Risk aversion and health behavior change: Evidence from a pilot study of acceptability of a new malaria diagnostic technology in Nigeria

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Abstract

Surprisingly little research has been conducted on risk aversion and behavior change for malaria prevention and treatment, despite the scale of morbidity and mortality from malaria in much of the developing world. In this study, we explore the relationship between risk aversion—measured when people believe they are sick—and the acceptability of a new health technology, malaria rapid diagnostic tests (RDTs) and adherence to treatment. In Oyo state, adult customers of selected privately owned pharmacies and proprietary and patent medicine vendors were recruited as they exited shops having bought an anti-malaria drug to treat their suspected illness. In addition to a risk assessment involving a simple game, individuals were tested with an RDT, provided with the results along with the appropriate treatment advice, and called four days later to assess treatment adherence. Of 418 respondents, 64.4% were risk averse, 27% risk moderate, and 9% risk loving. Compared to more risk averse individuals, riskier individuals not only were poorer, less educated, and more likely to be male, but also were more likely to seek care immediately, report complete disability due to their illness, and pay more for their drugs. In contrast, risk averse individuals were more likely to adhere to the correct treatment regimen and report an increase in their willingness to pay for an RDT compared to riskier individuals. Wealth, but not education, appears to mediate the observed relationships between risk preferences and health behaviors. Estimates will serve as the basis for power calculations for an expanded study.

Introduction and background

There is a long-standing belief that much of people's health behaviors and health decision-making comes down to personality traits and the origins of specific preferences. Classic studies (Farrell and Fuchs 1982) suggest that there are unobservable, fundamental characteristics, such as aversion to risk or time preferences, which are associated with good health behaviors. These characteristics drive avoidance of risky health behaviors, such as smoking, and can lead to improved health outcomes. Recent studies using experimental design confirm this association more directly. For example, using Holt and Laury's (2002) measures of risk aversion, Anderson and Mellor (2008) find that individuals who are risk averse are less likely to smoke, drink, be overweight or drive over the speed limit, and are more likely to use a seat belt. However, little is known about risk aversion in relation to acceptability of new health technologies and adherence to medical treatments in general, and for developing country contexts more specifically. For health innovations, risk aversion may actually be a barrier to accepting a beneficial new health technology. Risk aversion may make people more willing to follow past behaviors and may limit learning from new experiences. Risk aversion could explain large barriers to acceptance or slower-than-expected adoption of new health technologies.

Further, risk aversion is a concept well-tested in developed countries, whose institutional and legal frameworks provide structural reinforcement and boundaries for the judgment of risk behaviors and their consequences. In developing countries, these boundaries often remain less defined and more fluid, while individuals regularly contend with greater degrees of competing risks (e.g. for mortality). Thus, strategies/studies for measuring risk aversion in experimental settings in developed countries are not easily generalizable to poorer populations. Experimental designs for measuring risk aversion in developing settings require a thorough understanding of

probabilistic events and calculations that are likely to be more challenging for less-educated populations (Cardenas and Carpenter 2008). While some studies have used simplified modules with real payouts in developing countries (Yesuf and Bluffstone 2007; Cameron and Shah 2010), none have measured risk aversion with real prizes and payouts specifically when individuals are sick. Levels of risk aversion may depend on the state of health and the influence of risk preferences effect on health behaviors may be different when individuals are faced with real health decisions.

Finally, none have assessed the effect of risk aversion in relation to learning about health behavior over time and during the course of patient's transition from a sick state to a healthy state. Individuals may increasingly internalize the value of a new health technology, as they understand the benefits (or otherwise) associated with the innovation in direct relation to their health status. Moreover, as individuals update their beliefs with information about their true health status, the relationship between risk aversion and health behaviors may be moderated by the new beliefs. Specifically, evaluation of the technology may be influenced by how it compares to the default course of action—the course that would have been taken without the technology. The added value of this information may not only be a critical factor in determining treatment adherence in the short run, but also permanent health behavior change in the long run.

Malaria diagnostic and treatment practices in Nigeria

Risk aversion and assessment as a fundamental and unobservable determinant of healthy behaviors has served as a basis for a host of health behavior change interventions, such as those aimed at helping individuals to internalize and recognize risky sexual practices for transmission of HIV/AIDS. However, little research has been conducted on risk assessment, risk aversion, and

behavior change for malaria prevention and treatment (Mwenesi 2005) despite the scale of morbidity and mortality from malaria in much of the developing world.

Interventions for malaria have been massively scaled-up over the last decade with the assistance of donor aid to countries with the highest burdens of malaria (WHO 2012). Since 2000, these combined efforts have driven down global incidence by 17% and mortality by 26% (WHO 2012). While this downward trend is encouraging, the rate of decline is slower than expected and unlikely to meet the child mortality Millennium Development Goals in sub-Saharan Africa (UN 2012). Process indicators show that, despite the delivery of large quantities of insecticide treated nets to populations at risk, adherence and compliance to regular use is low in many places (Mwenesi 2005) and more emphasis on fostering behavior change is necessary. In addition, large-scale distribution of highly subsidized artemisinin combination therapy (ACTs) drugs[1] has driven down prices of all malaria drugs (even ineffective ones) and increased access. However, without accompanying access to reliable diagnostics for malaria, presumptive treatment of malaria had led to concerns of over-treatment, which can fuel drug resistance, as well as lack of appropriate treatment for non-malaria illnesses.

New technologies for malaria diagnosis, such as rapid diagnostic tests (RDTs), hold promise for improving the quality of treatment in resource-poor settings that is cheap and requires minimal skills training to deliver. However, take-up and adherence remain challenges. Even among trained and educated providers, trust and acceptability of RDT results are difficult to instill when clinical experience in symptomatic diagnosis signal a contradictory diagnosis (Kyabayinze et al. 2010). Nonetheless, some countries, such as Tanzania and Senegal, have successfully implemented RDTs in the public health sector. In these cases, provider acceptability

[1] ACTs e first-line treatment for malaria due to the P. falciparum, the parasite primarily affecting sub-Saharan African countries.

improved over time, resulting in sizable cost-savings from decreased over-prescription of anti-malaria drugs (Yukich et al. 2010).

However, RDTs have mainly been viewed as a public sector health service largely provided for free or at highly subsidized cost at public health facilities rather than a consumer product. It remains unclear whether the successes of Senegal and Tanzania can be matched in countries where a large proportion of healthcare is provided by the private sector. In the private sector, health services are unlikely to be provided for free and large subsidies are often not financially feasible unless backed by donor aid. For example, in Nigeria, over 50% of malaria sufferers seek care from private sector drug shops (NPC 2012). While RDTs are not yet widely available in Nigeria, the Ministry of Health is currently developing guidelines for the deployment of RDTs in the health system, largely focusing only on the public sector of the health system. If and when RDTs are introduced as the standard of care for malaria, provider acceptability and adherence may only be half the story. Nothing is known about the acceptability of RDTs and the adherence to treatment among patients who would ultimately pay for the service from private sector providers. This is of particular concern because of long-standing practices of presumptive treatment with very little consumer demand for malaria diagnosis by existing microscopic methods (De La Cruz et al. 2012). Although RDTs may improve the quality of malaria diagnosis in Nigeria, more information is needed on both the potential barriers to their widespread adoption and possible interventions to overcome these obstacles.

Aims of this study

This study is designed to investigate the acceptability of and adherence to a new technology—the malaria rapid diagnostic test—in relation to risk preferences among sick

customers who have sought treatment for malaria. This is part of a larger pilot study of the quality of malaria diagnosis and treatment in privately-owned pharmacies and proprietary and patent medicine vendors (PPMVs) conducted in Ibadan, Nigeria.

In general, we hypothesize that risk preferences among sick customers will be related to both adherence to the appropriate treatment and valuation of the new health technology. However, the direction of these relationships, on net, is *a priori* unclear. Only 4.2% of individuals enrolled in this study were found to be RDT-positive, but all had previously purchased some type of malaria medication just prior to being tested. For such individuals who are also more risk averse, s/he may value the RDT less and be less likely to adhere to the appropriate treatment (i.e. still take anti-malarial medication), continuing instead to presumptively treat oneself based on past experiences in treatment malaria episodes. Thus, risk aversion may inhibit the adoption of new behaviors because of past priors about what works to cure malaria and deviating from this might incur greater uncertainty for illness recovery. Alternatively, risk averse individuals may place greater value on the RDT and the diagnostic information it provides since it removes one element of uncertainty in medical treatment. Hence, they may be more apt to follow the recommended course of action as indicated by the test result. We intend to explore the directionality of this relationship, as well as investigate possible mediating pathways through which risk preferences may be influencing health behaviors and the uptake of diagnostic information.

Methods

Data collection

This study took place in Oyo state in southwest Nigeria, in and around the cities of Ibadan and Ogbomosho. In October 2012, 53 selected private sector retailers (45 in Ibadan, 8 in Ogbomosho) of over-the-counter anti-malaria drugs were enrolled into the study. Site selection was initially random, but was later modified to exclude small drug retailers whose main business is not medicinal sales. Adult customers (excluding pregnant women) who had just purchased malaria drugs for their own use were approached, screened for eligibility, and asked to complete a short survey, allow a study nurse to administer an RDT, and agree to an accounting of all drugs just purchased. In addition to basic demographic characteristics, the survey queried individuals' usual health-seeking behaviors for malaria. At the conclusion of the questionnaire, study nurses provided respondents with their RDT results and an advice care with instructions for appropriate treatment of malaria (i.e. take ACTs[2]) or non-malaria (i.e. do not take any anti-malaria drugs). The entire procedure lasted about 15-20 minutes on average. A 5-minute phone survey administered four days later asked the respondent about his/her illness status and specifically about which medications s/he original purchased were taken to treat the episode of illness condition. Respondents were compensated with 100 Naira (equivalent to about US$0.63) in mobile credits for cell phone time used to conduct the phone survey. Over the course of 10 weeks, 465 people were recruited and tested with an RDT. Over 90% (N=427) of respondents were successfully followed up by phone. Only 4.2% of tested individuals were positive for malaria according to the RDT and 97.9% of respondents reported feeling better four days later in the phone survey.

As part of the survey questionnaire, respondents are asked to participate in a game where they can win a payout in the form of mobile phone credits. The choices in the games are simply

[2] Individuals who tested positive were given a free course of ACTs to ensure that they had access to efficacious drugs.

structured so that the module can be conducted rapidly and without confusion (see Table 1). In all three games, the probabilities of win/loss are constant at 50% as is the expected payout of 200 Naira. These simplifications were made to isolate only risk tolerance associated with the variance in the amounts at risk and minimize confounding due to differences in expected payouts or miscalculation of probabilities.

To help assess acceptability and valuation of RDTs, respondents were asked the same willingness to pay questions at three times throughout the study—once before the RDT (hypothetical assessment when sick), once after receiving the RDT result (valuation based on experience when sick), and once during the phone follow-up survey after treatment should be completed (valuation based on experience when well). Because RDTs in Nigeria currently do not have an equilibrium market price, as they are not widely available, the repeated measure of willingness to pay enables us to examine *changes* in valuation rather than levels, which may be inaccurate.

Data analysis

We explore the relationship between risk game choices and willingness to pay and treatment adherence through bivariate and multivariate regression analyses. Multivariate regressions are conducted to explore various pathways—education and wealth—that may mediate the relationship between risk preferences and health behavior outcomes, potentially also testing alternative explanations for observed relationships. Logistic regressions are used for binary outcomes and negative binomial regressions are used for count data (e.g. days waited before seeking care). All standard errors are clustered by drug retail site.

Results

Of 418 individuals for whom there are completed follow-up surveys for, 64.4% chose the game with a certainty payout of 200 Naira, 26.8% chose the game with moderate risk (i.e. 100 Naira vs. 300 Naira), and 8.9 percent chose the game with the largest risk (i.e. 0 Naira vs. 400 Naira) (see Table 1). Table 2 displays characteristics of the sample by choice of game. Individuals of different risk categories were significantly different by gender, education, employment status, and asset wealth measures. Nearly 65 percent of individuals choosing the riskiest game were male, compared to only 45.8 percent of risk moderate and 51.2 percent of risk averse individuals. Less risky individuals generally had higher educational attainment than riskier types. More risk loving individuals had less than a primary school level of education, 17.6 percent, compared to only 8.4 percent and 6.2 percent among risk moderate and risk averse individuals. While a greater proportion of risk averse and risk moderate individuals are unemployed than among risk loving individuals, the latter group has a significantly higher rate of self-employment. Across asset wealth measures, risk averse individuals appear to be somewhat wealthier with a significantly higher proportion holding bank accounts and significantly lower proportion having exposed and unfinished concrete floors in their home.[3] While not significantly, different, more risk loving individuals were recruited at PPMV sites compared to risk averse and risk moderate individuals. On average, there also no significant differences in age, but a closer examination of the age profile between groups shows that the riskiest group was generally older and the moderate risk group was generally younger when compared to the most risk averse group (see Figure 1).

Differences in health behaviors—both for general health-seeking practices related to malaria and specifically for the current illness episode—are summarized in Table 3. More risk

[3] Higher wealth is measured by having a finished floor covered with carpet, tiles, wood, or other type of material.

loving individuals report ever having a test for malaria (71.9 percent) compared to only 51.0 percent of risk moderates and 63.5 percent of risk averse types. Moreover, nearly twice as many risk moderates and risk loving individuals report usually getting diagnosed with malaria with a test, which were reported to include blood pressure measurements, eye exams, and temperature readings, but not tests of blood. About 26 percent of risk averse and risk moderate individuals report consulting with a provider as part of their usual malaria diagnosis, but only 12.5 percent of risk loving individuals do so. Riskier types were also more likely to self-report greater severity of illness: 25.0 percent of risk loving individuals reported that their last episode of malaria rendered them completed unable to perform normal daily activities compared to only 18.4 percent of risk moderates and 15.7 percent of risk averse individuals. Risk loving individuals usually waited one less day on average before seeking care, were more likely to see a PPMV for their last suspected case of malaria, and paid more money on average for the malaria drugs they purchased. However, only differences for ever being tested and days waited before seeking care are significantly different across risk types.

Although there were not any statistically significant differences in health behavior outcomes related to actions taken after the RDT result was provided, there are some notable trends. Despite the fact that none of the risk loving individuals had a positive RDT result, only 62.9 percent followed the correct treatment procedure (i.e. “you do not need to take anti-malaria medication treat your condition because your test indicates you do not have malaria”) and 37.1 percent went on to take anti-malaria drugs. In contrast, malaria incidence was slightly higher (but not significantly different) among risk averse (4.6 percent) than risk moderates (2.9 percent), and nearly three-fourths of these individuals followed the correct treatment procedure according to their test result. Moreover, among those risk moderates and risk averse that were RDT-negative,

over three-fourths still took their non-malaria drugs to treat symptomatic conditions. More risk averse individuals reported consulting the advice card provided to them by the nurse that contained their RDT result and the recommended treatment procedure, but more risk loving individuals report contacting the nurse hotline for additional advice. More risk averse and risk moderate individuals reported a higher willingness to pay amount at the end of the study compared to the beginning of the study (12.8 percent and 15.2 percent, respectively) compared to risk loving individuals (5.7 percent).

Multivariate regression analyses that investigate possible mediating pathways between fundamental risk preferences and health behavior outcomes through education or wealth are displayed in Table 4. Only two outcomes for which there were significant differences in bivariate analysis are shown—ever had a malaria test (columns 1-3) and days waited before seeking care (columns 4-6). The first column in each set replicates bivariate point estimates (with the most risk averse type as the reference category), the second adds educational attainment categories, and the third includes asset measures that were significantly different in bivariate analysis. For ever having had a test for malaria, when education is included as a predictor, the significance of the point estimate for risk moderates goes away and both point estimates for risk categories move slightly in the positive direction. Education, and particularly more than secondary schooling, is highly predictive of increased likelihood of testing by more than two-fold. When wealth measures are separately included, the estimated effects of risk preference types increases in the positive direction even further. Risk loving individuals are more than two times as likely to have ever had a test for malaria, and this estimate is now statistically significant. Estimates on asset measures suggest that wealthier individuals are also significantly more likely to have ever been tested. When examining days waited before seeking care, the addition of education does not

change the result or significance of the risk preference types (with a similarly large and independent effect of more than secondary schooling). However, when asset measures are included, the estimate effect of risk loving preference becomes less negative (i.e. will wait even less time). Estimates on asset indicators generally indicate that greater wealth is related to less time lapsed before seeking care.

Discussion

From a pilot study of the quality of malaria diagnosis and treatment in private sector malaria drug retailers in Oyo state, Nigeria, we find suggestive evidence that one fundamental personality trait, risk preference, influences individuals' choices about the actions they take to address episodes of suspected malaria. Sick customers who had just purchased an anti-malaria medication from selected PPMVs and pharmacies participated in a simple game to determine their risk profile, and also tested with an RDT to determine their malaria status and provided with a recommended course of treatment based on the test result.

Nearly two-thirds of respondents chose the game without any risk and under 10 percent choosing the riskiest game—a distribution that appears roughly normal. A comparison of basic demographics between risk profiles suggests that our measure of risk preference may be valid. In line with conventional findings, riskier individuals were more likely to be male and be self-employed. Riskier individuals were also less wealthy and had lower education, the latter of which may contribute to a poor understanding of the game's structure, the payouts, or indicate lack of numeracy. Contrary to usual findings from developed countries, the individuals in the riskiest group were generally older than their risk averse counterparts. This contrast could be explained by cultural differences, and in particular the high regard for seniority and positions of

authority. Further qualitative analysis is needed to better understand the external validity of this measure.

Bivariate analyses show that riskier individuals are more likely to visit PPMVs for malaria treatment, more likely to be tested, but with an inappropriate test for malaria, seek out care sooner, report greater debilitating impact of illness on normal daily activities, and spend more to buy drugs. Differences in socioeconomic status may explain many of these observed relationships as poorer or less educated are generally though to have lower health status and face greater barriers to accessing health services. In the Nigerian context, PPMVs are perceived to provide lower quality drugs and care than pharmacists and disproportionately serve the poor (and potentially sicker) populations (De La Cruz et al. 2012; NPC 2012). In the urban and peri-urban areas where this study took place, malaria drugs and ACTs are widely available and access is generally not an issue as sick individuals have many choices in where to seek care. When education is added as a predictor in multivariate analyses, it does not substantially affect the estimates of risk preferences. But when asset wealth measures are separately added, risk preference estimates do substantively change, indicating that wealth is an important mediator between risk tolerance and health behaviors. When wealth is controlled for, riskier individuals are much more likely to get a (inappropriate) test for malaria and not wait as long before seeking care. Moreover, even though riskier individuals in the study were poorer according to asset holdings, they paid more for their drugs on average. Hence, even though ability to pay may be a key explanatory factor, risk preference is still a significant driver of behavior independent of wealth. RDT results show that there were no differences in malaria burden across risk groups, indicating that risk loving individuals are not disproportionately sicker than others, at least in

terms of malaria. Together, these results suggest that our measure of risk aversion is not just proxy for socioeconomic status.

However, there may be other personality traits, such as time preferences or conscientiousness, which may alternatively explain and/or mediate the relationships observed with some health behaviors. Personality traits, believed to be relatively stable across time and situations, have been shown to predict an array of economic outcomes (Borghans et al., 2008 Paunonen 2003, Hurd et al. 200?), but few have examined decisions involving health. For example, rather than being a riskier person, individuals might be time inconsistent and need immediate gratification or solution to their problem, especially in an illness situation. This may better explain why riskier individuals seek care sooner rather than later and pay more for it. In contrast, individuals in the risk averse group wait one day more on average, which may reflect more rational decision-making in terms of illness severity and progression. This time inconsistency for risk loving individuals may also explain why they are more likely to undergo inappropriate tests of malaria as part of needing immediate attention for their illness. Indeed, studies of smoking cessation and gym attendance show that quitting or exercise behavior is linked to time preferences (Gine et al., 2010, Dellavigna and Malmendier, 2006)

It could also be the case that risk categories instead reflect different degrees of conscientiousness, or attentiveness and care in their actions. More conscientious individuals may seek out higher quality of care at pharmacies whereas less conscientious individuals may opt for the nearest and most convenient provider regardless of quality—and these may be highly correlated with risk aversion. Without direct measures of this, we can only infer that conscientiousness may explain why risk averse individuals report consulting the advice card more often than riskier types. In studies of retirement behavior, conscientiousness has been

shown to predict better economic preparation (Hurd et al. 2012), which may similarly be the case when sick individuals are seeking care.

Alternatively, these behaviors may also reflect differences in the framing of the game versus the real life choice to seek care when feeling ill. The game is framed in terms of potential gains associated with different levels of variance in payout amounts, and thus risk loving individuals, defined as accepting of uncertainty, are classified as those who choose the game with the highest variance. However, during an episode of illness, the uncertainty involves a loss in health and an illness of unknown severity. In this case, risk loving individuals may exhibit risk averse tendencies. Motivated by the potential losses, these individuals may try to decrease the uncertainty in illness recovery and seek care immediately, try inappropriate tests, and ultimately pay more. In contrast, risk averse people identified through a game with gains, may exhibit more tolerance for risk when losses due to illness are at stake, and thus wait longer before seeking care, need less certainty through testing, and pay less for drugs that may be of lower quality. Thus, the frame in which risk is measured in the game may not be directly relatable to decisions regarding illness while in a sick state.

One unique contribution of this study is that risk preferences are evaluated in relation to the introduction of a new health device, the uptake of new information, and the implications of diagnostic certainty on actual treatment behaviors. Although results are not statistically significant for any treatment outcomes, owing to the small sample size, the directionality of the observed relationships suggest that individuals of different risk types process health information differently, which ultimately influences treatment adherence. Riskier individuals are less likely to follow the correct treatment procedures and more likely to take both their malaria and non-malaria drugs compared to risk averse individuals. Not only did a higher proportion of risk

averse individuals follow the correct treatment procedure, very few took their ACTs or other anti-malaria drugs which they were specifically instructed not to take. Yet, many of them still took their non-malaria drugs to treat symptomatic conditions. Thus, it appears that risk averse individuals may be more discerning in relating the disease-specific diagnosis to the appropriate curative or sympotatic drugs. Additional pathway analyses conducted for drug adherence outcomes did not show that education or wealth were important mediators, but sample size limits preclude a more decisive conclusion. The ability to process more complex health information may also be related to conscientiousness as risk averse individuals were also more likely to report consulting the advice card given to them. More risk averse individuals reported a higher willingness to pay for the RDT after recovering from their illness compared to when they were initial seeking care, suggesting a greater understanding of the value of diagnostic testing.

It is important to note that all health outcome measures are self-reported. To the extent that risk preferences are also correlated with reporting bias, we may not be actually measuring real behavioral outcomes. However, the fact that malaria drugs and non-malaria drugs had difference results suggests that reporting bias may be minimal.

This study advances the understanding of health decision-making as it relates to risk tolerance. In addition, our risk preference assessment is employed on a sample that is more representative of individuals who must make real health choices under uncertainty rather than being abstracted from important contextual elements as in similar experimental studies. However, these contextual complexities also reveal several limitations in our measure of risk tolerance and potentially related factors that may mediate or alternatively explain observed health behavior outcomes. In particular, future work should seek to assess the contributions of time preferences, decision frames, and conscientiousness to risk tolerance and health decision-making. Measuring

risk aversion should also include additional games to assess different dimensions of a risk profile, such as loss aversion, as well as include supplemental measures to assess numeracy and differentiate risk aversion with time preferences. These modifications will also help to better interpret a risk moderate profile, individuals who at times appear act more like the risk averse while at other times act more like risk loving types. Lastly, estimates obtained in this pilot study will serve as the basis for power calculations of a larger expanded study, which will enable a more thorough multivariate analysis.

While much more research is needed to differentiate between different personality traits, the main findings suggest that traits, such as risk aversion, do influence the way individuals process health information. Communications designed to change behavior often ignore differences in the uptake and processing of health advice. Even though large-scale media campaigns may be able to reach greater numbers of people, they may not reach those individuals who potentially exhibit the most risky or perverse behaviors. It is likely to be impractical to identify and sort individuals according to risk of personality types before delivering messages. However, messages, whether delivered through provider-patient interactions or through more targeted social mobilization, can be constructed so that they are framed in multiple ways to reach more than one type. Different modalities need to be tested to assess what decision frame resonates most with different personality types.

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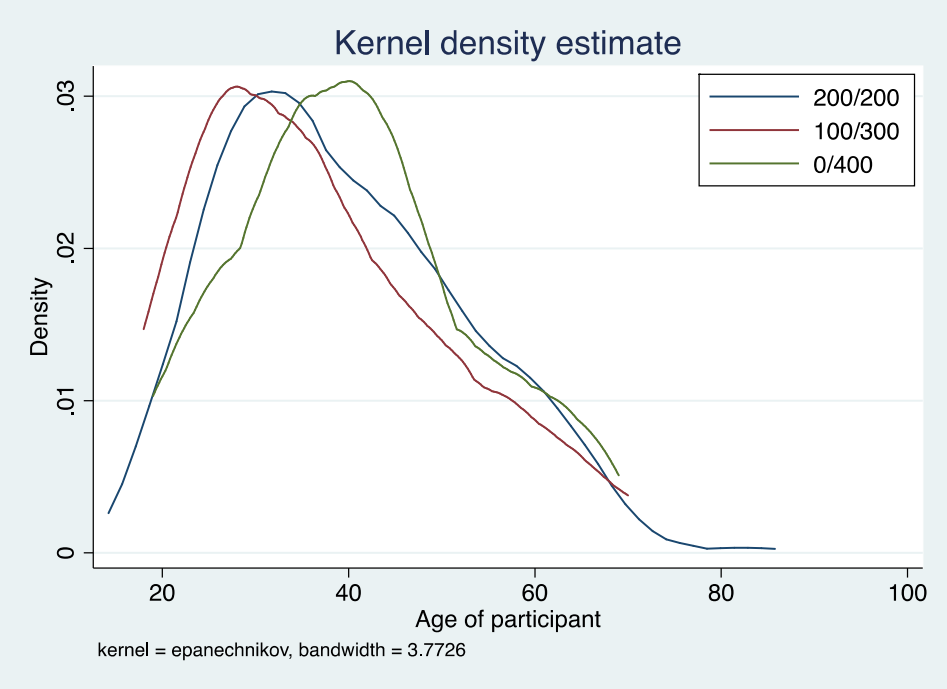
Figures

Figure 1. Kernel density distribution of participant's age



Tables

Table 1. Risk aversion game choices (N=418)

Game	Risk preference	Probabilities	Expected Payout	N	%
1	Risk averse	½ 200 Naira; ½ 200 Naira	200 Naira	269	64.35
2	Risk moderate	½ 100 Naira; ½ 300 Naira	200 Naira	112	26.79
3	Risk loving	½ 0 Naira; ½ 400 Naira	200 Naira	37	8.85

Note: 1 USD = 160 Naira

Table 2. Sample characteristics

	Risk averse (N=258)	Risk moderate (N=107)	Risk loving (N=34)	Significantly different?
Recruited at PPMV (vs. pharmacy)	0.438	0.449	0.471	
Recruited in Ibadan (vs. Ogbomosho)	0.736	0.720	0.706	
Male (vs. female)	0.512	0.458	0.647	*
Age	39.558	36.981	41.206	
Married	0.698	0.654	0.794	
Less than primary	0.062	0.084	0.176	*
Completed primary	0.112	0.196	0.059	*
Completed secondary	0.395	0.383	0.353	
More than secondary	0.430	0.336	0.412	
Employed full time	0.310	0.243	0.324	
Employed part time	0.043	0.009	0.000	
Self-employed	0.504	0.589	0.588	**
Unemployed	0.143	0.159	0.088	
Electricity	0.961	0.953	0.912	
Radio	0.946	0.879	0.941	
TV	0.915	0.888	0.912	
Refrigerator	0.663	0.654	0.559	
Cable	0.512	0.421	0.471	
Generator	0.713	0.710	0.647	
Air conditioner	0.155	0.131	0.176	
Computer	0.376	0.327	0.324	
Electric iron	0.891	0.888	0.912	
Fan	0.919	0.944	0.824	**
Motorbike	0.221	0.187	0.353	***
Car	0.484	0.421	0.441	
Bank account	0.868	0.738	0.676	***
Flush Toilet	0.764	0.701	0.765	**
Kerosene	0.636	0.673	0.647	
Unfinished concrete floor	0.535	0.617	0.706	**
Uses bottled water for drinking	0.310	0.336	0.294	
Cooks with tap water	0.225	0.252	0.176	
No. rooms in house	2.550	2.355	2.441	
Household size	4.380	4.252	4.265	

* p<0.10, ** p<0.05, *** p<0.01

Table 3. Bivariate analysis of malaria health outcomes by risk preference

	Risk averse (N=238)	Risk moderate (N=102)	Risk loving (N=35)	Significantly different?
Before RDT results are provided				
Ever had malaria test	0.635	0.510	0.719	**
Usually gets diagnosed with a test[1]	0.242	0.582	0.438	
Usually diagnosed via provider consult	0.260	0.265	0.125	
Was completely disabled because of malaria	0.157	0.184	0.250	
Days waited before seeking care	2.526	2.500	1.531	**
Number of symptoms reported	3.052	2.878	3.156	
Saw PPMV last time suspected malaria	0.387	0.418	0.563	
Amount paid for drugs (Naira)	370.674	337.857	413.750	
Bought an ACT	0.429	0.398	0.469	
Bought a non-malaria drug	0.375	0.388	0.385	
After RDT results are provided				
RDT-positive	0.046	0.029	0.000	
Took correct treatment	0.739	0.735	0.629	
Took all malaria drugs[2]	0.256	0.273	0.371	
Took all drugs	0.176	0.192	0.229	
Took any drug	0.551	0.535	0.657	
Took ACTs[1]	0.070	0.121	0.143	
Took non-malaria drugs[3]	0.768	0.746	0.826	
Consulted advice card	0.670	0.667	0.571	
Contacted advice nurse[4]	0.131	0.162	0.231	
Sought additional care	0.057	0.061	0.029	
Amount willing to pay for RDT (Naira)	402.423	418.687	402.857	
Increased willingness to pay from baseline	0.128	0.152	0.057	

* p<0.10, ** p<0.05, *** p<0.01

[1] Reported to include blood pressure measurement, eye exams, temperature readings, but not tests involving blood

[2] Restricted to those who were RDT-negative (N=361)

[3] Restricted to those who purchased a non-malaria drug (N=241)

[4] Restricted to those who were sent an SMS (N=149)

Table 4. Mediating pathways for risk preferences

	Ever had a malaria test[1] (odds-ratios)			Days waited before seeking care[2] (incidence-rate ratios)		
	(1)	(2)	(3)	(4)	(5)	(6)
Risk averse (reference group)						
Risk moderate	0.630*	0.686	0.724	-0.014	0.039	0.036
	(0.152)	(0.161)	(0.163)	(0.118)	(0.127)	(0.128)
Risk loving	1.438	1.530	2.220*	-0.567**	-0.563***	-0.389*
	(0.609)	(0.676)	(0.973)	(0.235)	(0.214)	(0.223)
Less than primary (reference group)						
Completed primary		0.851			0.293	
		(0.427)			(0.379)	
Completed secondary		1.244			0.311	
		(0.555)			(0.389)	
More than secondary		2.499**			0.607**	
		(1.167)			(0.308)	
Fan			1.592			0.292
			(0.549)			(0.296)
Motorbike			0.819			-0.583***
			(0.176)			(0.201)
Flush toilet			1.091			-0.182
			(0.204)			(0.186)
Concrete floor			0.452***			0.092
			(0.115)			(0.151)
Has bank account			2.062**			0.409*
			(0.730)			(0.219)
Constant	1.809***	1.179	0.977	0.932***	0.499	0.487
	(0.345)	(0.554)	(0.544)	(0.115)	(0.357)	(0.408)
N	407	405	405	385	383	384

* p<0.10, ** p<0.05, *** p<0.01

Robust standard errors in parentheses, clustered by site

[1] Predicted using logistic regression

[2] Predicted using negative binomial regression