This note discusses the representativeness of potential participants in an RCT on the impact of water treatment, delivered through a coupon program, on under-2 or under-5 mortality. There is some concern that participants in the study would not be representative of possible beneficiaries of water treatment programs in general, due to selection effects.

This note discusses three possible sources of selection: antenatal care (ANC) attendance, coupon redemption, and use of water treatment.

ANC attendance

If most child deaths occurred in households who do not attend ANC, then a program which recruits participants at ANC visits might have limited effects on overall child mortality, and a study of such a program might be under-powered or unrepresentative of water treatment programs in general. This section shows that since ANC attendance is very high, higher mortality rates among ANC non-attendees only has a small effect on the study. We have adjusted our power calculations to address this.

ANC attendance rates are high in Kenya, and in areas of Nigeria in which we would work. According to DHS data, 96% of pregnant women attend at least one ANC visit in Kenya, 98% in south-east Nigeria, 97% in south-west Nigeria, and 94% in south-south Nigeria. Because the proportion of women not attending any ANC visit is so low, it's likely that they belong to unusual populations who would be difficult to reach through most interventions (e.g. teenage girls hiding their pregnancies, refugees, people in areas with limited reach by the state).

Even very high child mortality rates among non-attendees do not imply low mortality rates among ANC attendees. We have data on this from both Kenya and Nigeria at the national level.

According to DHS data, in Kenya the mortality rate for those attending no ANC visits is 2.7 times higher than for those who attend at least one ANC visit.[1] According to the GBD in 2019, the U5 mortality rate (U5MR) was 41 deaths per 1,000 live births. We can therefore estimate an U5MR of 39 for those who attended at least one ANC visit, and 103 for those who attended no ANC visits in 2019. We are able to calculate the same proxies of U5MR per ANC status per each county (see sheet "Kenya_county")

According to DHS data, in Nigeria the mortality rate for those attending no ANC visits is 1.5 times higher than for those who attend at least one ANC visit. In Nigeria, national ANC attendance rates are low, but this is driven by northern states. We therefore focus on southern states, which have both high ANC attendance and high child mortality. As table 1 shows, there are many states where ANC attendance rates and U5MR among ANC attendees are high.

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[1] All women aged 15 - 49 are asked whether they gave birth in the previous five years. However, the DHS survey only asks about ANC attendance for the most recent birth. This means the children for whom we have data on mortality rate by ANC attendance are younger on average, so the overall mortality rate is lower. We assume that the ratio of the mortality rate among those who do and don't attend ANC should be similar.

We will adjust our power calculations for the new assumed mortality rate among ANC attendees in Kenya and in Nigeria.

Table 1. Predicted mortality rates for those attending ANC, by states in Nigeria, for those states we could work in.

State	Region	At least 1 ANC visit (% of HHs)	U5 child mortality	Estimated U5MR for group with at least 1 ANC visit
				Ratio between U5MR by ANC status
				1.49
osun	south west	98.76	70	69.58
imo	south east	97.54	87	85.97
anambra	south east	96.58	58	57.05
enugu	south east	96.25	61	59.91
ogun	south west	96.21	30	29.46
ondo	south west	95.39	79	77.26
lagos	south west	95.38	59	57.70
ebonyi	south east	94.41	91	88.59
ekiti	south west	93.15	95	91.93
edo	south south	89.95	71	67.69
oyo	south west	87.87	64	60.43
fct abuja	north central	87.71	75	70.76
nasarawa	north central	77.61	120	108.19

Note: We include all the states with at least 75% of HH with at least 1 ANC visit, and safe places to travel.
Source: 2018 DHS

Redemption of coupons

Dupas et al., (2016) find that use of coupons does not filter out those who would use water treatment if it had been delivered to them for free. In unscheduled follow up visits, 34.5% of those in the free delivery group had chlorine residual in their water, compared to 34.4% in the coupon group. So we should not expect a study of a coupon program to estimate a different mortality effect than a program with free delivery of water treatment.

In our proposed study, we aim to make coupon redemption as easy as possible to minimize the risk of screening out those who might treat their water. The study will observe women/children from pregnancy through age two. Mothers visit the clinic frequently during this period for ANC, routine immunization, and growth monitoring. During pregnancy women are encouraged to visit health facilities monthly. After a child is born, women are encouraged to visit monthly for growth monitoring during the first years of life. More typically, mothers attend for vaccination visits at 6 weeks, 3 months, and 6 months, 9 months, and 12 months. After 12 months, women are supposed to come to health facilities every 6 months until the child turns age 5.

We plan to make the coupon attachable to the ANC booklet. Usually, women bring their ANC booklet to their routine ANC check-ups to get services (we will collect data on this during piloting). This should avoid the possibility that mothers forget to bring their coupons to the clinic when they do visit.

When people make fewer trips to the clinics (for example when their child turns 1 and needs less medical attention), we could allow mothers to redeem two or three coupons at a time (so they only need one trip every two-three months instead of one trip every month). It will also be possible for mothers to send someone to redeem the coupon on their behalf–a relative, neighbor or friend. To the extent that clinics are typically near shopping centers or markets, it is expected that most mothers will have at least one acquaintance visiting the area of the clinic every other month. Finally, we could consider allowing coupons to be redeemed at shops as well as clinics. This would require us to set up a redemption system in local shops, and might add cost but it could be explored.

Use of water treatment

It is possible that baseline mortality rates vary between those who would take-up water treatment due to the coupon program (compliers) and those who will not treat their water (never-takers)[2].

This could affect the study in two ways. First, if compliers have lower baseline child mortality rates than never-takers, we would need a larger sample-size. This would be the case if poorer, less educated, or more marginalized people, who typically face higher child mortality rates, are *less* likely to treat their water despite receiving free coupons. Second, if the proportion of child deaths which are avertable through water treatment is higher among never-takers than compliers, the results of this study would be different from a study in which everybody receives treated water.

Dupas et al. (2016) and Dupas et al. (2021) do not have large enough samples to compare mortality rates between compliers and never-takers. However, we do have data on intermediate outcomes that can at least suggestively speak to this question.

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[2] A third group, 'always-takers', treat their water regardless of treatment. We expect them to have lower baseline mortality rates. This is not a problem for the study design: even a water treatment intervention with universal take-up would not influence their water-treatment status.

Dupas et al. (2016) shows that while almost all participants redeemed at least one voucher, those with a lower asset score were significantly *more* likely to redeem at least two vouchers. This is evidence that households who redeem coupons are on average less wealthy than households who do not.

Dupas et al. 2021 finds that, among coupons recipients, households using lower quality water sources (who report worse child health on average) were *more* likely to redeem coupons, and *more likely to* use water treatment. The paper shows that households with an unprotected source redeem 19 percentage points (three and a half) more coupons, on average, than those with a protected source (Table 7). They are also 13 percentage points more likely to be treating their water (Figure 6). It is also important to note that the average distance to the shop where the coupons could be redeemed was significantly greater for households with an unprotected source: 2.3km vs. 1.9km, a 400m gap. This is evidence that, in a coupon program, those most at risk of water-borne disease are in fact *more* likely to be compliers than never-takers. So the proportion of child deaths which are avertible through water treatment may in fact be higher among compliers.

The available empirical evidence thus does not seem to fit a story in which child mortality is higher among those who do not take up free water treatment offered through coupons.

We also note that, even if it were the case that those who treat their water in response to full subsidies for water treatment have *lower* mortality, this would be a problem not only for coupon programs but for all point-of-use treatment programs, since we have shown that coupons do not screen out users relative to free delivery. We note that in GiveWell's pooled analysis of water treatment and child mortality, three out of five studies were of point-of-use chlorination (the remaining two being WASH Benefits studies, which included both point-of-use, and point-of-collection treatments). Similarly, many of the studies in Kremer et al. 2022 are of point-of-use water treatment. Both of these pooled analyses show large treatment effects.

Gathering more data on potential selection effects

As discussed, we have obtained a smaller grant from J-PAL, and we plan to begin piloting in the HDSS site in Kenya soon. During piloting and during the main study we will monitor possible selection issues by comparing demographics between those who do and don't redeem coupons. This includes:

1. Caregiver reported diarrhea at baseline

2. Type of water source

3. Contamination of household water at baseline

4. Education level of the household members and wealth

5. Distance from household to clinic and water-source.

Evidence Action has rich demographic data on take-up of Dispensers for Safe Water in Kenya. We could ask to look at their data, to try to understand differences between compliers and never-takers in the context of DSW. Although this is a different program, we think it would contain some information about potential selection effects for a point-of-use chlorination study.

References

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