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Odour reduction interventions for simple pit latrines in rural Ethiopia: a randomized study

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Pit latrines are promoted in resource-limited settings, but unpleasant odours may deter their use. In this study, latrines in rural Ethiopia were randomized to the addition of cooking ash, the addition of boiling water or neither. Study staff ranked odour on a 6-point scale before and approximately 24 h after intervention. Following intervention, odour grades were on average 0.2 points lower (95% confidence interval [CI] 0.7 lower to 0.3 higher) in ash-treated latrines and 0.4 points lower (95% CI 0.9 lower to 0.1 higher) in boiled water-treated latrines, although the difference between the three groups was not statistically significant ($p = 0.21$). Larger studies might detect a smaller difference.

Keywords: Toilet facilities, odorants, smell

Introduction

An essential component of water, sanitation and hygiene (WASH) programs is the simple pit latrine, typically consisting of a pit dug into the ground and covered by a concrete slab, dirt or wood.¹ Many latrine-promoting interventions struggle to achieve high coverage and long-term use.^{2,3} Strong odours are often noted as a reason why people prefer not to build or use latrines.⁴ WASH programs promote the use of ash to reduce the smell in a pit latrine, although we are unaware of a strong evidence base for this practice.⁵ Moreover, while conducting formative research for a WASH trial in Ethiopia, we learned that some individuals pour boiling water in their latrine pits to reduce the smell. The present study was conducted in order to determine whether any of these odour-reduction methods should be promoted in our planned trial.

Methods

The study took place in January 2018 in a single community in the Sekota Zuria woreda (district), WagHemra zone, Amhara region, Ethiopia. The community is located within the larger study area of the Water Upgrades for Health in Amhara (WUHA)

trial (ClinicalTrials.gov NCT02373657) but not enrolled in that study. Households with simple unimproved pit latrines were invited to have their latrines included in the present study; inaccessible or non-functioning latrines were excluded. A total of 60 household latrines were randomized to three intervention groups: 20 received 350 ml of cooking ash in the latrine drop hole, 20 received 350 ml of boiling water in the drop hole and 20 received no intervention. The pre-specified primary outcome was the strength of latrine odour graded on a 6-point Likert scale, with higher numbers indicating stronger smell. A group of 25 graders masked to the intervention assignment and to each other's grades performed outcome assessments. Each grader assessed approximately 20 latrines at two single time points, immediately before and approximately 24 h after the intervention. Odour assessments were made directly over the uncovered pit. The intervention assignment was balanced across individual graders, with a median of 4 ash, 4 boiling water and 4 control latrines per grader.

Odour grades were modelled in a mixed effects linear regression model that included pre-intervention odour grades and treatment assignment as fixed effects and grader and latrine as crossed random effects. Little prior evidence existed to guide sample size calculations. Including 20 latrines per arm provided >80% power to detect a 1-point difference in pairwise

comparisons assuming a standard deviation of 1 and an alpha of 0.05. Analyses were performed in R 3.6.0 (R Foundation, Vienna, Austria). Ethical approval was obtained from the University of California, San Francisco. We obtained verbal consent from households whose latrines were enrolled in the study. Clinical trial registration was not required since this was not human subjects research.⁶

Results

Pre- and post-intervention odour grades are depicted for each latrine in Figure 1. Each of the 60 enrolled latrines had a pre-intervention assessment (a median of seven graders per latrine). Mean pre-intervention odour grades were 2.3 (95% confidence interval [CI] 1.9 to 2.7) for the control group, 2.3 (95% CI 1.8 to 2.7) for the ash group and 1.6 (95% CI 1.1 to 2.0) for the boiling water group. Pre-intervention measurements displayed moderate agreement between graders (ICC 0.64 [95% CI 0.63 to 0.75]). Odour grades at the two time points in the control group were only moderately correlated (Pearson’s R = 0.50). The mean post-intervention odour grades were 2.2 (95% CI 1.8 to 2.6) for the control latrines, 2.1 (95% CI 1.7 to 2.5) for the ash-treated latrines and 1.7 (95% CI 1.3 to 2.0) for the boiling water-treated latrines. Treatment assignment was not significantly associated with odour in a mixed effects linear regression adjusted for pre-intervention grades (p = 0.21; pre-specified primary analysis). Odour grades at the 24-h visit were estimated to be on average 0.2 points lower (95% CI 0.7 points lower to 0.3 points higher) in the ash group than the control group and 0.4 points lower (95% CI 0.9 points lower to 0.1 points higher) in the boiling water group than the control group.

This study was limited by the absence of standardized or validated methods for assessing latrine odour, a statistically noisy outcome, lack of ancillary data on latrines (e.g. age, daily frequency of use) and a relatively small sample size, which reduced the statistical power and may have led to relatively imbalanced randomization in terms of pre-intervention smell grades. These limitations were partly ameliorated by the paired design (i.e. pre- and post-intervention measurements from the same person) and by including many graders per latrine, but a study with more latrines would be able to detect a smaller effect. The study was conducted in a single community with a single style of latrine during a single 24-h period. The community had sufficient firewood in the form of eucalyptus logs, and boiling water and ash were familiar, feasible, culturally acceptable modes of odour reduction. Community members did not inform us of any other latrine odour reduction methods in use. It is unclear if the interventions would have different effectiveness in other settings or over longer time periods.

Conclusions

In summary, this study did not provide evidence that introducing cooking ash or boiling water to latrines was an effective method for improving the smell of household latrines when compared with latrines without any anti-odour intervention. Larger studies of communities in more diverse geographic settings and more

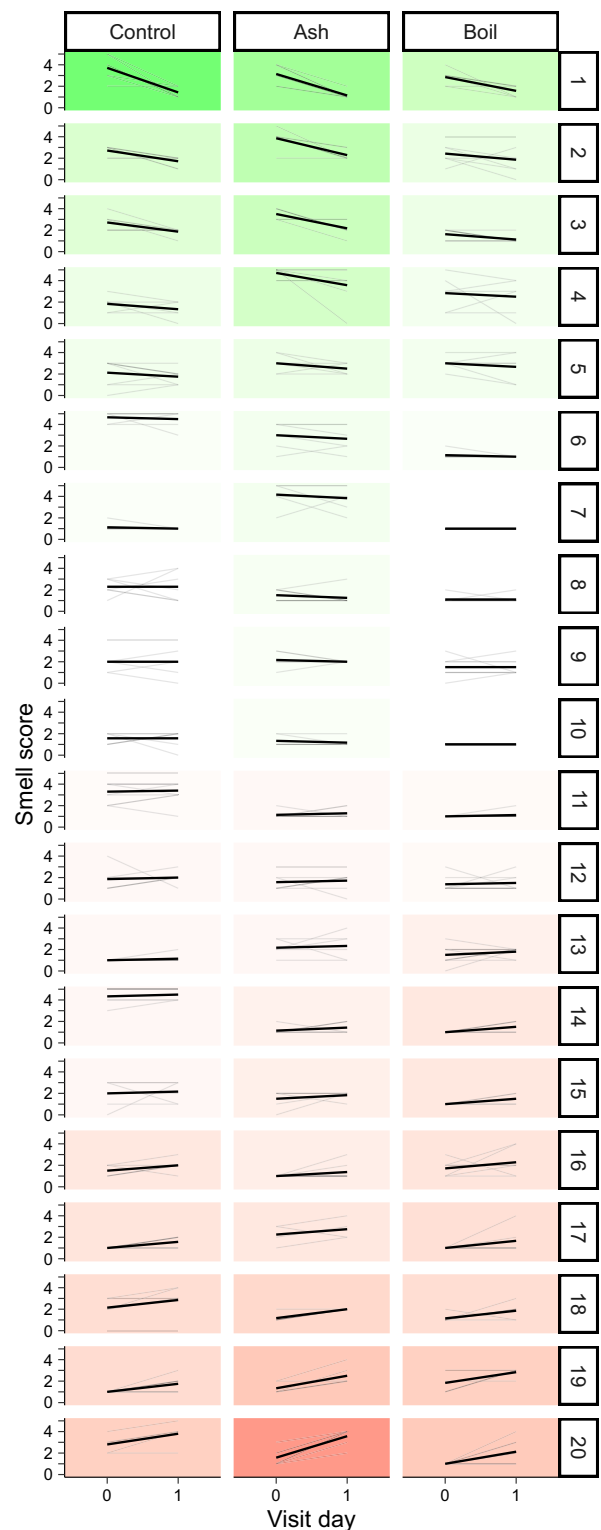


Figure 1. Odour grades stratified by intervention group and latrine. Light lines represent the change in the pre- vs post-intervention odour grade of a single grader for a particular latrine, based on a 6-point Likert scale, with higher numbers signifying stronger odour. Dark lines represent the mean of all graders for that latrine. Latrines are ordered in each intervention group by the mean change in odour between the two time points.

variable environmental conditions, as well as the development of more precise methods for assessing latrine odour, could provide stronger evidence on the effectiveness of competing methods for latrine odour reduction.

Authors' contributions: SA, DMW, KA, MJS and JDK conceived the study. SA, DMW, KA, MJS, SDN, ZT and JDK implemented the study. JSM and JDK analysed and interpreted the data. DMW, JSM and JDK made major contributions to writing the manuscript. All the authors read and approved the final version.

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Competing interests: None declared.

Ethical approval: Ethical approval was obtained from the University of California, San Francisco. The study was conducted in accordance with

the Declaration of Helsinki. Verbal consent was obtained from households whose latrines were enrolled in the study.

References

- 1 World Health Organization. Water sanitation hygiene: fact sheets on environmental sanitation. Available from: https://www.who.int/water_sanitation_health/emergencies/fs3_1/en.
- 2 Rotondo LA, Ngondi J, Rodgers AF, et al. Evaluation of community intervention with pit latrines for trachoma control in Ghana, Mali, Niger and Nigeria. *Int Health*. 2009;1(2):154–62.
- 3 Ngondi J, Teferi T, Gebre T, et al. Effect of a community intervention with pit latrines in five districts of Amhara, Ethiopia. *Trop Med Int Health*. 2010;15(5):592–9.
- 4 Aiemjoy K, Stoller NE, Gebresillasie S, et al. Is using a latrine “a strange thing to do”? A mixed-methods study of sanitation preference and behaviors in rural Ethiopia. *Am J Trop Med Hyg*. 2017;96(1):65–73.
- 5 Netherlands Water Partnership. Smart sanitation solutions: examples of innovative, low-cost technologies for toilets, collection, transportation, treatment and use of sanitation products. Available from: <https://www.ircwash.org/resources/smart-sanitation-solutions-examples-innovative-low-cost-technologies-toilets-collection>.
- 6 De Angelis C, Drazen JM, Frizelle FA, et al. Clinical trial registration: a statement from the International Committee of Medical Journal Editors. *N Engl J Med*. 2004;351(12):1250–1.