The construct validity of a novel method for quantifying water consumption in slum settlements in Mumbai, India

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Background

• Use of an inadequate quantity of water is associated with poor health outcomes, due to deterioration in hygiene of the hands, body, clothes, and eating utensils, which promotes diarrheal, parasitic, and skin diseases.
• Quantifying water consumption in urban slums is difficult, as water meters are often absent and hundreds of people may use a single tap.
• We have developed a novel method for quantifying water consumption using an inventory of water storage containers, estimation of each container’s volume, and a count of how many times each container was filled in the last week (“the container enumeration method”).

Methods

Hypothesis Generation

• We performed 40 qualitative individual interviews and 6 focus group discussions with KB residents in mid-2011, to understand causes of use of inadequate water quantity

Table 1: Representative quotations that facilitated hypothesis generation

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Multivariable regression model findings</th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of people in household</td>
<td>4-5</td>
<td>4.35 (1.06-15.57)</td>
</tr>
<tr>
<td>Home ownership status</td>
<td>Owns his/her living space</td>
<td>--</td>
</tr>
<tr>
<td>Cost of water in Indian rupees per 1000 liters</td>
<td>INR &gt; 200 per 1000 liters</td>
<td>--</td>
</tr>
<tr>
<td>Number of times in a week water was delivered</td>
<td>4-5</td>
<td>7.75 (1.75-34.77)</td>
</tr>
<tr>
<td>Method of obtaining water</td>
<td>Water delivered directly at home</td>
<td>--</td>
</tr>
<tr>
<td>Relationship between water price and quantity</td>
<td>4 or more times</td>
<td>0.17 (0.04-0.78)</td>
</tr>
</tbody>
</table>

TAKE HOME POINTS

Water Poverty in Slums

• Cost of water is the strongest predictor of the quantity of water used by slum households
• Reliability of the water supply (i.e., number of time water was obtained in the last week) and mode of access are also strong predictors of use of ≤20 LPCD of water

The “Container Enumeration Method” for measuring water use

• Findings from the quantitative analysis of data gathered using the container enumeration method are concordant with the hypotheses generated from the qualitative data
• This concordance suggests that the container enumeration method has a reasonable level of construct validity, such that it may have utility for identifying sub-populations in slums that are relatively vulnerable to water poverty
• Future research should assess the precision and reliability of this method, which involves one-week recall of water use, to a “gold standard” of daily assessment of water use
• This method may be useful for monitoring and evaluation of water service delivery in settings where water supply is intermittent, requiring storage of most water prior to use.

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Figure 1: (A) Hose water recipients, (B) Water fetchers

**Table 1: Representative quotations that facilitated hypothesis generation**

- “We never receive water every day. Sometimes we only receive water after five or six days. Sometimes we only get water after fifteen days.” - 55 year old Muslim woman from Kaula Bandar
- “We receive water once a week or even two or three times a month. Then we have to buy water.” - 45 year old Muslim man from Maharashtra
- “If you pay money then you get water . . . It all depends on how many containers you have.” - 48 year old Hindu woman from Tamil Nadu
- “Since there are so many people in this house, we have to buy six drums of water at a time.” - 48 year old Muslim woman from Kaula Bandar
- “We never get water daily; it comes through the hoses once or twice a week, but at those times everyone is shouting and fighting each other to get the hose, so we never get to fill all our containers. Sometimes we only get water after fifteen days.” - 25 year old Muslim woman from Kaula Bandar
- “We never get water daily; it comes through the hose once or twice a month, but at those times everyone is shouting and fighting each other to get the hose, so we never get to fill all our containers. Sometimes we only get water after fifteen days.” - 41 year old Muslim woman from Kaula Bandar
- “We get water once a week, twice a week or even half a week. It is not regular.” - 48 year old Muslim woman from Kaula Bandar
- “We get water once a week, twice a week or even half a week. It is not regular.” - 48 year old Muslim woman from Kaula Bandar
- “We never receive water every day. Sometimes we only receive water after five or six days access.” - 48 year old Muslim woman from Kaula Bandar
- “If you don’t have a water meter, you can’t have water. If you don’t have a water meter, you can’t have water.” - 48 year old Muslim woman from Kaula Bandar
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**Figure 1:** (A) Hose water recipients, (B) Water fetchers