria risks, respondents having prior experiences of malaria were deliberately not screened out. This is because even when one recovers from malaria, he/she remains equally susceptible to future attacks of the disease as compared to others who have not had prior malaria-related history. Recovery from malaria does not ensure full immunity to the disease, and hence was our plan not to differentiate between prior patients and non-patients of malaria when determining respondents' eligibility. Following only the age criterion, a heterogeneous mix[35] of respondents in the sample comprising heads of households, their spouses, other responsible adult members etc., was ultimately arrived at, thereby ensuring a fairly adequate representation of household-level decision-makers of various types and ages.

## 3.3 Design of the Survey: Key Features

In this section, the elements comprising the crucial core of our survey design are briefly illustrated. The structure of the final questionnaire and framing of its key constituent parts were substantively modified on analyzing the results emerging from the focus group discussions (FGD) and pretest sessions conducted prior to the actual survey (See Section 3.4 for the details on how

[35] See Chapter 4 for the details on the descriptive statistics of the respondents in our sample.

the actual survey was implemented in stages through the FGD and pretests, and see Section 3.5 for the sections in the actual survey). But what follows below chiefly pertains to our core survey design and the background literature which inspires developing such a design suited to the research needs of this dissertation.

### 3.3.1 Elicitation of Risk Beliefs

One of the key motivations behind the field study was to assess respondents' beliefs on the risk of occurrence of malaria in the following one year, starting from the date of the interview. For the purpose, a physical device, comprising a pack of 11 cards pasted on a cardboard[36], was developed as a risk scale, and to motivate relevance of the cards to the context of malaria, each card was described as a "Malaria Card" to the respondents. Each of the cards, labeled 0 through 10, was explained to be representing a particular level of belief that malaria would occur (i.e. a certain level of malaria risk). Each card was so constructed that the grid consisted of 10 squares arranged in 5 rows and 2 columns. Some of the squares were colored red while the rest were blue. Blue meant the possibility that malaria would not occur. Red indicated the possibility that malaria would occur. The number of squares colored red on a certain malaria card was used to represent the level of risk. Counting the number of squares colored red, and also by following the number label that accompanied each card, respondents could comprehend what level of risk each card was representing. For instance, the annual malaria risk of 6/10 (i.e. 6 out of 10 chances) was illustrated by the Malaria Card No. 6 on our risk-elicitation device, on which 6 out of 10 squares were red while the rest of the squares (i.e., 4) were blue.

[36] The physical process of construction of the risk scale is explained in detail in Section 3.4.

In the survey, after verifying respondents' eligibility, and asking 12 initial questions on family demographics, socio-economic status (respondents' and families' income conditions, religion etc.), past malaria history in the family, and respondents' basic perceptions on how and why malaria generally occurs, the Malaria Cards were introduced to respondents. Immediately before describing the physical device, it was explained to respondents how dreadful malaria is, and the ways in which the disease spreads with the help of a particular species of female mosquitoes, namely *Anopheles*, which acts as the disease carrier. Having explained the morbidity and mortality dimension of malaria, respondents were let known of the survey's focus on the morbidity dimension only and were asked to pick one of the 11 Malaria Cards to represent the risk-level that best resembled the extent of vulnerability to the disease that they perceived for themselves for the future one year time-horizon. Before they did pick one, respondents were oriented on the risk-scale in detail.

Respondents were shown three examples of scales representing risk levels of 0, 6 and 10 and for each of such examples, they were told about the relationship between a particular level of perceived risk (of getting malaria in the next one year) and the distribution of red and blue squares in each card. Along with verbal descriptions of the above examples, interviewers pointed to Cards 0, 6 and 10 (one at a time) to keep the respondent engaged in the card concerned. In addition to these specific examples, respondents were told: "As one moves down the board from card "0" through "10" , the number of red squares in each card increases in comparison with the number of blue cards…. Since red stands for malaria risk, this implies that as we move down the board, the belief that malaria would occur gets bigger. Thus, if someone believes that his/her chances of getting affected by malaria are big, he/she would pick a card towards the bottom of the board. In contrast, anyone believing his/her chances of getting the disease are not too high, may go for a card amongst those on the top of the board. In this way, any person can express what he/she believes his/her chances of getting the disease are, by using this set of 11 Malaria Cards." Immediately after the illustration of examples a practice session ensued to condition the respondents more on the specificities of the risk scale, and to induce their familiarity with our device. Interviewers pointed to two specific Malaria Cards, Nos. 4 and 8, and engaging the respondents solely on the said cards, asked: "Suppose I pick Card No. 4 and Card No. 8 . Between these two cards, which card do you think represents a greater belief/ risk (out of 10 chances) that malaria would occur? Notice the distribution of red and blue in each of these two cards carefully and answer". Each respondent was given two chances to answer this practice question. After respondents successfully used the two select cards to accurately answer the posed question, the actual question on malaria risk assessment followed and respondents estimated , on a scale of 0-10, their own chances of getting malaria over the following one-year horizon. As each respondent was thinking of their choice, interviewers emphasized on two aspects: (i) Respondents were not being asked to estimate severity of malaria if the disease potentially occurred on the stated future horizon; rather the question concerned how likely respondents believed their chances of getting malaria were; and (ii) The question was not a test of respondents' knowledge since no one exactly knew what chances/risks were going to be like; thus, it was a question on beliefs and there were no right or wrong answers.

Our methodology of using a 0-10 scale for risk elicitation in the survey is somewhat akin to Delavande and Kohler (2009) who do the same in a developing country setting. In Delavande and Kohler (2009), the risks of contracting HIV/ Aids in Malawi are elicited by the use of a visual aid whereby out a total of 10 beans, respondents are asked to place any number of beans to a plate, and are informed, that the number of beans they choose to place on the plate would indicate the "chance" or "probability" that they would be affected. Likewise, in our design the link between the number of squares colored red and the chances of getting malaria (out of 10 ) in the next one year was explicitly mentioned to the respondents. This was designed given that Delavande et al. (2011) apprehend that the absence of an explicit mention of "probability" / "chance" in the risk-elicitation question[37], and merely asking respondents to allocate beans depending on how "likely" they think an event is (i.e., in our framework this would amount to choosing any one of the cards depending on only the color distribution and not using the "out of 10 squares" clause and not linking the number of red squares to the "risk" level or the probability) may produce interpersonal differences in how "likely" is interpreted. Attanasio (2009) discusses the prospect of using risk-elicitation methodologies in the context of a developing country to understand how beliefs affect different behavior and how beliefs, in turn, are shaped by policies and different economic environments. This study offers motivation to our plan of assessing health-related risk perceptions in India, particularly in the context of a recurring infectious disease like malaria that places a substantive burden on the population of the country. In addition to risk-elicitation, another key constituent of our survey design comprised an

[37] See Hill (2009) for details on a design where "probability" is not linked to the visual aid in the risk-elicitation question.

instrument to assess people's evaluation of proportionate changes in perceived risks that were randomly assigned to respondents. The following sub-section illustrates the same.

### 3.3.2 Stated Preference (CVM) Component

Given our interest in empirically observing how people evaluate the perceived benefits of competing disease control strategies, and in gaining insights into the interplay of private-public dimensions to risks (and associated social preferences) on the issue of malaria control, we structured the survey as follows. After collecting the required information regarding malaria risk perceptions, a between-subject design was alluded to. Two treatments, namely a "community-level health intervention" and a "private-level health intervention", were designed and respondents randomly assigned to any one of the same. In the community-level treatment, respondents were presented with a hypothetical package of community[38]-wide malaria control measures that the local government may implement in the area. They were informed that this public health program would reduce their perceived malaria risks (which they chose by picking a card from amongst the pack of 11 Malaria Cards) by a certain percentage. The percentage risk-reductions (for their private risks) were presented pictorially with the help of another card, tucked underneath the one a respondent chose [39]. In addition, it was explained that the program, owing to its community-wide scale, would bring forth the same amount of health-related benefits (i.e. equal amount of percentage risk reductions) for every other member in the community.

[38] The definition of "community" and the geographical limits of the same (e.g., "Ward" , in an urban area , and "Village", in a rural area) were clearly communicated to the respondents.

[39] In our design, first the elicitation of private health risks and then, the offer of risk-reductions could potentially avoid problems of participants not believing that risk levels assigned to them are correct (Alberini et al., 2004).

Finally, respondents' intentions for financially contributing towards implementation of this community-wide program, which would benefit both the respondent and others in her community, were recorded. This part of the survey served as a means to know how respondents valued community-level health risk reductions. A social-desirability bias was potentially avoided by using a single dichotomous question (using a single stated price)[40] that targeted to benefit both the respondent and her fellow community members.

Likewise, subjects randomly assigned to the "private health intervention" treatment were offered percentage risk reductions via the option of purchasing a new private hypothetical malaria-preventing product, namely a mosquito-repelling lotion, which was explained to be qualitatively superior to other similar products existing in the market. Respondents were told that, on using the product regularly for one year, the annual private malaria risks (perceived and reported by the respondent through the choice of a colored card on our risk-elicitation device) would reduce by a certain percentage, pictorially described as in the other treatment described above. Given the successful use of product-labels in the CVM literature (Viscusi and Magat, 1987; Dickie and Gerking, 1996 etc.), the effectiveness of the preventive product is conveyed through product labels (See Questionnaire in Appendix E).

Note that, in keeping with our theoretical model, the two treatments in our design were so planned to make a clear distinction between the nature of benefits that the two hypothetical scenarios brought forth. While the community-level malaria-control treatment generated malaria

[40] Different stated prices were used in the CVM question in our survey across the two health intervention treatments. These prices were finalized after analyzing the results of our FGD and pretest sessions prior to the conduct of the actual survey. 4 final prices (INR 55, INR 75, INR 125 and INR 225) were decided upon and respondents in each health intervention treatment randomly assigned to one of these 4.

risk-reductions both at the individual and community levels, the private-level context aimed to benefit the respondent's health only, conditional upon a respondent's willingness to purchase the mosquito-repelling product. In each of the treatments, two effectiveness percentages, namely 50 % and 90 %, were randomly offered. Note that risk-elicitation in the context of malaria and subsequent valuation of perceived risk-reductions, as a survey design, had not so far been applied in the context of our study site[41]. So far, Prabhu (2010) has been identified as the only study in India using CVM to evaluate perceived valuations of the health-related benefits (percentage risk reductions) through a hypothetical malaria vaccine in Navi-Mumbai. We use the effectiveness rates (50 and 95 %) of vaccines, as in Prabhu (2010), as a preliminary guiding tool to base our risk-reduction figures on. To facilitate comparability across the two treatments, even for the community-level treatment, the same amount of proportionate risk-reductions were planned to be randomly dropped. Moreover, in each treatment, we used a narrative reminding respondents of the budget constraints and available substitutes of the malaria control measures we offered. Whittington (2010) asserts, among other things, the benefits of using such narratives in terms of ensuring best-practice implementation of CVM instruments. Besides, at the end of the Yes/ No answers in the CVM question, a few clarifying questions are included. Given the hypothetical nature of the intervention presented, respondents' perceptions on the extent of confidence/

[41] However, our study site features in CVM studies in the context of other diseases. In the context of cholera and typhoid, for instance, Whittington et al. (2009) estimate private demand for hypothetical vaccines in Kolkata (India). Cook et al. (2009b) develop a framework for estimating the private and social economic benefits of vaccinations for infectious diseases and explore herd protection effects, considering two neighborhoods in the city of Kolkata. Risk-perceptions, in the manner we intend have not been studied in the site, till date, though. However, Cook et al. (2009 a) have looked into the elicitation of risk-attitudes of the urban poor, using a Multiple Price List (MPL) format.

certainty they place on their own Yes/ No answers are recorded. Besides, respondents were requested to specify the reason/s behind their affirmative / negative financial decisions.

We extended the between-subject design of eliciting private and public values of health risk reductions, illustrated in Arana and Leon (2002), to our framework. Herein, note that, we attempted to implement a design feature proposed as a concluding remark in Johansson (1994) that different subsamples of respondents may be asked to respond to different valuation questions. In the process, information on the magnitude of WTP associated with different forms of altruism in the population could potentially be ascertained. In terms of framing of the CVM question, although close to Arana and Leon (2002), our design departs from theirs on a crucial aspect. In contrast to their use of a hypothetical baseline[42] of risks of flu, we first assessed the perceived private risks of malaria from each respondent in each treatment which comprised the baseline for exploring the valuation of health risk reductions, which were offered subsequently, through the CVM instrument. Our between-subject design contrasts with the within-subject treatments in Viscusi et al. (1988). Nevertheless, Viscusi et al. (1988) offer us significant motivation to conceive the importance of altruism in the valuation of morbidity risk reductions. Our between-subject design also gains support from Zhang et al. (2008) who empirically explore how the value of mortality and morbidity risk reductions are affected by altruism in the valuation of a public good, namely a drinking water treatment program, for reducing water-related health risks. Besides, our empirical plan of recovering the valuation of community-level health risk reductions (i.e. the social preference component) is largely influenced by a similar exercise in

[42] See Whittington (2010) and Whittington and Adamowicz (2010) for the potential issues with regard to using hypothetical baselines of risks in CVM surveys.

Zhang et al. (2008), albeit with a difference. In Zhang et al. (2008), one treatment exclusively measures the altruistic motivations and the other measures both the altruistic and self-interest dimensions to preferences. In contrast, we structured two treatments: one, which would explore the private valuation of health-related benefits only, while the other would deal with valuation of both public and private dimensions to malaria risk reductions. Arana and Leon (2002) guide us on how to design and effectively implement such a between-subject methodology.

### 3.3.3 A "2 X 2 X 4" Design

This sub-section summarizes the core points already covered in sub-sections 3.3.1 and 3.3.2 above, and wraps up the illustration of the key features that underscore our survey design. The survey was so designed that crucial information on malaria history of the respondents, other perceptions, actual prevention strategies, community living conditions etc would be recorded. But, above all, the risk-elicitation scheme (using the Malaria Cards we developed) and the between-subject randomized design served as the crux of the survey. Respondents were randomly assigned to one of the two health intervention treatments: community-level and private level. In the community-level health intervention treatment, each subject received one of the two descriptions whereby risks would reduce by either 50% or 90%. Likewise in the private-level health intervention treatment, descriptions assigned risk reductions of 50% or 90% and a respondent randomly received one such description. Finally, in each of the community-level and private-level health intervention treatments, for each kind of percentage risk-reduction offered with the proposition of a community-wide malaria reducing program or use of a private preventive product, a cost (INR "T") was randomly posed to respondents to elicit their purchase decision. The cost (INR "T") for availing of the public program/cream that reduced health risks (public or private) by a certain effectiveness rate (50% or 90%) was randomly selected from among four values (INR 55, INR 75, INR 125 and INR 225). More precisely each respondent in the community-level health intervention treatment was asked : "When the civic authority may consider introducing this new mosquito-control program in your Ward/ Village, would you be willing to pay Rs. T [randomized over INR 55, INR 75, INR 125 and INR 225] as financial contribution ( e.g. tax) for implementing this community-level program, such that malaria risks for you and others in your community are reduced by X% [randomized over 50% and 90 %]?". In contrast, a typical respondent in the private-level health treatment was posed the question: "Would you be willing to pay Rs. T [ randomized over INR 55, INR 75, INR 125 and INR 225 ] to buy the lotion that would reduce your malaria risks by X % [randomized over 50 % and 90%]?"

Thus, in effect, the survey involved a 2 X 2 X 4 design and accordingly, 16 types of questionnaires were prepared. About 50 copies of each of the 16 types of questionnaires were fielded to respondents across the urban (Ward No. 72 and slum area) and rural sites. Ultimately, 780 responses were arrived at, contingent upon the consent of respondents contacted on door-to-door visits.

## 3.4 <u>Stages of Implementation of the Survey</u>

### 3.4.1 Focus Group Discussion (FGD)

The Malaria Risk and Prevention Survey was implemented in stages in the study sites in India over the period September-December, 2011. Prior to administration of the final version of survey between November and December, 2011, a focus group discussion (FGD) followed by pre-testing of the survey instruments were done in and around the study sites during October 2011. All materials for the field survey (pretest materials, final questionnaires, human subject research protocol etc.) and their corresponding versions in the local language (Bengali) suitable for the study location at hand, were granted approval of the UCF Institutional Review Board (IRB Number: SBE-11-07808; dated 08/24/2011). The outcome of the review process of UCF IRB and approval of the translated survey instruments, duly confirmed by a professional translator and Faculty of Bengali, University of Calcutta, Govt. of West Bengal, are appended to the dissertation in Appendix D. For the purpose of an efficient conduct of the survey protocol within a stipulated time-frame, professional interviewers were recruited and adequately trained on the survey instrument both under in-class and field conditions over a 7-day period in September, 2011. In the following sub-sections, brief illustrations of the different stages of survey execution are presented.

The FGD was planned to be conducted in a rural site, particularly since in a developing country context, it was deemed an utmost priority to first test the acceptance of the risk-scale (use of such a visual aid to elicit risk perceptions was hitherto not experimented with in the study locations) among a rural audience, generally characterized by lower levels of literacy, income and socio-economic status. The FGD was designed with three primary objectives: (1) To elicit subjects' perceptions on health issues in general and on malaria, in particular, with associated information on actual prevention they adopt; (2) To examine if the risk-scale with the constituent bi-colored Malaria Cards was comprehensible to individuals; and (3) To gauge if at all people were willing to opt for a hypothetical intervention (community-wide malaria improving program/ private malaria-preventing product) to reduce their health risks from malaria.

The FGD was conducted in the Langalberia village under Kalikapur-I Gram Panchayat, South 24 Parganas, on the 14th of October, 2011. The West Bengal Government Primary Health Center in the village served as the venue where a group of 10 village residents and community health workers (contacted 10 days prior to the FGD through verbal announcements by the health center workers), assembled for the purpose. Among the 10 participants, there were 3 male members while the rest were female. The FGD interview materials were prepared after in-depth discussions with experts, scientists and health workers familiar with the area in course of other similar health projects. But, malaria had hitherto not been worked on in the area under any previous government/ non-government project which made it all the more interesting for us to examine our independent research protocol in a rural setting. The National Institute for Cholera and Enteric Diseases (NICED), a premier research institute under the Govt. of India, which administers projects on diseases like diarrhea, rota virus etc. in the area, extended significant support in publicizing the FGD pertaining to our project. Note herein that, although conducted in the same Gram Panchayat which was selected as our second-stage sampling unit, the FGD was not organized in the specific village (namely, Kalikapur) which we sampled. This is because, in a rural setting, the word of mouth is a strong medium of communication within a village and hence, it could not be fully ruled out that, if conducted in the same village as where our survey respondents would finally be recruited, experiences and views of the FGD participants would not potentially affect the final-stage survey respondents and their attitudes towards malaria and our project. Since the FGD would be more of an open session to examine the applicability of the survey instruments, we apprehended such a possibility and planned for testing of the instruments on the actual site (i.e., Kalikapur Village) only with pretest questionnaires, which would be close-to-final versions of the actual questionnaires and hence, more structured. Nevertheless, note that Langalberia village is very close to the actual site of our final survey and is qualitatively similar on socio-economic, geographical and other key aspects, making it likely that the FGD outcomes would generate meaningful guidelines for effectively applying our survey protocol to the final site of fieldwork.

Two trained moderators, conducted the FGD session in the local language, Bengali, which lasted for about 2.5 hours. The author of this dissertation research who served the Principal Investigator on site, and for whom Bengali is the mother tongue, took down notes in the FGD session and intervened wherever necessary to engage the participants on specific questions of interest. To operationalize the risk-scale, a card board (about 1.5ft X 1.5 ft) was prepared and made use of in the FGD (A snapshot of the risk-scale is given in Appendix F). On the board, 11 cards, made from hard photomailer envelopes were pasted. On each of the 11 cards, the grid comprising 10 squares and the red-blue color scheme across the same was prepared in Excel, color-printed and pasted on each card. Each card came with a label (0-10) written in Bengali numeric to facilitate understanding of the rural participants.

All of the 10 FGD participants expressed no difficulty in understanding the risk-scale and the constituent Malaria Cards and the results of the risk-elicitation process showed a good variation of the perceived risk levels. In order to randomly assign subjects to either a hypothetical public health intervention treatment or a private-level treatment (mosquito-repelling cream), an equal number of two types of descriptions (i.e. of the public program and the cream) sealed in brown envelopes were placed in a serving tray and each participant chose one amongst the same. Attached to the descriptions were also a few questions on whether they would pay for such a program/cream to reduce the chances of risk that they had just expressed, and the reasons behind their decisions. After the completion of the envelope choice and payment decision sessions, the moderators talked to all of the participants for more details on their opinions on the procedures. Note that in the FGD, our plan was not to show subjects the percentage reductions (the 50% and 90% risk-reductions were kept to be examined in the pretest sessions only); rather the FGD was the first step to examine if the risk scale and the possibility of availing a hypothetical health intervention available at a flat cost of INR 60 (arrived at by comparing the prices of preventive sprays, coils and other means already available in the market) were acceptable to people.

The FGD outcomes contributed to significant improvements in the description of the treatments. For instance, for the public health treatment, the free-riding dimension to public goods was raised by a participant, expressing apprehension as to why should she pay when she was not confident that others in her village would pay for the intervention. Accordingly, post-FGD, a statement was included in the pretest and final questionnaires which asked subjects to assume everyone else in the area had already agreed to make a payment when any respondent was considering his/her own purchase decision. For the private good treatment, the description was refined too and especially, the statement (present in the FGD description) that the private cream did not affect mortality risks, was removed, since one of the participants expressed confusion on the same. An adequate variation of Yes/No answers to the payment question in each treatment was arrived at and by asking debriefing questions on the flat cost stated ( i.e., INR 60), important information on prices participants might actually be willing to pay (at the maximum or, minimum), were obtained.

### 3.4.2 Pretest Sessions

The refinements emerging from the FGD were incorporated and the pretest questionnaire fielded to 38 respondents in the two[43] actual sites, namely, Ward No.72 (urban site) and the Kalikapur village (rural site), between October 20, 2011 and October 31, 2011. Prior to the pretest sessions, the sampling process had already been accomplished as per the plan and therefore, interviewers paid door-to-door visits to the households not already selected for the final sample and recruited adult household representatives from those households only, once they consented on participating. In this regard, considerable help was extended to the author by the Kolkata Municipal Corporation, the civic authority in the city, in terms of providing the Ward Map for Ward No. 72, the pretest and final urban site, thereby facilitating the survey team in locating the households. A group of 5 interviewers including the author herself administered the pretest sessions. In all, 14 households were visited in Ward No. 72, and 24 in Kalikapur village. Two main objectives underscoring the pretest were: (1) To examine if the benchmark percentage risk-reductions (50 % and 90 %) which had so far been planned for being offered with the hypothetical health intervention treatments needed revisions; and (2) To obtain information on

[43] The pretest was not conducted in the slum area on time considerations.

the willingness to pay and explore the possible values of the cost of the public program/ private preventive product, to be finally used in the survey.

In order to pictorially represent the 50 % and 90 % risk reductions to pretest respondents with the help of the Malaria Cards, we did the following while preparing for the pretest session. The physical device for risk-elicitation, i.e., the board which we used in the FGD, had already 11 bi-colored cards, named Malaria Cards pasted on it. Each card with its unique red-blue color distribution (red meant risk) depicted a particular level of risk on a scale of 0-10. We prepared a new board with a similar set of 11 Malaria Cards. One board was meant to be used for respondents randomly assigned to the 50 % risk-reduction treatment while the other would be used for the 90 % randomized group. Also, briefly note at this point that each Malaria Card was prepared by cutting photomailer cards into halves (thus, a total of 5.5 photomailers were used in making the 11 cards on a single board) and hence, each card had a pocket and was open on the right. For each card, we used the pocket to place a new bi-colored card inside to pictorially depict the risk-reduction the hypothetical treatment would offer. For instance, for the board to be used with the 50 % respondent group, inside each of the cards labeled from 1-10 ( since the card labeled "0" already meant no level of risk making the need for a further risk-reduction futile) , another card, with the corresponding 50 % risk-reduction and changed red-blue color distribution, was placed. Likewise, each card on the 90 % board had a proportionate risk-reducing card tucked inside. For both types of boards, once a respondent would pick a Malaria Card to represent his/her perceived risk level on a scale of 0-10, the interviewers were trained to pick that chosen card from the board and close the board, thus, helping bring the respondent's focus to only the card he/she had just selected. Then in the CVM section of the survey, after reading the description of the hypothetical treatment (public/private), the interviewers would bring out the new risk-reducing card from inside the pocket of the chosen card and visually illustrate the risk-reduction (50 % or, 90%) that the description claimed to offer. In each of the malaria cards and the corresponding risk-reducing card tucked inside it, the grid of 10 squares colored with red and blue and printed on paper, was prepared strictly following mathematical proportions on Excel worksheet.

On each site ( i.e., urban and rural), in order to aid practical convenience of the interviewers on field, a total of 4 boards, two of each kind, 50 % and 90 % risk-reduction, were prepared. Each of the two 50 % boards was wrapped in yellow colored paper while the 90 % boards were covered with dark green wrapping sheets[44]. There was no mention of the figure "50%" or "90%" on a board, thus, ensuring that the figures could not potentially influence or confuse a typical respondent. The need to avoid such a confusion was felt particularly since, even before the risk-reducing hypothetical treatment would be offered, respondents would be using the same physical device (the board with its constituent 11 Malaria Cards) to express their perceived risks. Thus, in effect, it was only the color of the wraps which marked the apparent distinction between the 50% and 90% risk-devices. Since, the survey design involved a between-subject plan, this distinction would only be known to the interviewers.

Given that in the pretest sessions, there were two hypothetical health intervention treatments (public and private) and , alongside, a randomization over a 50 % or 90% risk-

[44] A snapshot of the two kinds of the risk-eliciting boards is presented in Appendix D.

reduction, in all, it was a 2X2 design with 4 kinds of questionnaires. Across the private and public treatments, the random assignment of 50% risk reductions was associated with a certain starting price while the 90 % reductions involved a slightly higher price. In both the 50% and 90% questionnaire types, once the initial purchase response of a respondent was noted, a follow-up price (greater than the starting price if initial response was "Yes" and a lower price if the response was "No") was offered. To avoid the possibility of an interviewer bias, each of the 5 interviewers conducting the pretests was given about 8-10 copies of each type of the 4 questionnaire types. On a typical day, each interviewer would take out either a 50% or a 90% board, and in the 50% (or 90%) stack of questionnaires the interviewer would carry on the day, there would be questionnaires pertaining to both the public and private treatment. This called for a fair amount of coordination among the interviewers, the process of which was monitored all through by the author herself. Also, for ruling out any potential bias, each interviewer was trained to read out the descriptions and questions present in any kind of questionnaire verbatim.

In the pretest sessions, 22 respondents were randomly assigned to the public health intervention treatment while 16 fell in the private group. The average age of respondents in the sessions was 37.21 years and 55.26 % of people reported their household incomes in the range INR 3000-10,000. The pretests yielded a fair amount of variation in the perceived risk levels and on the scale of 0-10, the mean risk perception level was noted as 4.69. A key finding emerging from the sessions was that respondents reacted positively to larger percentage changes in malaria risks. Note that owing to missing entries on CVM responses for 4 respondents, the variation of purchase decisions to risk changes was studied for 32 respondents out of a total of 38. The results showed that while 86 % of respondents assigned to the 90% risk reduction treatment said “Yes” to a health intervention, comparatively much lesser proportions (56 %) in the 50 % risk reduction category did so.

The pretest exercises helped in constructive improvements on certain aspects that deem particular mention. Considering the variation of “Yes”/ “No” responses across the prices offered (two starting prices with subsequent two follow-ups), a range of prices (i.e. stated costs of the public/private health interventions) from which to choose the 4 randomized values, for use in the final survey, was computed. Thirdly, the order of certain socio-economic questions (especially involving household income and expenditure categories) was altered. Besides, more clarity, particularly in colloquial terms, was incorporated in the description of the risk device. Moreover, the pretest results pertaining to the malaria history of the respondents indicated the necessity to alter the recall period from 2 to 5 years. Finally, wording revisions were made in a few questions on household and community characteristics.

### 3.4.3 Final Survey

Post pretest sessions, 4 final prices (INR 55, INR 75, INR 125 and INR 225) were decided upon and respondents in each health intervention treatment ( public and private) were decided to be randomly assigned to one of these 4. Having progressed in stages, the final survey finally assumed a 2 X 2 X 4 design (2 health treatments, public and private; 2 kinds of risk-reductions, 50% and 90%; and 4 kinds of prices) and accordingly, 16 types of questionnaires were prepared. A group of 8 professional interviewers (4 in urban and 4 in the rural sites) were trained on the survey protocol and the final survey conducted in November and December, 2011.

For survey operations on the urban site, Economic Information Technology, a premier survey-executing agency in the city, helped in the recruitment of interviewers and the author trained the selected interviewers over a 4-day period including conduct of a field test. For the rural site of Kalikapur, NICED, a governmental research body, extended support to the interviewer recruitment process and interviewers, essentially familiar with the rural area and local customs, were appointed. A total of 8 risk-elicitation devices (4 each for the 50 % and 90% risk reductions) were prepared. The descriptions of the hypothetical treatments were finalized taking inputs from both the pretest results and from opinions of key specialists and scientists in the Vector Control Department of the Kolkata Municipal Corporation, the civic body in Kolkata. As in the pretest, each interviewer was assigned an equal number of each of the 16 types of questionnaires and coordination in the interviewer team overseen by the author, especially on the issue of exchanging the two kinds of risk-boards on alternate days. Ultimately, 780 responses were gathered across the urban, rural and slum sites, commensurate with the prior sampling plan.

## 3.5 Sections of the Final Survey

A typical survey, comprising 6 sections in all, began with a question to verify the eligibility criterion with respect to the respondent's age (18 years or above). The survey proceeded in steps as the following:

*Part I:* Background questions on family demographics (age, relationship with the household head, gender, education, employment status etc.) were asked. Also, the respondent's monthly income (if employed) and family-level monthly earnings were recorded. In the questions on income, response order effects (Holbrook et al., 2007; Krosnick and Presser, 2009) were avoided by not asking a dichotomous question. Rather while the interviewer read aloud the different categories, the respondent was asked to stop the interviewer at the income category that he/she thought best accommodated her "actual" income.

*Part II:* Malaria-related experiences of the respondent and her family-members, randomly picked by the interviewer from the demographic list in Part I, in a recall period of 5 years, were recorded. Also, the current health-status of the respondent was assessed on a Likert scale. Alongside, certain basic questions on malaria-related perceptions (cause of malaria, extent of malaria problem in the household and factors contributing to vector breeding etc.) were asked.

*Part III:* The risk-elicitation device comprising the Malaria Cards was introduced followed by a brief practice session invoking familiarity with the visual aid. Given that a respondent successfully answered the practice question, his/her perceived levels of malaria risks were elicited. Immediately later, the CVM component was incorporated. A typical respondent was randomly assigned to either the community-level treatment or the private-level treatment. In each treatment, either the 50 % or the 90% risk reduction was offered and the respondent's purchase decision was recorded against a stated cost (randomly selected from amongst 4 values). A few de-briefing questions followed.

*Part IV:* Information on revealed prevention strategies that a respondent generally adopted (say, the use of bed nets, their cost and frequency of use etc.) were recorded in this section. Besides, questions on the general family behavior on medical care, food expenditures, household spending, and health-related decision-making processes, were posed.

*Part V:* Socio-economic characteristics of the houses of the respondent were elicited.

*Part VI:* Questions were asked on the characteristics of the local community and on living conditions in the areas the respondent lived in.

# CHAPTER 4:DESCRIPTION OF DATA

## 4.1 Introduction

This chapter lays out the descriptive statistics pertaining to data collected in the Malaria Risk and Prevention Survey, 2011. Of the 780 household representatives interviewed, 30 refused to reveal their perceived levels of malaria risks while 60 either refused or were undecided while giving their purchase decisions in the CVM section of the survey. Besides, three responses could not be analyzed owing to missing entries on crucial aspects like past malaria occurrences and slum/non-slum household identification. Thus, leaving aside an approximate 12 % of non-responses (93 units out of 780)[45], the description here considers a total 687 sampling units encompassing the urban, rural and slum regions in and around Kolkata (India). Amongst the 687 households considered, a total of 350 units fall in the urban area while the remaining 337 comprise the rural sub-sample. In the urban area, a further disaggregation of the 350 units into slum and non-slum residential areas yields a total of 82 slum households with the rest pertaining to the non-slum section.

The chapter is organized in broad sections under which different aspects of the sample are presented, such as: (i) characteristics of the respondents; (ii) family demographics and household socio-economic status; (iii) malaria history of respondents; (iv) actual prevention

[45] Out of the 93 sampling units not considered fit for final analysis, 52 happened to be randomly assigned to the private treatment while 41 fell under the public health intervention treatment. 86.02% of the non-responses were observed in the urban area with relatively more response issues found in the non-slum regions. In the sub-set of these 93 sampling units, respondents were mainly of the age-group, 31-50, and 63.44% of them female. 38 respondents ( i.e., about 41 %) reported being earning members of their families. About 35.48% of the non-response units did not express their household income. But, approximately 28% and 20% revealed family incomes in the ranges, INR 1000-4999, and INR 5000-14999, respectively. 27.96% of the non-response group were Class7-10 educated with also about 26% stating that they were College educated. On account of malaria incidences in the past, 11 of 93 respondents (12 % approx.) affirmed their first-hand suffering from the disease in a 5-year recall period.

methods and disease-related awareness; (v) levels of perceived malaria risk and purchase decisions under the given private/public prevention scenarios in our study; and (vi) aspects of the community respondents live in.

In each of the sections that follow, first a reference is made to the full sample characteristic with a subsequent brief explanation of what the urban and rural sub-samples exhibit with regard to the characteristic/variable concerned. The slum sub-sample from within the urban area is also discussed alongside, at times when certain features deem special mention.

## 4.2 Respondent Characteristics

The average age of the respondents in the survey was about 41.96 years (See Table 1). While in the full sample, the majority of respondents (42.79%) reported their age in the "31-50" category, in the urban area, sizeable proportions of respondents (40.29% and 40.86% respectively) belonged to both the "31-50" and "above 50" age groups. Data in the rural area and the slum area showed similar features as the full sample and, hence, had most of their respondents within the "31-50" age group. The religion found to be the most conspicuous among sample respondents was Hinduism (98.69%).

Among the participating respondents 65.79% were female. In the urban area, the gender composition of participants was almost even with 48.57 % male and 51.43 % female. The rural area too saw a huge majority of female respondents (80.71%). Of the 687 household representatives interviewed, 29.99% were heads of households. In the urban area, the proportion of responding heads was 42.57%. In contrast, in the rural sub-sample, a very small proportion of respondents (16.91%) was found to head their respective households. In the full sample and all of the sub-samples, the majority of respondents were married.

**Table 1: Respondent Characteristics**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes Slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Age** | | | | | | | | |
| 18-30 | 200 | 66 | 134 | 18 | 29.1% | 18.9% | 39.8% | 22.0% |
| 31-50 | 294 | 141 | 153 | 43 | 42.8% | 40.3% | 45.4% | 52.4% |
| >50 | 193 | 143 | 50 | 21 | 28.1% | 40.9% | 14.8% | 25.6% |
| **Gender** | | | | | | | | |
| Male | 235 | 170 | 65 | 33 | 34.2% | 48.6% | 19.3% | 40.2% |
| Female | 452 | 180 | 272 | 49 | 65.8% | 51.4% | 80.7% | 59.8% |
| **Married** | 561 | 257 | 304 | 61 | 81.7% | 73.4% | 90.2% | 74.4% |
| **Respondent Heads** | 206 | 149 | 57 | 28 | 30.0% | 42.6% | 16.9% | 34.1% |
| **Education** | | | | | | | | |
| Illiterate or below Classs 1 | 90 | 24 | 66 | 15 | 13.1% | 6.9% | 19.6% | 18.3% |
| Class 1-6 | 74 | 32 | 42 | 18 | 10.8% | 9.1% | 12.5% | 22.0% |
| Class 7-10 | 224 | 99 | 125 | 33 | 32.6% | 28.3% | 37.1% | 40.2% |
| Class 11-12 | 90 | 46 | 44 | 7 | 13.1% | 13.1% | 13.1% | 8.5% |
| BA-Ph.D | 178 | 148 | 30 | 9 | 25.9% | 42.3% | 8.9% | 11.0% |
| Vocational Education/Diploma | 0 | 0 | 0 | 0 | 0.0% | 0.0% | 0.0% | 0.0% |
| Can sign | 25 | 0 | 25 | 0 | 3.6% | 0.0% | 7.4% | 0.0% |
| Don't know/ Refused | 6 | 1 | 5 | 0 | 0.9% | 0.3% | 1.5% | 0.0% |
| **Respondent Earning Member** | 275 | 188 | 87 | 53 | 40.0% | 53.7% | 25.8% | 64.6% |
| **Religion Hinduism** | 678 | 343 | 335 | 81 | 98.7% | 98.0% | 99.4% | 98.8% |
| **Respondents' Malaria History** | 114 | 111 | 3 | 24 | 16.6% | 31.7% | 0.9% | 29.3% |

The education level of respondents has been found to vary substantively but a conspicuous majority (32.61%) belonged to the "Class 7- Class 10" level, followed by 25.91 % , who received College/ University/ advanced degrees ("Bachelors-PhD" level). Table 1 above also shows that a separate analysis of data on the urban area revealed that a substantive proportion of participants (42.29%) were College-PhD level educated. In the slum sub-sample within the urban area, about 18.29% of respondents were illiterate but the majority were still

“Class 7- Class10” educated. In the rural area, 19.58% of respondents were illiterate and about 7.42% could only sign.

In the sample, about 40.03% of the respondents were earning members in the households. Of these earning individuals most reported having private businesses (21.45%), followed by 17.45% who stated being in private sector occupations. As compared to the full sample, the urban area saw a higher proportion of earning respondents (52.71%) and relatively lesser so was observed in the rural area (25.82%). While in the urban sub-sample businesses still emerged as the major occupation, in the rural sub-sample, the majority (20.69%) revealed to be working in small shops/factories or as casual labor. In the overall sample, only one respondent refused reporting his occupation.

Since the survey mainly comprised a health-related one, to get an idea of respondents’ general health perception, a question (based on a 5-tier Likert scale) was asked on their perceived current health status. A major chunk, 49.64 % of respondents in the overall sample, reported having fair health status, with a similar observation in the rural sub-sample as well. In the urban area, 37.71% reported fair status while an almost equally large proportion (30%) perceived their status to be medium. In the context of malaria occurrence in the past, a sizeable number of respondents reported having prior experience of the disease. 16.59% of respondents had suffered from malaria within 5 years preceding the date of the survey. In the urban area, the disease was found to be very prominent with a substantive 31.71% of respondents revealing their first-hand malaria experience in the said recall period. In the rural area, in stark contrast, only 3 respondents had suffered from the disease. The urban-rural sub-sample analysis, thus, threw up contrasting incidence features, prompting interest in a further disaggregated empirical analysis of respondents' preventive behavior and health attitudes according to different regions. Such an exercise is considered in Chapter 6.

## 4.3 Household Characteristics and Socio-Economic Status

More than half of the sampled households (about 57.21%) were families with 3 to 4 members. Such family sizes emerged as the majority not only in the full sample, but also in the urban/rural/ slum sub-samples. Family sizes of the order 5-8, also accounted for a conspicuous proportion (28.82%). Compared to families in the urban area and the urban-specific slum regions, the rural area generally contained families of larger sizes, with 36.5% of rural respondents representing families with 5 to 8 members (See Table 2 for details).

In about 45.56% of households, children of the age 0-12 years resided. While, as compared to the full sample, the urban area separately accounted for a lower percentage of families with children (31.14%), the rural-area families mostly had children (60.53%).

Based on the overall sample data, the average household monthly income category was found to be INR 5000-10,000. The largest share of households, about 39.88% of the overall sample, belonged to the monthly income group, INR 1000-4999, while 26.35 % fell in the INR 5000-14999 category. About 1.6 % of households reported very high income (above INR 50,000). In the urban area and also in urban slum pockets, the income category, INR 5000-14999, was the socio-economic rung most found (33.71% for urban; and 45.12 % for urban slum), while in the rural area, the majority of households (67.36%) accounted for average monthly incomes ranging between INR 1000-4999. About 7.28 % of respondents in the overall sample refused to report their household incomes (or said they did not remember/know), with relatively more such refusals recorded in the urban area.

Data on household monthly expenditure conform to a similar pattern as household income. About half the sample (49.64%) reported incurring expenditures between INR 1000-4999. This expenditure category emerges as the most observed range in the rural area and the slum pockets as well. In the urban area, however, the majority of respondents (48.86%) reported monthly expenditures in the next higher range INR 5000-14999. In the overall sample, there were about 9.9% of sampling units where respondents refused to disclose their households' monthly spending.

**Table 2: Household Demographics and Socio-Economic Status**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes Slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Family Size** | | | | | | | | |
| 1 to 2 | 80 | 60 | 20 | 10 | 11.6% | 17.1% | 5.9% | 12.2% |
| 3 to 4 | 393 | 208 | 185 | 48 | 57.2% | 59.4% | 54.9% | 58.5% |
| 5 to8 | 198 | 75 | 123 | 24 | 28.8% | 21.4% | 36.5% | 29.3% |
| Above 8 | 16 | 7 | 9 | 0 | 2.3% | 2.0% | 2.7% | 0.0% |
| **Families with Children (0-12 yrs)** | 313 | 109 | 204 | 31 | 45.6% | 31.1% | 60.5% | 37.8% |
| **Monthly Household Income** | | | | | | | | |
| Cannot remember/Don't know/Refused | 50 | 42 | 8 | 6 | 7.3% | 12.0% | 2.4% | 7.3% |
| Below 1000 | 10 | 1 | 9 | 1 | 1.5% | 0.3% | 2.7% | 1.2% |
| 1000-4999 | 274 | 47 | 227 | 25 | 39.9% | 13.4% | 67.4% | 30.5% |
| 5000-14999 | 181 | 118 | 63 | 37 | 26.3% | 33.7% | 18.7% | 45.1% |
| 15000-24999 | 112 | 90 | 22 | 11 | 16.3% | 25.7% | 6.5% | 13.4% |
| 25000-49999 | 49 | 42 | 7 | 2 | 7.1% | 12.0% | 2.1% | 2.4% |
| Above 50000 | 11 | 10 | 1 | 0 | 1.6% | 2.9% | 0.3% | 0.0% |

**Table 2: Household Demographics and Socio-Economic Status**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes Slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Monthly Food Expenditure** | | | | | | | | |
| Refused/Don't know | 66 | 40 | 26 | 6 | 9.6% | 11.4% | 7.7% | 7.3% |
| <100 | 5 | 3 | 2 | 1 | 0.7% | 0.9% | 0.6% | 1.2% |
| 100-499 | 14 | 4 | 10 | 1 | 2.0% | 1.1% | 3.0% | 1.2% |
| 500-999 | 111 | 22 | 89 | 8 | 16.2% | 6.3% | 26.4% | 9.8% |
| 1000-4999 | 373 | 183 | 190 | 51 | 54.3% | 52.3% | 56.4% | 62.2% |
| 5000-9999 | 106 | 86 | 20 | 14 | 15.4% | 24.6% | 5.9% | 17.1% |
| Above 10000 | 12 | 12 | 0 | 1 | 1.7% | 3.4% | 0.0% | 1.2% |

In response to the question on monthly food expenditure in the family, more than half of the respondents in our sample (54.29%) reported spending in the range, INR 1000-4999. This range emerges as the most observed category in the urban, rural and slum sub-samples as well. Besides, in the urban area, about 24.57% of households fell in the INR 5000-9999 spending group while 37.69% of the rural respondents expressed spending less than INR 1000 on account of food.

In order to elicit information on respondents' health behavior pertaining to both malaria control and beyond, several questions in our questionnaire were framed on health-specific household aspects the results of which are presented in Table 3. 38.72% of respondents reported monthly health expenditures within the range, INR 100-499. The next highest proportion of respondents (25.91%) was observed in the INR 500-999 category, followed closely by 21.83 %, who reported spending less than INR 100 per month on health. In the rural and slum sub-samples, the majority of respondents incurred expenditures between INR 100-499, but, exclusively in the urban area, the next higher spending category, INR 500-999, was the most reported. When asked about any malaria incidences that respondents knew had directly occurred to their family members in the past 5 years, 20.09% in the sample reported positively. Data in the urban area had about 37.71% saying malaria had occurred to their family members in the 5-year recall period. In the urban slum pocket, 35.37% of the respondents reported having family members who had been malaria victims. In the rural area, in sharp contrast, in only about 1.78% of cases, family members of respondents had suffered from malaria.

In 48.47% of households interviewed, heads of households were reported as having sole control in health-related decision-making in the family. Close to about 30 % of respondents expressed the fact that they themselves made decisions on health. Approximately about 21 % of respondents in the sample reported that it was some other family member's decision (other than the head or respondent) or collective decision making that prevailed in their families in health matters. The predominance of heads of households as the sole decision makers in health emerged as being particularly strong (59.05%) in the rural areas. In the full sample, when respondents were asked about the usual treatment methods that their families usually sought during general illness (such as services from private doctors; government health practitioners; public/ private hospitals ; self-treatment; herbal ways of healing etc), more than 55% said that they usually sought private doctors' help. About 30% reported resorting to medical practitioners in government health centers, and about 12% said they took help from local medical shops to ask for suitable medicines at times of need.  Very few respondents (0.46%) reported using traditional methods at home for cure. The urban-rural sub-sample analyses yielded the fact that in contrast to comparatively a fewer number of respondents (15.76%) in the urban area who sought public health support for treatment, the majority in the rural area (49.12%) made use of government health centers when sick.

**Table 3: Health-Related Household Attributes**

| | FULL SAMPLE | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes Slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Monthly Health Expenditure** | | | | | | | | |
| <100 | 150 | 43 | 107 | 20 | 21.8% | 12.3% | 31.8% | 24.4% |
| 100-499 | 266 | 110 | 156 | 31 | 38.7% | 31.4% | 46.3% | 37.8% |
| 500-999 | 178 | 126 | 52 | 17 | 25.9% | 36.0% | 15.4% | 20.7% |
| ]1000-4999 | 42 | 38 | 4 | 4 | 6.1% | 10.9% | 1.2% | 4.9% |
| 5000-9999 | 3 | 3 | 0 | 0 | 0.4% | 0.9% | 0.0% | 0.0% |
| Refused/Don't Know | 48 | 30 | 18 | 10 | 7.0% | 8.6% | 5.3% | 12.2% |
| **Family Malaria Status** | | | | | | | | |
| Respondents having Relatives who suffered (Years 2006-2011) | 138 | 132 | 6 | 29 | 20.1% | 37.7% | 1.8% | 35.4% |
| **Health-related Decision Making** | | | | | | | | |
| Respondent | 205 | 133 | 72 | 36 | 29.8% | 38.0% | 21.4% | 43.9% |
| Head | 333 | 134 | 199 | 29 | 48.5% | 38.3% | 59.1% | 35.4% |
| Other/Joint decision making | 146 | 81 | 65 | 17 | 21.3% | 23.1% | 19.3% | 20.7% |
| Don't Know | 3 | 2 | 1 | 0 | 0.4% | 0.6% | 0.3% | 0.0% |
| **Treatment Modes (General Illness)** | | | | | | | | |
| Hometreat | 4 | 4 | 0 | 0 | 0.5% | 0.8% | 0.0% | 0.0% |
| Local medicine shop | 108 | 96 | 12 | 13 | 12.4% | 20.2% | 3.0% | 11.6% |
| Private Doctor | 487 | 301 | 186 | 59 | 55.8% | 63.2% | 46.9% | 52.7% |
| Government Doctor | 270 | 75 | 195 | 40 | 30.9% | 15.8% | 49.1% | 35.7% |

Our interest in health matters prompted the inclusion of several questions on the living conditions and hygiene in the dwellings respondents lived in. About 3.64% of households (25 out of 687) reported having no access to electricity, with most such households concentrated in the rural area. In the full sample, 65.5 % of respondents lived in *pucca* (completely dried-brick built) households, while 26.35% semi-*pucca* (half-dried) dwellings were observed. *Kutcha* households, built in raw clay/mud, accounted for about 8 % of the sample.

In the overall sample, the majority of households (47.31%) reported having no provision of running water in their lavatories. 44.25%, however, had running water access. In 1.75% of households (12 households in the sample), there was no arrangement of toilet altogether, with all of such deprived households falling in the rural area. In the urban area, most of the households (65.62%) had running water provision in toilets, but the slum pockets, when viewed separately, produced a larger share of families without such a provision. In the rural area most did not have a continuous water facility and about 11.24% of households reported having the retrograde style of toilet functioning.

51.23% of households in the sample had access to the water distribution provided by the Kolkata Municipal Corporation at different hours of the day. A little over 25% of respondents reported having continuous water supply at home. A whopping 23% expressed that they had to walk to distant areas to fetch good quality water for use at home. In the urban area most households had either the KMC water supply (52.28%) or had running water provision (47.42%). Within the urban area, almost all of the slum households (more than 90 %) had access to KMC piped water. In the rural area, a substantive proportion of respondents (45.1%) reported spending time and effort in collecting water from far-off places. The rural area also saw about 5 % houses with tube well facilities.

When asked where they generally stored drinking water, multiple storage devices were mentioned by respondents. Most households (about 82%) in the sample used plastic bottles for water storage. Similar patterns on plastic usage were observed in the urban (70.9%), rural (93.8%) and slum (74.4%) sub-samples as well. While in the full sample 30% of households had water filters/purifiers in use, in the urban area, 48.2 % had such systems in place. In the rural area and the urban slum pockets, 11.2% and 12.2 % respectively, had purchased such filtration systems.

## 4.4 Malaria History and Cost of Illness

In Table 4 details on respondents' past malaria incidences encompassing diagnosis, treatment, illness duration, expenditures etc. are presented. About 16.59% of respondents (114 out of a total of 687) in the sample had suffered from malaria in the 5 years preceding the date of the survey. Considering the exclusive sub-sample of these 114 malaria victims, it is found that 10.53% had suffered the disease in recent times (less than a year ago), 53.51% had had the disease between 1-2 years back and 31.58% were affected more than 2 years ago. Approximately 4 % of respondents could not remember the date of occurrence of the disease. The urban sub-sample depicted similar features as the full sample, but the slum area within the urban sample had most respondents as recent victims (25% suffered less than a year ago; 37.5% got the disease 1-2 years back). In the rural sub-sample, amongst the 3 victims (out of a total of 337 rural sampling units, i.e., 0.89%), only one respondent could remember the occurrence year more than two years back).

**Table 4: Respondents' Malaria History**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Year of Occurrence** | | | | | | | | |
| Cannot remember | 5 | 3 | 2 | 2 | 4.4% | 2.7% | 66.7% | 8.3% |
| More than 2 years ago | 36 | 35 | 1 | 7 | 31.6% | 31.5% | 33.3% | 29.2% |
| 1-2 years ago | 61 | 61 | 0 | 9 | 53.5% | 55.0% | 0.0% | 37.5% |
| less than a year ago | 12 | 12 | 0 | 6 | 10.5% | 10.8% | 0.0% | 25.0% |
| **Malignant Malaria** | | | | | | | | |
| Yes | 33 | 33 | 0 | 9 | 28.9% | 29.7% | 0.0% | 37.5% |
| **Duration of Sickness** | | | | | | | | |
| Cannot remember | 4 | 3 | 1 | 2 | 3.5% | 2.7% | 33.3% | 8.3% |
| Upto 10 days | 65 | 64 | 1 | 12 | 57.0% | 57.7% | 33.3% | 50.0% |
| Between 10 and 20 days | 33 | 33 | 0 | 8 | 28.9% | 29.7% | 0.0% | 33.3% |
| Between 20 and 30 days | 8 | 8 | 0 | 1 | 7.0% | 7.2% | 0.0% | 4.2% |
| Above 30 days | 4 | 3 | 1 | 1 | 3.5% | 2.7% | 33.3% | 4.2% |

### Table 4: Respondents' Malaria History

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Blood Test Diagnosis** | | | | | | | | |
| Blood test | 111 | 109 | 2 | 23 | 97.4% | 98.2% | 66.7% | 95.8% |
| **Treatment Mode** | | | | | | | | |
| Other means/cannot say | 3 | 2 | 1 | 1 | 2.6% | 1.8% | 33.3% | 4.2% |
| Govt doctor/ facility/hospital | 21 | 21 | 0 | 10 | 18.4% | 18.9% | 0.0% | 41.7% |
| Private doctor/ private nursing home/ facility | 90 | 88 | 2 | 13 | 78.9% | 79.3% | 66.7% | 54.2% |
| **Hospitalized** | | | | | | | | |
| Yes | 12 | 12 | 0 | 6 | 10.5% | 10.8% | 0.0% | 25.0% |
| **Cost of Illness (in INR)** | | | | | | | | |
| Cannot say/ Forgotten | 17 | 16 | 1 | 5 | 14.9% | 14.4% | 33.3% | 20.8% |
| Less than 100 | 6 | 6 | 0 | 1 | 5.3% | 5.4% | 0.0% | 4.2% |
| Between 100 and 500 | 18 | 18 | 0 | 5 | 15.8% | 16.2% | 0.0% | 20.8% |
| Between 500 and 2000 | 59 | 58 | 1 | 12 | 51.8% | 52.3% | 33.3% | 50.0% |
| Between 2000 and 5000 | 12 | 12 | 0 | 1 | 10.5% | 10.8% | 0.0% | 4.2% |
| Above 5000 | 2 | 1 | 1 | | 1.8% | 0.9% | 33.3% | 0.0% |

In the full sample, almost all of the respondents (97.37%), who reported getting malaria in the past, claimed that they had been diagnosed by blood tests. Even in the urban, slum and rural sub-samples, blood tests comprised the diagnosis method that was most found. Considering the full sample, in about 28.95% of respondents, who had suffered from the disease, malaria took the malignant form while for 67.54% the disease was non-malignant.3.51% could not distinguish between malignancy and non-malignancy and, hence, refrained from answering. The urban area, its constituent slum pockets, and the rural area also had majority of respondents not suffering malignancy. In the sample (considering all of the regions: urban, rural and slum), about 18.42 % of respondents, once affected, had been treated in a government facility (in a hospital or by a private doctor). A whopping 78.95% took to private treatment facilities such as private medical practitioners, private nursing homes or hospitals. A similar pattern emerged in the urban and rural sub-samples as well. But, in the urban slum pockets a substantive proportion of malaria victims (41.67%) had been treated by government health practitioners.

In response to the question on hospitalization, about 10.53% of respondent-victims in the sample reported being hospitalized for malaria treatment. In the remaining 89.57% of cases, victims were treated at home. The urban and rural areas showed similar patterns in data. But, the slum sub-sample had about 25% hospitalization cases, well above the respective full-sample figure. The costs of illness pertaining to past malaria occurrences of the respondents were also recorded in the survey. Most respondents in the sample (51.75%) incurred between INR 500-2000 on account of their sickness. 15.79% had spent within the range INR100-500 and 10.53 % reported spending between INR 2000-5000). It was found that 1.35 % (only 2 respondents out of a total of 687) had spent very high amounts (above INR 5000), and about 5 % reported very low spending (less than INR 100). 14.91% could not recall the expenditure and hence did not answer. The urban sub-sample analysis produced similar features with about 52.25% respondent-victims falling in the INR 500- 2000 category. With only 3 malaria cases (out of a total of 337) in the rural area, the sub-sample analysis is not explained in detail here, but is nevertheless provided in Table 4.

More than half of the past malaria victims reported a sickness duration not exceeding 10 days. 28.95% were ill for 10-20 days and about 10% went through the sickness for more than 20 days. The full sample exercise along with the sub-sample analyses made clear that the majority had suffered for about 10 days or so. On account of their sickness, respondents (both employed and unemployed) were asked if they had missed work, and if so, about the approximate duration for which their productivity loss had prevailed. A large majority of respondent-victims in the sample (86.84%) stated that the sickness had indeed taken a toll on their work. With regard to the duration of their productivity loss, 43.86 % of 687 respondents in the overall sample reported uneasiness for about a week or so, and 42.11 % stated being physically weak for more than 7 days, but not exceeding one month. Considering the urban area in isolation, almost identical data features were identified.

When asked about medications taken during the treatment period, in the whole sample, only about 6% of respondents could recall any medicines. The rest either could not remember or said they did not know.

### 4.5 Actual Prevention Methods and Disease-related Awareness

Our interest in the CVM methodology notwithstanding, data was also collected on the revealed preferences of individuals on account of malaria control, which provide interesting dimensions for the valuation analyses of Chapter 6. Responses on actual prevention methods covering a plethora of options like bed nets, mosquito coils, repellant oils, sprays etc. were recorded and are, hence, presented in this sub-section along with information on respondents' knowledge and awareness perceptions on malaria.

When asked about the prevention modes they commonly engaged in, respondents mentioned multiple strategies citing three options in particular: tying bed nets, burning mosquito repelling coils and/or using electric-operated repellant diffusers. For the purpose of classifying households according to different *levels* of prevention across these three strategies, a prevention/preventive index is constructed. The methodology adopted in the index construction is as follows: First, information on the frequency of use (e.g., daily, not so regularly, season wise etc.) of each of the above three preventive options is noted and only regular usage (code 1) is considered as valid. In the next step, it is found out if across all three options (nets, coils, electric diffusers), regular usage (i.e., code 1) is observed. Then, adding across the three options, an index on a scale of 0-3 is made for each household who reported using none/one/two/ all of the options. Households are then clubbed under rungs 1 through 3 to indicate the levels of prevention they adopt. For instance, families tagged with the number “1” adopt one of these three prevention strategies, while those marked as “2” adopt any two of the same. Likewise, the ones with the tag “3” adopt all three options and hence, take the utmost prevention. The distribution of households over the different rungs of the index is presented in Table 5. Note here that the few households observed in rung “0” do not take regular prevention on any of these options.

Once the index constructed, data on perceived malaria risk (elicited on our visual risk-elicitation scale of 0-10) and education are juxtaposed on the household classification which reveals two interesting dimensions to the prevention index: (i) Households with greater levels of risk perception take higher levels of prevention; and (ii) The more educated individuals are, they are more akin to taking greater prevention.

**Table 5: Preventive Index**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | URBAN | RURAL | Mean Risk Perception | Respondent Education |
|---|---|---|---|---|---|---|---|
| **Preventive Index** | | | | | | | |
| 0 | 26 | 23 | 3 | 6.6% | 0.9% | 4.6 | 4.0 |
| 1 | 331 | 156 | 175 | 44.6% | 51.9% | 4.6 | 4.0 |
| 2 | 260 | 110 | 150 | 31.4% | 44.5% | 5.1 | 5.0 |
| 3 | 70 | 61 | 9 | 17.4% | 2.7% | 6.2 | 7.0 |

For further insights on how households span over the three main preventive strategies, e.g., nets, coils and diffusers, a further analysis of the preventive index shows that bed nets were reported in most homes (70 %), followed by electric diffusers (51%) and repellant coils (33 %). Amongst the ones who used mosquito nets, 40 % relied only on such nets whereas 45 % used them in tandem with either a repellant coil or a diffuser. 14 % of the respondents were found to use all three measures of protection.

Mosquito nets being the most reported some additional information on their use may be discussed to get an idea on prevention habits of households. On account of bed nets most respondents, especially in the urban area, could not remember the one-time expenditure they had incurred for the nets, but about 28 % in the full sample reported spending between INR 200-300 and 21% roughly made INR 100-200 expenditures. In the full sample, 97% of households reporting nets as a protection measure said all family members used such nets. These apart, given that children are  particularly vulnerable to malaria, respondents who reported bed net usage and had children in their households, were, further asked if the children at home used bed nets regularly.  96% of families with children and familiar with bed nets, claimed that children too used them. Likewise, the urban, rural and slum areas also saw the majority of homes using bed nets for their children's health protection.

To elicit respondents' perception on the relative effectiveness of different prevention modes they made use of, a question was framed asking respondents to name the prevention strategy they thought to be most powerful in prevention. 50.8% of respondents in the sample felt mosquito nets were the most effective, while a substantive 28.38% answered in favor of mosquito repellant electric diffusers. Alongside, 16.59% expressed that repellant coils were the best and about 2 % named other modes (e.g., burning leaves, using hand-fans etc). In the urban area, the majority of respondents (46.29%) perceived electric diffusers as being the most effective while 23.43% felt it was bed nets that kept away mosquitoes best. In the rural area, a huge number of respondents felt positively toward bed nets (79.23%).

On the question of how they perceived the disease to be occurring, respondents expressed their thoughts on the possible causes (to explore the depth of awareness on the issue, the survey design deliberately did not involve giving respondents options to choose from). Having found multiple responses from each respondent, a frequency distribution across the correct and wrong causes was constructed. Most respondents (74.4%) in the sample identified the correct cause, viz. mosquito bites, as one of the reasons behind malaria occurrence. About 7 % in the full sample identified the wrong cause, viz. polluted water, and likewise approximately 10.05% felt wrongly that unclean environment was one of the causes. In the urban, rural and slum sub-groups, the frequency distribution of respondents over the wrong causes follow quite a similar pattern as found in the full sample.

Respondents were also asked about reasons why mosquitoes might increase in number. More than half the sample (54.16%) correctly identified stagnant water to be one such factor. About 1.32% thought that it was the general rise in temperature that caused a spurt in mosquitoes. Besides, 3.75% correctly said that irrigation water might also be a reason. But, given that respondents were asked to identify as many factors they thought to be applicable, 36 % of the sample identified the wrong cause by saying that pollution caused mosquitogenic conditions to worsen.

### 4.6 Risk-Perception Levels and Willingness to Buy/Adopt Prevention Strategies

Perceived levels of malaria risk when elicited on a 0-10 scale in our visual risk device show a considerable amount of variation as shown in Table 6. The mean risk level is found to be 4.96. In the sample, about 39 % of respondents estimated their annual risks of getting the disease between levels 1 and 4 on the scale. Besides, 14% chose level 5. A whopping 37.3% opted for risks between 6 and 8 and about 8% thought they had very large risks (above level 8). On digging deeper, we find that a total of 24 respondents out of 687 (3.49%) thought the disease was inevitable while 3 individuals (0.44 %) did not perceive any risk at all. In the urban area, about 43.14% chose risk levels between 6 and 8 while in the rural area, about 31 % did so. Also, 9.43% among the urban respondents felt that they had high risks of contracting the disease (above level 8 on the scale) as against approximately 8 % such respondents in the rural area.

Responses to willingness to pay questions across the public and private treatments in the full sample and sub-samples are summarized in Table 6. Considering all risk changes and costs, respondents in the private treatment who expressed willingness to purchase the new mosquito repelling cream comprised 64.18% , while 70.71% in the public treatment opted for the government-administered prevention strategy. In the urban, rural and slum sub-samples, the proportions of people saying "Yes" to a private program were 62.6%, 65. 9% and 55.6% respectively. Likewise for the public treatment, 70.7%, 64 % and 78.3 % of the relevant sample sizes opted for the public program in the urban, rural and slum sub-groups respectively. Table 6 shows respondents' willingness to opt for malaria prevention across the two risk changes (50% and 90%), aggregating over all costs and private/public treatments. In the urban and slum sub-groups, respondents were more likely to say that they would adopt a prevention strategy that offered larger as compared to lesser risk changes.

**Table 6: Malaria Risk Level and CVM Responses**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes Slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Malaria Risk Level** | | | | | | | | |
| 0 | 3 | 3 | 0 | 1 | 0.4% | 0.9% | 0.0% | 1.2% |
| 1 to 4 | 270 | 114 | 156 | 34 | 39.3% | 32.6% | 46.3% | 41.5% |
| 5 | 98 | 49 | 49 | 9 | 14.3% | 14.0% | 14.5% | 11.0% |
| 6 to 8 | 256 | 151 | 105 | 28 | 37.3% | 43.1% | 31.2% | 34.1% |
| Above 8 | 60 | 33 | 27 | 10 | 8.7% | 9.4% | 8.0% | 12.2% |
| **CVM (50% Risk Reduction)** | | | | | | | | |
| No | 108 | 54 | 54 | 18 | 32.6% | 32.5% | 32.7% | 40.0% |
| Yes | 223 | 112 | 111 | 27 | 67.4% | 67.5% | 67.3% | 60.0% |
| **CVM (90% Risk Reduction )** | | | | | | | | |
| No | 116 | 52 | 64 | 10 | 32.6% | 28.3% | 37.2% | 27.0% |
| Yes | 240 | 132 | 108 | 27 | 67.4% | 79.5% | 65.5% | 73.0% |

**Table 6: Malaria Risk Level and CVM Responses**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes Slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **CVM (Private Treatment)** | | | | | | | | |
| No | 125 | 67 | 58 | 20 | 35.8% | 37.4% | 34.1% | 44.4% |
| Yes | 224 | 112 | 112 | 25 | 64.2% | 62.6% | 65.9% | 55.6% |
| **CVM (Public Treatment)** | | | | | | | | |
| No | 99 | 39 | 60 | 8 | 29.3% | 22.8% | 35.9% | 21.6% |
| Yes | 239 | 132 | 107 | 29 | 70.7% | 77.2% | 64.1% | 78.4% |

But, viewed overall, in the full sample, respondents did not quite react positively to larger risk changes. The associated issue on the variation of purchase decisions with respect to risk changes necessitates considering absolute risk changes in the estimation procedures which is duly taken up in Chapter 6.

## 4.7 Community Characteristics and Perception on Neighborhood Living Conditions

With a view to knowing respondents' perceptions on the surrounding living conditions, responses were elicited on a series of questions on community characteristics and on the threats of malaria in the neighborhood (See Table 7 for an analysis of responses on the same). But before such neighborhood features were discussed, respondents' familiarity with the local areas was elicited by asking about the duration of their stay in the areas they lived in. It was found that about 32.61 % of respondents in the sample were familiar with the local communities for a really long time (26-50 years) and a little over 7 % had been staying for more than 50 years. Most of the people (48.47%), however, reported they had been in the areas dating back to 6-25 years.

When asked about the mosquito problem in the area, half of the respondents in the full sample felt that mosquito density in the local community was either high or very high, while a large proportion (34.79 %) perceived the density issue to be medium. About 13.68% reported that the problem was low/very low. There were about 9 respondents (1.31 %) who felt that mosquitoes were not an issue at all. The full sample patterns were more or less observed in the sub-samples as well and hence, are not illustrated in detail. Since stagnant water is a crucial inducing factor in mosquito breeding, respondents were asked if water logging was a conspicuous issue they perceived while staying in the community. A whopping 57.5% reported in the affirmative.

**Table 7: Community Characteristics**

| | FULL SAMPLE (n=687) | URBAN (n=350) | RURAL (n=337) | SLUM (n=82) | FULL SAMPLE | URBAN (includes Slum) | RURAL | SLUM |
|---|---|---|---|---|---|---|---|---|
| **Density of Mosquitos the area** | | | | | | | | |
| No threat | 9 | 9 | 0 | 1 | 1.3% | 2.6% | 0.0% | 1.2% |
| Very high or high | 344 | 167 | 177 | 41 | 50.1% | 47.7% | 52.5% | 50.0% |
| Medium | 239 | 130 | 109 | 32 | 34.8% | 37.1% | 32.3% | 39.0% |
| Low/very low | 94 | 43 | 51 | 7 | 13.7% | 12.3% | 15.1% | 8.5% |
| Cannot say | 1 | 1 | 0 | 1 | 0.1% | 0.3% | 0.0% | 1.2% |
| **Water Logging Problem in Community** | | | | | | | | |
| Yes | 395 | 156 | 239 | 33 | 57.5% | 44.6% | 70.9% | 40.2% |
| **Water Body in Vicinity** | | | | | | | | |
| Yes | 307 | 32 | 275 | 3 | 44.7% | 9.1% | 81.6% | 3.7% |
| **Govt. Spraying Program in Locality** | | | | | | | | |
| Don't know/cannot remember | 22 | 17 | 5 | 0 | 3.2% | 4.9% | 1.5% | 0.0% |
| No | 373 | 42 | 331 | 7 | 54.3% | 12.0% | 98.2% | 8.5% |
| Yes | 292 | 291 | 1 | 75 | 42.5% | 83.1% | 0.3% | 91.5% |
| **Govt. Action Last Seen** | | | | | | | | |
| Cannot remember/ Cannot say | 4 | 4 | 0 | 0 | 1.4% | 1.4% | 0.0% | 0.0% |
| Less than one month ago | 179 | 179 | 0 | 56 | 61.3% | 61.5% | 0.0% | 74.7% |
| 1-6 months back | 103 | 103 | 0 | 19 | 35.3% | 35.4% | 0.0% | 25.3% |
| 1 year ago or more | 6 | 5 | 1 | 0 | 2.1% | 1.7% | 100.0% | 0.0% |

On the question of government-administered malaria control spraying programs, 42.5% of individuals surveyed felt that such actions were regularly taken in their communities. In the urban sub-sample where the disease was relatively more prevalent, almost all of the respondents (83.14 %) said they saw such actions being taken. In contrast, barring 7 respondents out of 337 in the rural area, all of the respondents felt that such actions were not seen. Recalling that the rural area saw very little prevalence in the past 5 years, these observations on the absence of public malaria control activities in the rural regions seem sensible, in keeping with the reality.

To the respondents who responded in the positive that public malaria control was present in their local areas, a further clarifying question was asked on when such actions were seen last. In the full sample, of the 292 people who saw actions were taken, about 61.3 % reported seeing public malaria control programs very recently (less than a month ago) while a little over 35% remembered seeing such actions between 1-6 months. Only about 2.05% felt they saw such programs long ago (1 year back or even earlier). To keep mosquitoes in check, swamps and ponds need be regularly cleaned. Thus, on the question if their neighborhoods had water bodies present in proximity, 44.69% in the sample responded "Yes". In the urban area while there were only about 9 % respondents saying so, in the rural regions most households (81.6%) reported having water bodies close by.

On questions of general cleanliness, most respondents (approx. 71 %) in the sample felt that their neighborhoods were clean. Similar patterns were found in the sub-sample analyses as well. With regard to garbage disposal arrangements in the community, almost half of the sample (about 49.2%) reported throwing away everyday household garbage in local ponds, drains , open fields , with almost all such households (334) falling in the rural area. The next most reported disposal mechanism (41.5%) comprised using the regular dumpsters maintained by the local civic bodies. In the urban area about 81.1% of respondents reported disposing in such dumpsters.

When asked to name the disease that worried them the most while living in the communities they lived, about half the sample (50.6%) reported perceiving malaria as most dreadful. In the urban area about 265 respondents (out of 350; i.e., about 75.7%) felt so while in the rural area a comparatively lesser proportion of such responses were observed (24.63% out of a total of 337 households). In order to elicit respondents' attitudes towards informal exchange of health-related information with their community-members, about 64.19% of responses in the full sample stated that such households indeed shared health aspects (disease incidences in the family etc) with their neighbors. In the urban area, while a little over half the sample (54.3 %) felt they exchanged health information, in the urban slum pockets and the rural area, substantive community-level social interactions are observed, as evident from the whopping proportions (91.5% in slum and 74.5% in urban).

Thus, a detailed illustration on the sample characteristics, given above, offer the backdrop against which health issues particularly in the context of malaria are analyzed (See Chapter 6 for the CVM results). What largely emerges from the descriptive statistics is that people in the survey area were adequately aware of malaria; adopted prevention on a regular basis; and some had even been victims in the past. All of these make the valuation question explored in Chapter 6 even more interesting and lend the CVM responses more credibility.

# CHAPTER 5:EMPIRICAL METHODS AND ECONOMETRIC SPECIFICATION

## 5.1 Introduction

In this chapter, willingness-to-pay functions in two contexts are specified econometrically to help build an empirical framework consistent with the theoretical expressions illustrated in equations (14) and (18) of Chapter 2. The two contexts are defined as one, (i) where a public health malaria control policy generates both private and community-level health benefits and the other (ii) where a private good generates private benefits only. Thus, in the former, an individual is informed about a new (but hypothetical) community-wide governmental program of vector control. In the latter, a hypothetical mosquito-repelling lotion, treated as a new private preventive good, is offered. In keeping with model specification in Chapter 2, where each preventive measure has been shown to be associated with different dimensions to benefits - private and public - the empirical exercise attempts to place a value on the associated reductions in the health risks that these two hypothetical contexts bring forth. In the process, the externality aspects of malaria control (and hence, social preferences) can also be indirectly explored.

## 5.2 Empirical Methods: The "Community-Level Health Intervention" Treatment

Recall the theoretical specification of equation (14) in Chapter 2, Section 2.3.1:

$\frac{\partial WTP}{\partial g} = \left[\frac{\frac{\partial U(.)\partial r^S}{\partial R^S\ \partial g}}{\lambda^*}\right] + \left[\frac{\frac{\partial U(.)\partial r^C}{\partial R^C\ \partial g}}{\lambda^*}\right]$, where $\frac{\partial WTP}{\partial g}$ is interpreted as the change in the WTP to pay for an additional unit of provision of the governmental malaria control efforts $g$. The RHS comprises two parts: the monetized marginal utility of the private dimensions to health risk reductions that a unit of $g$ brings in, and that associated with the community dimension to health risk reductions which $g$ further achieves. In this regard, note that $\frac{\partial r^S}{\partial g}$ and $\frac{\partial r^C}{\partial g}$ denote the marginal effectiveness of public efforts, in reducing private risks, $R^S$ , and community risks, $R^C$ , respectively.

Instead of making assumptions about the relationship between $r^S$ (or $r^C$) and $g$ (and hence, about their marginal products), the empirical specification of the above equation is made operational (keeping in mind the survey protocol) via a direct reduction in the amount of risks itself. Thus, the marginal products can be substituted by the changes in risk themselves: $\frac{\partial WTP}{\partial g} = \left[\frac{\frac{\partial U(.)}{\partial R^S} dR^S}{\lambda^*}\right] + \left[\frac{\frac{\partial U(.)}{\partial R^C} dR^C}{\lambda^*}\right]$. Further, the risk changes are offered in percentage terms[46] so that, in essence, an individual pays for the percentage reduction in health-risks, which is 'achieved' or 'brought about' via $g$ at a certain stated cost. In order to facilitate treatment of risk changes in terms of percentages, in our empirical framework, we do the necessary algebraic manipulations as follows:

$$\frac{\partial WTP}{\partial g} = \left[\frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*}\right] \frac{dR^S}{R^S} + \left[\frac{\frac{\partial U(.)}{\partial R^C}.R^C}{\lambda^*}\right] \frac{dR^C}{R^C} \tag{19}$$

Equation (19) can be interpreted as the value of the public efforts, $g$, comprising : $\left[\frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*}\right]$, i.e., the valuation of proportionate changes (reductions) in private risks, $\frac{dR^S}{R^S}$ ; and

[46] This procedure is akin to the welfare analysis in Dickie and Gerking (2007). Dealing with perceptions on skin cancer risks, in their valuation exercise, the authors use percentage changes in risks to facilitate simplified econometric tests and analysis.

$\left[\frac{\frac{\partial U(.)}{\partial R^C}.R^C}{\lambda^*}\right]$, the valuation of proportionate community risk changes, $\frac{dR^C}{R^C}$. At this juncture, it needs to be mentioned that the field survey is so designed that percentage risk reductions are communicated to be the *same* for the decision-maker and her community. More simply put, in the field, respondents were let known about the hypothetical possibility under which a new vector-control program, $g$ , reduces malaria risk by a certain percentage for the entire community where the respondent lives (thus, benefiting the individual in question and fellow community-members as well). This is to say that $\frac{dR^S}{R^S} = \frac{dR^C}{R^C} = \frac{dR}{R}$ [47]. Equation (19) can now be expressed as follows:

$$\frac{\partial WTP}{\partial g} = \left[\frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*} + \frac{\frac{\partial U(.)}{\partial R^C}.R^C}{\lambda^*}\right]\frac{dR}{R}\ . \qquad (19.1)$$

The econometric specification of equation (19.1) is given as

$$MWTP^g = \gamma_0 + \gamma_1(risk\_r) + \gamma_2(controls) + \epsilon^g, \qquad (20)$$

where $MWTP^g$ is the marginal willingness to pay for the public malaria control efforts, $g$, and the variable $risk\_r$ denotes the percentage reduction in risks brought about by $g$; $controls$

[47] Note that although $R^S$ and $R^C$ are modeled separately in our model, the empirical procedure involves reduction of the two risk concepts to a single dimension of risk, namely malaria risk. This is particularly prompted by two reasons. Firstly, the focus in our theoretical and empirical analysis lies clearly on the way benefits accrue as a result of a malaria-prevention strategy and not on the risk-perception levels per se. In accordance with this, in our survey design , the nature in which benefits accrue (i.e. if the associated health risk reductions have a private or community dimension), are clearly communicated to the respondents through a suitable CVM question across the two treatments. In both the treatments, we elicit perceived private risks $R^S$ on a risk-scale. But the differential framing of the two contexts of health interventions allows for investigating the manner in which people respond to different contexts, namely private and public. Secondly, our methodology of restricting ourselves to elicitation of $R^S$ only (and not $R^C$ separately) is motivated by the existing literature on risk elicitation, across a variety of diseases, where risk-questions have been variously framed in both first-person(e.g. Dickie and Gerking, 2007, in the context of skin cancer risks ; Mahmud, 2005, on general mortality risks , etc.) and third-person formats (e.g. Viscusi, 1990, on lung-cancer risks) without any stated differences of these formats on the derived risk-levels. This makes us contemplate that $R^S$ and $R^C$ , even if elicited separately from an individual may be quite close empirically, if not synonymous. For our purpose, we stick to the first-person format and hence, elicit $R^S$. Even though the risk levels may quite be the same, our model and hence the empirical plan expect that, conveying the different ways benefits of a health intervention ensue (i.e., if the CVM instrument influences $R^S$ / $R^C$) will have a different bearing on individuals' attitudes towards a particular health intervention.

capture the individual and community-specific characteristics that affect the $MWTP^g$ , such as income, education, age, location of the household, household size etc; and $\epsilon^g$ is the random disturbance term representing the unobserved characteristics of the individual. The coefficient $\gamma_1$captures the WTP for a percentage reduction in malaria risk, where $\gamma_1 = \frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*} + \frac{\frac{\partial U(.)}{\partial R^C}.R^C}{\lambda^*}$. However, at the moment, we do not obtain separate estimates for the valuation of reductions of health risks that accrue to the decision-maker (i.e, $\frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*}$) and to her community ($\frac{\frac{\partial U(.)}{\partial R^C}.R^C}{\lambda^*}$), from the community-level malaria control intervention generating both private and social benefits. In order to examine if such private and public valuations differ, we, thus, need to implement a second treatment, namely, the "private-level health intervention treatment" on a set of individuals. In the latter, an individual is offered risk reductions (in percentage terms) for private risks, $R^S$, only, through the offer of purchasing a new malaria-preventing good, namely a lotion, illustrated in Section 5.3.

### 5.3 Empirical Methods: The "Private-Level Health Intervention" Treatment

In this section, we briefly lay out the empirical specification of the willingness-to-pay function for a new malaria-preventing product, $L$, pertaining to individuals who are randomly assigned to the "private-level health intervention" treatment in our field survey. The illustration is akin to the empirical methodology given in Section 5.2.

Recall the theoretical specification given in equation (18), i.e., $\frac{\partial Z}{\partial L} = \left[\frac{\frac{\partial U(.)\partial r^S}{\partial R^S\ \partial L}}{\lambda^*}\right]$. Similar to the methodology in Section 5.2 risk changes are offered in percentage terms so that, in essence, an individual pays for the percentage reduction in health-risks, which is 'achieved' or 'brought about' via $L$ at a certain stated price. To bring in percentage forms of risk reductions in our specification, we do the following:

$$\frac{\partial Z}{\partial L} = \left[\frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*}\right]\frac{dR^S}{R^S} \tag{21}$$

Equation (21) can be interpreted as the value of the new private preventive good, $L$ . The RHS, i.e., $\left[\frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*}\right]$ stands for the valuation of the proportionate changes (reductions) in private risks, $\frac{dR^S}{R^S}$, that $L$ brings forth. The econometric specification of equation (21) is given as:

$$MWTP^L = \gamma'_0 + \gamma'_1(risk\_r) + \gamma'_2(controls) + \epsilon^L , \tag{22}$$

where $MWTP^L$ is the marginal willingness to pay for $L$ and the variable *risk_r* denotes the percentage reductions in malaria risks brought about by $L$ ; *controls* capture the individual and community-specific characteristics that affect the $MWTP^L$ , such as income, education, age, location of the household, household size etc; and $\epsilon^L$ is the random disturbance term representing the unobserved characteristics of the individual. The coefficient $\gamma'_1$captures the WTP for a percentage reduction in private malaria risks [i.e., $\frac{\frac{\partial U(.)}{\partial R^S}.R^S}{\lambda^*}$].

Note that the elements in the coefficient $\gamma'_1$ are the same as the first additive component in equation (19.1), in the "public health intervention" treatment. This facilitates a comparison of the valuation results across the two treatments. Below a discussion is presented on such a comparative exercise and its associated implications.

## 5.4 A Comparison of the Valuations of the Health-Related Benefits across Treatments

We use results from the two treatments to attempt for the valuations of different preventive strategies that may be implemented to combat malaria. Additionally, note that we would like to compare the estimates of the structural parameters (gammas) across equations (20) and (22). The inclusion of $controls$ ensures that differences (if any) in the estimates of the gammas are attributed to the difference in the nature and modes of delivery of the prevention technologies only, that we offer across our treatments. Further, a random assignment of risk reductions across respondents renders the variable $risk\_r$ orthogonal to both the observed and unobserved characteristics of the respondents.

### 5.4.1 Probit Estimation

In the "community-level health intervention" treatment of our survey, each individual's decision to make a stated financial contribution for the provision of $g$ are recorded. For the purpose, a Probit equation is specified as follows:

$$Prob(\,Yes) = Prob(\,MWTP^{g} \; > t), \tag{23}$$

where t = the stated tax amount randomly assigned to the respondent. Using equations (20) and (23) we get,

$$Prob(\,Yes) = Prob[\,\gamma_0 + \gamma_1(risk\_r) + \gamma_2(controls) + \epsilon^{g} > t] \tag{24}$$

Or, $Prob(\,Yes) = Prob[\,\epsilon^g > t - \gamma_0\, - \gamma_1(risk\_r) - \,\gamma_2(controls)]$ (25)

Assuming $\epsilon^g$ follows a normal distribution with mean 0 and variance $\sigma_g^2$, the symmetry of the distribution allows us to write equation (26) as follows:

$$Prob(\,Yes) = Prob[\,\frac{\epsilon^g}{\sigma^g} < \frac{\gamma_0}{\sigma^g} + \frac{\gamma_1}{\sigma^g}(risk\_r) + \,\frac{\gamma_2}{\sigma^g}(controls) - \frac{t}{\sigma^g}] \qquad (26)$$

Using Maximum Likelihood estimation methodology, the coefficients in equation (26) can be estimated consistently and efficiently. Note that in Probit estimation, the coefficient of $t$ is $\frac{-1}{\sigma^g}$ where $\sigma^g$ is the variance of the error term. Thus, using Cameron (1988) we can recover the estimate of $\sigma^g$ from the estimated coefficient of $t$ and hence get unstandardized estimates of $\gamma_0, \gamma_1$ and $\gamma_2$. The same estimation methodology is used to obtain parameter estimates for the "private-level health intervention" treatment. Thus,

$$Prob(\,Yes) = Prob[\,\frac{\epsilon^L}{\sigma^L} < \frac{\gamma_0^{'}}{\sigma^L} + \frac{\gamma_1^{'}}{\sigma^L}(risk\_r) + \,\frac{\gamma_2^{'}}{\sigma^L}(controls) - \frac{t'}{\sigma^L}]\,, \qquad (27)$$

where $t'$ stands for the stated price of the preventive product that is offered to respondents, randomly assigned to the "private" treatment.

Once Probit estimates are obtained, a likelihood ratio test facilitates the comparison of the coefficients, $\gamma_1$ and $\gamma_1^{'}$ whereby we are able to restrict only the structural coefficients, while allowing for the unobserved heterogeneity across the two equations to vary.

### 5.4.2 A Likelihood Ratio (LR) Test

A comparison between the coefficients corresponding to the variable $risk\_r$ across the two probit equations (26) and (27) can be accomplished by testing the null hypothesis $H_0\colon \gamma_1' = \gamma_1$.

Note that the restriction is placed only on the structural parameters corresponding to the variable $risk\_r$ while the variances of the error terms are allowed to vary. Merely comparing the corresponding estimated probit coefficients would imply making restrictive assumptions regarding the variances of the error terms. The calculation of the restricted and unrestricted likelihoods, as laid out below, shows how the hypothesis test can be carried out.

For the LR test, we assume that $\delta_i$=1, if the respondent is offered the private preventive product; 0 otherwise. In addition, for the purpose of the LR test, $\Phi_{pub}$ [48] and $\Phi_{pvt}$ [49] are given as follows:

$\Phi_{pvt} = \Phi\left\{\frac{1}{\sigma^L}(\gamma_0^{'} + \gamma_1^{'}.risk\_r + \gamma_2^{'}.controls - t'\right\}$ and

$\Phi_{pub} = \Phi\left\{\frac{1}{\sigma^g}(\gamma_0 + \ \gamma_1 risk\_r + \gamma_2.controls - t\right\}$.

The restricted log-likelihood is given as:

$$Log\ LL_R = \sum_{i=1}^{n}\left[\delta_i \log\left(\Phi_{pvt}\right) + (1-\delta_i)\log\left(\Phi_{pub}\right)\right]$$

The unrestricted log-likelihood is written in a similar manner but without with the restriction,

$\gamma_1' = \gamma_1$ : $Log\ LL_U = \delta_i \sum_{i=1}^{n}\left[\log\left(\Phi_{pvt}\right)\right] + (1-\delta_i)\sum_{i=1}^{n}\left[\log\left(\Phi_{pub}\right)\right]$

Following the LR test, the difference between the two likelihoods follows a chi-square distribution with 1 degree of freedom:

$\chi^2 = 2[\log LL_R - \log LL_u] \backsim \chi_1^2$

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[48] The subscript "$pub$" refers to the community-level treatment.

[49] The subscript "$pvt$" refers to the private-level treatment.

A non-rejection of the test would imply that the null hypothesis is valid. This, in turn, would imply that the willingness-to-pay to reduce malaria risks by a given percentage is the same whether it is achieved through a risk control intervention of a private nature or through a community-wide vector control program. Also, given the nature of the community-level risk control program, which benefits all individuals in the community including the decision-maker (i.e., the respondent) herself, a non-rejection of the above hypothesis can also be interpreted as the individual not having other-regarding preferences in terms of the malaria risks facing her community. This would imply that the individual cares only about the private aspect of the malaria risks and values either health interventions in a similar manner.

### 5.4.3 An Attempt to Explore the Public Good Dimension to Malaria Control: A Note

Even as the private prevention spillovers are suppressed in our analysis, the above empirical design illustrates that the public good dimension to malaria control can be indirectly tested for in the framework. This is possible because both in the theoretical and empirical models, benefits ensuing from a publicly administered malaria control program accrue to the community at large (including the decision-maker), while those from the private preventive strategies are essentially private. Given such an overlap of private and public dimensions to risks, a between-subject survey design is alluded to (as in Arana and Leon, 2002). This facilitates examining if social preferences at all exist.

A caveat deems mention though. Given the infectiousness of malaria, our primary focus lies on malaria-related social-preferences towards the community only. Nevertheless, in the context of malaria control, intra-household decision-making on prevention and associated externalities may assume equal importance as well. This dimension, not explored here, indicates a potential limitation of the present approach. Despite a between-subject design, it may be econometrically hard to argue that the WTP for overall community-level risk reductions (in the public health intervention treatment) does not contain any element of consideration for the health of the other family members of the respondents. However, econometrically, this issue may be somewhat resolved by considering , in the set of controls, a host of household-specific characteristics (like the household size, presence of child in the household, age of the respondent etc) while estimating the WTP equation. We argue that although potentially related to the error term, inclusion of such variables makes the coefficient of $risk\_r$ uncontaminated from the influence of household features, particularly since percentage risk-reductions are randomly dropped. Hence, the WTP estimate derived from the $risk\_r$ coefficient would indicate the valuation of community-level risk reductions only (in the public health intervention treatment), free of intra-household considerations.

#### 5.4.4 Auxiliary Hypotheses

Apart from the primary hypothesis given above, the empirical procedures include several subsidiary exercises:

(i) <u>Splitting the Sample according to Degrees of Revealed Prevention Behavior and Exploring Valuations:</u> In addition to the CVM component in the survey protocol, questions on actual expenditures on avoiding mosquito-exposure are included. This provides an opportunity to divide the sample into different degrees of prevention behavior (by constructing an index) and compare the relative valuations of the private and public health interventions across different groups of respondents who reveal different attitudes towards *actual* disease prevention.

(ii) Splitting the Sample according to Risk Perception Levels and Past Malaria History and Exploring Valuations: Likewise the sample is divided according to varied levels of perceived malaria risk , $R^S$, and past sufferings etc. and the comparative valuation question is explored in greater depth.

The results of empirical exercises, primary and auxiliary, are illustrated in detail in Chapter 6.

# CHAPTER 6: RESULTS

## 6.1 Introduction

Following the econometric specifications laid out in Chapter 5, this chapter sets out with three primary motivations: (i) explore how respondents assess health risk reductions in the context of malaria; (ii) investigate if valuations of public and private health interventions differ; and (iii) conduct the valuation exercise across different sub-samples to analyze if individuals with varying levels of disease exposure, perceived risks, and socio-economic attributes value public malaria programs and private preventive efforts differently. The organization of the chapter is as follows: Section 6.2 presents the results forthcoming from the econometric exercise that considers percentage risk reductions, while Section 6.3 involves absolute risk reductions. In Section 6.4 the key findings in light of both the percentage and absolute risk exercises are discussed. Finally, Section 6.5 presents a collection of relevant split-sample analyses, considering percentage risk changes again.

It needs mention as to why both percentage and absolute risk changes feature in the analysis. Given the empirical plan in Chapter 5 in conformity with our theoretical model, the survey included random assignment of percentage risk reductions to respondents. However, the analysis in Section 6.2 brings forth certain issues on percentage risk variations, as a follow-up to which Section 6.3 accomplishes the same set of empirical procedures in terms of absolute risk reductions. Such exercises on absolute risk changes are facilitated by the fact that prior to random offers of percentage risk reductions by the public and private health treatments, perceived levels of malaria risk were elicited from each respondent in the survey.

In each of the two Sections, 6.2 and 6.3, a basic sequence is maintained while presenting the results. For instance, first, the full sample WTP results are presented with 3 variants of the econometric model which include different dummy variables of importance. In the next step, the full sample is divided into two parts based on the type of health intervention offered: public and private, and the valuation results pertaining to these two kinds of treatments are presented. Next, the same procedures are repeated for the urban and rural sub-samples, whereby, first, a general valuation of malaria risk reduction is investigated in the concerned sub-sample, followed by an inquiry as to how individuals classified on the basis of the public/private treatments within that sub-sample assess health risks.

## 6.2 Results and Discussion: Empirical Exercise on Percentage Risk Reductions

### 6.2.1 Full Sample Analysis

At the very outset, before a comparison is made between public and private health valuations, the interest lies in finding out if respondents value the percentage risk-reductions brought about by any health intervention (both private and public), and in analyzing how cost considerations, and other factors, affect their purchase decisions. For the purpose, let us recall equations (20) and (22), corresponding to the public and private treatments respectively:

$$MWTP^{g} = \gamma_0 + \gamma_1(risk\_r) + \gamma_2(controls) + \epsilon^{g} \tag{20}$$

$$MWTP^{L} = \gamma'_0 + \gamma'_1(risk\_r) + \gamma'_2(controls) + \epsilon^{L} \tag{22}$$

We consider the basic equation underlying these two specifications, and estimate a binomial probit equation for the full sample comprising 687 respondents. In this basic model, no qualitative distinction is made between $g$ and $L$ (i.e., the two treatments) and hence, the LHS simply stands for $MWTP$ for health risk reductions in the context of malaria. Results of this model estimated for the full sample are presented in Table 8. The second and third columns reflect the probit coefficients that result from taking two other variants of the basic specification, one with a dummy variable added for the urban area, and the other with a dummy on the public health treatment.

**Table 8: Probit Estimates (Percentage Risk) – Full Sample**

| | Model 1 | Model 2 | Model 3 | |
|---|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient | Mean |
| Constant | 0.832** | 0.767** | 0.744** | |
| | (0.115) | (0.127) | (0.126) | |
| =1, if risk reduction is 50% | -0.007 | -0.007 | -0.006 | 0.48 |
| | (0.100) | (0.100) | (0.100) | |
| PRICE | -0.003** | -0.003** | -0.003** | 116.87 |
| | (0.001) | (0.001) | (0.001) | |
| =1, if area is urban | | 0.123 | - | 0.51 |
| | | (0.100) | - | |
| =1, if risk reduction mechanism is public | | | 0.169 | 0.49 |
| | | | (0.100) | |
| Sample Size | 687 | 687 | 687 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

As all of the 3 models suggest, the percentage risk changes do not play a significant role in determining the purchase decisions that respondents make. But, cost considerations of the public/private health programs significantly influence the likelihood of respondents' saying "Yes" to a particular health intervention. Thus, the coefficient of price is negative and significant (at 1% level of significance) in all three models suggesting that a higher price of a preventive program negatively affects the decision-maker to opt for the same. The coefficients of the urban and public dummies fail to emerge significant. Although not reported in this paper, similar econometric exercises including other relevant controls such as the respondent's age, education, prior disease experience, household income, presence of child in household etc. have been undertaken in addition to the ones presented. But, given that the randomly assigned percentage risk reductions and costs of prevention efforts are orthogonal to the observed and unobserved characteristics of respondents, addition of further controls does not significantly change the risk and cost coefficient estimates.

Now, with an interest in the comparative valuation exercise across public/ private treatments, the full sample is divided into two sub-groups, namely the set of respondents assigned to the public program as against those offered the private strategy. Equation (20) is estimated for the public sub-group and likewise, equation (22) for the private. Table 9 reports the results forthcoming from such a comparative exercise based on 337 "public" sampling units and 350 "private".

**Table 9: Probit Estimates (Percentage Risk) – Full Sample, Public and Private Treatments**

| | Public | | Private | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.909** | | 0.75** | |
| | (0.168) | | (0.160) | |
| =1, if risk reduction is 50% | -0.041 | 0.48 | 0.028 | 0.48 |
| | (0.145) | | (0.139) | |
| PRICE | -0.003** | 115.07 | -0.003** | 118.62 |
| | (0.001) | | (0.001) | |
| Sample Size | 337 | | 350 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

As in the full sample analysis, in both the public and private treatments, the coefficient of the percentage risk reductions is not found to be significantly determining respondents' purchase decisions. In each treatment, the coefficient of the cost of health interventions is negative and significantly different from zero at 1%, indicating that price levels offered indeed determine if a respondent would opt for the said intervention or not.

### 6.2.2 Sub-Sample Analysis: Urban

As a follow-up to the full-sample exercise above, the sample is now divided into two sub-groups, urban and rural, and the urban sub-sample comprising 350 respondents considered for analysis. Recalling from Chapter 4 that disease exposure and observed levels of public malaria control efforts varied starkly across urban and rural areas, this sub-sample analysis may facilitate a deeper understanding of individuals' health valuations particularly in the urban area. Table 10 reports the results forthcoming from estimating two variants of the basic econometric model on the urban sub-group (similar to the full sample exercise of Section 6.2.1).

**Table 10: Probit Estimates (Percentage Risk) – Urban Sample**

| | Model 1 | Model 2 | |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Mean |
| Constant | 0.875** | 0.678** | |
| | (0.163) | (0.177) | |
| =1, if risk reduction is 50% | -0.133 | -0.132 | 0.47 |
| | (0.142) | (0.143) | |
| PRICE | -0.002* | -0.002* | 115.53 |
| | (0.001) | (0.001) | |
| =1, if risk reduction mechanism is public | | 0.405** | 0.49 |
| | | (0.144) | |
| Sample Size | 350 | 350 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

The second column in Table 10 reflects the results ensuing from adding a dummy variable on the public treatment. Coefficient estimates of risk changes are still insignificant. The price levels that respondents in the urban area were randomly assigned to, significantly determine respondents' opting for a prevention program. In both models, the price coefficient is negative and significantly different from zero at 5%.

Interestingly, in Model 2, the coefficient of the public dummy emerges positive and significant at the 1% level, and hence, illustrates the positive role of a public health program in inducing people more towards malaria prevention.

In the next step of our econometric procedures, the urban sub-sample is divided into two sub-groups: public (sample size: 170) and private (sample size: 180) and the two econometric models, as per equations (20) and (22) estimated. Results derived are given in Table 11.

Coefficients pertaining to percentage risk changes and the price of interventions appear insignificant in both the treatments.

**Table 11: Probit Estimates (Percentage Risk) – Public and Private Treatments Within the Urban Sample**

| | Public | | Private | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 1.110** | | 0.665** | |
| | (0.248) | | (0.219) | |
| =1, if risk reduction is 50% | -0.23 | 0.47 | -0.052 | 0.47 |
| | (0.215) | | (0.192) | |
| PRICE | -0.002 | 112.33 | -0.003 | 118.59 |
| | (0.002) | | (0.001) | |
| Sample Size | 170 | | 180 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

### 6.2.3 Sub-Sample Analysis: Rural

Similar to the urban sub-sample exercise, the 337 households falling exclusively in the rural area of our sample are analyzed separately. First, the two variants of the basic econometric model are estimated, and the normalized coefficient estimates of percentage risk changes and health program costs are illustrated in Table 12. The second column reflects the results on adding a dummy on the public treatment, as done earlier for the full sample and urban area analyses. In both Models 1 and 2, the price coefficient is negative and significant. Unlike the urban area where the public dummy was instrumental in influencing respondents' likelihood of agreeing on a prevention strategy, in the rural regions, the publicness of a health program no longer matters in a respondent's purchase decision.

**Table 12: Probit Estimates (Percentage Risk) – Rural Sample**

| | Model 1 | Model 2 | |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Mean |
| Constant | 0.789** | 0.818** | |
| | (0.165) | (0.181) | |
| =1, if risk reduction is 50% | 0.122 | 0.121 | 0.49 |
| | (0.142) | (0.142) | |
| PRICE | -0.004** | -0.004** | 118.26 |
| | (0.001) | (0.001) | |
| =1, if risk reduction mechanism is public | | -0.055 | 0.50 |
| | | (0.142) | |
| Sample Size | 337 | 337 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

Dividing the rural sub-sample further into public (sample size: 167) and private (sample size: 170) treatments, the probit equation is estimated separately. For the public sub-group, the price coefficient is negative and significant at 5%, while it is significant at 1% for the private treatment (See Table 13).

**Table 13: Probit Estimates (Percentage Risk) – Public and Private Treatments Within the Rural Sample**

| | Public | | Private | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.725** | | 0.855** | |
| | (0.232) | | (0.234) | |
| =1, if risk reduction is 50% | 0.13 | 0.49 | 0.113 | 0.49 |
| | (0.201) | | (0.201) | |
| PRICE | -0.004* | 117.87 | -0.004** | 118.65 |
| | (0.002) | | (0.002) | |
| Sample Size | 167 | | 170 | |

* Significant at 5% level of significance
** Significant at 1% level of significance

### 6.2.4 Likelihood Ratio (LR) Test: Price Sensitivity Across Sub-Samples

As seen above, the price coefficients come out to be significant for the full sample, the constituent public and private groups, as well as the rural public/private analyses. This prompts further investigation into comparing the price sensitivities across various sub-samples using LR tests. Given our emphasis on knowing the nuances of a private-public comparative valuation, the issue of price sensitivity assumes importance as well, particularly for policy questions on appropriate pricing of prevention strategies to induce greater use and commitment.

First, an LR test is conducted to compare the structural price coefficients across the public and private treatments, considering the full sample. A high p-value results in, implying that the null hypothesis, specifying the structural parameters to be the same across the two treatments, cannot be rejected. Thus, a respondent facing a private intervention reacts to costs of the intervention in the same way as does a respondent in the public treatment. A similar result is obtained when an LR test is performed with the public and private price coefficients in the rural sample as well. The equality of price sensitivities across the public and private treatments imply that a decision-maker choosing to prevent malaria in a developing country faces the same kind of disincentives from higher prevention costs irrespective of the fact if such a prevention effort generates benefits privately or for the community at large. This result makes it worth exploring further if risk coefficients too behave the same way across public and private treatments. The risk coefficients being insignificant for percentage risk changes, an LR test on risk parameters is kept aside for Section 6.3 where absolute risk changes are considered.

### 6.2.5 The Need to Consider Absolute Risk Changes: A Note

Since the coefficient of the percentage risk changes emerges insignificant in the full sample and the sub-groups considered above, some relevant issues pertaining to our empirical procedures deem discussion. In Section 6.2 the percentage risk changes comprise an explanatory variable by which we attempt to explain respondents' valuation of different kinds of malaria prevention programs. But, offers of two types of risk reductions, namely, 50% and 90%, in our survey, result in essentially two types of risk changes, rendering the regressor quite similar to a dummy variable with reduced variation. It is, thus, envisaged that perhaps inducing more variation in the risk changes could have thrown up better results. However, even as one contemplates increasing the risk variation in future extensions, other factors and trade-offs deserve careful consideration. Variation could have been increased along the lines of Dickie and Gerking (2007) who, in course of exploring parental altruism, elicit two types of risks from an individual parent respondent, viz., her own health risks and that of her child's. Thus, even with two risk changes, they achieve a stronger variation in the explanatory variable. Despite our interest in a comparative public/private valuation exercise and a theoretical model with two dimensions to risks, namely private and community (analogous to parent's and child's health risks in Dickie and Gerking, 2007) our field plan did not involve both such dimensions. This is because, perception measurement, as what this research endeavors to explore, was apprehended to assume extremely difficult proportions in the context of a developing country if two apparently similar types of risks viz., private and community health risks, were presented to respondents to have their responses on.

Besides, on contemplating further, we find that even on a single dimension of health risk we had, i.e., private, more percentage risk changes (perhaps 3 or 4) instead of just, 50% and 90%, could have been attempted for. But, this, in turn would have required a sample size far greater than the 780 units, we originally set out with. It also needs particular mention here that our main motivation lay in the public/private treatments. Thus, bringing in more treatments on account of risk changes and prices, would have expanded the research scope considerably, especially since, even with two risk changes, the number of treatments designed for the research question at hand was already 16 ( recall the 2 X 2 X 4 design). Even when one envisages incorporating more such risk variations and increases the sample size, an associated practical challenge emerges, particularly if an interviewer-assisted survey is fielded in a developing country. Unlike the computerized risk elicitation in Dickie and Gerking (2007), our risk device comprising colored cards was manually operated, and respondents randomly assigned to either the 50% risk device (Yellow Risk Board) or the 90% one (Green). Having more risk variations would bring in the necessity to construct and apply more difference across the risk devices, along with maintaining greater interviewer-coordination. This is achievable but fairly difficult to efficiently implement in the field, given cost and time considerations.

Finally, the difficulty finding a variation of purchase decisions with respect to percentage risk changes (i.e., an insignificant risk coefficient) needs to be considered against a backdrop where the disease in question is recurrent, with predominantly morbidity consequences. Unlike fatal diseases involving extreme health states, malaria is a recurring public health threat in the survey area, inducing people to adopt prevention on a regular basis, thus perhaps making it less likely that *risk reductions* per se would be adequately valued by the respondents as expected.

Notwithstanding the above issues, the perceived levels of malaria risks elicited in the survey allow us a possible extension of the empirical plan for exploring the public-private valuation question. The percentage risk changes that respondents received from the public/private health programs, together with the initial malaria risk levels that they estimated, help us compute absolute risk changes for each respondent. All econometric tasks are now performed with absolute risks in Section 6.3.

## 6.3 Results and Discussion: Empirical Exercise on Absolute Risk Reductions

### 6.3.1 Full Sample Analysis

A reasonable amount of variation in the perceived risk levels on a scale of 0-10 in the survey, when used in conjunction with the two risk changes we offered, i.e., 50% and 90%, essentially brings in considerable variation in the absolute risk changes across respondents. The explanatory variable becomes changes in risk *levels* and is no longer in terms of percentages. Table 14 contains the results obtained from estimating the basic specification behind equations (20) and (22) for the full sample (687 respondents), without dividing the sample into public and private treatments. Columns 2 and 3 bring in the dummies for the urban area and public treatment respectively. Notably, the coefficient of the absolute risk changes is positive and significant at 1% in all three specifications. This implies that a larger risk change brought about by a health intervention (private and/or public) significantly increases the likelihood of respondents opting for the said prevention option.

**Table 14: Probit Estimates (Absolute Risk) –Full Sample**

| | Model 1 | Model 2 | Model 3 | |
|---|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient | Mean |
| Constant | 0.539** | 0.502** | 0.451** | |
| | (0.130) | (0.137) | (0.140) | |
| risk reduction | 0.091** | 0.089** | 0.091** | 3.49 |
| | (0.025) | (0.025) | (0.025) | |
| PRICE | -0.003** | -0.003** | -0.003** | 116.87 |
| | (0.001) | (0.001) | (0.001) | |
| =1, if area is urban | | 0.084 | - | 0.51 |
| | | (0.101) | - | |
| =1, if risk reduction mechanism is public | | | 0.172 | 0.49 |
| | | | (0.101) | |
| Sample Size | 687 | 687 | 687 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

In Table 14 above, the price coefficient is negative and significant at conventional levels in all models, corroborating the law of demand in the present health context. However, in Models 2 and 3, the dummy variables on the urban area and public treatment emerge insignificant in explaining the variation in respondents' purchase decisions.

Next, our interest lies in exploring if dividing the sample into public and private sub-groups affects respondents' valuation of risk reductions. As shown in Table 15, the risk coefficient pertaining to the public treatment comprising 337 respondents is positive and significant at 1%. The private counterpart is positive and significant at the 5% level, when the model is run on 350 respondents. Thus, in both the public and private treatments a greater amount of risk reductions significantly drives people more towards adopting the health intervention offered. Table 15 also depicts that the coefficient of price is strongly significant in both the public and private treatments, implying that people react negatively to the prices associated with any prevention strategy.

**Table 15: Probit Estimates (Absolute Risk) –Public & Private Treatments**

| | Public | | Private | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.55** | | 0.523** | |
| | (0.181) | | (0.187) | |
| risk reduction | 0.123** | 3.48 | 0.068* | 3.50 |
| | (0.038) | | (0.033) | |
| PRICE | -0.004** | 115.25 | -0.003** | 118.44 |
| | (0.001) | | (0.001) | |
| Sample Size | 337 | | 350 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

Even though the risk coefficient emerges significant in the full sample, as well as the constituent private/public sub-groups (in Tables 14 and 15), one may argue that our consideration of absolute risk changes renders the risk estimates biased. Such a bias is likely since respondents' perceived risk levels, which we use for computing the absolute risk changes, may be correlated to the error term, bringing in the issue of endogeneity. However, despite such challenges, empirical exercises involving absolute risk variations are intended primarily because the ultimate aim lies in comparing the risk coefficient estimates across the private and public treatments. We assert that even in the case when one may believe that both the risk coefficients are biased, the significance of the estimates across both private and public interventions allows for an LR test to facilitate a comparison of the structural parameters corresponding to the absolute risk reductions. Such a test of the *difference* between structural parameters mitigates the issue of endogeneity to a significant extent.

For the purpose at hand, an LR test is conducted. The structural risk coefficients when compared across the private and public treatments produces a high p-value, indicating that the null hypothesis on the equality of the risk parameters cannot be rejected at conventional levels of significance. Thus, individuals differentiated according to the nature of health programs offered, private or public, react in a similar manner to the risk changes that such programs bring forth. This renders an answer to our primary research question by asserting that individuals' valuations of public and private health programs do not differ even when the delivery mechanisms and the scope of benefits of such health interventions diverge.

### 6.3.2 Sub-Sample Analysis: Urban

Now considering the urban sub-sample in isolation, the basic econometric model behind equations (20) and (22) is estimated for the 350 urban respondents. Table 16 reports the results of running such a model with two specifications (Models 1and 2). It is found that the risk coefficient is positive and significant at 1%, quite similar to what was observed for the full sample, earlier in Table 14. The coefficient of price is negative but significant only at the 5% level. The dummy on public programs, considered in Model 2, emerges positive with a 1% level of significance. Thus, urban respondents are more likely to say "Yes" to a health prevention strategy, if the said strategy is government-administered.

**Table 16: Probit Estimates (Absolute Risk) – Urban Sample**

| | Model 1 | Model 2 | |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Mean |
| Constant | 0.338 | 0.124 | |
| | (0.188) | (0.203) | |
| risk reduction | 0.138** | 0.14** | 3.73 |
| | (0.036) | (0.036) | |
| PRICE | -0.003* | -0.003* | 115.53 |
| | (0.001) | (0.001) | |
| =1, if risk reduction mechanism is public | | 0.42** | 0.49 |
| | | (0.146) | |
| Sample Size | 350 | 350 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

With our emphasis on a public/private comparative valuation exercise, the urban sub-sample is further divided into two constituent treatments (public and private) and the results presented in Table 17.

**Table 17: Probit Estimates (Absolute Risk) – Private and Public Treatments Within the Urban Sample**

| | Public | | Private | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.451 | | 0.194 | |
| | (0.277) | | (0.262) | |
| risk reduction | 0.175** | 3.74 | 0.12** | 3.73 |
| | (0.059) | | (0.046) | |
| PRICE | -0.003 | 112.66 | -0.003 | 118.24 |
| | (0.002) | | (0.001) | |
| Sample Size | 171 | | 180 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

The public and private sub-groups consist of 171 and 179 respondents respectively. As is evident from the table, the risk coefficient is positive and significant at the 1 % level for both the sub-groups. But, interestingly, unlike the full sample, the price coefficient in the urban area ceases to be significant at conventional levels. Given that malaria is highly prevalent in the specific area we surveyed, the absence of price sensitivity with regard to prevention attitudes as is obtained from the urban sub-sample, seems practicable owing to the recurring threats of the disease.

The significance of the private and public treatment risk coefficients allows for an LR test on the structural risk parameters. Results show that the null hypothesis cannot be rejected, thus, implying that health valuations in the malaria-prone urban area do not differ on the basis of the public/private nature of health programs that respondents have access to.

### 6.3.3 Sub-Sample Analysis: Rural

Now, the above econometric procedures followed for the urban sub-sample are repeated for the rural area in order to gain further insights on the respondents' valuation of risk changes and price sensitivity in a rural setting where malaria occurrences are relatively infrequent. The rural sub-sample comprises 337 households. Table 18 reports the probit estimates. In both models, the coefficient of risk level changes is found to be insignificant, marking a notable departure from the observations in the urban area. Another interesting dimension of contrasts arises. Unlike price insensitivities found in urban regions, price in the case of the rural sub-sample significantly affects prevention decisions given that its estimated coefficient is negative and significant (1% level of significance). Since malaria is rare in the specific rural area we surveyed, the expectation that prevention is likely to be price-sensitive gains support from the results.

**Table 18: Probit Estimates (Absolute Risk) – Rural Sample**

| | Model 1 | Model 2 | |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Mean |
| Constant | 0.727** | 0.756** | |
| | (0.181) | (0.196) | |
| risk reduction | 0.041 | 0.041 | 3.24 |
| | (0.035) | (0.035) | |
| PRICE | -0.004** | -0.004** | 118.26 |
| | (0.001) | (0.001) | |
| =1, if risk reduction mechanism | | -0.056 | 0.50 |
| is public | | (0.142) | |
| Sample Size | 337 | 337 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

When the rural sample is divided on the basis of the private and public treatments, the risk coefficient ceases to be significant in both cases. Still an LR test is performed with the structural risk parameters (See Table 19 for the risk coefficient estimates) which renders the same result as what has earlier been observed for the full sample and urban sub-sample: respondents assess health risk reductions from the private and public health programs in a similar way.

**Table 19: Probit Estimates (Absolute Risk) – Private and Public Treatments Within the Rural Sample**

| | Public | | Private | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.619* | | 0.859** | |
| | (0.244) | | (0.271) | |
| risk reduction | 0.07 | 3.22 | 0.014 | 3.25 |
| | (0.051) | | (0.048) | |
| PRICE | -0.004** | 117.87 | -0.004** | 118.65 |
| | (0.002) | | (0.002) | |
| Sample Size | 167 | | 170 | |

*Significant at 5% level of significance
**Significant at 1% level of significance

## 6.4 Key Findings: A Summary

The econometric exercises in Sections 6.2 and 6.3 drive home two key outcomes, mainly applicable for the full sample: (i) respondents value health risk reductions from a private preventive strategy in exactly the same manner as they value the health benefits of a publicly-administered malaria-control program in the community; and (ii) Costs of health interventions (public and private) significantly influence respondents' prevention decisions.

The valuation results generally support the externality dimension to malaria control. Even though the two health interventions, private and public, diverge on account of their delivery mechanisms and scope of benefits, respondents do not significantly view the associated risk reductions differently. This is evident from an LR test on the structural risk parameters. The aspect of externality, as is evident from the results, thus, necessitates a greater role of government in combating malaria. Besides, the sensitivity of willingness to pay decisions to costs of the health interventions has implications for malaria control policies that strive for offering the correct price incentives to induce people more towards malaria prevention.

### 6.5 Auxiliary Split-Sample Analyses

In order to gain further insights into how individuals with varied levels of disease exposures and differential urban/rural attributes assess malaria-related health risks, a set of auxiliary empirical exercises are performed. The primary motivation for these additional econometric tasks derives from some contrasting urban-rural features that emerge from data analysis. In this regard, recall a greater prevalence record associated with the urban area (see Chapter 4, Section 4.3).

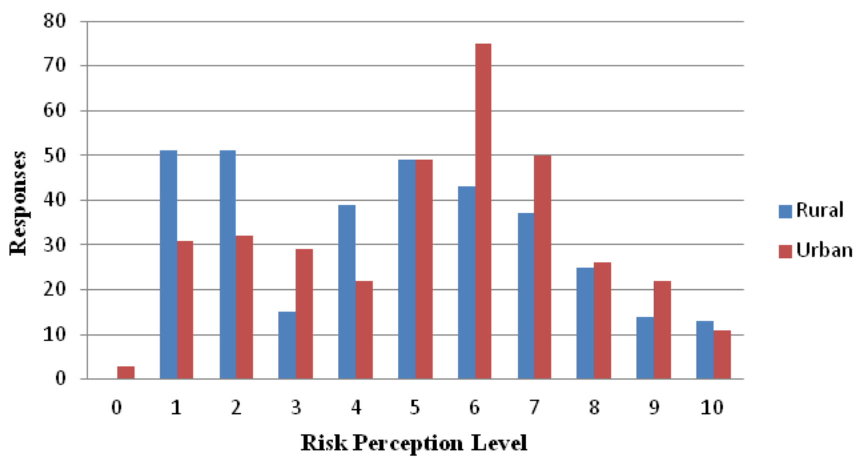



**Figure 1: Risk Perception Distribution**

Also, a rural-urban analysis of the risk perception levels shows that relatively a larger number of respondents are distributed across higher perceived risk levels in the urban area (Figure 1). In the rural area, in contrast, more people have lower risk perceptions.

Given such rural-urban differences, different split-samples are created based on (i) actual prevention levels, (ii) perceived malaria risk levels; and (iii) past malaria histories of respondents with the urban/rural locational factor included alongside. Once created, these various sub-groups facilitate exploring the valuation question in greater depth. Note that the analysis here involves percentage risk reductions only.

### 6.5.1 Valuation Exercises under Different Levels of "Actual" Prevention

Recall that for the purpose of exploring different levels of actual prevention which households commonly engage in, a prevention/preventive index was constructed considering three types of preventive products: bed nets, coils and diffusers (recall descriptive statistics of actual prevention in Chapter 4). The index (on a scale of 0-3) facilitates empirically testing if valuations differ across the urban and rural survey respondents, when they are classified on the extent of their preventive attitudes. In order to rank households according to "high" and "low" actual prevention categories, responses indexed 2 or 3 (meaning households use two or all three above prevention modes) are clubbed in the "high" prevention rung while those indexed 1 or 0 are identified with "low" protection.

Once the "high" and "low" prevention households are ranked, a simple binomial probit equation is estimated in both the urban and rural areas. Considering the set of 171 "high" prevention households in the urban sample, it is found that representatives of such households no longer consider prices when they make purchase decisions in the health intervention treatments we offered (Table 20 and Table 21). Given that the urban area is considerably malaria-prone, households which already adopt a higher degree of protection against mosquitoes are not quite affected with the disincentives that higher prices of health interventions bring. Moreover, for these overtly protective households, it does not matter if the intervention is privately or publicly executed (the government dummy is insignificant even at 5% level). These insensitivities of households seem in tandem with conventional expectations, particularly against the backdrop of high disease prevalence and high preventive investments.

**Table 20: Probit Estimates - Urban Sample, High-Low Preventive Measures**

| | Low Preventive Measures | | High Preventive Measures | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.42 | | 0.947** | |
| | (0.240) | | (0.278) | |
| =1, if risk reduction is 50% | -0.133 | 0.47 | -0.136 | 0.48 |
| | (0.192) | | (0.225) | |
| PRICE | -0.003 | 119.56 | -0.002 | 111.31 |
| | (0.001) | | (0.002) | |
| =1, if risk reduction mechanism is public | 0.393* | 0.47 | 0.406 | 0.50 |
| | (0.194) | | (0.225) | |
| Sample Size | 179 | | 171 | |

* Significant at 5% level of significance
** Significant at 1% level of significance

A similar exercise in the rural area, (where malaria incidences are relatively less) contrastingly reveals (See Tables 20 and 21) that a higher price of a health intervention significantly deters the prevention decisions of respondents who already stand on the "high" rung of the prevention index. However, such rural area participants who already prevent adequately do not quite factor in the health intervention vehicle (public/private) when they make a decision to opt for a preventive strategy.

Considering the split-sample of urban households, with a "low" level of actual prevention, it is found that a publicly-administered government program makes respondents more likely to opt for the same. Perhaps people who protect less in a malaria-prone area might see public disease control programs as being relatively more effective, and hence, such a result. In contrast to this, rural households who do not protect much and, hence, are marked “low”, are not likely to be influenced more if a public program is offered.

**Table 21: Probit Estimates - Rural Sample, High-Low Preventive Measures**

| | Low Preventive Measures | | High Preventive Measures | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.51* | | 1.14** | |
| | (0.251) | | (0.264) | |
| =1, if risk reduction is 50% | 0.107 | 0.51 | 0.147 | 0.47 |
| | (0.194) | | (0.217) | |
| PRICE | -0.002 | 120.73 | -0.005** | 115.50 |
| | (0.001) | | (0.002) | |
| =1, if risk reduction mechanism | 0.069 | 0.48 | -0.164 | 0.52 |
| is public | (0.195) | | (0.217) | |
| Sample Size | 178 | | 159 | |

* Significant at 5% level of significance
** Significant at 1% level of significance

### 6.5.2 Valuation Exercises under Different Levels of Perceived Malaria Risk

Further split-samples are created on the basis of different levels of perceived malaria risks and are analyzed across the urban and rural segments of our sample. In the urban area, respondents with high levels of perceived malaria risk (i.e., with risk levels 6 or higher on a scale of 0-10) are not significantly affected by higher costs of health interventions when they make choices of prevention to guard against malaria. As against this result, it is found that even when rural participants perceived greater annual malaria risks for themselves, they are likely to be significantly more attracted to a preventive option when the said strategy is less expensive (the rural price coefficient in Table 22 is negative and significant at 1 % level). Besides, it is found that in both the rural and urban sub-samples, the presence of government-administered programs does not add to inducing such apprehensive respondents (with higher risk levels) more towards prevention.

**Table 22: Probit Estimates – By Levels of Risk Perception**

| | High Risk Perception Sample | | | | Low Risk Perception Sample | | | |
|---|---|---|---|---|---|---|---|---|
| | Rural | | Urban | | Rural[$$] | | Urban | |
| Variable | Coefficient | Mean | Coefficient | Mean | Coefficient | Mean | Coefficient | Mean |
| Constant | 1.332** | | 0.657* | | 0.563 | | 0.655* | |
| | (0.300) | | (0.265) | | (0.331) | | (0.316) | |
| =1, if risk reduction is 50% | 0.172 | 0.52 | -0.117 | 0.46 | 0.048 | 0.49 | -0.238 | 0.49 |
| | (0.239) | | (0.213) | | (0.285) | | (0.245) | |
| PRICE | -0.008** | 119.70 | 0 | 118.29 | -0.002 | 126.85 | -0.005** | 114.50 |
| | (0.002) | | (0.002) | | (0.002) | | (0.002) | |
| =1, if risk reduction mechanism is public | 0.072 | 0.50 | 0.412 | 0.49 | | | 0.432 | 0.50 |
| | (0.241) | | (0.213) | | | | (0.246) | |
| Sample Size | 132 | | 184 | | 81 | | 117 | |

[$$]All respondents in the rural area with low risk were given the private treatment.
[*]Significant at 5% level of significance
[**]Significant at 1% level of significance

Table 22 further asserts that in the urban area individuals with lower levels of perceived risks (0-4 on a scale of 0-10) are significantly influenced by prices of prevention when they express their willingness to opt for the said strategy.

After the CVM exercise, along the same lines, it may also be worth noting that data on levels of *actual* protection that respondents adopt (for the full sample) clearly shows a pattern of relation to perceived malaria risks (See Figure 2 below). This reiterates the indication (as what has been observed in the CVM analysis above) that depending on the nature of risk perception, respondents are likely to vary with regard to their attitudes towards malaria control.

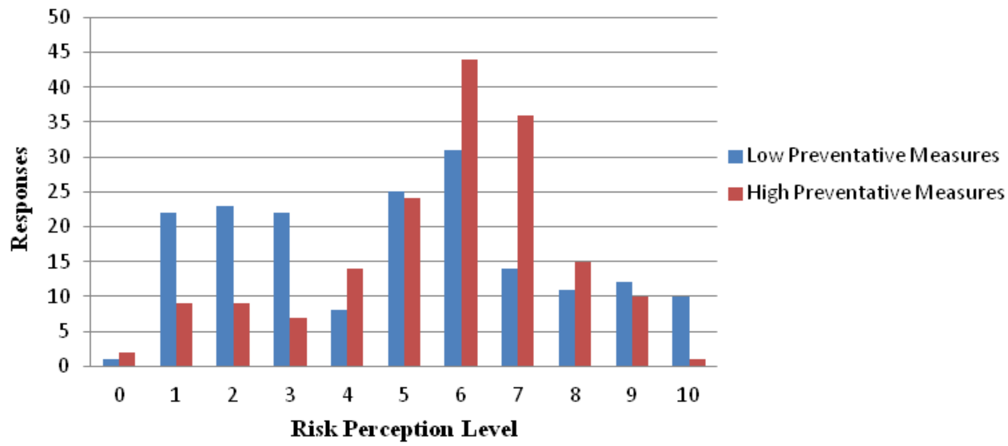



**Figure 2: Risk Perception Distribution – Level of Preventive Measures**

### 6.5.3 Valuation Exercises under Different Degrees of Disease Exposure

Splitting the sample on the basis of the malaria history of respondents, it is found that more than 97% of malaria cases had occurred in the urban area. Thus, to make the sub-samples mutually comparable, the urban area is considered solely and split-samples created to distinguish between prior malaria patients and non-patients within the urban sample. The motivation lies in exploring how the willingness to adopt a preventive strategy is shaped by different factors across the patients and non-patients. An interest in such a split-sample CVM analysis according to past disease exposures also arises from an observation emerging from data analysis: (i) Out of a total of 111 urban malaria victims, a large number of individuals stand on higher rungs (2 and 3) in the prevention index while most of the non-patients take low-medium actual protection (i.e., are indexed to 0-2) (Figure 3).

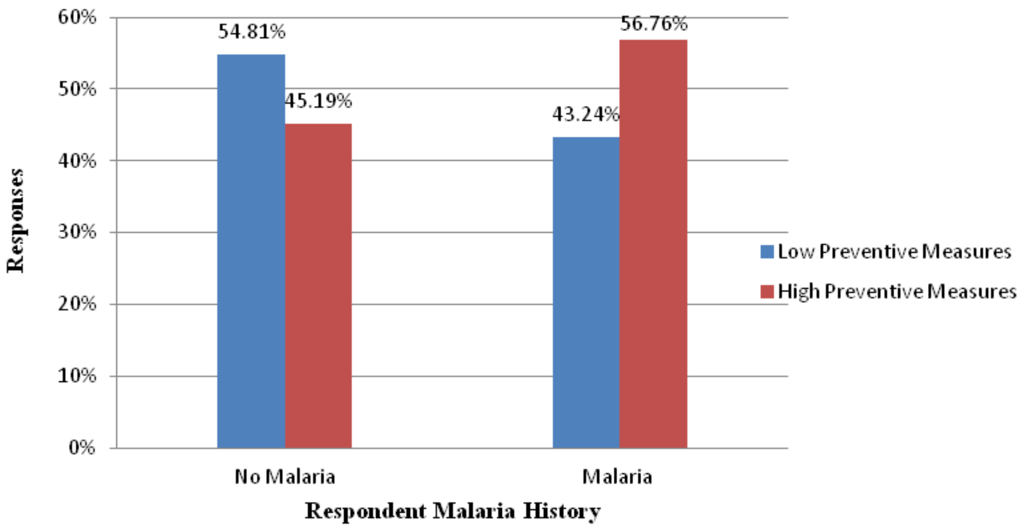



**Figure 3: Actual Prevention and Malaria History: Urban Sample**

Figure 3, thus, makes it worth exploring with a valuation exercise now to investigate if patients value health risk reductions differently from non-patients. The CVM results are reported in Table 23 below.

**Table 23: Probit Estimates – Urban Sample History of Malaria**

| | Malaria History* | | No Malaria History | |
|---|---|---|---|---|
| Variable | Coefficient | Mean | Coefficient | Mean |
| Constant | 0.864** | | 0.627** | |
| | (0.339) | | (0.210) | |
| =1, if risk reduction is 50% | 0.076 | 0.51 | -0.251 | 0.46 |
| | (0.256) | | (0.173) | |
| PRICE | -0.002 | 118.35 | -0.003* | 114.01 |
| | (0.002) | | (0.001) | |
| =1, if risk reduction mechanism | -0.063 | 0.54 | 0.572** | 0.47 |
| is public | (0.257) | | (0.175) | |
| Sample Size | 114 | | 239 | |

*Most of the People (97%) with a history of malaria in the sample are from the urban area
* Significant at 5% level of significance
** Significant at 1% level of significance

As Table 23 suggests, respondents having a prior malaria history in a 5-year recall period do not consider costs of prevention and the mode of malaria control (i.e., if the program is public or private) when choosing for malaria control. On the other hand, people who had not suffered from the disease before tend to considerably think about prices when expressing their purchase decisions for a preventive option (the price coefficient is negative and significant at 5% level of significance). Besides, for such non-patients, if a program is publicly administered, the likelihood of opting for the same increases (the public dummy is positive and significant at 1% level).

Having obtained different dimensions as to how willingness to pay decisions are shaped for malaria patients and non-patients, we perform an auxiliary Chi-square test of independence in the urban sample to examine if *actual* prevention efforts that individuals take are correlated with their prior malaria history. Table 24 asserts that actual levels of malaria control respondents engage in are indeed not independent of their past sufferings from the disease.

**Table 24: Prevention Level and Respondent Malaria History in Urban Area: Test of Independence**

Row Variable: History of Malaria
Column Variable: Prevention Index
Chi-squared test of Independence [3]= 15.5 Prob Value=.0014
Chi-squared test of Independence [3]= 14.7 Prob Value=.0021

Joint Frequencies For Row Variable: History of Malaria and Column Variable: Prevention Index

| History of Malaria | TOTAL | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| No History | 239 | 15 | 116 | 79 | 29 |
| Suffered in last 5 yrs | 111 | 8 | 40 | 31 | 32 |
| TOTAL | 350 | 23 | 156 | 110 | 61 |

# CHAPTER 7:SUMMARY AND CONCLUSION

## 7.1 Motivation, Key Outcomes and Policy Relevance

This dissertation explores the health risks of malaria, a vector-borne infectious disease that comprises a major public health threat in tropical developing countries. Despite concerted supply-side efforts to promote preventive options like bed nets, the private demand for malaria prevention is still inadequate. This makes malaria control a conspicuous issue in the contemporary public health debate across the globe. The demand-side issue assumes added importance given that private malaria prevention generates positive spillovers. This externality dimension owing to the infectious nature of the disease, thus, calls for a greater role of the government in combating the disease. Given that both private and public roles of malaria control are required, this dissertation empirically explores if both such control options are equally valued by the rational individual decision-maker who makes preventive choices. Such a comparative valuation exercise puts to test the public good nature of the problem and the results become meaningful for public policy on how to effectively combat the disease.

Chapter 1 of this dissertation sets the backdrop as to why malaria control assumes importance, and discusses issues of private-public feedbacks and the associated externality dimension. Primarily, a research question is posed: "How do individuals value health risk reductions associated with two competing disease control (prevention) measures, viz. a publicly-administered community-level malaria control measure as against private preventive choices?". Chapter 2 develops a non-market valuation framework to theoretically model the values for private and community-level action. Chapter 3 illustrates the design and implementation of a field survey carried out in and around the city of Kolkata (India) over the period October-December, 2011. In the survey, malaria-related risk perceptions were elicited using a measurable visual-aid and respondents' perceived valuations of health-risk reductions randomly offered with two intervention treatments, viz. public and private, were empirically ascertained using CVM techniques. Chapter 4 presents the descriptive statistics of the data. Chapter 5 develops the econometric framework to perform a comparative valuation exercise across the private and public treatments. In Chapter 6, results of the empirical procedures are illustrated in detail.

In each of the private and public treatments, respondents' willingness to pay decisions are explored with respect to randomly assigned health risk reductions (both in terms of percentage and absolute risk changes) and costs of health interventions. Using a Likelihood Ratio Test on the structural risk parameters, it is seen that individuals' valuations of health risk reductions are the same across the private and public treatments. The comparative valuation exercise, thus, corroborates the externality dimension to malaria control and indicates towards a possible substitutability between private and community-level efforts, thereby calling for a significantly greater amount of public action to combat malaria.

Although the valuations of risk reductions do not differ across treatments, respondents' willingness to pay elicited separately in the community-level (public) treatment turn out to be substantive in the urban area, thus, helping us reflect on the feasibility of emboldened government control measures in Kolkata. It is found that, on the average, an urban respondent is annually willing to pay INR 58[50] (for absolute risk reductions) and INR 115[51] (for percentage risk reductions) for community-level health benefits of a public risk-control measure. Even when the annual WTP estimate of INR 58 is treated with caution for being biased (since it is computed with absolute risk reductions), the figure, nevertheless, provides a lower bound to the WTP. Strikingly, even this lower bound, when extrapolated with the population of Kolkata, 4486679 (Census of India, 2011, Govt. of India), produces an aggregated WTP that well surpasses the rough annual cost of the Kolkata Municipal Corporation (KMC) on account of vector control for the year 2011-2012 (INR 94260194, See Appendix B for details on the cost break-up obtained on the basis of personal communication with the Vector Control Department, KMC). Even though such cost figures are approximate, and are not directly comparable to the valuation of specific risk reductions offered in the survey, still the difference between the benefit estimates and costs indicates the possibility that a scaled-up community-level malaria control effort in the urban malaria-prone area will be viable. In addition to the above urban-specific public WTP figure, for plausible future policy references, this study computes and presents the private and public WTPs simultaneously, for the full sample, as well as for the urban-rural sub-samples (See Appendix B for the private-public tabulated WTPs ). Herein, note as a caveat that although the monetary valuations may appear to differ in such a private-public tabulation, the statistical difference between the WTPs will not necessarily follow. Thus, the tabulation is intended only for the purpose of understanding how monetary valuations may ensue for different individual policy questions, private and public. But, for additional comparison across the monetary values,

[50] WTP= Risk Coeff. / Price Coeff. ; Thus, 0.175/.003= INR 58.
[51] .23/.002 =INR 115

complex statistical procedures (as the LR test exercise in this study) need to be performed before a policy implication can be definitively ascertained.

The WTP analyses aside, a key finding that emerges from the empirical procedures indicates that private prevention is significantly price-responsive. This, in turn, informs malaria control policies on the need for correct price incentives to induce greater prevention. Issues of health valuation and price sensitivity are further explored across different split-samples differentiated on the basis of socio-economic attributes, disease exposure, actual prevention efforts and perceived malaria risks. Such exercises help analyze the valuation question in greater depth.

The results of the empirical analysis contribute to policy with regard to the following: (i) Demand-side assessments of private and public malaria control tools, offered simultaneously in the field, are obtained for the first time in the literature; (ii) Implications for scaling up government-administered community-level actions arise since private and public valuations are derived to be equal; (iii) Additional information on price-sensitivity of private prevention demand is generated ; and (iv) The viability of a scaled-up public malaria control action is discussed by comparing the annual willingness to pay estimates derived in the public treatment to the estimated annual vector control costs that the Kolkata Municipal Corporation (KMC) incurs.

Seeking to explore a future route to handling the issue on percentage risk variation that was encountered in the empirical analysis, it is envisaged that perhaps in future extensions of the project, elicitation of two dimensions to risks from a single respondent, viz., private and community-level risks, could be attempted for. This is because, despite challenges of perception measurement in a developing country, respondents in our survey have been found to understand the 0-10 risk elicitation scale fairly well and the resultant risk levels reflect a reasonable amount of variation. With two risk dimensions, even a few percentage risk changes may generate a better variation in risks having an important bearing on the valuation question. Besides, it could plausibly be further explored whether respondents could distinguish between private and community risks and if they really do so, the externality dimension to malaria control (and hence the social preference component) can be more directly tested for in a within-subject survey design. Although such a design will require managing order issues with care, an empirical exercise along those lines will, nevertheless, comprise a meaningful extension involving strategic factors.

Finally, given essentially the morbidity nature of the disease in the survey site we selected, future applications will require careful refinements while communicating the benefits of a malaria control policy.

# APPENDIX A: FIRST AND SECOND STAGE UNITS OF SAMPLING

# A Sample of Media Report
# 35 cases in Ward 72 alone

**Express News Service**
Posted: Nov 01, 2008 at 0208 hrs

**Kolkata, October 31** Ward number 72 in Bhowanipore has been brought to its knees by malaria, but the Kolkata Municipal Corporation is yet to sit up.

Officials connected to the health clinic in Ward 72 admitted that last week, 22 cases of malaria have been reported. This week, the ward has already seen 13 cases this despite KMC claims that fumigation has been carried out in the area and in the homes of the affected people.

The residents, however, hotly deny it.

Bawaj Kamat, a resident of 25/4 Chakraberia Road (South), who had recently suffered a bout of malaria, said the civic authorities are yet to visit his home and conduct fogging operations.

"Many malaria cases have been reported from this locality and although none of them were fatal, the authorities did not visit any of the homes," he said. "Now my nephew has contracted the disease."

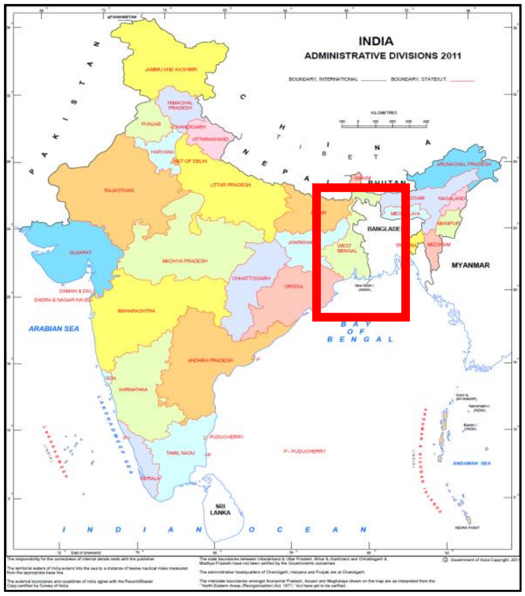
Most residents say the KMC officials have not visited the area in a year. Rajesh Yadav, another resident, said people in the slums are furious about the civic body's negligence.

"Almost every family has suffered from malaria. We go for blood tests, take medicines and recover and then someone else in the family falls ill and the cycle starts again," he said.

Most worry that it is only a matter of time before someone succumbs to the disease. Many of the slum dwellers who had been afflicted with malaria have already left for their villages in Bihar.

Councillor Sachidananda Banerjee confirmed that the KMC is yet to take any action in the area. "The authorities have not visited the ward and taken control of the situation. Neither do they come for spraying. There have been 25 cases of malaria, including malignant malaria and three cases of dengue in the ward, but there has been no positive response from the authorities," said Banerjee.

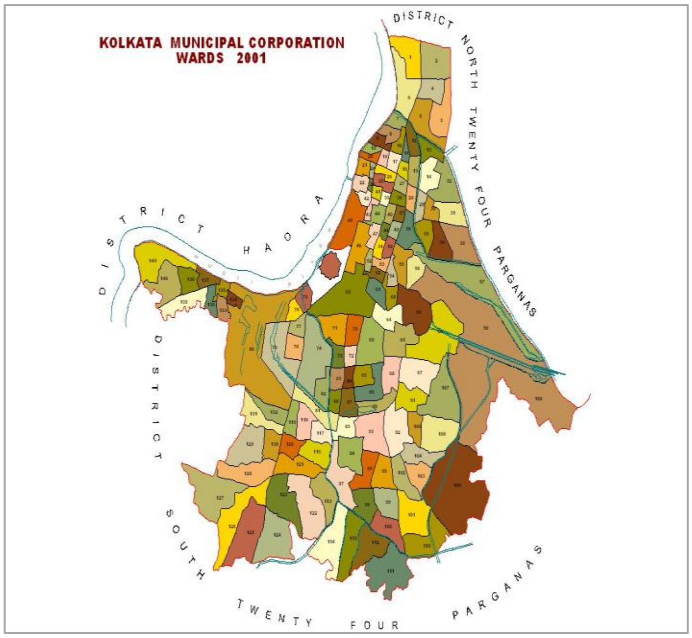
For now, the health officials at the KMC clinic are only too thankful that no case of dengue has been detected in the area.




**Map of India**

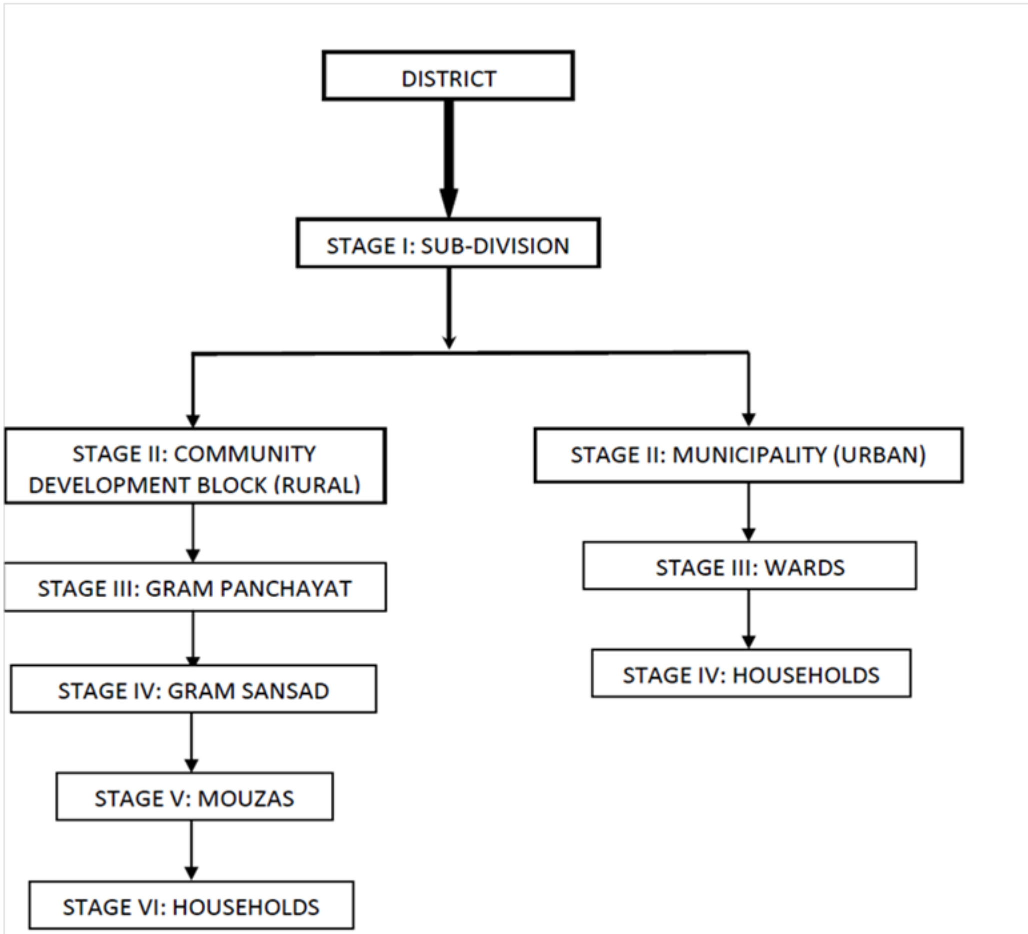

Source: Census of India (2001)

**District Map of West Bengal**

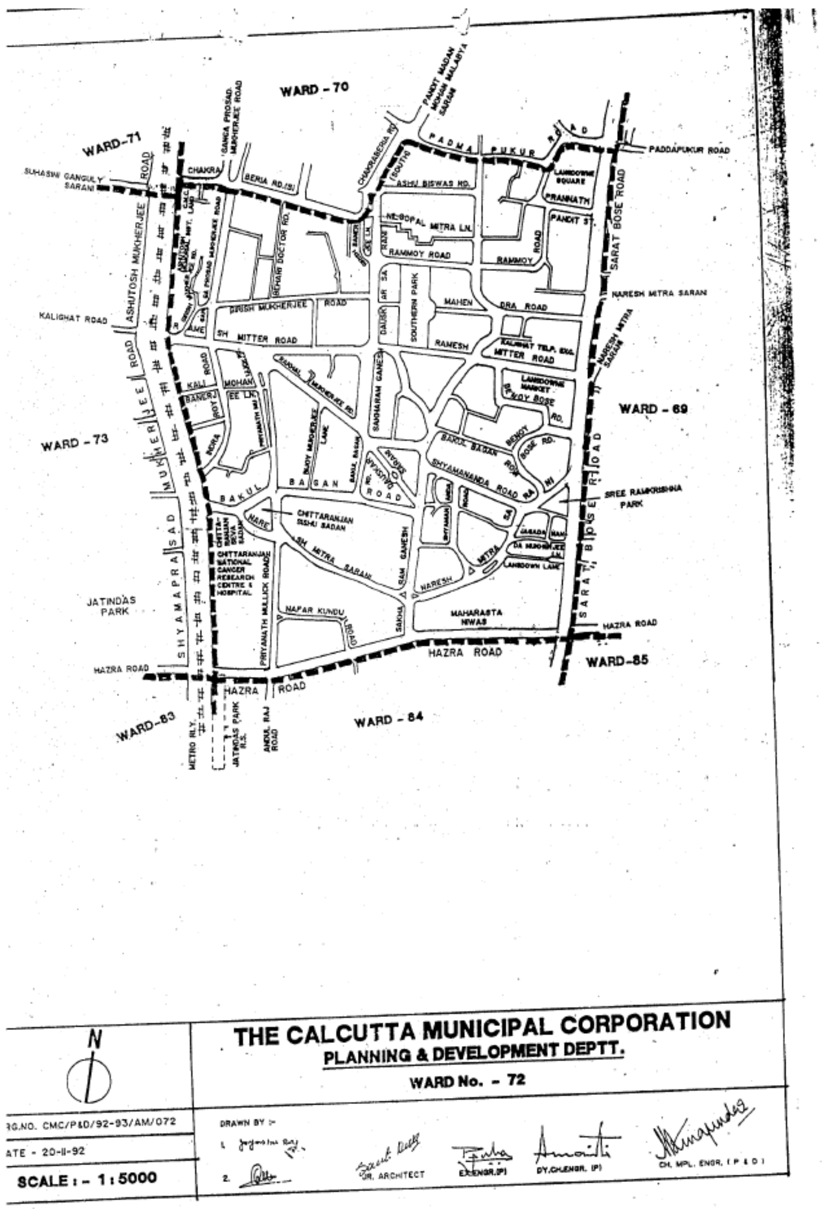



Source: Census of India, 2001

**141 Wards of Kolkata, West Bengal**




**Schematic Diagram of the Administrative Structure in Each District in West Bengal (India)**




Source: Kolkata Municipal Corporation (2011)

**Map of Ward No. 72 provided by the Kolkata Municipal Corporation**

**Enumeration of Units at Different Sampling Stages Preceding the Selection of Households as Ultimate Units**

| South 24 Parganas | | | | | | |
|---|---|---|---|---|---|---|
| **Sub-division** | | | **Gram Panchayat** | **Gram Sansad** | **Mouzas** | **Wards** |
| **Alipore (Sadar)** | **Blocks** | Bishnupur - I | 11 | 156 | 87 | |
| | | Bishnupur - II | 11 | 153 | 62 | |
| | | Budge-Budge-I | 6 | 74 | 16 | |
| | | Budge-Budge-II | 11 | 126 | 64 | |
| | | Thankurpukur Mahestala | 6 | 95 | 39 | |
| | **Municipalities** | Budge Budge | | | | 20 |
| | | Pujali | | | | 15 |
| | | Maheshtala | | | | 35 |
| **Baruipur** | **Blocks** | Baruipur | 19 | 261 | 138 | |
| | | Bhangore - I | 9 | 140 | 83 | |
| | | Bhangore - II | 10 | 136 | 60 | |
| | | Joynagar - I | 12 | 152 | 72 | |
| | | Joynagar - II | 10 | 142 | 49 | |
| | | Kultali | 9 | 130 | 46 | |
| | | Sonarpur | 11 | 120 | 75 | |
| | **Municipalities** | Baruipur | | | | 17 |
| | | Rajpur Sonarpur | | | | 33 |
| | | Joynagar-Majilpur | | | | 14 |
| **Diamond Harbour** | **Blocks** | Diamond Harbour - I | 8 | 98 | 71 | |
| | | Diamond Harbour | 8 | 126 | 92 | |
| | | Falta | 13 | 181 | 133 | |
| | | Kulpi | 14 | 183 | 182 | |
| | | Magrahat - I | 11 | 164 | 90 | |
| | | Magrahat - II | 14 | 194 | 84 | |
| | | Mandirbazar | 10 | 142 | 112 | |
| | | Mathurapur - I | 10 | 129 | 99 | |
| | | Mathurapur - II | 11 | 152 | 27 | |
| | **Municipalities** | Diamond | | | | 16 |
| **Kakdwip** | **Blocks** | Kakdwip | 11 | 150 | 39 | |
| | | Namkhana | 7 | 110 | 39 | |
| | | Pathar Pratima | 15 | 218 | 92 | |
| | | Sagar | 9 | 124 | 47 | |
| **Canning** | **Blocks** | Basanti | 13 | 201 | 67 | |
| | | Canning - I | 10 | 173 | 61 | |
| | | Canning - II | 9 | 124 | 62 | |
| | | Gosaba | 14 | 170 | 51 | |

# APPENDIX B: MALARIA SCENARIO IN KOLKATA CITY (2005-2010) ; ESTIMATED VECTOR CONTROL COSTS FOR KOLKATA MUNICIPAL CORPORATION (2011-2012); AND PRIVATE-PUBLIC WTP ESTIMATES

**Table III: Malaria scenario in the city of Kolkata**

| Month | 2005 | | 2006 | | 2007 | | 2008 | | 2009 | | 2010 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cases | Pf | Cases | Pf | Cases | Pf | Cases | Pf | Cases | Pf | Cases | Pf |
| January | 716 (10.2) | 106 | 586 (9.1) | 120 | 618 (8.3) | 65 | 398 (7.0) | 40 | 975 (11.9) | 106 | 935 (13.2) | 215 |
| February | 751 (8.7) | 56 | 716 (9.0) | 47 | 664 (9.6) | 40 | 420 (6.3) | 24 | 912 (9.8) | 127 | 1440 (12.5) | 149 |
| March | 1398 (12.5) | 26 | 1181 (11.3) | 20 | 1040 (12.8) | 27 | 548 (8.2) | 8 | 1144 (15.0) | 19 | 1630 (17.2) | 59 |
| April | 1683 (15.0) | 9 | 1427 (19.5) | 8 | 1551 (21.9) | 5 | 668 (9.9) | 10 | 2042 (23.7) | 156 | 2946 (24.1) | 48 |
| May | 1487 (15.6) | 8 | 2169 (19.2) | 17 | 2039 (23.8) | 9 | 1162 (12.5) | 2 | 2384 (15.9) | 58 | 3962 (24.7) | 41 |
| June | 3579 (14.9) | 11 | 4392 (16.7) | 26 | 2960 (14.7) | 22 | 1362 (11.3) | 12 | 3151 (24.8) | 59 | 4090 (24.2) | 31 |
| July | 3821 (16.4) | 36 | 5749 (22.9) | 78 | 2985 (19.7) | 64 | 3207 (18.6) | 126 | 6663 (32.9) | 613 | 10842 (25.6) | 486 |
| August | 7211 (15.4) | 144 | 8000 (22.0) | 271 | 4267 (26.5) | 158 | 6651 (25.1) | 341 | 15156 (35.3) | 1872 | 15104 (33.7) | 1208 |
| September | 17891 (16.0) | 670 | 10063 (27.3) | 733 | 4590 (22.4) | 268 | 9689 (25.2) | 873 | 22035 (33.7) | 3016 | 20118 (30.7) | 2699 |
| October | 9046 (22.1) | 750 | 8372 (19.6) | 860 | 4456 (17.7) | 341 | 15426 (28.5) | 3284 | 18554 (31.2) | 4446 | 18869 (31.4) | 4202 |
| November | 6858 (22.8) | 1036 | 8062 (19.0) | 1438 | 4600 (16.0) | 533 | 9847 (23.0) | 3684 | 10732 (30.5) | 3729 | 12500 (25.8) | 3629 |
| December | 2233 (15.2) | 564 | 1485 (14.0) | 322 | 1246 (11.1) | 219 | 1888 (17.9) | 931 | 3675 (21.6) | 1390 | 4257 (20.5) | 1459 |
| **Total** | **57674 (16.7)** | **3416** | **52202 (19.8)** | **3940** | **31016 (17.7)** | **1751** | **51266 (21.7)** | **9335** | **87423 (29.0)** | **15926** | **96693 (27.2)** | **14226** |

Source: Kolkata Municipal Corporation (KMC)

**Malaria Scenario in Kolkata**

**ESTIMATED BUDGET FOR VECTOR CONTROL ACTIVITIES IN 2011-2012**

| Sl No | Item | Qty. reqd. | Rate/lt /kg (Rs) | BI Code | Financial involvement (Rs) |
|---|---|---|---|---|---|
| 1 | Temephos 50% EC | 2000 L | 1400.00 | 6221/500 | 2800000.00 |
| 2 | Bti-WP | 6000 Kg | 1100.00 | ” | 6600000.00 |
| 3 | Bti-12AS | 4000 L | 1350.00 | ” | 5400000.00 |
| 4 | Lambdacyhalothrin 10% WP | 1500 Kg | 2100.00 | ” | 3150000.00 |
| 5 | Pyrethrum 2% extract | 750 L | 450.00 | ” | 337500.00 |
| 6 | Diesel | 25000 L | 45.00 | ” | 1125000.00 |
| 7 | Petrol | 5000 L | 60.00 | ” | 300000.00 |
| 8 | Mobil | 250 L | 100.00 | ” | 25000.00 |
| 9 | Phenyl | 50 L | 50.00 | ” | 2500.00 |
| 10 | Miscellaneous | | | ” | 150000.00 |
| 11 | Surveillance team comprising 5 volunteers of Baishakhi Sangha | 5 persons | 4654.00 | 6221/600 | 279240.00 |
| 12 | KMC-deployed contractual FWs | 699 | 4654.00 | ” | 39282402.00 |
| 13 | KMC-deployed Contractual Lab Techs | 119 | 6000.00 | ” | 8609650.00 (inclusive of exgratia) |
| | Agency-provided contractual FWs | 201 (151+ 50) | 5492.00 | ” | 13317054.00 (inclusive of exgratia) |
| 14 | Contractual Sweeper | 1 | 4654.00 | ” | 56198.00 (inclusive of exgratia) |
| 15 | Contractual Consultant Entomologists | 3 | 22000.00 | ” | 793050.00 (inclusive of exgratia) |
| 16 | Maintenance of sprayers, fogging machines and the office building | | | 6221/400 | 2000000.00 |
| 17 | Brass knapsack sprayer | 500 | 2500.00 | 6221/800 | 1250000.00 |
| 18 | Van Fog machine | 25 | 25000.00 | ” | 625000.00 |
| **Total** | | | | | **8,61,02,594.00** |
| 19 | RAS team | 50 | | | 3857600/- |
| 20 | Training & Maintenance | | | | 1,00000/- |
| 21 | IEC | | | | 50,00000/- |
| | | | | | 94260194 |

Source: Kolkata Municipal Corporation (KMC)

**Estimated Budget of Vector Control Activities by KMC**

**Table 25: WTP Estimates for Public and Private Malaria Control Interventions (Based on Percentage Risk Reductions)**

| Sample | Model | Risk Coeffcient | Price Coefficient | WTP (in Rs.) |
|---|---|---|---|---|
| Full | Public | 0.041 | 0.003 | 13.7 |
| | Private | 0.028 | 0.003 | 9.3 |
| Urban | Public | 0.23 | 0.002 | 115.0 |
| | Private | 0.052 | 0.003 | 17.3 |
| Rural | Public | 0.122 | 0.121 | 1.0 |
| | Private | 0.004 | 0.004 | 1.0 |

# APPENDIX C: PROPERTIES OF UTILITY AND RISK FUNCTIONS

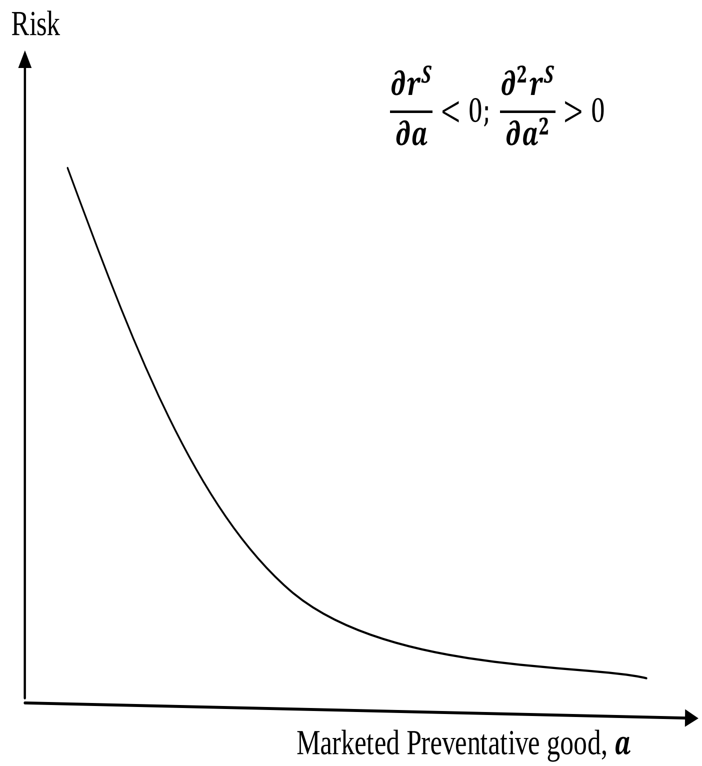



**Figure 4:The Risk Function: Risk as a function of Marketed Preventive Good**

Although, successive reductions in $R^S$ decline from buying each additional unit of $a$ successively, the algebraic sign of $\frac{\partial^2 r^S}{\partial a^2}$ is positive, akin to the characteristics of the function illustrated in Simon and Blume (1994; pp.43-44, Fig 3.6).

$$\boldsymbol{\partial U / \partial R^S} < 0 \ ; \ \boldsymbol{\partial^2 U / \partial R^{S^2}} < 0$$

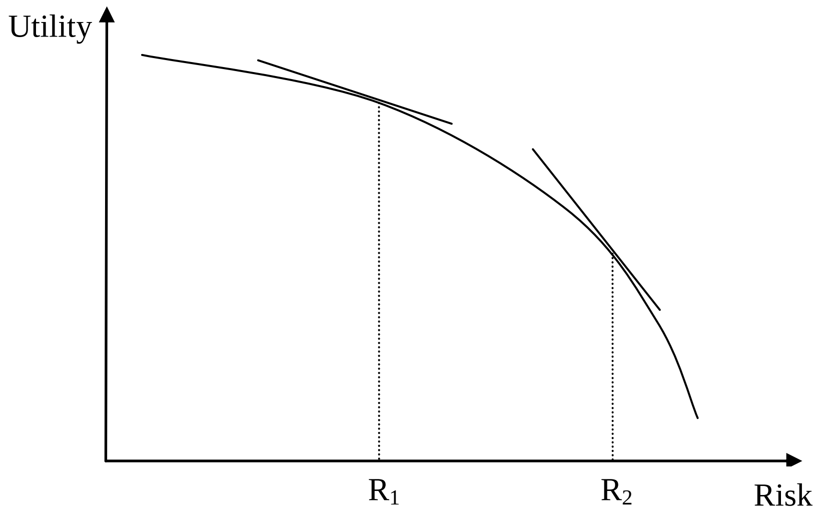



**Figure 5:The Utility Function: Utility as a function of Risk**

Following Simon and Blume (1994; p. 44) the utility function with risk as an argument can be considered as a decreasing function which is concave downwards. Risk generates disutility to the individual $\partial U/\partial R^S < 0$ . In addition, as risk increases, the marginal disutility is higher as indicated by the slope of $U(R^S)$ at $R_2$ as compared to $R_1$ i.e., $\partial^2 U/\partial R^{S^2} < 0$ , i.e., at higher levels of risk, an additional increase in risk brings about a substantial decrease in the utility levels.

# APPENDIX D: IRB HUMAN RESEARCH APPROVAL, APPROVAL OF THE TRANSLATED QUESTIONNAIRE, INTRODUCTION LETTERS FOR SURVEY PERSONNEL ON SITE

University of Central Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

## Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
**FWA00000351, IRB00001138**

To: **Shreejata Samajpati** and Co-PIs if applicable:

Date: **August 24, 2011**

Dear Researcher:

On 8/24/2011, the IRB approved the following activity as human participant research that is exempt from regulation:

| | |
|---|---|
| Type of Review: | Exempt Determination |
| Project Title: | Malaria Risk and Prevention Survey |
| Investigator: | Shreejata Samajpati |
| IRB Number: | SBE-11-07808 |
| Funding Agency: | University of Central Florida( UCF ) |
| Grant Title: | N/A |
| Research ID: | N/A |

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 08/24/2011 04:40:41 PM EDT

Joanne Muratori

IRB Coordinator

Govt. of West Bengal
পশ্চিমবঙ্গ সরকার

Bethune College, 181, Bidhan Sarani
Kolkata - 700 006
Tel. : 2241-1731 (PBX), 2257-1712 (Office)
Telefax : 2219-2097
e-mail : bethunecollege@vsnl.net

বেথুন মহাবিদ্যালয়, ১৮১, বিধান সরণী
কোলকাতা - ৭০০ ০০৬
দূরভাষ ঃ ২২৪১-১৭৩১ (PBX)

Date / তারিখ ঃ 24th AUGUST, 201

To / প্রাপক ঃ

Shreejata Samajpati,
Principal Investigator,
Malaria Risk and Prevention Survey,
Department of Economics,
University of Central Florida.

Dear Ms. Samajpati,

With regard to the request you placed to examine the accuracy of translation of the survey instruments pertaining to the Malaria Risk and Prevention Survey, 2011, I hereby certify the following on reading both the English and Bengali versions of the instruments:

1) The English and Bengali versions of the consent forms match. The contents of the English version have been translated properly. Hence, the Bengali version adequately conveys the meaning that the English version represents.

2) The English and Bengali versions of the questionnaires conform to each other in meaning and comprehension.

3) The English and Bengali versions of the pre-test questionnaires match.

Thus, I endorse the propriety of the translated versions of your survey instruments.

Thanks.

Rupa Banerjee
24/8/2011

Associate Professor
Bethune College, Kol-6
Govt. of W. B.

Rupa Banerjee nee Samajpati,
Associate Professor,
Department of Bengali,
Bethune College,
181, Bidhan Sarani,
Kolkata-700006
Office Tel: +91-33-22571712
Cell: +91-9830021418

Date : 28/10/2011

To Whom It May Concern

This is to inform you that an academic research work titled "Malaria Risk and Prevention Survey 2011' funded by the Department of Economics, University of Central Florida (UCF), USA, is currently taking place in Ward No. 72 of Kolkata. This field survey pertains to the PhD dissertation of Ms. Shreejata Samajpati, Doctoral Candidate of Economics at UCF, who is organizing and overseeing the survey.

The undersigned are aware that the above survey has been approved by the Institutional Review Board of UCF, USA (IRB NUMBER: SBE-11-07808; IRB APPROVAL DATE: 8/24/2011 ). It is our request to the residents of Ward No. 72 that you please cooperate with Ms. Samajpati and her survey assistants who will visit the households in the area shortly, in connection with the above research work, over the period November-December, 2011.

Thanking you,

Shelby Gerking
(Professor of Economics , UCF,
& PhD Committee Chair)

Mark Dickie
(Department Chair, UCF,
& PhD Committee Member)

Michael Caputo
(Professor of Economics, UCF,
& PhD Committee Member)

Joyashree Roy,

(Professor of Economics, Jadavpur University
& External PhD Committee Member)

Satchidananda Banerjee
(Chairman, Kolkata Municipal Corporation)
Chairman
THE KOLKATA MUNICIPAL CORPORATION

Date: 9/11/2011

To Whom It May Concern

This is to inform you that an academic research work titled "Malaria Risk and Prevention Survey 2011' funded by the Department of Economics, University of Central Florida (UCF), USA, is currently taking place in Ward No. 72 of Kolkata. This field survey pertains to the PhD dissertation of Ms. Shreejata Samajpati, Doctoral Candidate of Economics at UCF, who is organizing and overseeing the survey.

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Thanking you,

Krishna Nandy 9/11/11

Krishna Nandy,
Councillor, Ward 72,
The Kolkata Municipal Corporation.

KRISHNA NANDY
Councillor
Ward No - 72
Kolkata Municipal Corporation

9/11/11

Atin Ghosh
Member,Mayor-in-Council (Health),
The Kolkata Municipal Corporation.

**ATIN GHOSH**
***Member,***
***Mayor - in - Council, Health***
***The Kol, Municipal Corporation***

তারিখ: ৩১/১০/২০১১

# একটি ঘোষণা

খুব সম্প্রতি কলকাতার ৭২ নং ওয়ার্ড এ ইউনিভার্সিটি অফ সেন্ট্রাল ফ্লোরিডার (UCF, USA) অর্থনীতি বিভাগ পরিচালিত "ম্যালেরিয়া রোগ ও তার প্রতিরোধ বিষয়ক সার্ভে" নামক একটি গবেষণা আরম্ভ হয়েছে। গবেষণাটির মূল উদ্দেশ্য কলকাতা ও পার্শ্ববর্তী অঞ্চলে ম্যালেরিয়া রোগ সম্পর্কে মানুষের মতামত জানা, ম্যালেরিয়া রোগ প্রতিরোধে কী কী ব্যবস্থা মানুষ নিয়ে থাকেন তা পরিমাপ করা।

এই সার্ভেটি UCFএর অর্থনীতি বিভাগে গবেষণারত ছাত্রী শ্রীমতি শ্রীজাতা সমাজপতি র PhD গবেষণার অঙ্গ। শ্রীমতি সমাজপতির তত্ত্বাবধানে এই সার্ভেটি পরিকল্পিত ও অনুষ্ঠিত হচ্ছে।

আমি অবগত যে সার্ভেটি মানবজাতি বিষয়ক রিভিউ বোর্ড ( Institutional Review Board, UCF, USA) এর পর্যালোচনা পর্বে উত্তীর্ণ হয়ে যথাযথ অনুমোদন প্রাপ্ত হয়েছে ( অনুমোদন নং : SBE-11-07808 ; অনুমোদন তারিখ : 08/24/2011 )। নভেম্বর-ডিসেম্বর, ২০১১ এর মধ্যে খুব শীঘ্রই এই সার্ভেতে কর্মরত সার্ভে পার্সোনেলরা আপনার গৃহে আসতে পারেন। ৭২ নং ওয়ার্ড এর সকল অধিবাসীবৃন্দর কাছে আন্তরিক অনুরোধ যে আপনারা এই সার্ভেটিতে দয়া করে অংশগ্রহণ করুন। আমার বিশ্বাস আপনাদের সহযোগিতায় এই গবেষণাটি সাফল্যমন্ডিত হয়ে উঠবে।

ধন্যবাদান্তে -

সচ্চিদানন্দ ব্যানার্জী,
চেয়ারম্যান, কলকাতা পুরসভা
চেয়ারম্যান
কলকাতা পৌরসংস্থা

# APPENDIX E: QUESTIONNAIRE

## Malaria Risk and Prevention Survey
## August-December, 2011
## -Questionnaire-

EXPLANATION OF RESEARCH

Title of Project: Malaria Risk and Prevention Survey
Principal Investigator: Shreejata Samajpati
Faculty Supervisor: Shelby Gerking

You are being invited to participate in a research study. Whether you take part is up to you.

- The purpose of this research is to understand what people living in and around Kolkata believe their own risks are for getting malaria and the prevention measures they take in this regard.

- You are invited to participate in a survey about malaria prevention. If you agree to participate, you will be asked questions regarding your beliefs about risks of malaria. If you participate you will also be asked about the value to you of malaria prevention. The survey includes questions on what you and your family do on malaria prevention as well as some background questions about your family.

- Your knowledge and opinions are important for this study. There is no right or wrong answer to the survey questions. If you participate, please answer the questions as thoughtfully as you can. The survey will take place in the privacy of your home, if you agree.

- The survey takes about 25-30 minutes on average. Please take the survey now only if you can give it your full attention at the present moment. Your participation is completely voluntary. You do not have to answer any question that you do not wish to answer. You may withdraw from the survey at any time without prejudice or penalty. We thank you in advance for your time and careful attention to this survey.

You must be 18 years of age or older to take part in this research.

**Study Contact for questions about the study or to report a problem**: If you have questions, concerns, or complaints: Shreejata Samajpati, Graduate Student, Department of Economics, University of Central Florida, Box 161400, Orlando, FL 32816-1400, at 91-9831675798 (Kolkata); shreejata.samajpati@gmail.com; ssamajpati@bus.ucf.edu.You may also contact Dr. Shelby Gerking, Faculty Supervisor and Professor, Department of Economics, University of Central Florida, Box 161400, Orlando, FL 32816-1400, at 407-823-4729; or email at sgerking@bus.ucf.edu.

**IRB contact about your rights in the study or to report a complaint**: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research and Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at 407-823-2901.

Do you agree to take part in the survey? **[TICK ANY ONE]**

- Yes **[ IF "YES" THANK THE RESPONDENT, GIVE THE INFORMATION SHEET TO THE RESPODENT AND CONTINUE WITH THE SURVEY]**
- No **[ IF "NO" TERMINATE THE INTERVIEW; ASK IF THE RESPODENT WOULD LIKE TO KEEP THE INFORMATION SHEET AND THANK THE RESPONDENT; MOVE TO THE NEXT SELECTED HOUSEHOLD]**

**BACKGROUND INFORMATION:**

Questionnaire number: ______________________

Name of the Interviewer: _____________________

Date: ____________________________________

Time Start: ________ Time Finish: _________

**[FILL UP THE FOLLOWING BEFORE PART I OF THE SURVEY STARTS]**

1. Age of the Respondent ______________________ **[IF RESPONDENT IS BELOW 18 YEARS OF AGE , TERMINATE THE INTERVIEW AND THANK THE RESPONDENT; MOVE TO THE NEXT SELECTED HOUSEHOLD]**

2. Location type **[TICK ANY ONE]**
   - Urban Area ______ [**GO TO Q 3 ]**
   - Rural Area ________ **[GO TO Q 4 ]**

3. **[IF URBAN IN Q 2 ]** Area of Residence:

   (i) Ward No : __________________

   (ii) Slum ☐ Non-Slum ☐ **[TICK ANY ONE ]**

4. **[IF RURAL IN Q 2]**, Area of Residence:
   - Gram Panchayat Name : ___________

## PART I: DEMOGRAPHICS

### RT A: DEMOGRAPHICS

**A1**. Before we get started on talking about malaria-related health issues, please tell me a bit about you and other people living with you in your house:

| List of. Members In the family (1) | Relationship with the head of the hh (2) | Age ( in years) (3) | Sex 1. M 2. F **[TICK /CIRCLE ANY ONE OPTION IN EACH ROW ]** (4) | Marital Status 1. Unmarried 2. Married 3.Separated 4.Divorced 5.Widowed 6.Living together (5) | Highest level of education attained (6) | Earning member in the hh? Yes /No **[TICK/CIRCLE ANY ONE OPTION IN EACH ROW ]** (7) | Occupation **[IF YES IN COL7]** (7.1) | Religion 1.Hindu 2. Muslim 3Christian 4.Jain 5. Other(Please Specify) (8) |
|---|---|---|---|---|---|---|---|---|
| 1**Respondent | | | M F | | | Yes No **[IF YES, ASK COL 7.1 & Q A2]** | | |
| 2 | | | M F | | | Yes No | | |
| 3 | | | M F | | | Yes No | | |
| 4 | | | M F | | | Yes No | | |
| 5 | | | M F | | | Yes No | | |
| 6 | | | M F | | | Yes No | | |

Table 1

**CODES: DON'T SHOW CODES TO RESPONDENT AND DO NOT USE CODES WHILE REPORTING:**

| **Relationship with the head of the hh** | **Marital Status** | **Highest level of Education Attained** | **Occupation** | **Religion** |
|---|---|---|---|---|
| 1.Head<br>2.Wife ( or spouse )<br>3.Son/Daughter<br>4. Spouse of Son/Daughter<br>5.Brother/Brother-in-law<br>6.Sister/Sister-in-law<br>7.Parent<br>8.Grandchild<br>9.Other | 1. Unmarried<br>2. Married<br>3.Separated<br>4.Divorced<br>5.Widowed<br>6.Living together | 1.Below Class 1<br>2.Class 1-5<br>3.Class 5-10<br>4.Class 10-12<br>5. B. A./ B.Sc<br>6. M.A./ M.Sc<br>7.PhD<br>8. Vocational education<br>9. Not literate<br>10.Other | 1.Teacher<br>2.Service (Govt.)<br>3. Service (Private/Corporate)<br>4.Doctor<br>5.Business<br>6. Self-employed<br>7. Unemployed<br>8. Student<br>9. Housewife<br>10.Other | 1.Hindu<br>2. Muslim<br>3. Christian<br>4.Jain<br>5. Other |

**A2. [IF RESPONDENT IS AN EARNING MEMBER, I.E., SAID YES TO COLUMN 7, ROW 1, IN Q.A1]** Since you said you contribute to family income, what is the category you think best describes **YOUR approx. average monthly income**?

**[READ ALOUD EACH ROW AND TICK ANY ONE ROW]**

| **Income Category (in Rs.)** | **Yes** |
|---|---|
| [1] <5000 | |
| [2] 5000-9999.99 | |
| [3] 10000-14999.00 | |
| [4] 15000-19,999.00 | |
| [5] 20,000-24,999.99 | |
| [6] 25,000-29,999.99 | |
| [7] Above 30,000 | |
| [8]Don't Know | |
| [-95] Cannot Remember | |
| [9] Refuse to Answer | |

Table 2

**A3.** What is the category you think best describes the **average monthly income** of your **HOUSEHOLD**, considering all the earning members in your family?

**[READ ALOUD EACH ROW AND TICK ANY ONE ROW]**

| **Income Category (in Rs.)** | **Yes** |
|---|---|
| [1] <5000 | |
| [2] 5000-9999.99 | |
| [3] 10000-14999.00 | |
| [4] 15000-19,999.00 | |
| [5] 20,000-24,999.99 | |
| [6] 25,000-29,999.99 | |
| [7] Above 30,000 | |
| [8]Don't Know | |
| [-95] Cannot Remember | |
| [9] Refuse to Answer | |

Table 3

**A4.** What is the approx. **monthly average expenditure** of your **HOUSEHOLD**, considering all the earning family members in your family?

**[READ ALOUD EACH ROW AND TICK ANY ONE ROW]**

| **Expenditure Category ( in Rs.)** | **Yes** |
|---|---|
| [1] <5000 | |
| [2] 5000-9999.99 | |
| [3] 10000-14999.00 | |
| [4] 15000-19,999.00 | |
| [5] 20,000-24,999.99 | |
| [6] 25,000-29,999.99 | |
| [7] Above 30,000 | |
| [8]Don't Know | |
| [-95] Cannot Remember | |
| [9] Refuse to Answer | |

Table 4

**A5.** Is there any child aged between 0-10 years in your family? **[TICK ANY ONE]**

- Yes __________
- No ___________

**A6.** Do you belong to the Scheduled Caste (SC)/ Scheduled Tribe (ST)/ Other Backward Classes (OBC)? **[TICK ANY ONE]**

- Yes **[IF YES, TICK ANY ONE]**: → SC ☐ ; ST ☐ ; OBC ☐
- No

**A7.** How long have you been staying in the present household that you are currently living in? (In years, months, etc) ______________________

## PART II: YOUR VIEWS ON YOUR OWN HEALTH STATUS AND PAST MALARIA-RELATED EXPERIENCES

We move into that part of the survey where we will discuss about your health status, how you have been in the past and how feel at the current times:

**B1**. How do you want to describe your current overall health-condition? **[READ ALOUD EACH OPTION AND TICK ANY ONE]**

- Excellent
- Very Good
- Good
- Fair
- Poor

**B2**. Have you suffered from Malaria in the last 2 years? **[TICK ANY ONE]**

- Yes. ___**[IF YES]** ⟶ No. of times suffered in the last two years ___**[GO TO Q B3 ]**
- No. ___________**[GO TO Q B3.1]**
- Do not Remember ____**[GO TO Q B3.1]**

**B3. [IF YES TO Q B2, FILL UP THE FOLLOWING SPACES]**

**Your Own** Malaria-Related Experiences:

| Ep sd. | Year of Occurrence (1) | Malignant Yes No (2) | No of Days Suffered? (3) | Who diagnosed it? (4) | Who did you seek treatment from? (5) | Were you hospitalized? Yes No (6) | What medicines you took to cure malaria? (7) | Approx. total Expenditure Incurred (in Rs.) (8) | Did you miss work/ school? Yes No (9) | How many days have you missed work? (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ep. 1 | | Y N | | | Y N | | | | Y N | |
| Ep. 2 | | Y N | | | Y N | | | | Y N | |
| Ep. 3 | | Y N | | | Y N | | | | Y N | |
| Ep. 4 | | Y N | | | Y N | | | | Y N | |

Table 5

**B3.1 [RANDOMLY PICK A FAMILY MEMBER FROM THE TABLE IN Q A1 IN PART I ]**

Has ___[**MENTION THE CONCERNED PICKED FAMILY MEMBER'S RELATIONSHIP WITH THE HEAD OF THE HOUSEHOLD**] suffered from malaria in the past 2 years? **[TICK ANY ONE OPTION]**

- Yes **[IF YES]** → No. of times he/she suffered in the last two years ______**[GO TO Q. B3.11]**
- No ___________ **[GO TO Q. B4]**
- Do not Remember **[GO TO Q. B4]**

**B3.11 : Some Details about HIS/ HER ( ie the family-Member's Malaria-Related Experiences)**

**Other Family-Member's** Malaria-related Experiences:

| Episode | Year of Occurrence (1) | Malignant Yes No (2) | No of Days Suffered (3) | Who diagnosed it? (4) | Treatment sought from? (5) | Was he/she Hospitalized? Yes No (6) | What medicines were taken to cure malaria? (7) | Approx. total Expenditure Incurred (in Rs.) (8) | Did he/she miss work/ school? Yes No (9) | How many days has he/she missed work? (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ep. 1 | | Y N | | | | Y N | | | Y N | |
| Ep. 2 | | Y N | | | | Y N | | | Y N | |
| Ep. 3 | | Y N | | | | Y N | | | Y N | |
| Ep. 4 | | Y N | | | | Y N | | | Y N | |

Table 6

| Column 4: ( Who Diagnosed it) | Column 5 ( Sought Treatment from ) | Column 7 ( What medicines were taken to cure malaria) |
|---|---|---|
| **[1] Went to the KMC health facility and took blood samples<br>[2] Diagnosed by health worker at the KMC health facility, no blood sample<br>[3] Diagnosed by a private doctor<br>[4] Went to a government hospital<br>[5] Went to a private nursing home<br>[6] Traditional healer<br>[7] Friend or relative<br>[8]We diagnosed it ourselves<br>[95] Other<br>[-9] Don't know<br>[10] Don't Remember** | **[1] KMC Doctor<br>[2] Private Doctors<br>[3] Government hospital<br>[4] Private Nursing Home<br>[5] Doctors of Alternative Medicine ( Homeopathic etc.)<br>[6] Herbal Medicine at home<br>[7] Did not seek treatment at all<br>[95] Other<br>[-9] Don't know<br>[10] Don't Remember** | **[1] Chloroquine<br>[2] ACT<br>[95] Other medicines<br>[-9] Don't know<br>[10] Don't Remember** |

**B4: What do you think causes Malaria?**

| Question: | [TICK ALL THAT APPLY : DO NOT READ ALOUD] |
|---|---|
| **B4**. What do you think causes Malaria? | • [1] Mosquitoes<br>• [2]Polluted water<br>• [3]Getting wet in the rain<br>• [4]Flea/Tick bite<br>• [5]Unclean environment<br>• [6]Clean stagnant water<br>• [95]Other ___________________<br>• [-9]Don't know/Can't say |

Table 7

**B5: Are mosquitoes present in your household?**

| Question: | [TICK ANY ONE] |
|---|---|
| **B5.** Are Mosquitoes present in your household? | • [1] Yes<br>• [2] No<br>• [-9] Don't Know/Can't say |

Table 8

**B6: What factors do you think affect the number of mosquitoes that you confront?**

| Question: | [TICK ALL THAT APPLY: DO NOT READ ALOUD] |
|---|---|
| **B6.** What factors do you think affect the number of mosquitoes that you confront? | • [ 1 ] Amount of rainfall<br>• [ 2 ] Amount of stagnant water<br>• [ 3 ] Cleanliness of community or household surroundings/dirty environment<br>• [ 4 ] Temperature<br>• [ 95 ] Other ___________________<br>• [-9 ] Don't know/can't say |

Table 9

## PART III: FUTURE HEALTH-RISKS OF MALARIA

In this part of the survey we will discuss about what you believe your chances are of getting malaria in the future. In other words, we will ask for your opinion on malaria risks for yourself. To help you pin down your answers on malaria risks, we want you to use these colored cards. These are named as "Malaria Cards" **[SHOW THE BOARD CONTAINING THE 11 BI-COLORED CARDS]** .

In a moment you will have pick any one of these 11 cards. But, before that, let me tell you how each of these cards measures beliefs about malaria risks. This will help you give an idea how to pick one card that best represents your own belief about getting malaria.

On this board, there are 11 cards in all. In each card there are 10 squares. Some of them are colored **Red** while some are **Blue**. Blue means the possibility that malaria would not occur. Red means the possibility that malaria would occur. The distribution of red and blue squares in each card indicates out of 10 chances (recall there are 10 squares) what someone believes to be his/her own chance of getting malaria. In other words, the number of red squares indicate the risk-level ( out of 10) associated with each card.

e.g. The first card on the top, labeled "0" **[ POINT TO CARD NO. "0"]**, is all blue and hence, means that out of 10 chances, there is "0" chance that malaria would occur (i.e., the risk –level is "0") . This is because there is no (that is zero number of) red-colored square in this card. On the other hand, the card labeled "6" " **[POINT TO CARD NO. "6"]**, has 6 red squares out of 10 squares and the rest are blue. This means that out of 10 there are 6 chances that malaria may occur (i.e. risk-level is 6 ). We can also pick, say, the card labeled "10" **[POINT TO CARD NO. "10"]**, where all the 10 squares are colored red, thereby implying that out of 10 chances , malaria is sure to happen. As one moves down the board from card "0" through "10" , the number of red squares in each card increases in comparison with the number of blue cards. Since Red stands for malaria risk, this implies that as we move down the board, the belief that malaria would occur gets bigger. Thus, if someone believes that his/her chances of getting affected by malaria are big , he/she would pick a card towards the bottom rather than the cards towards the top and vice versa.

**C1.** Now it is time for us to practice choosing amongst the cards. Suppose I pick Card No "4" and Card No. "8" . Between these two cards **[POINT TO CARD NOS. "4" AND "8"]** which card do you think represents a greater belief/ risk (out of 10 chances) that malaria would occur? Notice the distribution of red and blue over the 10 squares in each of the cards carefully and answer.

**[READ ALOUD AND TICK ANY ONE OPTION]**

Card 8 __________You are absolutely right ! Congrats! **[ASK Q. C2]**

Card 4__________ Sorry your answer is wrong. No problem, I will explain the matter again and repeat the question ! **[REPEAT Q C1]**

Second attempt: **[READ ALOUD AND TICK ANY ONE OPTION]**

Card 8 __________You are absolutely right! Congrats! **[ASK Q. C2]**

Card 4__________ Sorry your answer is wrong again. But do not worry, I will explain the cards once more, and we will continue with the survey **[ASK Q. C2]**.

**C2**. Now I will ask a question that requires you to pick one of the cards for yourself to represent your beliefs about **YOUR** own health. Standing at the present moment today when we both are talking about health issues, please think about the day exactly one year from now **[SAY THE DATE].** In this coming one year, out of 10 chances, what do you think your chances are of getting malaria?

Please carefully look at the 11 cards on the board. Recall that each card contains 10 squares. Thus, by observing the distribution of red and blue squares in each card, you can pick one card for yourself that best represents **your** belief that malaria would occur to you in the next one year.

As you think about your chances of getting malaria for the next one year, please remember two things. First, I'm <u>not</u> asking about how serious you think it would be to have malaria, but only about <u>how likely</u> it is that you will get it. Second, no one knows exactly what your chances are of getting malaria. This is a question about your beliefs, not a test of your knowledge. So feel free to express what you believe your risks are and pick any of the cards. There is no right or wrong answer.

**[FILL UP THE FOLLOWING]**

- Card-Number_______**[WRITE THE CARD NO. THAT THE RESPONDENT PICKS]**
- Don't know: _______ **[SKIP Q C3 AND GO TO PART IV]**
- Refuse to Answer: __ **[SKIP Q C3 AND GO TO PART IV]**
- Don't understand the question ___ **[REPEAT Q C2]**

THE FOLLOWING TWO TREATMENTS WILL BE RANDOMIZED AND RESPONDENTS WILL BE RANDOMLY ASSIGNED TO ANY ONE OF THE TWO TREATMENTS

TREATMENT 1:

**[ONLY IF THE RESPONDENT PICKS A CARD LABELED BETWEEN 1-10 IN Q C2 ASK:]**

You just stated what you believe your future malaria risks are. Now I would like you to imagine a situation when a **HYPOTHETICAL** lotion is introduced in the market that reduces **YOUR** own malaria risks. You will be asked to evaluate the lotion. The lotion is named SoftLOtion which you can apply on any part of the body (hands, face, legs etc). Once applied it helps keep away mosquitoes. Thus, your malaria risks come down. Here is a label describing the lotion. **[SHOW RESPONDENT THE LABEL]**

In many ways, the mosquito-control protective lotion would resemble products already on the market. But in other significant ways, the new lotion differs from existing products on the market and have some additional attractive features **[POINT TO "**SoftLOtion® has these added features too**" ON THE LABEL].** E.g., it would be more suitable for all skin types and non-greasy, effective outdoors too and one application of the lotion would last the whole day. But, as in any other skin-care product (say, the face cream you use), SoftLOtion might generate some initial skin-reactions for some people, but they are very minor and are sure to disappear promptly within 1-2 days of use.

How SoftLOtion® Works to Reduce **YOUR** Malaria Risks:

Let me now show you the specific benefits that the lotion offers in terms of reducing the malaria risks you face. If you use SofLOtion regularly for about one year, your malaria risks (that you just stated by picking the card) would reduce by **X % [RANDOMIZED OVER 50/90] .**

Your risk would reduce by the amount that I now show you. Let me open the card that you picked and you can see for that particular card and malaria risk, what is the reduction that the lotion would bring in. You can clearly see that in the card tucked underneath the one that you picked, the distribution of red squares falls by a certain amount, thus protecting you from malaria by that amount. The point of using these cards and colors is to demonstrate to you the effectiveness that the use of the new lotion would bring forth.

**[OPEN THE CARD THAT THE RESPONDENT PICKED IN Q C2 AND OPEN IT. SHOW THE CARD INSIDE AND POINT TO THE REDUCED MALARIA RISKS]**

As we discuss the benefits of the lotion, please consider three things additionally:

- Although not yet introduced in the market, this new product is not free. Thus, once in the market, one has to pay from one's pocket to get it. One who will purchase this product will have less money to spend on other necessary things beside malaria prevention.

- If available on the market, the lotion will be available to partially prevent people from getting malaria.

- Also, some people might say that they do not need the lotion as they are quite sure that the current private prevention they take (say using bed-nets, spraying their homes etc.) will be able to provide them protection.

Having discussed the characteristics of this lotion, now I would like to ask you a question.

**C3.** Would you be willing to pay Rs. T **[RANDOMIZE OVER 55/75/125/225]** to buy the lotion that would reduce your malaria risks by **X % [RANDOMIZED OVER 50/90]**?

Please take a moment to consider all the aspects of the lotion and feel free to express what you would do if this lotion were available in the market:

- Yes, would buy the lotion __________________**[GO TO Q C4]**
- No, would not buy the lotion________________ **[GO TO Q C6]**
- Not sure if would buy the lotion_____________ **[GO TO Q C6]**

**C4. [IF YES TO Q C3]** You said you would be willing to pay Rs. T [**RANDOMIZE]** to buy the mosquito-control lotion, if it were available on the market. If the lotion were actually available, how certain are you that you would really do this? **[READ ALOUD AND TICK ANY ONE]**

1. Definitely **[GO TO Q C5]**

2. Probably **[GO TO Q C5]**

3. Uncertain **[GO TO Q C5]**

**C5. [If YES TO Q C3]** Which is/are the reason/s why you chose to buy the lotion that I just offered?

Please specify the reason/s_________________**[WRITE IN WORDS, SKIP Q C6 AND GO TO PART IV ]**

**C6.** [**IF NO OR NOT SURE TO Q C3]** Which is/are the reason/s why you did not choose / were not sure if you would buy the lotion that I just offered?

Please specify the reason/s______________________________ **[WRITE IN WORDS]**

**[LABEL: FRONT- VIEW]**

New Mosquito-Control

Protective

SoftLOtion ®

*Keeping*

*Mosquitoes*

*Away From*

*You...............*

*.........*

Dermatologist-Tested and

**[LABEL: BACK- OF-THE-BOTTLE- VIEW]**

# New Mosquito-Control Protective SoftLOtion®

*It's better to protect than to treat!*

| Keeps Away Mosquitoes |
|---|
| Used as directed in clinical trials, SoftLOtion® reduced *risk* of malaria occurrence by: |
| 50 %[52] |
| Used as directed in clinical trials, SoftLOtion® had *no* effect on the risk of dying if malaria already occurred |
| |
| SoftLOtion® has the following attractive features for Protection: |
| |
| 1. Keeps Away Mosquitoes<br>2. Does not block skin pores<br>3. Non-greasy and as light as your daily oil-free facial moisturizer<br>4. Comes in a mild floral fragrance<br>5. Protects both indoor and outdoor |
| SoftLOtion® has these added features too : |
| • Suitable for all skin types<br>• Non-greasy<br>• High in herbal content<br>• Effective outdoor<br>• Ultra Long-lasting effectiveness formula<br>• One application lasts long<br>• Hypoallergenic<br>• Does not stain clothes |
| DIRECTIONS: Apply in small amounts to all exposed areas when at home or before going out. |

ACTIVE INGREDIENTS: Diethyl Phenyl Acetamide, Grapefruit Extracts, Aloevera ; See Crimp For Date of Expiry

[52] Or, 90%

TREATMENT 2:

**[ONLY IF THE RESPONDENT PICKS A CARD LABELED BETWEEN 1-10 IN Q C2]**

You just stated what you believe your future malaria risks are. Now please think about a hypothetical situation where the civic authority comes in to play a role in malaria-control in **YOUR COMMUNITY.** What I mean by a "community" is the Ward / Panchayat you live in **[MENTION WARD NO/ PANCHAYAT NAME]**.

Imagine the situation when the civic authority in your Ward/Panchayat introduces a revamped vector-control program and a new swamp-clean drive to be in effect for the next one year, whereby a scientifically tested new chemical would be sprayed to hold mosquitoes in check in the area you live in. Scientists say that exercising vector control programs and taking care in killing mosquito larvae in ponds/swamps go a long way in curbing mosquito breeding and survival. This arrests malaria spread in the nearby areas. The civic bodies, in response, to the threat of malaria in your area, may plan to exercise these efforts specifically tuned for your Ward/ Panchayat which will have the potential to reduce the malaria risks you just stated by choosing the card. But note that since the civic authority exercises malaria-control on a larger scale, the benefits in terms of reduced malaria risks could be enjoyed not only by you but by each of your fellow community-members as well, who live in your Ward/ Panchayat. Please remember that these strategies would provide extra protection from malaria over and above the benefits that the residents in your Ward/Panchayat are currently getting from different community-level programs that are already in effect.

<u>How This Program Works to Reduce Malaria Risks for **YOU** and **YOUR COMMUNITY**</u>

Let me now show you the specific benefits that the vector control program offers in terms of reducing the malaria risks you and your community face. If the civic authority performs this new program for about one year, malaria risks (that you just stated by picking the card) would reduce by **X %** **<u>[RANDOMIZED OVER 50/90]</u> ,** for you and others in the community as well. Risks would reduce by the amount that I now show you. Let me open the card that you picked and you can see for that particular card (i.e. for that level of malaria risk) what is the specific reduction that the new community-level would bring in. You can clearly see that in the new card tucked underneath the one that you picked, the distribution of red squares falls by a certain amount, thus protecting you and others in your community from malaria by that amount. The point of using these cards and colors is to demonstrate to you the effectiveness that the use of the new chemicals would bring forth.

**[OPEN THE CARD THAT THE RESPONDENT PICKED IN Q C2 AND OPEN IT. SHOW THE CARD INSIDE AND POINT TO THE REDUCED MALARIA RISKS]**

As we discuss the benefits of this new government malaria-control, please consider three things additionally:

- Although not yet introduced in your area, the implementation of this new vector-control program is expensive. Thus, opinions on financial contributions from community members (in the form of taxes) is required before a plan for its implementation is finalized. One who pays for the program, has to pay from one's own pocket. Thus, he/she will have less money to spend on other necessary things beside malaria prevention.

- If introduced in your area, the vector-control program will be able to partially prevent people from getting malaria.

- Also, some people might say that they do not need the new vector-control program as they are quite sure that the current private prevention they take and/or the current government/ civic authority programs will be able to provide them enough protection.

Having discussed the characteristics of the new program, now I would like to ask you a question.

**C3.** Under these circumstances, when the civic authority may consider introducing this new mosquito-control program in your Ward/ Panchayat, would you be willing to pay Rs. T **[RANDOMIZE OVER 55/75/125/225]** as financial contribution (e.g. tax) for implementing this community-level program, such that malaria risks for you and others in your community are reduced by X% **[ RANDOMIZE BETWEEN 50/90]**?

Please take a moment to consider all the aspects of this program and feel free to express what you would do if you are asked to contribute to the program:

**[TICK ANY ONE OPTION]**

Yes, would pay the tax _____________ **[GO TO Q C4 AND Q C5]**

No, would not pay the tax __________ **[GO TO Q C6]**

Not sure if would pay the tax _______ **[GO TO Q C6]**

**C4. [IF YES TO Q C3]** You said you would be willing to pay Rs. T **[RANDOMIZE]** as taxes If the civic authority actually implements this new program. How certain are you that you would really pay the tax ? **[READ ALOUD AND TICK ANY ONE]**

1. Definitely **[GO TO Q C5]**
2. Probably **[GO TO Q C5]**
3. Uncertain **[GO TO Q C5]**

**C5. [IF YES TO Q C3]** Which is/are the reason/s why you chose to pay the stated amount of tax for the program that I just spoke about?

Please specify the reason/s_____________________________[WRITE IN WORDS]

**C6**. **[IF NO OR NOT SURE TO Q C3]** Which is/are the reason/s why you did not choose / were not sure to pay the stated amount of tax for the program that I just offered?

Please specify the reason/s___________________ **[WRITE IN WORDS]**

## PART IV : MALARIA PREVENTION BEHAVIOR THAT YOU ALREADY TAKE

In this part of the survey we will discuss about what you and other family members generally do to prevent yourself from mosquito bites and a few other questions:

**D1.** What do you do to protect **Yourself** and **Your Family Members** from Getting Malaria?

| Actions **[TICK ALL THAT APPLY: READ EACH ROW AT A TIME AND COVER ALL COLUMNS FOR EACH ROW &THEN PROCEED TO NEXT ROW]** (1) | Frequency of Use (2) | Approx. Monthly /Initial Expenditure( in Rs.) (3) | Does everyone in your hh. do this ? • Yes • No (4) | | Do all the children in the house take this action? • Yes • No (5) | | What do you think is the most effective way to to prevent malaria ? **[CIRCLE ANY ONE]** (6) |
|---|---|---|---|---|---|---|---|
| [1]Use mosquito nets | | | Y | N | Y | N | 1 |
| [2] Use mosquito repellant creams on the body | | | Y | N | Y | N | 1 |
| [3] Burn mosquito coils | | | Y | N | Y | N | 1 |
| [4] Use electric mosquito mats | | | Y | N | Y | N | 1 |
| [5] Spray insecticide inside/outside home | | | Y | N | Y | N | 1 |
| [6] Do not let water stagnate in any container | | | Y | N | Y | N | 1 |

| | | | | | |
|---|---|---|---|---|---|
| [7] Keep the home surroundings clean | | | Y N | Y N | 1 |
| [8] Use Window Nets | | | Y N | Y N | 1 |
| [9] Use Fans | | | Y N | Y N | 1 |
| [10] Burn plants/ herbs | | | Y N | Y N | 1 |
| [11]Take anti-malarial drugs | | | Y N | Y N | 1 |
| [95] Other ( Specify)_________ | | | | | 1 |
| [-9] Do not know | | | | | 1 |
| [ -8] Do not take any action | **( Go to Q D2)** | | | | |

Table 10

| **Column 2 ( Frequency of Use)** |
|---|
| • [1] Everyday throughout the year<br>• [2] Not so regularly<br>• [3] Only rainy season<br>• [-95]Don't know |

**D2. Why do you not take any preventive action for malaria? [ONLY ASK THOSE WHO SAY THEY DO NOT TAKE ANY PREVENTIVE ACTION in Q D1]**

| **Question:** | **DO NOT READ ANSWERS ; TICK ALL THAT APPLY** |
|---|---|
| **D2.** Why do you not take any preventive action for malaria? | • [ 1 ] There are not much mosquitoes around<br>• [ 2 ] Malaria is not a problem in the locality<br>• [ 3 ] Too time consuming to prevent<br>• [ 4 ] Too expensive to prevent<br>• [ 5 ] Not aware of Malaria<br>• [ 6 ] Preventive actions are not effective<br>• [ 7 ] Prevention is the public health/civic authorities' responsibility.<br>• [ 95 ] Other_____________<br>• [ -9] Don't know |

Table 11

**D3. Can you please tell me what you think the symptoms/ signs of malaria are in general?**

| Question: | DO NOT READ ANSWERS ; TICK ALL THAT APPLY |
|---|---|
| **D3.** Can you please tell me what you think the symptoms/ signs of malaria are in general? (Do not read answers, circle all that apply) | • [ 1 ] Fever<br>• [ 2 ] Headache<br>• [ 3 ] Joint pains<br>• [ 4 ] Convulsions<br>• [ 5 ] Nausea/vomiting<br>• [ 6 ] Anemia<br>• [ 7 ] Diarrhea<br>• [ 95 ] Others______________<br>• [ -9] Don't know/Can't say |

Table 12

**D4.** Where do you usually go to seek medical care when you suspect that you or a member of the family is sick?

| Question: | DO NOT READ ANSWERS ; TICK ALL THAT APPLY |
|---|---|
| **D4.** Where do you usually go to seek medical care when you suspect that you or a member of the family are sick? | • [ 1 ] You treat the person at home<br>• [ 2 ] Buy drugs from pharmacy/drug shop<br>• [ 3 ] Private doctors/private health facilities<br>• [ 4 ] Government clinics/ health centers/ hospitals<br>• [ 5 ] Use alternative medicines/ traditional procedures |

Table 13

**D5.** What is the average monthly expenditure of your household on health?

| Question: | READ ANSWERS ; TICK ANY ONE CATEGORY |
|---|---|
| **D5.** What is the average monthly expenditure on health of your household? **[IN Rs.]** | • [ 1 ] <1000<br>• [2] 1000-5000<br>• [3] 5000-10000<br>• [4] Above 10,000<br>• [5] Don't know<br>• [6] Refuse to answer |

Table 14

**D6. Who makes Health-related Decisions in your household?**

| Question: | DO NOT READ ANSWERS ; TICK ALL THAT APPLY |
| --- | --- |
| **D6.** Who makes health-related Decisions in your household? | • [1] Self<br>• [2] Head of the Household<br>• [3] Other<br>• [4] Don't know |

Table 15

**D7. What is the average monthly expenditure of your hh on food?**

| Questions: | READ ANSWERS ; CIRCLE /TICK ANY ONE CATEGORY |
| --- | --- |
| **D7.** What is the average monthly expenditure on food of your household? **[IN Rs.]** | • [ 1 ] <1000<br>• [2] 1000-5000<br>• [3] 5000-10000<br>• [4] Above 10,000<br>• [5] Don't know<br>• [6] Refuse to answer |

Table 16

## PART V : HOUSEHOLD CHARACTERISTICS

**E1.** Now, I would like to know a bit about the household where you live in:

**[PROCEED BY ONE ROW AT A TIME; FOR EACH ROW, TICK ANY ONE OPTION IN COL. 2]**

| COLUMN 1 | COLUMN 2 |
|---|---|
| **1.**Nature of your house | • Kutcha<br>• Semi-Pucca<br>• Pucca |
| | |
| **2.** Surroundings of the House | • Clean<br>• Average<br>• Dirty |
| | |
| **3**. Number of Rooms | 1 2 3-5 More than 5 |
| | |
| **4**. Electricity in the House | • Yes<br>• No |
| | |
| **5.** In the week before this interview, average no. of hours without power per day | ________________________Hours ( in Mins.)<br>__________ |
| | |
| **6.** Separate Kitchen in the House | • Yes<br>• No |
| **7.** Type of Cooking | • Ordinary Chulha/Any Other Smoke emitting Stove<br>• Smokeless Chulha<br>• Kerosene<br>• LPG/Other Non-Smoking Stoves |
| | |
| **8.** Chimney/Smoke Outlet in the Cooking Place | • Yes<br>• No |
| **9.** If housing rented/ owned | • Rented<br>• Owned<br>• Other |
| | |
| **10.** Water supply system | • 24 * 7 Running water<br>• KMC Intermittent daily supply<br>• Travel to other areas by foot/transport to fetch water<br>• Other (Please specify) |

| | |
|---|---|
| | |
| **11.**Water storage | • Plastic bottles<br>• Plastic Buckets<br>• Iron/Steel/ Copper Container<br>• Earthen containers<br>• No storage |
| | |
| **12**.Type of Toilet | • Service toilet<br>• Flush toilet<br>• No Toilet at home<br>• Other |
| | |
| **13**.Wastes discharging into | • Sewer system<br>• Septic Tank<br>• Pit<br>• Drain or River<br>• Don't know |
| | |
| **14.**Garbage disposal in your locality | • By local authority<br>• By private arrangements among residents<br>• By hh. members<br>• Others |
| | |
| **15**.Durable goods you possess **[TICK ALL THAT APPLY]** | • TV<br>• Water Filter<br>• Aqua-Guard<br>• Radio/TV<br>• Computers/laptops<br>• Bicycle<br>• 2-Wheeler<br>• 4-Wheeler<br>• Plots of Land<br>• Other properties ( houses/ shops etc.)<br>• Other________________________<br>• Other________________________ |
| | |

Table 17

## PART VI : ABOUT THE COMMUNITY THAT YOU LIVE IN

In this section, we will discuss about your views on the general conditions prevailing in your community i.e Ward/ Panchayat.

**F1.** Living Conditions in Your Ward, Disease Pattern (if Any) and Social Network:

**[PROCEED BY ONE ROW AT A TIME]** **[FOR EACH ROW, TICK ANY ONE]**

| | |
|---|---|
| **1.**Is your community in general clean? | • Yes<br>• No<br>• Don't know |
| | |
| **2.** Is there a water body in the vicinity of your house? | • Yes **[ASK Q. 2.1 & Q 2.2]**<br>• No **[GO TO Q 3]**<br>• Don't know **[GO TO Q 3]** |
| **2.1** What is the condition of the water body? | • Clean<br>• Average<br>• Dirty |
| **2.2.** Have you ever seen the water body being cleaned? | • Yes **[GO TO Q 2.3]**<br>• No **[GO TO Q 3]**<br>• Don't know **[GO TO Q 3]** |
| **2.3** Who have you seen cleaning the water body? | • Neighbors<br>• Civic authority Staff<br>• Others you could not recognize<br>• Don't remember |
| | |
| **3.** Have you ever seen civic staff spraying insecticides in your locality? | • Yes **[GO TO Q 3.1]**<br>• No **[GO TO Q 4]**<br>• Don't remember **[GO TO Q 4]** |
| **3.1.** When did you last see them spraying? | • Less than a month before<br>• More than one month back<br>• About 6 months back<br>• One year back<br>• Long ago<br>• Don't remember |
| | |
| **4.** Which of the diseases worries/worry you the most | • Diarrhea<br>• Malaria |

| | |
|---|---|
| while living in this community? **[TICK ALL THAT APPLY]** | • Typhoid<br>• Dengue<br>• Tuberculosis<br>• HIV/AIDS<br>• Unknown fever<br>• Other diseases ( specify)_________<br>• No health issues as such<br>• Refuse to answer |
| | |
| **5.** Which season do you find diseases rising in your locality? | • Summer<br>• Rainy<br>• Winter<br>• Can't say<br>• Not aware of diseases in your locality |
| | |
| **6.** Which season do you find malaria rising in your locality? | • Summer<br>• Rainy<br>• Winter<br>• Can't say<br>• Not aware of malaria being prevalent in your locality |
| | |
| **7.** What are the sources that you use most to make yourself updated on happenings around you? | • Radio<br>• Newspaper<br>• TV<br>• Internet<br>• Family and Friends<br>• Neighbors<br>• Local Clubs/ social joints in the locality<br>• Other ( Please specify) __________ |
| | |
| **8.** What/ Who do you get **health-related** information from? | • Radio<br>• Newspaper<br>• TV<br>• Internet<br>• Family and Friends<br>• Government and Civic authority campaigns<br>• Campaigns by local leaders from Local Clubs<br>• Neighbors<br>• Other ( Please specify) |
| | |
| **9.** Do you discuss about **health issues** that affect you and others in your family with your | • Yes<br>• No<br>• Don't know |

| | |
|---|---|
| neighbors? | • Refuse to answer |
| | |
| **10.**Have you seen any campaign on malaria in particular in your locality by the govt./ civic authorities in recent times? | • Yes **[GO TO Q 10.1]**<br>• No **[SKIP Q 10.1]**<br>• Don't remember **[SKIP Q 10.1]**<br>• Refuse to answer **[SKIP Q 10.1]** |
| **10.1.**What kind of campaign on malaria control have you seen ? | • Pamphlet distribution<br>• Audio Publicity on Rickshaws/ Autos<br>• Free blood testing camps<br>• Other ( Please specify)____________________ |
| | |
| **11.** Do you have water-logging problem in your locality? **[SURVEY ENDS HERE]** | • Yes<br>• No<br>• Can't Say<br>• Refuse to Answer |

Table 18

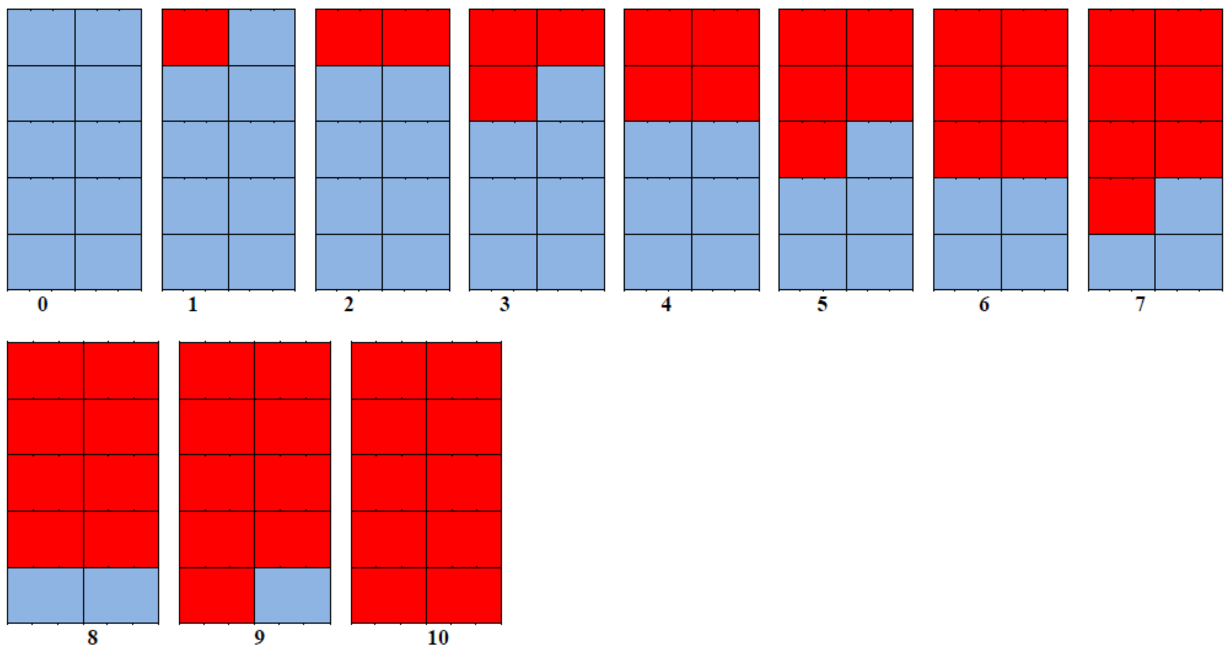
This brings us to the end of the interview. Thank you very much for your time! We appreciate your cooperation and careful attention in listening to and answering all the questions I have asked. [53]

[53] The final version of the questionnaire prepared in the local language, Bengali, with considerable alterations incorporated in the order of the questions posed, is available on request.

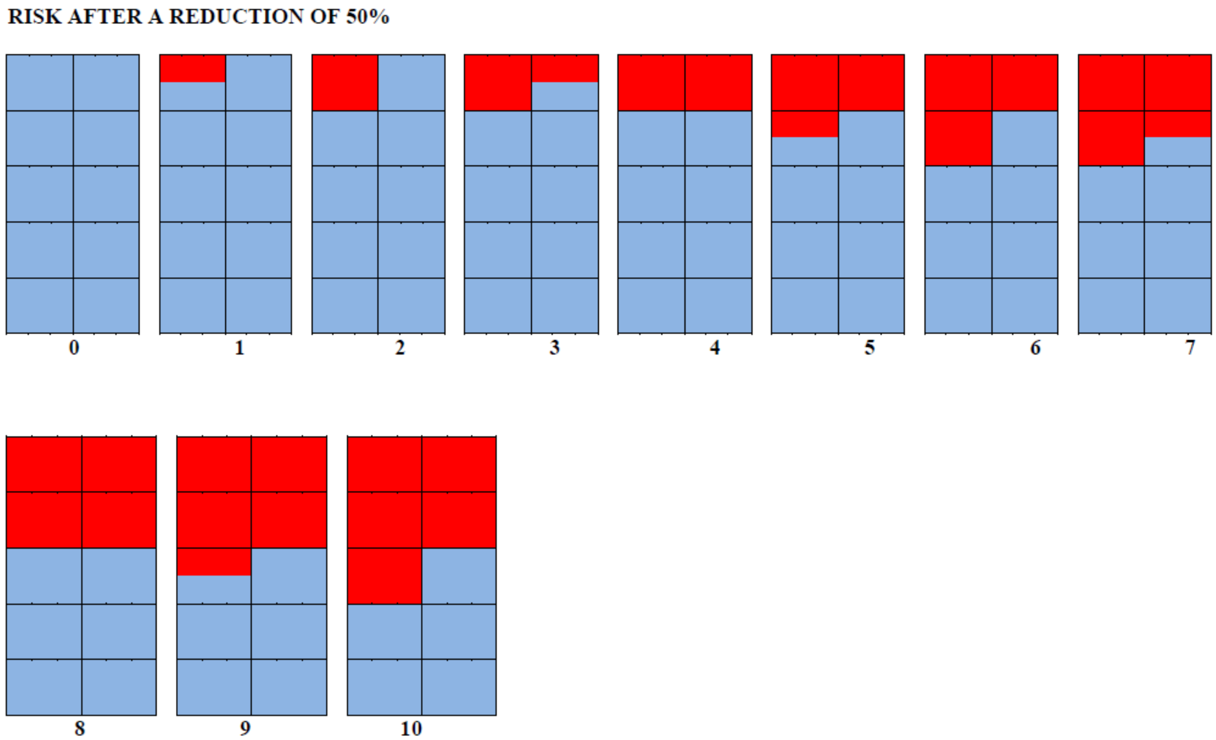
# APPENDIX F: EXCERPTS FROM THE FIELD

### The Risk Elicitation Device namely the “Malaria Cards”

REPRESENTATION OF RISK (BEFORE REDUCTION) USING “MALARIA CARDS”



## A Sample of 50% Risk-Reductions Offered Through the “Malaria Cards”



**Focus Group Discussions pertaining to the Malaria Risk and Prevention Survey underway in Langalberia Village, South 24 Parganas, West Bengal, India.**

**Interviewers in the rural area illustrating the Risk-Elicitation Device with the constituent bi-colored Malaria Cards labeled from 0-10 in the local language (Bengali)**

**Interviewers in the rural area illustrating the two kinds of the Risk-Elicitation Device (Green= 90% Risk Reductions; Yellow= 50% Risk Reductions)**

**A snapshot of an alley in the Kalikapur Village which constituted the rural site of our survey**

**The entire rural area interviewer team at the site**

**Interviewers at work at Ward No.72, the urban area selected for the Malaria Risk and Prevention Survey, 2011**

**The urban area interviewer team at the site**

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