

Short Communication

Ceramic pot filter user satisfaction and water quantity production in tsunami-affected Sri Lankan communities

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ABSTRACT

Sri Lanka was heavily damaged by the December 2004 Indian Ocean tsunami. To reduce risks from unsafe water, the Red Cross distributed ceramic pot filters to households. This analysis was undertaken to determine if flow rate affects user satisfaction with water production by the filter, and if filters produce enough water for household use. Mean filter flow rate was ~1.25 L/hr, with wide filter-to-filter variation. The relationship between flow rate and user perception of whether the filter produced enough water for household needs is complex. Results suggest that many households had flow insufficient to produce 2 L per household member per day. Although continued use in this population remains high and users express satisfaction with filters, the amount of water produced remains a limitation of the filter.

Key words | ceramic pot filter, ceramic water purifier, filter, point-of-use, tsunami

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INTRODUCTION

As point-of-use (POU) water treatment is scaled up, sustainability is of critical importance. Many evaluations of POU technologies focus on water quality improvement and diarrheal disease prevention. However, users often lack access to water quality data, and may have only subjective impressions of whether treating water improves their health. Evaluations of continued use must consider factors that influence user perception, such as impressions of water quantity produced and whether it meets household needs.

Sri Lanka was heavily damaged by the 2004 Indian Ocean tsunami. In response, from February 2007 – December 2008 the Red Cross distributed 12,000 ceramic pot filters to households in affected communities. In 2009, a cross-sectional follow-up survey was undertaken of 452 of these households, 345 of which were still using filters (Casanova *et al.* 2012a,b). Analyses were done in a subset of households that were (1) filter users and (2) reported either a tap only

($n = 154$) or a well only ($n = 150$) as the household water source to determine (1) does flow rate affect user satisfaction with water production by the filter? (2) Based on flow rate, do filters produce enough water for household use?

METHODS

The study was a cross-sectional survey; methods have been described in detail elsewhere (Casanova *et al.* 2012a, 2012b). Study protocols and materials were approved by the UNC Biomedical Institutional Review Board and the Ethics Board of the Faculty of Medicine, University of Ruhuna, Sri Lanka. Data were collected from September to December 2009. For flow rate measurement, respondents were asked to place water in the filter and allow it to run while the study survey was administered. The filter flow rate was recorded by

measuring water filtered during a 1-hr period into a container with volume measurement markings. Flow rates are in L/hr.

RESULTS

Mean flow rate was ~ 1.2 L/hr in both well and tap households, with considerable filter-to-filter variation. Filters were sorted according to ceramic pot filter quality control guidelines (Figure 1) (Ceramic Filter Manufacturing Working Group 2011). Flow rate was not related to source water turbidity, which was < 2 nephelometric turbidity units in most households (data not shown).

In response to a multi-option question ‘what types of problems have you had with the filter?’ 15 of 150 well and 24 of 154 tap households chose ‘flow rate is too slow’. There was no association between water source and reporting flow rate was too slow ($p = 0.14$). In tap households, mean flow rate was lower in households that reported the flow rate was too slow (0.9 L/hr) than in those that did not (1.3 L/hr) ($p = 0.29$). For well households, the difference was significant (0.56 L/hr vs. 1.3 L/hr) ($p = 0.01$).

In response to the question ‘Does the filter produce enough water for your household each day?’ only one well and five tap households answered ‘rarely’ or ‘no’. In tap households, flow rate was higher among households that chose ‘most of the time’ (1.46 L/hr) or ‘sometimes’ (1.61 L/hr) vs. ‘always’ (1.19 L/hr) ($p = 0.44$). In well households, flow rate was highest in households that chose ‘always’ (1.34 L/hr) vs. ‘most of the time’ (1.07 L/hr) and ‘sometimes’ (0.55 L/hr) ($p = 0.17$).

Most households reported putting water through the filter at least once per day (well 87%; tap 71%); there was

no relationship between frequency and flow rate ($p = 0.44$). However, based on household size, even if water was put through the filter continuously over a 12 hr day, only 62% of well and 48% of tap households had a flow rate sufficient to produce 2 L/person/day. Of these, 32 well (58%) and 56 (71%) tap still reported that the filter ‘always’ produced enough water for their household.

DISCUSSION

In Sri Lankan households using pot filters 2 years post-distribution, even users who express satisfaction with their filters may have filters that do not produce enough water for minimum household needs. The Ceramic Filter Manufacturing Working Group, which assembled guidelines for the manufacture and testing of locally produced pot filters, recommends that ‘A minimum flow rate of 1 L in the first hour should provide enough drinking water for a family of five if the filter is filled 4–5 times a day’ (Ceramic Filter Manufacturing Working Group 2011). Most households are not filtering water this frequently; about half reported putting water through the filter once per day. A Cambodian study found an average of 1.8 times/day (Brown *et al.* 2009), suggesting these households are not filtering less frequently than users in other settings. There was no relationship between flow rate and frequency of filtration; households do not appear to compensate for lower flow rate by putting water through the filter more often.

A major concern is that insufficient water production may lead to (1) stopping use or (2) using a mixture of treated and untreated sources which add up to ‘enough’ water.

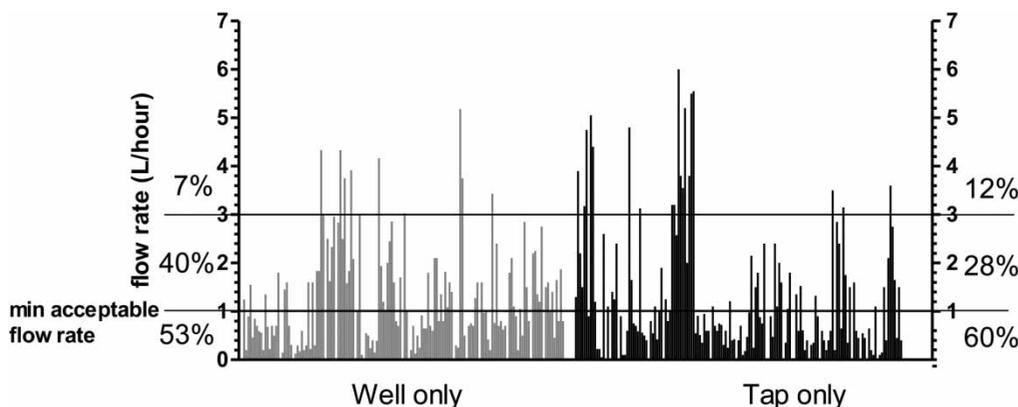


Figure 1 | Filter-to-filter variation in flow rate among filters still in use at time of survey (lines = individual filters; % = percentage of total filters in each flow rate category).

Quality control recommendations state 'Filters that do not meet a minimum flow rate of 1 L/hr should be rejected and destroyed since their failure to treat a sufficient quantity of water could cause the consumer to stop using the filter, thereby placing their health at risk' (Ceramic Filter Manufacturing Working Group 2011). However, flow rates this low may not lead households to stop use; 67% of tap and 57% of well households still using the filter were under 1 L/hr. Only a small percentage of users reported stopping because the filter did not produce enough water. The results do not suggest there is a threshold below which users become dissatisfied with the flow rate. Only a small percentage of users identified slow flow rate as a problem; this was also seen in a Cambodian study (Brown *et al.* 2008). The mean flow rate in this group was 0.70 L/hr; 142 households that had flow rates less than this did not identify slow flow rate as a problem. Overall, respondents' opinion of whether the filter produces enough water is influenced by perception of flow rate in some households, but does not have a straightforward relationship with absolute flow rate.

The majority of users report using filtered water for drinking only, consistent with other post-implementation studies of pot filters (Brown & Sobsey 2007). Using a minimum requirement just for drinking of 2 L/person/day, comparison of flow rates with average household size and reported frequency of filtration suggests that many households in this study have flow rates barely sufficient to produce this minimum. A large number of households that did not have flow rate sufficient to meet this minimum still reported that the filter produced enough water for their needs. Therefore, 'enough' water in these households may mean enough water for drinking, but not enough for other household uses, or could mean that drinking water is a mix of treated and untreated sources. Either of these possibilities could mean that filter use is not fully protecting users against waterborne disease.

CONCLUSIONS

Filters in use between 1 and 2 years in Sri Lanka have highly variable flow rates, but the relationship between flow rate and user perception of water production is complex. Many

households' filters may not produce sufficient water for the household size. Although continued use remains high and users express satisfaction with them, the amount of water produced remains a limitation of the ceramic pot filter.

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