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Article

Psychic vs. Economic Barriers to Vaccine Take-Up: Evidence from a Field Experiment in Nigeria

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Abstract

This paper experimentally evaluates the relative importance of psychic costs of tetanus vaccination compared to monetary costs among women in rural Nigeria. We compare vaccine take-up between two conditions to receive cash incentives: clinic attendance vs. vaccine take-up. Because the only difference between these two conditions is whether a woman was required to receive a vaccine upon arrival at the clinic, the difference in clinic attendance between these two groups captures the psychic costs of vaccination. Contrary to conventional wisdom, we find no evidence for significant psychic costs. Priming about disease severity increases the perceived severity of disease, but not vaccine take-up. Monetary costs strongly affect vaccination decisions.

JEL classification: O12, D83, I12

Keywords: vaccination, psychic costs, monetary costs, priming, nigeria

Every year, vaccinations avert two to three million deaths from diphtheria, tetanus, pertussis, and measles worldwide (WHO 2014). Vaccination is an extremely cost-effective way to improve health. For example, treating one case of measles costs 23 times the cost of one vaccination, and $24 is saved for every $1 spent on the diphtheria-tetanus-pertussis (DTP) vaccine (Ehreth 2003). Despite the huge benefits of preventing diseases at low cost, the persistent low vaccine take-up remains a puzzle (for example, see Suk, Lopalco, and Celentano [2015]). This paper reports results of a field experiment explicitly designed to evaluate psychic and monetary costs as potential barriers to tetanus vaccine take-up among women of childbearing age in rural Nigeria.

Psychic costs of vaccination, which we define as residuals that cannot be explained by monetary factors, such as beliefs and perceptions about vaccines, could influence vaccination decisions

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(Pebley, Goldman, and Rodriguez 1996; Steele, Diamond, and Amin 1996).[1] Most extant studies examine barriers to vaccine take-up using qualitative methods, typically by asking respondents their reasons for non-vaccination (Jheeta and Newell 2008; Nichter 1995). Such observational studies, however, cannot identify the causal effects of potential barriers to vaccination.[2] This paper presents a causal examination and compares the behavioral effects of psychic costs and monetary costs on vaccine take-up.

The relevance of psychic costs as barriers to vaccination has been commonly documented in Africa.[3] In northern Nigeria, a polio vaccination campaign was famously boycotted by Islamic leaders due to a false rumor that polio vaccines make women infertile or cause them to contract HIV (Jegede 2007).[4] This distrust of vaccine efficacy led to a widespread refusal to receive polio vaccinations among the general population, resulting in increased polio-virus transmission throughout the country and the spread of polio into 20 countries (Kaufmann and Feldbaum 2009). The Nigeria Demographic and Health Survey (NDHS 2008) shows that more than one-third of women (36.8 percent) did not take their children for vaccination because of reasons related to psychic costs, such as fear of side effects, fear that their children might get diseases from the vaccine, and a belief that vaccines did not work.[5] Rainey et al.'s (2011) systematic review shows that psychic costs account for 17.2 percent of reasons for non-vaccination in 51 low- and middle-income countries. These episodes and observational findings have led to conventional wisdom: a presumption commonly held by researchers that psychic costs of vaccination are large barriers to vaccine take-up. No causal studies, however, have systematically examined this conventional wisdom.

We study tetanus toxoid vaccines, which are lifesaving and available mostly free of charge in most clinics, but do not attain high take-up. Up to 16 percent of global neonatal tetanus deaths, which can be effectively prevented by tetanus toxoid vaccines, occur in Nigeria, which remains one of 25 countries still reporting neonatal tetanus as a cause of infant mortality (WHO 2013).[6] Providing tetanus toxoid vaccines to mothers most effectively protects both mothers and newborn babies from tetanus.[7] Tetanus toxoid vaccine prevents neonatal tetanus with efficacy of over 80 percent with five years of protection

1 Observational studies suggest various other reasons for low vaccine take-up, including monetary costs, limited information, and supply-side constraints. See Thysen et al. (2014) for monetary costs of health clinic visits, such as transportation costs and opportunity costs; Orimadegun, Adepoju, and Akinyinka (2014) for limited information about diseases and vaccinations; and Santibanez et al. (2012) for supply-side constraints, such as vaccine shortages. Examples of beliefs and perceptions about vaccines as psychic costs of vaccination include fear of needles; fear of vaccine safety, such as side effects; misperceptions about vaccines, such as the belief that vaccines might give a person HIV or other diseases; and religious beliefs against vaccines.

2 Currie (2006) reviews the literature that examines the effects of stigma on the take-ups of social benefits in developed countries, where stigma is defined as disutility arising from participating in a welfare program. This study concludes that stigma is not a large barrier to participating in social benefits programs. Although this provides suggestive evidence that stigma has a small effect on benefit uptake, none of the studies reviewed provide causal evidence.

3 The anti-vaccination movement underlaid by psychic costs is commonly observed in developing and developed countries (e.g., Omer et al. 2009).

4 Similar movements opposed tetanus vaccination campaigns in Cameroon in 1990 (Feldman-Savlesberg 2008) and polio vaccination campaigns in Kenya, Uganda, and Tanzania (UNICEF 2001).

5 Other common reasons included lack of information (27.2 percent) and distance to a health clinic (13.4 percent).

6 In Nigeria, tetanus contributes to a high neonatal mortality rate, which is up to 20 percent (Oruamabo 2007). Fatality from neonatal tetanus reaches almost 100 percent without medical treatment, which is difficult to obtain in rural Africa (Blencowe et al. 2010). The symptoms of tetanus include a series of muscle spasms, accompanied by severe pain.

7 Although tetanus toxoid vaccination can have side effects like any other vaccinations, symptoms are rarely severe (Middaugh 1979). Common adverse responses to tetanus toxoid vaccination include a sore arm, swelling, and itching, all of which are considered mild. Because neonatal tetanus is typically contracted at the time of delivery when the umbilical cord is cut with a non-sterile instrument, hygienic delivery is also critical to prevent tetanus infection.

if one follows the correct vaccination schedule.[8] Despite the huge benefits of tetanus toxoid vaccination, vaccine take-up is low in Nigeria. While 82 percent of newborn babies are protected from neonatal tetanus through tetanus toxoid vaccination to mothers worldwide (WHO 2011), only 52.8 percent of births are protected in Nigeria (DHS 2013).

We conducted our study in the northeastern region of Nigeria.[9] Our randomized experiment conducted among women of childbearing age captures monetary costs and psychic costs separately as potential barriers to tetanus vaccine take-up.[10] To capture monetary costs as potential barriers to vaccination, we randomized the amount of cash incentives provided to women whose condition was simply to attend a clinic. To capture psychic costs of vaccination as potential barriers, we gave a group of women their cash incentives with the additional condition of receiving a vaccine at the clinic. Because the only difference between these two conditions is whether a woman was required to receive a vaccine for cash rewards upon arrival at the clinic, the difference in clinic attendance between these two groups captures the psychic costs of vaccination. Furthermore, if those women whose condition for cash provision was clinic attendance refused to take the vaccine after showing up at the clinic, this is directly attributed to the psychic costs of vaccination. We also examine the effect of priming on vaccination by randomizing a disease message: either a "scared-straight" message, which emphasizes the severity of tetanus, or a control message, which provides the same information on tetanus without emphasis on the severity of the disease.[11]

The primary contribution of our study to the literature is to develop a novel experimental design causally detecting psychic costs of vaccination. For clean identification of psychic costs, we narrowly define them, sacrificing the external validity of our findings. Our experimental design cannot detect other potentially significant psychic costs, such as distrust of healthcare providers. Contrary to the emphasis on psychic costs in observational studies, we do not find that psychic costs of vaccination are large barriers to vaccination. The clinic attendance of women who were offered cash compensation for a clinic visit but not required to receive a vaccine did not differ from that of women who were required to get vaccinated at a clinic in order to receive the same compensation. Furthermore, almost all women (95.7 percent) actually received a vaccine upon their arrival at clinics, even when it was not necessary in order to receive cash rewards.

As caveats, the following limitations of our study should be noted. First of all, in our experimental design, our finding of nonsignificant psychic costs applies only to the women who attended clinics. Although we employ various amounts of cash incentives for clinic attendance to minimize the proportion of women who refuse to visit a clinic, over 10 percent of women offered the highest amount still did not show up at a clinic. It is possible that those women who refused to come to a clinic even with high cash incentives have significant psychic costs of vaccination, though this would be a small share of the population. Several other limitations potentially threaten the internal validity. Women who were instructed to simply attend

8 Following vaccine instructions is crucial for its efficacy. The World Health Organization (WHO 2006) recommends that women of childbearing age and pregnant women receive multiple doses of tetanus toxoid vaccine. A single dose can prevent only 43 percent of neonatal tetanus deaths (Ogunlesi 2011). It is also important to follow the vaccination schedule. The first dose should be taken at first contact or as soon as possible in pregnancy, followed by a second dose at least four weeks after the first dose and a third dose six months after the second dose (WHO 2006).

9 It is often indicated that distrust of health services is prevalent in northern Nigeria (for example, see Jegede [2007]).

10 Although vaccine studies in the public health literature tend to focus on the vaccination of children, we study adults because psychic costs of vaccination might influence their behaviors differently, depending on whether the decision is for themselves or for others. A person's decision for others could be more complicated than for themselves, as it could depend on other factors such as altruism. Since the tetanus vaccine for women of childbearing age protects newborn babies against tetanus, our study is relevant for child health and policy.

11 "Scared straight" originally referred to a program intended to deter juveniles from future crimes by showing them the severity of life in prison to emphasize the consequence of bad behaviors (Petrosino et al. 2014). We call a message that emphasizes the severity of a disease "scared straight" because the purpose of this message is to emphasize the consequences of non-vaccination, or "bad behavior."

clinics for cash might have misunderstood that they had to receive a vaccine at the clinic to receive the cash. Women who understood the conditionality well might have felt pressure to receive a vaccine from health staff. Finally, only women who could see high net benefits from vaccination might have attended the clinic under the conditionality of a simple clinic visit (i.e., self-selection). Although we implemented the experiment to minimize these threats, they may not have been perfectly eliminated.

Priming about disease severity did not alter vaccine take-up. The priming, however, did increase the perceived severity of disease as well as respondents' heart rate.[12] The paper contributes to the literature on priming by measuring as outcomes, for the first time in Africa, actual vaccination behaviors instead of hypothetical behaviors, which are commonly examined in extant studies (e.g., Nyhan et al. 2014), as well as heart rate, an objective measure of emotional response.[13]

Cash incentives strongly increase vaccine take-up: Giving two dollars in incentives increased vaccine take-up by 19.4 percentage points from the control level, 55.8 percent.[14] This strong effect of cash incentives is comparable to the one found in Banerjee et al. (2010): Small in-kind transfers (equivalent to $2.85) increase children's vaccination rates in India by 20 percentage points.[15] They attribute that large effect of small in-kind incentives to behavioral factors.[16]

The remainder of the paper is organized as follows. The next section discusses the experimental design. Section 2 introduces the model of psychic costs. Section 3 discusses the survey design and provides a description of the data. Section 4 conducts empirical analyses on monetary costs, psychic costs, and priming. The last section concludes.

1. Experiment Design

To evaluate potential barriers to vaccine take-up, our field experiment randomized three factors—the amount of cash incentives, the condition for cash incentives, and the type of disease message—given at the individual level within villages. The overall research design is depicted in fig. 1. This section explains each of these three factors and describes the randomization process and implementation.

Cash Incentives

To examine monetary costs as barriers to vaccination, we randomly varied the amount of cash incentives offered to respondents: 5 naira (C5; approximately 3.3 US cents), 300 naira (C300; 2 US dollars), or 800 naira (C800; 5.3 US dollars).[17] C5 can be considered as the control group.[18]

[12] Our finding is consistent with some recent works on framing and fear appeals in developed countries; Nyhan et al. (2014), for example, show that priming alters perceptions, but not behaviors.

[13] Heart rate has been used in the psychology literature to evaluate whether fear appeals induce fear because increased heart rate is considered an index for cognitive resources allocated to stimulus (for example, see Ordonana et al. [2009]).

[14] Two dollars is equivalent to about two days' earnings per person, and a little more than the average transportation costs (both ways) for a clinic visit among those in our sample who needed to pay for transportation.

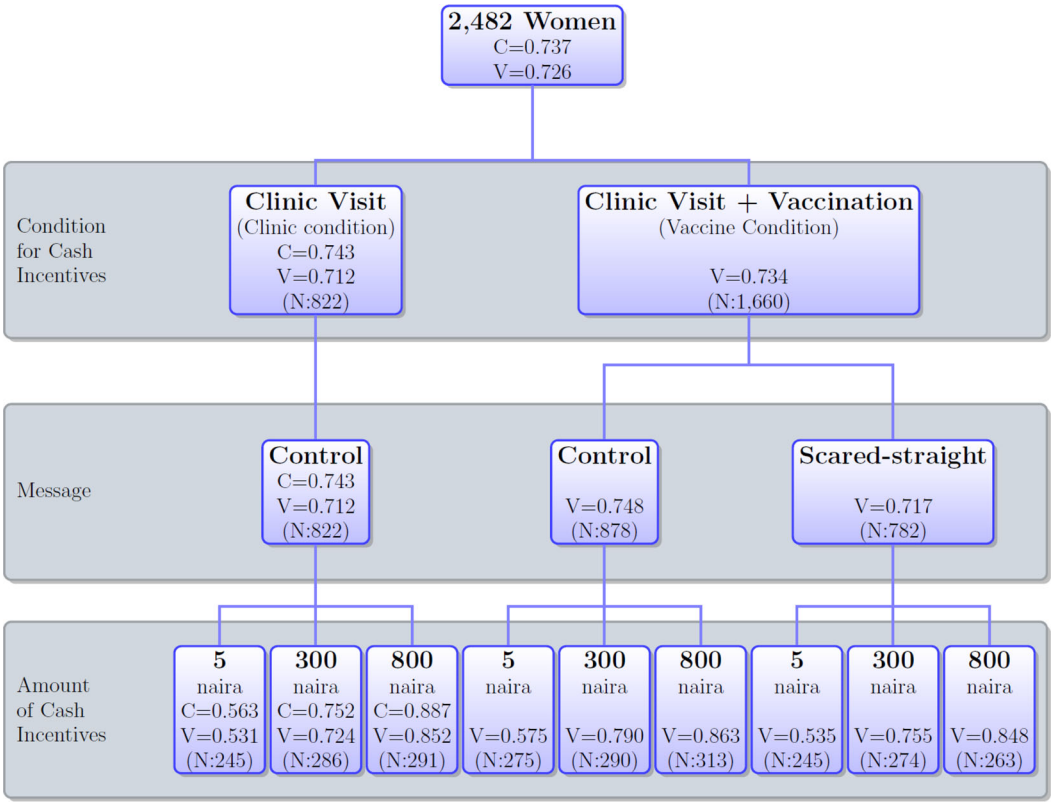
[15] Incentivizing people to induce a desirable behavior has been studied in detail. In developed countries, Sutherland, Leatherman, and Christianson (2010) review the effects of cash incentives on vaccination rates, concluding that cash incentives are effective in promoting vaccine take-ups. Weaver et al. (2014), for example, shows that cash incentives of 10 euros increase vaccine take-up by 27 percentage points. In developing countries, on the other hand, many studies find that effects of cash incentives on vaccination are small and limited (see, for example, Robertson et al. [2013]; Barham and Maluccio [2009]; Salinas-Rodríguez and Manrique-Espinoza [2013]).

[16] Their study boosts vaccine take-ups also through supply-side intervention by establishing an immunization camp in each village. Our study too reduces the supply-side constraints by ensuring sufficient vaccine stock, as discussed below.

[17] The mean daily earnings per household for the sample was approximately 1,000 naira (144 naira per person), and the mean transportation cost to the nearby health clinic was about 250 naira both ways among those who needed to pay for the transportation (50 percent of the sample).

[18] The purpose of providing the positive but minimum amount of cash to the control group was to track respondents who visited clinics by using the voucher with the amount of cash incentives indicated.

Figure 1. Research Design



Source: Figure by authors.

Note: These are based on the analysis sample of 2,482 women. 150 naira = $1 approximately. C is clinic attendance rate, V is vaccine take-up rate, and N is the number of observations.

Psychic Costs of Vaccination

To identify the psychic costs of vaccination, we randomly varied the condition of cash incentives under which each respondent could receive the cash compensation. The conditionality was either clinic attendance (Clinic condition) or clinic attendance and vaccination (Vaccine condition). Respondents under the Clinic condition could receive the assigned cash incentives (5, 300, or 800 naira) if they visited an assigned clinic regardless of vaccine take-up, while respondents under the Vaccine condition were entitled to the assigned amount of money if they visited an assigned clinic and received a tetanus toxoid vaccine at the clinic.

The difference in clinic attendance between respondents under the Clinic condition and the Vaccine condition reveals the effect of psychic costs of vaccination on vaccine take-up. This is because the additional action was required under the Vaccine condition, vaccine take-up upon clinic visit, in order to obtain the same amount of cash compensation as the Clinic condition. On one hand, the clinic visit by a respondent under the Clinic condition indicates that she had overcome the monetary costs of the clinic visit, such as transportation costs and opportunity costs, with her cash incentive. On the other hand, the clinic visit by a respondent under the Vaccine condition indicates that she had overcome not only the monetary costs of the clinic visit, but also the psychic costs of vaccination with the same amount of money. Then, if the clinic attendance under the Vaccine condition is shown to be lower than that under the Clinic condition, this difference results from the existence of psychic costs of vaccination. This design

does not allow us to capture the psychic costs of vaccination among women who would never attend the clinic even with the highest amount of cash incentives. To minimize this possibility, we set the highest amount of cash incentives (800 naira) so high that most respondents would be willing to attend clinics. By comparing C300 and C800, we can see whether and how psychic costs are compensated at different amounts.

Although the Clinic condition did not require respondents to receive the tetanus toxoid vaccine, they had an option to receive it if they wished to do so. This option does not invalidate the measurement of the psychic costs of vaccination through clinic attendance. How commonly respondents under the Clinic condition received a vaccine, even though they were not required to do so to receive cash rewards, can provide additional evidence for the psychic costs of vaccination: The lower the psychic costs of vaccination, the higher the rate of vaccine take-up.

Priming about Disease Severity

In addition to the comparison between the Clinic condition and Vaccine condition, some women were randomly selected to be primed about disease severity to measure the impact of priming on vaccine take-up. They received the "scared straight" message, while others received the control message. The message was conveyed to each respondent through a flipchart. We prepared two different flipcharts: one with frightening pictures of tetanus patients (i.e., the "scared straight" flipchart) and another without such graphic information (i.e., the control flipchart).[19] To capture the priming effect, we compared those respondents under the Vaccine condition (required to receive a vaccination to obtain cash rewards) who were shown the control flipchart with those who were shown the "scared straight" flipchart (Vaccine condition & Fear). For the comparison between the Clinic condition and Vaccine condition to be valid in capturing the psychic costs of vaccination, all respondents under the Clinic condition also received the control message.

Randomization Process

Randomization was done as follows. Interviewers took 20 questionnaires to each village every day of the survey. Each questionnaire indicated one of the three amounts (C5, C300, or C800), as well as one of the three treatment types (Clinic condition, Vaccine condition, or Vaccine condition & Fear), on the middle page. While the proportions of each amount of cash incentives in the 20 questionnaires were equal in each village, we randomly varied the proportion of Vaccine condition & Fear in the 20 questionnaires (from 20 through 70 percent) across villages.[20] The remaining questionnaires were equally divided into the Clinic condition and Vaccine condition.

When starting the interview with each respondent, the interviewer randomly picked out one of the 20 questionnaires. In this way, the assignment of the amount of cash incentives and the assignment of

[19] The "scared straight" flipchart contains 15 slides in total, and seven out of 15 show pictures of various tetanus patients to repeatedly emphasize the severity of tetanus symptoms. The remaining eight slides provide information about the symptoms of tetanus (severe pain and muscle spasms) and the effectiveness of the tetanus toxoid vaccination, written in the local language, Hausa. The control flipchart contains only the latter eight slides with written information and without any images of tetanus patients. Examples of flipcharts are shown in supplementary online appendix fig. S1.1. The difference between the two types of flipcharts was intended to capture the effect of the priming about disease severity on vaccination behavior. To differentiate only the salience of the messages and not the information in the messages, both flipcharts contain identical written information about tetanus and tetanus vaccination.

[20] This was to evaluate the potential spillover effects of the priming intervention on vaccine take-up. As the direct priming effects on vaccine take-up are shown to be insignificant below, its spillover effects are unlikely to be significant. Indeed, we have found insignificant spillover effects.

the treatment type are random within villages.[21] Overall, the combination of the three amounts of cash incentives and the three treatment types generated nine treatment groups in total, and each respondent in the sample was randomly assigned to one of them within villages.[22]

Implementation

Interviews and the priming intervention were conducted by 10 female interviewers. Interviewers conducted a baseline survey at each respondent's house. Immediately after this baseline interview, the respondent was shown either the "scared straight" flipchart or the control flipchart to provide information about tetanus and tetanus toxoid vaccination.[23] At the end of the flipchart session, each respondent was told about the cash compensation she could obtain and the criteria under which she would be eligible to receive it: clinic attendance or vaccination at the clinic. Respondents were instructed to attend an assigned health clinic within one week after the intervention, with a voucher (detailed below). Respondents were informed that the clinic would be open Monday through Saturday, 8 a.m. to 5 p.m.[24]

2. Model of Psychic Costs

This section introduces a simple model showing how psychic costs affect clinic attendance and vaccine take-up under the research design.

A respondent decides whether she visits a clinic or not, and given she visits a clinic, whether she receives a vaccine or not. She makes one choice from her choice set. Under the Clinic condition, the choice set and the net benefit from each choice are:

Do not attend clinic: 0

Attend clinic but refuse vaccine: $B_h + \tau$

Attend clinic and receive vaccine: $B_h + \tau + B_v$

where B_h is net psychic benefits of clinic visit (psychic benefits of clinic visit - psychic costs of clinic visit), B_v is the net psychic benefits of vaccination (psychic benefits of vaccination - psychic costs of vaccination), and τ is cash incentives. Under the Vaccine condition, the choice set and the net benefit from each choice are:

Do not attend clinic: 0

Attend clinic and receive vaccine: $B_h + \tau + B_v$[25]

Then, a respondent under the Clinic condition decides to attend the clinic and receive the vaccine if

$$B_h + \tau + B_v > 0 \quad and \quad B_h + \tau + B_v > B_h \, (thus \, B_v > 0) \tag{1}$$

[21] Although the assignment ratios of the amounts of cash incentives vary across villages, the proportions of the three amounts are largely the same as each other in the whole sample. Similarly, although the assignment ratios of the treatment types vary across villages, the proportions of each of the three treatment types are almost the same in the whole sample.

[22] Although we cannot rule out the possibility that in practice interviewers assigned treatment status across respondents in a non-random way, this is unlikely to be a major concern for the following reasons. First, interviewers received careful, concrete instruction to randomly pick a questionnaire. Second, interviewers had no personal relationship with any respondents. Thus, interviewers had little incentive to intentionally deviate from the randomization procedure. Third, baseline characteristics, health behaviors, and perceptions are well balanced across treatment groups, as discussed below. This suggests that the randomization was done well in practice.

[23] The intervention took place in a closed environment, where only an interviewer and a respondent were present, to avoid information spillover that is independent of respondents' will.

[24] Whereas uncertainty of the vaccine supply is often considered to be a barrier to vaccination, we eliminated this concern by making sure that each clinic had a sufficient supply of vaccines for all the respondents and by informing each respondent that the clinic had a sufficient vaccine supply so that she would be able to receive the vaccine if she wished to do so.

[25] The choice set under the Vaccine condition does not include "Attend clinic but refuse vaccine," because the experimental design is set up so that it is extremely unlikely for a respondent under the Vaccine condition to visit the clinic without receiving a vaccine. Indeed, there were none in our sample.

A respondent under the Vaccine condition decides to attend the clinic and receive the vaccine if

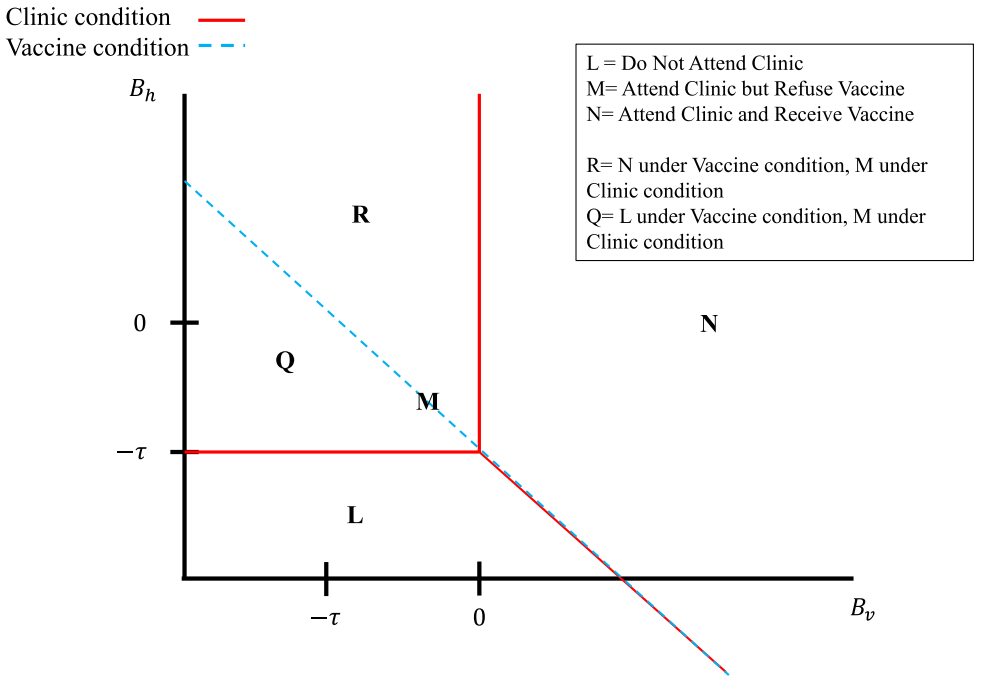
$$B_h + \tau + B_v > 0 \tag{2}$$

A respondent under the Clinic condition decides to attend the clinic but refuses to receive the vaccine if

$$B_h + \tau > 0 \quad and \quad B_h + \tau > B_h + \tau + B_v \,(thus\, B_v < 0) \tag{3}$$

Thus, this model shows how the psychic costs of clinic attendance and the psychic costs of vaccination interact with each other to affect the respondent's decision to attend the clinic and receive the vaccine, as depicted in fig. 2.[26] Under the Clinic condition, a woman chooses not to attend the clinic if both B_h and B_v are small (area L). She chooses to attend the clinic but refuses the vaccine if B_h is larger than $-\tau$ and B_v is less than zero (area M). She chooses to attend the clinic and receive the vaccine if B_h and B_v are large (area N). Under the Vaccine condition, a woman chooses not to attend the clinic if both B_h and B_v are below the dotted line, while she chooses to attend the clinic and receive the vaccine if both B_h and B_v are above the dotted line.

Figure 2. Model of Psychic Costs of Vaccination



Source: Figure by authors.
Note: Women in area L do not attend clinic; women in area M attend clinic but refuse a vaccine; women in area N attend clinic and receive a vaccine. Area M = area Q + area R. B_v is the net psychic benefits of vaccination, B_h is the net psychic benefits of clinic visit, and τ is the amount of cash incentives.

Thus, clinic attendance under the Clinic condition and under the Vaccine condition is different if a respondent is in area Q, and the vaccine take-up at the clinic under the Clinic condition and under the Vaccine condition is different if a respondent is in area R. Because the amount of cash incentives ranges

[26] This model assumes a linear cost function in which each component of cost is additive. However, the different components of costs, psychic costs of vaccination and psychic costs of clinic attendance, could interact with each other in a nonlinear way. Investigating the nonlinear case is beyond the scope of this paper.

from very low (5 naira) to relatively high (800 naira), the type of respondents who can be captured in area Q or R varies depending on the amount of cash incentives. On one hand, only with a higher amount of cash incentives (the line $B_b = -\tau$ shifts downward) can areas Q and R capture women with higher psychic costs of clinic attendance. On the other hand, with any amount of cash incentives, areas Q and R can capture women with any psychic costs of vaccination, because the vertical line $B_v = 0$ is fixed no matter what τ is.

Our research design allows us to test the existence of psychic costs of vaccination by evaluating the size of area M, which consists of areas Q and R.[27] A potential limitation of our research design is that even if the psychic costs of vaccination are significant, clinic attendance could be the same for the Clinic condition and Vaccine condition if respondents do not differentiate the psychic costs of vaccination from the psychic costs of clinic attendance, such as the distrust of health services in general.[28] The greater the psychic costs of clinic attendance, the more likely it is that respondents would never attend the clinic, even with C800. Thus, the potential positive correlation of two psychic costs is unlikely to be a major concern among the majority of respondents for whom we capture psychic costs of vaccination.

If the priming intervention increases the perceived severity of disease, then the entire distribution of women shifts rightward. There will be more women under N and fewer women under L; thus, priming increases the vaccination rate.

3. Data

We collected three pieces of data: baseline individual data, post-intervention individual data, and post-intervention clinic data. The baseline and post-intervention interviews took place at each respondent's house, and the post-intervention clinic interviews were carried out at health clinics only among respondents who visited the clinics.

Study Area and Sampling

Our study was conducted in the Jada local government area of Adamawa state in the northeastern region of Nigeria.[29] The experiment was implemented in March–May 2013.

We employed the following three-stage sampling. First, 10 main health clinics in all nine rural wards in Jada were selected.[30] Second, we selected a total of 80 villages that are situated within one of the catchment

[27] This model, however, cannot identify the case where women have positive Bv but they still have psychic costs that lower Bv, and therefore reduce the likelihood of getting vaccinated.

[28] In the model, we cannot rule out the case where women with high psychic costs of clinic attendance are distributed in area L no matter what the amount of cash incentives is, but they also have high psychic costs of vaccination. To minimize this possibility, we lowered the potential psychic costs of clinic attendance in three ways. First, when respondents under the Clinic condition decided whether to attend the health clinic, they were informed that they would not need to utilize any services at the clinic. Second, we eliminated a concern about uncertainty of the vaccine supply as a source of distrust of health services, as discussed above. Third, at the clinic, respondents interacted with health staff only after they agreed to receive the vaccine; thus, respondents did not need to interact with health staff at the clinic if they did not wish to. At the same time, this attempt to minimize the influence of the psychic costs of clinic attendance might have led to underestimated psychic costs of vaccination because the difference in conditionality, either clinic visit or vaccination, might have been nuanced, as discussed below.

[29] Northern Nigeria suffers from higher maternal and child mortality and lower utilization of health services than southern Nigeria. The under five child mortality rate is 260 per 1000 in northeast states, while it is 103 in southwest states (UNICEF 2013). The percentage of women receiving two or more injections against tetanus during their last pregnancy was 58.8 percent in Adamawa state, while southern states achieve about 75 to 80 percent (DHS 2013). Although the state government has been providing free antenatal care services including tetanus toxoid vaccination to pregnant women, the vaccination rate remains low.

[30] Among the 11 wards in Jada, we focused on all nine rural wards, each of which has one to five public health clinics. We selected the main health clinic from each ward, with an exception of one large ward, where we selected two clinics.

areas of the 10 health clinics in the sample.[31] All villages with more than 10 households located within the catchment area of each health clinic were selected, unless the total number of villages in the same catchment area was more than 15; if it exceeded 15, the priority was given to villages far from the health clinic to ensure enough variation in the distance to the health clinic.

Third, in each of the 80 villages in the sample, we selected one woman from each household who was age 15 to 35 and had not received a tetanus vaccine less than six months prior to the baseline survey.[32] In the case where there was more than one eligible women in the household, the priority was given to the following women in the following order: a pregnant woman, a non-pregnant woman who had never received a tetanus vaccine, and a non-pregnant women who had not received the tetanus vaccine in the past six months.[33] If more than one woman with the same priority was eligible, then we selected the first one in the alphabetical order of their first name.[34]

The sample covers 2,530 women in 80 villages in total. On average, a health clinic covers 305 women (range: 80–439) in 9.6 villages (range: 6–22), and a village covers 50.1 women (range: 9–189).[35]

Baseline, Intervention, and Post-Intervention

The baseline questionnaire was administered to all women in the sample to capture their prior knowledge, beliefs, and attitudes about tetanus and tetanus vaccination, as well as their own and their household's baseline characteristics. Global Positioning System (GPS) coordinates of respondents' dwellings were measured. At the end of the baseline survey, the heart rate was measured using a heart rate monitor to capture the baseline emotional state (or autonomic arousal) of each respondent.

Immediately after completing the baseline questionnaire, the flipchart intervention took place. After the session, respondents were provided a voucher that they could redeem at the assigned health clinic. The assignment of health clinic for each respondent was determined based on the village where she resided.[36]

After the intervention, respondents were asked questions related to tetanus and tetanus vaccination identical to those asked in the baseline survey to see whether the flipchart intervention triggered any changes in knowledge and beliefs. Respondents were also asked if the intervention caused an emotional arousal. The heart rate was measured immediately after the intervention once again in the same way as at the end of the baseline survey to measure the emotional response to the flipcharts.

Health Clinic

An interviewer (who was a different interviewer than the ones who had conducted the baseline surveys) administered a brief survey with each attendee in each clinic.[37] At the beginning of the interview, the

31 Catchment areas are defined by the primary healthcare development agency that is responsible for national immunization campaigns. None of the catchment areas of the 10 clinics in the sample overlap each other.

32 Our survey team visited households to find out if they had any eligible women.

33 This study examines psychic costs among women of childbearing age. Focusing only on pregnant women was practically infeasible because it would have required a much greater number of villages to be covered. Furthermore, targeting non-pregnant women of childbearing age in the study is as important as targeting pregnant women to protect newborn babies in the long run, because the immunity of tetanus toxoid vaccines lasts for several years.

34 We employed this simple selection procedure to minimize a potential threat that interviewers might pick a respondent based on their convenience and/or preference in practice, though we acknowledge that this procedure might have been less ideal than simple randomization.

35 Since we did not conduct a household census in the village, it is likely that we did not reach some households with an eligible woman. At the same time, because the survey team spent more time in larger villages, the number of eligible women in the sample should be positively correlated with the total number of eligible women in the population across villages.

36 The voucher indicated the respondent's name, her unique ID assigned in the project, date of the intervention, name of the health clinic she was assigned to attend, conditionality (Clinic condition or Vaccine condition), and the amount of cash compensation to be provided (5, 300, or 800 naira) if she satisfied the assigned conditionality.

37 Upon arriving at the assigned health clinic, all women were asked to form a line to wait to be served regardless of which intervention they had received. Since there is no significant difference in waiting time according to treatment status, waiting time should not cause any difference in vaccine take-ups across treatment groups.

attendee was given the vaccination upon her agreement by the health staff right then. Under the Vaccine condition, no respondents refused the vaccination. Respondents under the Clinic condition were also provided the vaccine if they would like to receive it when asked. Then, the interviewer recorded their vaccination decision in the survey form. Our measure of vaccine take-up is based on this clinic survey.[38] At the end of the interview, monetary compensation was made in exchange for the voucher indicating the assigned amount. Later, each redeemed voucher was matched with the baseline data. Our measure of clinic attendance is based on these administrative data.[39]

Descriptive Statistics and Balancing Tests

The analysis is based on 2,482 women age 15 to 35 years old for whom information of basic baseline characteristics and GPS coordinates are available. The proportions of respondents who were offered each of the three amounts of cash incentives are very similar across the Clinic condition, Vaccine condition, and Vaccine condition & Fear; the proportions of these three treatment types are also very similar for each amount of cash incentives (fig. 1).

On average, respondents are 25 years old. About half of the sample are Muslim, almost half (48.3 percent) have never received any education, 15.3 percent have never gotten married, 18.0 percent are pregnant, and 76.5 percent have at least one child. Many respondents (43.5 percent) engage in paid work, including selling agricultural produce, and the average amount of household earnings per capita in the past month is about 5,000 naira (approximately 33.3 US dollars). On average, the distance to the assigned health clinic measured by GPS coordinates is 1.7 kilometers, while the one-way transportation costs to the clinic are around 125 naira and the opportunity costs of clinic visit are about 4 naira.[40] Overall, the majority of respondents (72.2 percent) had visited the assigned health clinic before, and 39.8 percent had received a tetanus toxoid vaccination at least once. These characteristics and health behaviors of women in the sample are comparable to those of the nationally representative sample (DHS 2008).[41]

In the whole sample, more than one-third of respondents (37.8 percent) thought that they were likely to contract tetanus; on average, respondents thought that 30 people out of 100 would die of tetanus; and

[38] The date and time of the attendee's visit, the means of transport from her house to the clinic, transportation costs paid, and perceptions about tetanus toxoid vaccination were also recorded. Although receiving multiple doses of tetanus toxoid vaccine is crucial for its efficacy, our experiment focused on a single-dose take-up to identify psychic costs of vaccination without introducing complexities in repeated take-up decisions. Covering multiple doses, which takes time, was also practically infeasible. The process of receiving a vaccine did not waste any time, because the interviewer was filling out the administrative information, such as the date of the interview, in the survey form, and copying the unique ID from the voucher to the survey form while the health staff were giving the attendee a vaccination at the same time, in the same place. The study made the process at the health clinic very smooth, contrary to the usual situation, for administrative purposes, and for minimizing the administrative difference between Clinic condition and Vaccine condition at the clinic. As a result, women under the Clinic condition might have accepted the vaccine more than in the normal setting. We employed this design to pursue the internal validity, but at the cost of external validity.

[39] All of the women who visited the health clinics showed up at the ones they had been assigned to attend. If some women who attended the clinic failed to be interviewed for operational reasons, clinic attendance would be underestimated. We believe that such attrition is extremely rare.

[40] Transportation costs are self-reported costs to visit the assigned health clinic using the mode of transport the respondent would typically use. Opportunity costs are calculated as the amount of money the respondent would have earned if she had not attended the clinic, based on the daily income of the household to which she belongs, her contribution to the household income, and the time it took for her to visit the clinic.

[41] While the Nigerian DHS sampled women age 15 to 49, we restricted the DHS sample to women age 15 to 35 to compare with our sample. In the DHS sample, over half of women are Muslim (57.3 percent), about half (49.6 percent) have never received any education, 14 percent are pregnant, and 62 percent engage in paid work. Distinct from our sample, only a very small proportion of women in the DHS sample are single (2 percent), and most of them (96.3 percent) have at least one child. In the DHS sample, 31.8 percent of women have received a tetanus vaccination. The means of most variables in the DHS sample are not statistically different from those in our sample (results not shown).

substantial proportions of respondents (35 to 50 percent) felt worried about tetanus, thought that tetanus is bad, and felt that it is important to get protected from tetanus. On average, respondents thought that 22 people out of 100 could be saved from tetanus with vaccines. The mean baseline heart rate was very high, 86.8 beats per minute.[42]

The balance of baseline characteristics, health behaviors, and perceptions (25 variables) is checked in table 1. Corresponding to the empirical analyses below, we conduct two sets of balance checks: one for the types of treatment and another for the amounts of cash incentives. The results indicate that the randomization performed well: The equality of means across the three treatment types and across the three amounts of cash incentives is not statistically rejected at conventional levels for most variables, and the corresponding joint test for all the 25 variables is not significant either.[43] Exceptions are age and transportation costs to the clinic, and some of the perception measures related to tetanus; their mean difference, however, is small (12 percent of the control mean at most). Importantly, the equality of means is not rejected for previous clinic visit and previous tetanus vaccine take-up.

4. Barriers to Vaccine Take-Up

This section conducts empirical analyses on potential barriers to vaccination. We show that cash incentives increase vaccine take-up substantially, psychic costs are nonsignificant barriers to vaccination, and priming about disease severity does not alter vaccination behavior, even though it increases perceived severity of disease. Overall, clinic attendance and vaccine take-up were high: 73.7 percent of women attended a clinic and 72.6 percent received the vaccine (fig. 1). Even among women who were offered the lowest amount of cash incentives (5 naira), over half of them (54.8 percent) received the vaccine. This high take-up might have been because of the basic information about tetanus and tetanus vaccination provided to all respondents.

Psychic and Economic Costs of Vaccination

Cash Incentives

Vaccine take-up is highly responsive to cash incentives: The effect of C300 on vaccine take-up is 19.3 percentage points and the effect of C800 is 28.2 percentage points, as compared to vaccine take-up under C5, which is 54.8 percent (supplementary online appendix table S1.2). We find a similar strong effect of cash incentives on clinic attendance as well. These incentive effects are comparable with the effect of an in-kind incentive found by Banerjee et al. (2010): The conditional in-kind transfer (equivalent to about $2.9 or around 435 naira in Nigerian currency) increases the rate of full immunization by 21 percentage points in rural India.[44]

[42] The baseline survey also asked questions regarding beliefs about vaccination in general. In the whole sample, while more than 90 percent of respondents thought that vaccines protect one from diseases, more than 60 percent felt that injection needles are scary and that vaccines have side effects. Around 25 percent of respondents thought that vaccines give diseases, and around 18 percent believed that vaccines give HIV.

[43] Specifically, in each balance check, we regress each variable on two corresponding treatment dummies (Clinic condition or C5 condition as a base), controlling for village fixed effects, and test a null hypothesis that the estimated two coefficients are both zero with standard errors clustered by village. The overall balancing test across the nine treatment groups, which does not necessarily correspond to the empirical analyses below, is reported in supplementary online appendix table S1.1. The equality of means across the nine treatment groups is rejected at a 10 percent significance level for some variables, and the joint test is also significant. With this imbalance, interpreting the estimation results below requires caution.

[44] It is noted that there exist substantial differences between our study and that of Banerjee et al. (2010) in terms of the eligible participants of the study (women of childbearing age vs. children), the location of vaccination (health clinic vs. camp within village), the type of vaccination offered (one dose of tetanus vs. any immunization), and the provision of detailed vaccine information (yes vs. no). Distinct from our experiment, this very large treatment effect can be also attributed to the extremely low vaccination rate at the baseline (6 percent).

Table 1. Balancing and Summary Statistics

	Treatment type				Cash incentives amount			
	Clinic condition	Vaccine condition	Vaccine condition & Fear	Joint significance (p-value)	C5	C300	C800	Joint significance (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Baseline characteristics:								
Age	24.77	25.25	25.30	0.164	24.89	24.91	25.49	0.092
Muslim	0.502	0.481	0.505	0.156	0.490	0.500	0.495	0.848
Any education	0.521	0.520	0.508	0.798	0.509	0.520	0.521	0.838
Marital status = Single	0.157	0.152	0.148	0.837	0.152	0.158	0.149	0.851
Currently pregnant	0.181	0.165	0.195	0.351	0.165	0.174	0.197	0.237
Have children	0.756	0.783	0.752	0.423	0.764	0.762	0.768	0.925
Has paid work	0.421	0.446	0.439	0.526	0.422	0.456	0.426	0.227
Monthly HH earning per capita (naira)	5974.3	5602.5	6078.2	0.385	5515.4	5973.3	6097.4	0.188
Distance to clinic (km)	1.713	1.720	1.690	0.299	1.708	1.707	1.709	0.989
Transport to clinic (naira)	119.61	129.72	120.87	0.305	124.92	109.99	135.67	0.029
Opportunity costs to clinic (naira)	3.818	4.182	4.203	0.787	4.289	3.846	4.091	0.718
Baseline behaviors:								
Ever used clinic	0.707	0.732	0.727	0.411	0.718	0.730	0.719	0.777
Received tetanus vaccine before	0.388	0.406	0.402	0.664	0.388	0.405	0.402	0.620
Baseline perceptions:								
Likely to contract tetanus	0.375	0.365	0.397	0.424	0.393	0.377	0.366	0.413
Number of people who die of tetanus	30.34	30.64	29.40	0.384	29.22	30.84	30.30	0.308
Very worried about tetanus	0.359	0.331	0.381	0.097	0.342	0.368	0.357	0.431
Tetanus is very bad	0.431	0.422	0.448	0.434	0.415	0.418	0.465	0.031
Very important to be protected from tetanus	0.501	0.474	0.513	0.073	0.469	0.507	0.505	0.174
Vaccine efficacy	22.30	22.82	21.57	0.567	22.00	22.09	22.64	0.829
Vaccines protect from disease	0.913	0.912	0.913	0.995	0.909	0.915	0.913	0.912
Needles are scary	0.592	0.631	0.626	0.124	0.631	0.608	0.610	0.196
Vaccines have side effects	0.654	0.679	0.646	0.254	0.675	0.665	0.643	0.137
Vaccines give diseases	0.256	0.281	0.276	0.371	0.280	0.267	0.266	0.559
Vaccines give HIV	0.186	0.186	0.178	0.825	0.197	0.188	0.167	0.100
Heart rate (beat/min)	86.53	86.33	87.72	0.192	86.73	86.92	86.83	0.954
Joint significance (p-value)[a]				0.411				0.258

Source: Authors' calculations as described in the text.

Note: These are based on the analysis sample of 2,482 women. Transportion and opportunity costs to clinic are the costs for one-way travel. "Likely to contract tetanus" is a binary variable; "Number of people who die of tetanus" is the number of people out of 100; "Very worried about tetanus," "Tetanus is very bad," and "Very important to be protected from tetanus" are binary variables. "Vaccine efficacy" is the difference between the hypothetical number of unvaccinated people whom each respondent thinks get tetanus and the number of vaccinated people who get tetanus (range: −100 to 100). 150 naira = $1 approximately. Sample means among women in each of three treatment groups with respect to the types of treatment and the amounts of cash incentives, respectively, are reported in columns (1)–(3) and (5)–(7); columns (4) and (8) report the p-value for the joint significance test for the equality of the means across three treatment groups. Specifically, we regress each variable on two treatment dummies (C5 or Clinic condition as a base) controlling for village fixed effects and test a null hypothesis that the estimated two coefficients are both zero (F test) with standard errors clustered by village (80 villages). [a]Joint significance (p-value) tests if all treatment coefficients are equal to zero across all variables.

Psychic Costs of Vaccination

To measure the effects of psychic costs of receiving a vaccine, we examine whether the rate of clinic attendance is different between respondents under the Clinic condition and Vaccine condition. To identify whether psychic costs reduce vaccine take-up in a regression framework, we estimate:

$$Y_{ij} = \alpha + \beta_1 VaccineCondition_{ij} + \beta_2 VaccineCondition\&Fear_{ij} + \sum_{d=300,800} \gamma_d Cd_{ij} + v_j + \epsilon_{ij} \quad (4)$$

where Y_{ij} is a dummy variable that takes 1 if a woman i in village j attends her assigned clinic; C is a dummy variable for each cash incentive d; 300 naira and 800 naira; *VaccineCondition*=1 if the conditionality of cash incentives is vaccination as opposed to clinic attendance while Vaccine condition & Fear is controlled for (Clinic condition is the comparison group).[45] Because treatment assignments are random within villages, all the specifications employed in this paper control for village fixed effects (v) and cluster standard errors by village (80 villages in total).[46] For a robustness check, we control for all baseline characteristics, behaviors, and perceptions reported in table 1 in all the regression analyses in the paper. All results are similar to each other without and with covariates.

The difference in clinic attendance between the Clinic condition and Vaccine condition may depend on the amount of cash incentives.[47] We examine this potential heterogeneity through the interaction terms between the condition and the amounts of cash incentives offered.

Clinic attendance is virtually the same between respondents under the Clinic condition and Vaccine condition: 74.3 percent vs. 74.8 percent. Table 2 (column 1, with no covariates in panel A and with covariates in panel B) presents the effect of the vaccination condition on clinic attendance as compared to the clinic attendance condition. On average, the attendance rate at health clinics under the Vaccine condition is not significantly different from the one under the Clinic condition. The effects of the Vaccine condition on clinic attendance are insignificant regardless of the amount of cash incentives (table 2, column 3). Among those who received the highest amount of cash incentives (C800), 13.4 percent did not attend the clinic and we cannot address potential psychic costs among them.[48] Even if we assume that every single woman who was not responsive to C800 had large psychic costs, this would still be a small share of the population. These results suggest that psychic costs of vaccination are not large barriers for the majority of women.

Vaccine Take-Up

While clinic attendance is a primary outcome to test the psychic costs of vaccination in our experimental design, we also examine vaccine take-up as a secondary outcome. Among 822 respondents under the Clinic condition, 611 attended clinics and 585 (95.7 percent) of them received a vaccine, even though it was not required for cash rewards.[49] Estimating equation (4) with a dummy for vaccine take-up as a dependent variable shows that the estimated effect of the Vaccine condition on vaccine take-up, 3.8 percentage points, is small, though it is statistically significant (table 2, panel A, column 2). When we include covariates, the effect gets even smaller: 2.5 percentage points, and it is no longer statistically significant (panel B, column 2).[50] Psychic costs might exist among a small fraction of women

45 Excluding women under the Vaccine condition & Fear yields results similar to those reported here.

46 Village fixed effects also control for village heterogeneity. As all respondents in the same village are assigned to the same health clinic, village fixed effects also control for clinic heterogeneity, such as supply-side factors.

47 On one hand, respondents who decided to attend the clinic under the Clinic condition with the low amount of cash incentives might not have gone to the clinic under the Vaccine condition if psychic costs could not be overcome with the small cash incentives. On the other hand, if respondents were offered a high amount of cash incentives under the Vaccine condition, the cash incentive might have compensated for psychic costs of receiving a vaccine.

48 The baseline characteristics and perceptions of women under C800 who attended the health clinic and who did not are mostly similar, with several exceptions: Compared to non-attendees, attendees are older and are more likely to be Muslim and have concerns about side effects; households of attendees earn less than those of non-attendees (supplementary online appendix table S1.3).

49 With the relative imbalance of baseline covariates shown in supplementary online appendix table S1.1, the number of women under the Clinic condition who refused the vaccine upon their arrival at the clinic serves as a useful outcome, because it is based on one treatment group. Under the Vaccine condition, the clinic attendance rate and the vaccination rate are identical, because all respondents who attended the clinic received the vaccine.

50 The estimated effect of the Vaccine condition among women under C300 (6.8 to 7.1 percentage points) is statistically significant (table 2, panels A and B, column 4).

Table 2. Psychic Costs of Vaccination

Dependent variables:	Attended clinic (1)	Received vaccine (2)	Attended clinic (3)	Received vaccine (4)
Panel A: No covariates				
Vaccine condition	0.006	0.038*	−0.004	0.029
	(0.016)	(0.019)	(0.034)	(0.039)
C300			0.170***	0.174***
			(0.040)	(0.044)
C800			0.293***	0.292***
			(0.039)	(0.041)
Vaccine condition*C300			0.046	0.042
			(0.045)	(0.050)
Vaccine condition*C800			−0.008	−0.007
			(0.038)	(0.041)
Observations	2482	2482	2482	2482
R-squared	0.001	0.002	0.096	0.092
Control mean of dependent variable	0.743	0.712	0.563	0.531
Fixed effects by village (80 villages)	X	X	X	X
p-values of F test:				
Vaccine condition + Vaccine condition*C300 = 0			0.105	0.010
Vaccine condition + Vaccine condition*C800 = 0			0.622	0.439
Panel B:With covariates				
Vaccine condition	−0.007	0.025	−0.018	0.009
	(0.018)	(0.021)	(0.035)	(0.039)
C300			0.167***	0.162***
			(0.040)	(0.043)
C800			0.286***	0.275***
			(0.040)	(0.042)
Vaccine condition* C300			0.053	0.059
			(0.042)	(0.046)
Vaccine condition*C800			−0.002	0.007
			(0.040)	(0.043)
Observations	2214	2214	2214	2214
R-squared	0.024	0.025	0.119	0.113
Control mean of dependent variable	0.746	0.713	0.567	0.540
Covariates	X	X	X	X
Fixed effects by village (80 villages)	X	X	X	X
p-values of F test:				
Vaccine condition + Vaccine condition*C300 = 0			0.213	0.022
Vaccine condition + Vaccine condition*C800 = 0			0.436	0.625

Source: Authors' calculations as described in the text.

Note: These are based on the analysis sample of 2,482 women; 268 observations with missing covariates are dropped in panel B. Robust standard errors clustered by village (80 villages) are in parentheses. Covariates are Vaccine condition & Fear, Woman's age, Age squared, Muslim, Any education, Marital status = Single, Currently pregnant, Have children, Has paid work, Monthly HH earning per capita (naira), Distance to clinic (km), Transport to clinic (naira), Opportunity costs to clinic (naira), Ever used clinic, Received tetanus vaccine before, Likely to contract tetanus, Number of people who die of tetanus, Very worried about tetanus, Tetanus is very bad, Very important to be protected from tetanus, Vaccine efficacy, Vaccines protect from disease, Needles are scary, Vaccines have side effects, Vaccines give diseases, Vaccines give HIV, and Heart rate (beat/min). Control mean of dependent variable is the mean under the Clinic condition in columns (1) and (2) and under the Clinic condition and C5 in columns (3) and (4). *significant at 10 percent; **significant at 5 percent; ***significant at 1 percent.

who refused the vaccine upon their arrival at the clinic, but they are not major barriers.[51] Overall, these results reinforce our early finding that the psychic costs of vaccination are not significant, because almost all women did not need additional incentives to receive a vaccine once they attended the clinic.

Threats to Internal Validity

Several limitations in our experimental design and implementation could prevent us from capturing the psychic costs of vaccination. First, respondents under the Clinic condition may have misunderstood that they had to receive the vaccine to receive the cash compensation (as under the Vaccine condition). Such misunderstanding might have been augmented by potential spillovers in our experiment with the individual-level randomization. We trained interviewers carefully to minimize this concern.[52] Second, even if women under the Clinic condition intended to attend the clinic without receiving a vaccine, they might have ended up receiving a vaccine due to social pressure they felt from health staff. Even though it is difficult to eliminate such social pressure at clinics, lack of interaction with health staff at the time when respondents made a vaccination decision should have greatly reduced such social pressure they might have felt.

Third, the basic information about tetanus and tetanus vaccination provided to all respondents might have reduced the psychic costs of vaccination. Similarly, asking about their vaccination behavior and beliefs in the survey might have induced respondents to perceive that vaccination is a desirable thing to do. These potential information and experimenter demand effects might have led to high clinic attendance and vaccine take-up rates even among women who were offered the lowest amount of cash incentives (5 naira). We do not believe that the basic information provided and asking questions on vaccination are strong enough to eliminate psychic costs of vaccination, though it is infeasible to test this possibility. Put differently, if the information and (or) experimenter demand effects significantly reduced psychic costs of vaccination, those costs are not major barriers to vaccination.

Fourth, women with higher net psychic benefits of vaccination (B_v) are more likely to decide to attend the clinic than those with lower net psychic benefits of vaccination. If this self-selection is significant, the nonsignificant psychic costs we found through clinic attendance are biased. A piece of counterevidence against the significant selection bias is that the baseline characteristics and perceptions of women who attended the health clinic under the Clinic condition and under the Vaccine condition are not significantly different from each other (supplementary online appendix table S1.5). Also, over 95 percent vaccine take-up among respondents under the Clinic condition cannot be explained solely by self-selection anyway.

Observational Data

Our baseline survey collected data on self-reported reasons for non-vaccination among women who had never received any vaccination before, as well as reasons why respondents who had children had never taken their children for any vaccination, if they had not previously done so, as is commonly done in observational studies (supplementary online appendix table S1.6). Although lack of awareness is the most common reason for women's non-vaccination (36.9 percent), psychic costs, such as fear of side effects and fear of injection, are the second main reason (17.4 percent). Similarly, psychic costs are the main reason for the non-vaccination of children together with supply-side problems, such as insufficient supply

[51] This result is driven by only 26 respondents. When women were provided an option to take up or refuse the vaccine at the clinic, only 26 refused it. We observe some, but not too stark, differences in characteristics between these 26 women and 585 women who accepted the vaccine under the Clinic condition (supplementary online appendix table S1.4). These 26 women are on average younger, more likely to be pregnant, and less likely to have visited the clinic before than others. They also perceive higher likelihood of contracting tetanus and are more worried about tetanus, but are less likely to feel scared about the needle. These differences in perceptions seemingly contrary to their behaviors provide additional evidence for the limitation of observational data discussed below.

[52] When we repeat all analyses with interviewer fixed effects additionally controlled for, all results are almost the same.

of vaccines. These patterns certainly can mislead us to conclude that psychic costs of vaccination are significant barriers to vaccination. However, among those women who listed psychic costs as the main reasons for non-vaccination either for themselves or for their children, more than 77 percent ended up receiving the vaccine in our study. Behavioral experiments are crucial to evaluate the causal effect of psychic costs.[53]

Priming about Disease Severity

This subsection examines whether the priming about disease severity increases the vaccine take-up. We find that although the priming intervention increases the perceived severity of disease, it does not increase the vaccine take-up.

To identify the effect of priming about disease severity on vaccine take-up in a regression framework, we estimate:

$$Y_{ij} = \alpha + \beta_1 VaccineCondition\&Fear_{ij} + \beta_2 ClinicCondition_{ij} + \sum_{d=300,800} \gamma_d Cd_{ij} + v_j + \epsilon_{ij} \quad (5)$$

where Y_{ij} is a dummy variable that takes 1 if a woman i in village j receives a vaccine; C is a dummy variable for each cash incentive d; 300 naira and 800 naira; $VaccineCondition\&Fear$=1 if a woman i is shown the "scared straight" flipchart, rather than the control flipchart. The Clinic condition is controlled for; thus, the Vaccine condition is the comparison group.[54] Recall that all respondents shown the "scared straight" flipchart were offered cash incentives under the Vaccine condition. We also examine the potentially differential effects of priming by the amount of cash incentives through the interaction terms between the priming intervention and the amounts of cash incentives offered.

Priming does not significantly influence vaccination. The point estimate for the effect of the priming about disease severity (Vaccine condition & Fear) is negative with no statistical significance (table 3, column 1). The interaction terms between the priming intervention and any amount of cash incentives also yield insignificant point estimates (column 3). These results indicate that the priming intervention does not influence vaccination at any amount of cash incentives.

We then evaluate if the priming increased women's perception of the severity of the disease.[55] Estimating equation (5) with perceived severity of tetanus as a dependent variable reveals that the priming did increase respondents' perceived severity at the post-intervention individual survey done at the respondents' house (table 4).[56] Women under the Vaccine condition & Fear were also more likely to feel frightened, tense, nervous, and uncomfortable than others (supplementary online appendix table S1.7). The priming also induced women's emotional response according to the objective measure: Those who viewed the "scared straight" flipchart had a higher heart rate, by 6.55 beats per minute, than those who viewed the control flipchart (table 4, column 7). These results provide evidence that the priming is salient

[53] It should be noted that our experiment cannot detect women who have significant psychic costs of vaccination but also have positive perceived net benefits of vaccination, Bv in the model, that is, those who would take up the vaccine despite the positive psychic costs. In such a case, the observational data is likely to indicate that they have psychic costs of vaccination, but our experiment would not detect this case. In other words, our experiment only captures the psychic costs of vaccination that are large enough to alter their vaccination behaviors.

[54] The analysis excluding women under the Clinic condition yields results very similar to those reported here.

[55] Both perception and objective measures increased on average after the intervention, regardless of the treatment status. This may be because of the basic information about tetanus and tetanus vaccination provided to all respondents.

[56] Specifically, respondents who were shown the "scared straight" flipchart were likely to believe that 2.52 more people would die from tetanus out of a hypothetical 100 people than respondents who were shown the control flipchart. The "scared straight" flipchart also increased the probability that respondents felt very worried about tetanus, felt that tetanus is very bad, and felt that it is very important to be protected from tetanus by 16.0, 13.8, and 11.1 percentage points, respectively.

Table 3. Effects of Priming on Vaccine Take-Up

Dependent variable:	Received vaccine			
	(1)	(2)	(3)	(4)
Vaccine condition & Fear	−0.028	−0.010	−0.015	−0.001
	(0.017)	(0.032)	(0.020)	(0.035)
C300		0.216***		0.222***
		(0.031)		(0.030)
C800		0.285***		0.282***
		(0.035)		(0.036)
Vaccine condition & Fear*C300		−0.026		−0.030
		(0.044)		(0.046)
Vaccine condition & Fear*C800		−0.023		−0.012
		(0.043)		(0.042)
Observations	2482	2482	2214	2214
R-squared	0.002	0.092	0.024	0.113
Control mean of dependent variable	0.748	0.575	0.741	0.570
Covariates			X	X
Fixed effects by village (80 villages)	X	X	X	X
p-values of F test:				
Vaccine condition & Fear + Vaccine condition & Fear*C300 = 0		0.212		0.278
Vaccine condition & Fear + Vaccine condition & Fear*C800 = 0		0.263		0.672

Source: Authors' calculations as described in the text.

Note: These are based on the analysis sample of 2,482 women. Robust standard errors clustered by village (80 villages) are in parentheses. Covariates are Clinic condition, Woman's age, Age squared, Muslim, Any education, Marital status = Single, Currently pregnant, Have children, Has paid work, Monthly HH earning per capita (naira), Distance to clinic (km), Transport to clinic (naira), Opportunity costs to clinic (naira), Ever used clinic, Received tetanus vaccine before, Likely to contract tetanus, Number of people who die of tetanus, Very worried about tetanus, Tetanus is very bad, Very important to be protected from tetanus, Vaccine efficacy, Vaccines protect from disease, Needles are scary, Vaccines have side effects, Vaccines give diseases, Vaccines give HIV, and Heart rate (beat/min). Control mean of dependent variable is the mean under the Vaccine condition in (1) and (2) and under the Vaccine condition and C5 in (3) and (4). *significant at 10 percent; **significant at 5 percent; ***significant at 1 percent.

enough to increase the perceived severity of the disease.[57] The priming is ineffective in promoting vaccine take-up arguably because psychic costs of vaccination are not major barriers to vaccination.[58]

5. Conclusion

This paper experimentally examined the relative importance of psychic costs compared to monetary costs as potential barriers to tetanus vaccine take-up among women of childbearing age in rural northeastern Nigeria. The primary contribution of our study to the literature is to develop a novel experimental design

[57] It is noted that the perceived risk of tetanus is extremely high among respondents. For example, the average perceived likelihood of contracting tetanus is 45.9 percent, though it is actually less than 1 percent of total newborns; at most 35,000 in Nigeria (UNICEF 2010). This extremely high perceived risk might explain why priming does not alter the vaccination behavior.

[58] There are several other potential reasons why the priming intervention did not alter women's vaccination behavior. First, the "scared straight" message may have increased the perceived severity of disease only among respondents who would have received the vaccine even without that message. A piece of counterevidence against this is that the priming increased perceived severity of disease especially among women with low perceived severity of disease at the baseline, and the perceived severity of disease at the baseline was positively correlated with the likelihood of receiving the vaccine. The second possible reason is the time effect of the intervention. For example, it is possible that the intervention only has a temporary effect on risk perceptions; that vanishes quickly over time, without affecting vaccination behavior. The interval from the time when a woman received the priming intervention to the time when she made a take-up decision may have been too short. As this interval is uniformly set at one week, we cannot investigate this potential reason.

Table 4. Effects of Priming on Perceptions (Post-Intervention)

Dependent variables:	Likely to contract tetanus (0/1)	Number of people who die of tetanus (0–100)	Very worried about tetanus (0/1)	Tetanus is very bad (0/1)	Very important to be protected from tetanus (0/1)	Vaccine efficacy (0/1)	Heart rate (beat/min)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: No covariates							
Vaccine condition & Fear	0.015	2.520**	0.160***	0.138***	0.111***	−0.876	6.551***
	(0.017)	(1.048)	(0.030)	(0.026)	(0.025)	(1.437)	(0.864)
Observations	2482	2479	2482	2482	2482	2476	2174
R-squared	0.000	0.002	0.028	0.019	0.020	0.000	0.046
Control mean of dependent variable	0.459	37.41	0.566	0.649	0.746	43.57	87.74
Fixed effects by village (80 villages)	X	X	X	X	X	X	X
Panel B: With covariates							
Vaccine condition & Fear	0.014	2.651**	0.151***	0.141***	0.109***	−0.883	6.473***
	(0.019)	(1.239)	(0.028)	(0.027)	(0.027)	(1.410)	(0.660)
Observations	2214	2211	2214	2214	2214	2210	2027
R-squared	0.077	0.088	0.143	0.108	0.118	0.116	0.404
Control mean of dependent variable	0.450	36.91	0.543	0.625	0.729	31.65	87.44
Covariates	X	X	X	X	X	X	X
Fixed effects by village (80 villages)	X	X	X	X	X	X	X

Source: Authors' calculations as described in the text.

Note: These are based on the analysis sample of 2,482 women; 268 observations with missing covariates are dropped in panel B. Missing observations in each column are due to missing values and invalid numbers in the dependent variable. Robust standard errors clustered by villages (80 villages) are in parentheses. All the dependent variables indicate the measurement after the flipcharts intervention. "Likely to get tetanus" is a binary variable that takes 1 if a respondent answers "high likelihood" to the question "What is the likelihood that you get tetanus?" "Number of people who die of tetanus" is the number of people out of 100 a respondent provides to a question "Once they have tetanus, how many people do you think would die because of tetanus?" "Very worried about tetanus" is a binary variable that takes 1 if a respondent answers "very worried" to the question "How worried are you that you might get tetanus? Very worried, worried, not too worried, not worried at all?" "Tetanus is very bad" is a binary variable that takes 1 if a respondent answers "very bad" to the question "How bad would it be if you get tetanus? Very bad, bad, not too bad, not bad at all?" "Very important to be protected from tetanus" is a binary variable that takes 1 if a respondent answers "very important" to the question "How important is it for you to make sure that you are protected from tetanus? Very important, important, not too important, not important at all?" "Vaccine efficacy" is the difference between the hypothetical number of unvaccinated people whom the respondent thinks get tetanus and the number of vaccinated people who get tetanus. "Heart rate" indicates the heart rate of a respondent measured. Covariates are Clinic condition, Woman's age, Age squared, Muslim, Any education, Marital status = Single, Currently pregnant, Have children, Has paid work, Monthly HH earning per capita (naira), Distance to clinic (km), Transport to clinic (naira), Opportunity costs to clinic (naira), Ever used clinic, Received tetanus vaccine before, Likely to contract tetanus, Number of people who die of tetanus, Very worried about tetanus, Tetanus is very bad, Very important to be protected from tetanus, Vaccine efficacy, Vaccines protect from disease, Needles are scary, Vaccines have side effects, Vaccines give diseases, Vaccines give HIV, and Heart rate (beat/min). Control mean of dependent variable is the mean under the Vaccine condition. *significant at 10 percent; **significant at 5 percent; ***significant at 1 percent.

that shows that contrary to conventional wisdom, psychic costs are not major barriers to vaccination. At the same time, due to several limitations in our experimental design and implementation, we cannot eliminate the possibility that psychic costs of vaccination are barriers to vaccination. The narrow definition of psychic costs of vaccination we employed also limits the external validity of our findings. We also found that priming is not effective at moving psychic costs, if any, in a way that translates into more vaccine take-up. Since the significance of psychic costs determines effective policies to promote vaccination, developing better ways to capture psychic costs is much needed. For example, a better research design might be to conduct door-to-door vaccination to eliminate the psychic costs of clinic attendance. Either way, our study highlights the importance of behavioral experiments in studying psychic costs.

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