

Drinking Water Quality in Ghana: Individual and Household Determinants

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Background

- **Unsafe water, sanitation & hygiene produce almost 6% DALYS in high mortality countries.**
- **Provision of clean water through municipal or private systems has not yielded the expected health improvements.**
- **Socio-demographic determinants of water use and quality need to be understood to efficiently target training to households and communities as water systems are introduced.**

Study Purpose & Sampling

- **To examine associations between socio-demographic characteristics and household (HH) drinking water quality in a representative sample of coastal districts of Ghana's Central Region.**
- **Representative clustered stratified sample of 36 EA's out of population of 6 Coastal Districts as part of a representative survey of 90 EA in rural, semi-urban, and urban residence strata.**
- **In 2004, up to 24 HH in each EA were chosen for water quality study and socio-demographic interview.**
- **Final sample of HH, N= 703 households.**

Household Water Quality Methods

- **Drinking water sample from vessel used to dispense water for immediate consumption**
- **100ml sample in sterile (γ -irradiated) plastic containers & stored on ice**
- **Transport - field to central laboratory <6 hours**

- *E. coli* counts quantified with enzyme-based method – IDEXX Colilert®
- Modified most probable number (IDEXX Quanti-Tray/2000®) assay
- Range of <1 to 2049 *E. coli* /100 ml
 - Colilert® & water sample mixed, incubated in Quanti-Tray
 - Post-incubation counting of individual large and small wells

Household Survey

- Administered by trained interviewers to the head of each sampled household
- Topics included:
 - Social and demographic characteristics
 - Drinking water sources
 - Toilet facilities and refuse disposal
 - Electricity
 - Physical characteristics of the house (e.g., flooring, roofing material, number of rooms)
 - HH possession of 11 specific consumer goods (e.g., bicycle, radio, etc.)
 - Summed scale index of possessions constructed to measure SES
- The distribution of *E. coli* / 100 ml H₂O is adjusted by a natural logarithm due to its right skew.
- *E. coli* counts classified for some analyses:
 - 0 -1 *E. coli* / 100 ml & ≥ 2 *E. coli* / 100 ml.
- Ordinary least squares models were used to determine factors associated with the natural logarithm of *E. coli* water quality measures.
- Logistic regression was also used to model categories of the *E. coli* counts.

Statistical analysis (cont)

- 1st model -water source & walk time to water
- 2nd model added toilet type
- 3rd model added waste disposal
- 4th model further added electricity in the home, rural or urban location, household size, the SES index and ownership of farmland.
- Allows for inferences on potential confounding of water source, toilet and waste disposal due to SES factors
- Regressions in subsample with no piped water access. Understand relative influence of water source and HH traits and urban/rural site

Characteristics of Study Sample N=703 HH

Frequency distribution of *E. coli* counts

Source of Water Matters Much

- Water out of the GWS pipe mostly OK
- Well water problematic
- Borehole Intermediate
- HH behavior implicated

Source, Residence, and HH Traits **ALL** Matter –
Predictions from MV Results

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Summary of Results

- Approximately one quarter have no or very low *E. coli* in household drinking water
- Compared to those using tap water, HHs using surface/rain water, well water, or boreholes have higher *E. coli* levels.
- Water from wells appears to be of particularly low quality
- Compared to those with a flush toilet and controlling for SES, HHs with poor sanitation – pit latrines or no toilet facility at all – have higher *E. coli* levels.

- HHs that do not dispose of refuse in 'nature' or public bins/dumps have lower *E. coli* levels.

Summary of Results

- HH SES (# possessions) is associated with better water quality (lower *E. coli* counts).
- HH size is associated with worse water quality (higher *E. coli* counts).
- These effects remain even after controlling for water source, sanitation (toilet facility), and refuse disposal practices.

Summary of Results

In sub-sample of HHs without piped water

- HHs getting water from tankers, boreholes or other sources have better water quality compared to HHs getting water from surface or rain water.
- Well water is not different from surface/rain water. They both are of lower quality.
- HH SES is associated with better water quality (lower *E. coli* counts).

Discussion

- Water quality is worse in those, ~40%, without piped water sources.
- Indicates need for continued construction of water systems to provide high quality water to rural and urban communities.
- Association of poor water quality with inadequate disposal of human waste, ~90% of households, regardless of source of water, suggests urgent need to develop sewage systems.
- The associations of both high household size and low number of possessions with poor water quality suggest that:
- SES factors influence water quality and probably operate through health literacy and sanitary practices.

Implications

- Piped Drinking Water Provision clearly Influential
- Common sources of water – often perceived to be OK – problematic
- HH level traits and behavior – HH sanitation, SES, education – of great consequence in addition to physical provision itself
- Urbanization and Development carry benefits → question efforts to restrain LDC urban growth
- Related project results
 - Education and communication can have impact
 - Local residents keenly aware of health and environmental issues, but not nec. transition mechanism

Strengths Limitations

- Lack of micro-behavioral data on sanitary practices around household water use and toileting. Prior work elsewhere indicates importance of sanitary habits and potential for clean water to be contaminated in household storage vessels
- Seasonal water sources change for those without piped water source. Impact of the wet/dry season indicated from our in-depth qualitative interviews.
- Future work focus on individual socio-demographic traits and sanitary habits

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