

Research Paper

Understanding women's decision making power and its link to improved household sanitation: the case of Kenya

Mitsuaki Hirai, Jay P. Graham and John Sandberg

ABSTRACT

Women experience many motivational drivers for improving sanitation, but it is unclear how women's role in household decision making affects whether a household opts for better sanitation. We analyzed the Kenya Demographic and Health Survey 2008/2009 with a representative sample of 4,556 married and cohabiting women to examine the association between women's decision making power in relation to that of partners and the type of sanitation facilities used by household members. The independent effects of respondents' education, employment status, and socioeconomic status on the type of sanitation facilities were also explored. The direct measurement of women's ability to influence sanitation practice was not available. To address this problem, this study used proxy measures of women's decision making power in the household. The results of this study revealed that women's decision making power for major household purchases was positively associated with households having better sanitation ($p < 0.05$). The findings suggest that increased gender equity could potentially have spillover effects that result in more households opting to improve their sanitation conditions.

Key words | gender equity, Kenya, sanitation, women

INTRODUCTION

Improving sanitation has the potential to reduce the burden of disease, enhance social equity, promote economic development, and mitigate environmental contamination (Jenkins & Curtis 2005; Mara *et al.* 2010). The health benefits of sanitation improvement in reducing the risk of diarrhea and soil-transmitted helminths have been well established (Esrey *et al.* 1991; Fewtrell *et al.* 2005; Cairncross *et al.* 2010; Ziegelbauer *et al.* 2012). Understanding what factors are associated with adoption of sanitation improvements is therefore of vital importance. Though the global burden of disease from inadequate sanitation is estimated to have declined from 1990 to 2010 (Lim *et al.* 2012), 2.5 billion (10^9) people still do not have access to adequate sanitation, and approximately one billion (10^9) people defecate in the open (World Health Organization [WHO]/United Nations Children's Fund [UNICEF] 2014).

Although defecation is well recognized as a personal behavior, people's preference for improved sanitation is shaped through multiple levels of influence including psychological, sociocultural, and structural factors (Jenkins & Curtis 2005; Jenkins & Scott 2007). Potential reasons for latrine adoption in developing countries identified in the empirical literature include avoidance of shame or embarrassment, desire for a high social status, an urban lifestyle, respect, security, aspirations for income generation, convenient access, good health, cleanliness, protection of privacy, and levels of satisfaction with present sanitation facilities (Jenkins & Curtis 2005; Jenkins & Scott 2007; Mahon & Fernandes 2010; Sara & Graham 2014). Some of the research findings have been translated to public health interventions including community-led total sanitation (CLTS), which aims to create open defecation free

Mitsuaki Hirai (corresponding author)

John Sandberg

Milken Institute School of Public Health,
Department of Global Health,
The George Washington University,
950 New Hampshire Ave., Suite 400,
Washington,
DC 20052 USA
E-mail: mhirai@gwu.edu

Jay P. Graham

Milken Institute School of Public Health,
Department of Environmental and Occupational
Health, Department of Global Health,
The George Washington University,
950 New Hampshire Ave., Suite 400,
Washington,
DC 20052 USA

communities by triggering people's sense of shame and disgust (Kar & Chambers 2008). Based on the recognition that constructing sanitation facilities may not have lasting impacts on people's sanitation behaviors, CLTS has been implemented in Asia, Sub-Saharan Africa, and Latin America to facilitate behavioral change at the community level (Kar & Chambers 2008).

Motivational drivers for improved sanitation can also be gender-specific. When a private sanitation facility is not available in the household, women may find limited opportunities for menstrual hygiene management and experience high levels of stress and embarrassment as a consequence (Mahon & Fernandes 2010). Women may also be at risk of sexual violence when visiting public sanitation facilities or seeking a remote, hidden place for defecation (Lennon 2011). Accordingly, women may find compelling reasons – potentially less relevant to men – to improve sanitation in their households.

What previous sanitation research has not fully elucidated are the roles of interpersonal factors, particularly women's ability to influence sanitation decisions in the household. Even if women may have a vested interest in improved sanitation, the level of their decision making power may well mediate the degree to which the household moves to act on their motivations. Previous research found that the level of women's decision making power in relation to men's is associated with a number of demographic and health related processes including fertility decisions (Mason 1987) and nutritional outcomes (Hindin 2000). The role of women's decision making power on sanitation practice, however, remains unknown, and only limited evidence from Kenya has been documented on women's decision making autonomy (Gwako 1997; Dodoo 1998).

Although direct measurement of women's ability to influence the household decision to have a private sanitation facility may not be available, proxy measures can be used to estimate the association between women's decision making power and improved sanitation. Two useful indicators for sanitation research are women's decision making power in health care and major purchases for the household. Given the demonstrated need for menstrual hygiene management, women with decision making power in health care are potentially more likely to advocate the possession and use of a private sanitation facility by framing

lack of improved sanitation as a health concern. The construction of a private sanitation facility in the household, however, requires adequate financial resources, which may not be granted without influencing the decision making process for major household-related purchases. Women's decision making power in health care and major purchases for the household, therefore, can be examined together to assess their influence on household sanitation practice.

Women's ability to influence households' decisions related to sanitation practices can be moderated by demographic and socioeconomic factors. Empirical evidence from Nepal suggests that women's decision making power on their health care and major household purchases is associated with age, education, employment status, number of children, place of residence, and wealth levels (Acharya *et al.* 2010). Ethnicity has also been shown to be associated with women's decision making on durable goods within households in Indonesia (Frankenberg & Thomas 2001). Women with higher education, jobs, and higher socioeconomic status are more likely to afford a latrine and may have more relative influence in the decision making process within the household for socioeconomic reasons. Having more children may also increase women's ability to influence household decisions by highlighting the importance of a sanitation facility for excreta disposal and child health. Furthermore, sociocultural norms for sanitation practice (e.g., level of acceptability for open defecation) may increase or decrease women's relative influence for sanitation improvement. Thus, women's age, education, employment, number of children, wealth, ethnicity, and sociocultural norms can confound the influence of their decision making power on sanitation practice.

CURRENT INVESTIGATION

The present study examines how women's decision making power over healthcare and purchasing decisions in the household, education, current employment, and socioeconomic status are individually and collectively associated with use of improved sanitation facilities, attempting to disentangle their relative influences. The potential confounders include the number of children in the household, respondent's age, place of residence, and ethnicity, which

have been examined previously in developing countries or may be expected to be associated with both women's decision making power and household sanitation facilities (Frankenberg & Thomas 2001; Becker et al. 2006; Acharya et al. 2010).

Women with greater autonomy within the household, more children, higher education, their own income, and higher socioeconomic status are more likely to influence the household to have an improved sanitation facility. It is hypothesized that each of these will be positively associated with use of improved sanitation facilities. Older women may also have increased bargaining power and be more capable of actualizing sanitation improvements they may desire, so we hypothesize that women's age will be positively associated with improved sanitation. Sociocultural norms regarding sanitation practice may differ by geographic areas, place of residence, and ethnic groups. Accordingly, it is hypothesized that geographic regions, place of residence, and ethnicity are significantly associated with improved sanitation.

METHODS

The Kenyan Demographic and Health Survey (DHS) 2008/2009 collected information from a nationally representative sample of 8,444 women (aged 15–49) in Kenya on a wide range of topics including household characteristics, nutritional status, reproductive health, maternal and child health, and Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS) (The Kenya National Bureau of Statistics & ICF Macro 2010a). Respondents were identified through a two-stage cluster sample. The response rate was 96% (The Kenya National Bureau of Statistics & ICF Macro 2010b).

In order to examine women's decision making power in relation to that of men in the household, the present study only included women who are currently married for statistical analyses. This selection criterion left the sample of 4,682 women. From this, 126 observations (of which 84 were non *de jure* residents) were eliminated, leaving the final analytic sample size of 4,556. Figure 1 illustrates the selection process of samples for this study. Given the relatively small number of cases eliminated because of missing data, we did not perform data imputations.

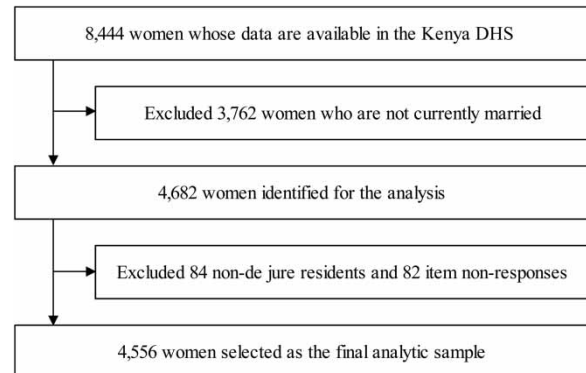


Figure 1 | Sample selection process.

Study variables

The dependent variable for the present study is the type of sanitation facility that respondents and their household members used at the time of the survey. This variable is measured with the following question: 'What kind of toilet facility do members of your household usually use?' (The Kenya National Bureau of Statistics and IMC Macro 2010b, p. 329). The answer options consist of five types of flush toilet, three types of pit latrine, three types of non-latrine toilet, and no facility. In accordance with the definition of improved sanitation in the Millennium Development Goals (MDG) target (WHO/UNICEF 2014), the responses are recoded into a binary variable (0 = using unimproved sanitation facilities, 1 = using improved sanitation facilities). Specifically, three types of flush toilet, ventilated improved pit latrine, pit latrine with slab, and composting toilet are considered as improved sanitation facilities. The rest of the options including flush to unknown locations, pit latrine without a slab, open defecation, bucket toilet, and hanging latrine are recoded as unimproved sanitation facilities. A shared sanitation facility is also regarded as an unimproved facility in this study.

Women's decision making power is measured through two questions concerning who usually makes decisions concerning health care for respondents and major household purchases, respectively. For each question, respondents selected their answer from five options: (1) respondent only; (2) husband or partner only; (3) respondent and husband/partner together; (4) someone else; and (5) other. Each response is recoded into a binary variable indicating

at least partial involvement on the part of women in the decision making process as a critical theoretical distinction (0 = husband or partner only, 1 = respondent only or joint decision between respondent and husband or partner).

Respondents' educational level is coded in four categories (0 = no education, 1 = at least some primary education, 2 = at least some secondary education, 3 = at least some higher education). Current employment status represents whether respondents worked in the past seven days with a binary category (0 = No, 1 = Yes). Respondents' socioeconomic status is determined by the wealth index, which categorizes respondents into five socioeconomic classes (0 = poorest, 1 = poorer, 2 = middle, 3 = richer, 4 = richest). The wealth index in DHS has been adopted as an alternative measure of people's economic status in developing countries where accurate income data may not be available in monetary terms (Rustin & Johnson 2004). This index is constructed with many indicator variables including major household assets (e.g., refrigerator, television, car), household characteristics concerning flooring materials, water supply, and sanitation facilities, and the number of household members per sleeping room (Rustin & Johnson 2004).

Finally, in this analysis we control for the potential confounding effects of respondents' age, number of children under 5 years in the household, ethnicity, urban versus rural residence, and geographic region on the association between household decision making power and facility type. As proxy measures of sociocultural norms regarding sanitation practice, place of residence and geographic regions are potentially simultaneously associated with household decision making and facility type. Women living in urban locations are more likely to have access to improved sanitation facilities than the rural counterpart for a structural reason, such as ease of access to construction materials.

Statistical analyses

We begin the analysis by performing tests of bivariate associations between women's decision making power, education and socioeconomic status and the presence of an improved sanitation facility in the household. Subsequently, multivariate nested models are run to ascertain the extent to

which education, employment status, and socioeconomic status independently and collectively moderate the main effects of women's decision making power on the likelihood of using an improved sanitation facility, controlling for potential confounders. Model 1 consists of two variables on women's decision making power, respondents' age, number of children, place of residence, ethnicity, and sub-country regions as the baseline specification. Model 2 adds respondents' educational attainment to the baseline specification. Model 3 includes respondents' employment status and the baseline specification. Model 4 adds respondents' wealth to the baseline model. Model 5 presents the joint specification of decision making power, educational attainment, labor force participation and wealth levels. Bivariate and multivariate analyses are adjusted for the complex survey design of the DHS, and estimates are presented as marginal and discrete change in probability associated with change in an independent variable, evaluating all other covariates at their mean values.

RESULTS

Descriptive statistics for the sample are summarized in Table 1. The mean age of respondents was 31.4 years, and the average number of children in the household was 1.25. Over 80% of the respondents received at least some primary education, and the proportion of respondents who received at least some higher education was small (8.0%). The majority of respondents used unimproved sanitation facilities (65.4%), worked at the time of the survey (59.3%), and lived in rural areas (72.8%).

Bivariate analyses

The results of zero-order regressions of improved sanitation facilities in the household on the independent variable and controls are presented in Table 2. Respondents' decision making power over major household purchases and health care, current employment, education, and socioeconomic status were significantly associated with the use of improved sanitation facilities in the expected directions. When women shared, or had full, responsibility for health care decisions, the likelihood that the family possessed an improved facility

Table 1 | Respondents' characteristics

Characteristics	Mean (SD)
Number of children in households	1.25 (1.0)
Respondents' age	31.4 (8.4)
	<i>n</i> (%)
Type of sanitation facilities	
Unimproved	3,521 (77.3)
Improved	1,035 (22.7)
Decision making on health care	
Husband alone	1,301 (28.6)
Wife alone or wife and husband	3,254 (71.4)
Decision making on major household purchases	
Husband alone	1,575 (34.6)
Wife alone or wife and husband	2,981 (65.4)
Respondents' education	
No education	878 (19.3)
At least some primary	2,383 (52.3)
At least some secondary	933 (20.5)
At least some higher	362 (8.0)
Currently working	
No	1,855 (40.7)
Yes	2,701 (59.3)
Sub-country region	
Nairobi	434 (9.5)
Central	481 (10.6)
Coast	662 (14.5)
Eastern	641 (14.1)
Nyanza	663 (14.6)
Rift Valley	712 (15.6)
Western	575 (12.6)
Northeastern	388 (8.5)
Socioeconomic status	
Poorest	1,026 (22.5)
Poorer	710 (15.6)
Middle	792 (17.4)
Richer	847 (18.6)
Richest	1,181 (25.9)
Ethnicity	
Embu	79 (1.7)
Kalenjin	404 (8.9)
Kamba	360 (7.9)
Kikuyu	732 (16.1)

*(continued)***Table 1** | continued

Characteristics	Mean (SD)
Kisii	231 (5.1)
Luhya	663 (14.6)
Luo	560 (12.3)
Masai	85 (1.9)
Meru	189 (4.2)
Mijikenda/Swahili	432 (9.5)
Somali	430 (9.4)
Taita/Taveta	63 (1.4)
Other	328 (7.2)
Place of Residence	
Urban	1,285 (28.2)
Rural	3,271 (72.8)

Kenya, 2008/2009. *n* = 4,556.

Source: Kenya DHS 2008/2009.

was estimated to be 0.046 higher than when the husband alone was responsible for these decisions. Similarly, the probability that a household possessed an improved facility was 0.087 higher when women had at least some input into major household purchases. This finding suggests that women's decision making power on major household purchases is more influential in predicting improved sanitation than women's ability to affect health care decisions. The current employment of respondents was also associated with a higher probability of having improved sanitation by 0.049 than that of respondents without employment. It appeared that both education and wealth quintiles have stronger zero-order associations than those related to women's decision making power. Compared to respondents without any education, the probability of adopting improved sanitation was 0.095, 0.228, and 0.500 higher among respondents who received at least some primary education, secondary education, and higher education, respectively. Socioeconomic status was also positively associated with use of an improved facility. The probability of having an improved sanitation facility for the poorer, middle, richer, and richest quintiles was 0.055, 0.161, 0.285, and 0.270 higher than that of the poorest quintile. There was not a statistically significant association between respondents' current employment status and utilization of improved sanitation facilities by household members.

Table 2 | Zero-order logistic regressions of sanitation facility type on household decision making power and other independent variables in marginal and discrete change in probability

	Dydx	Standard Error	Z	95% CI		F
Decision making power (ref: Husband only)						
Health care	0.046**	0.023	2.00	0.001	0.092	3.6
Major purchases	0.087***	0.022	4.04	0.045	0.129	14.2
Respondents currently working (ref: Not working)						
	0.049**	0.024	2.02	0.001	0.096	4.1
Respondents' education (ref: No formal education)						
						39.8
At least some primary	0.095***	0.022	4.39	0.053	0.138	
At least some secondary	0.228***	0.037	6.10	0.155	0.302	
At least some higher	0.500***	0.046	10.81	0.409	0.590	
Socioeconomic status (ref: Poorest)						
						23.5
Poorer	0.055**	0.024	2.24	0.007	0.103	
Middle	0.161***	0.268	6.01	0.109	0.214	
Richer	0.285***	0.287	9.95	0.229	0.341	
Richest	0.270***	0.508	5.31	0.170	0.369	

Kenya, 2008/2009. $n = 4,556$.

Source: Kenya DHS 2008/2009.

Note 1: One-tailed tests at $**p < 0.01$, $***p < 0.001$.

Note 2: Dydx is the marginal or discrete change in probability.

Multivariate analyses

The results of the multivariate regression analyses are presented in Table 3. In Model 1, the zero-order association between women's decision making power concerning household purchases and having improved sanitation facility was reduced somewhat in magnitude, but remained statistically significant. The zero-order association between health care decision making and having improved sanitation facility, however, was completely explained by respondents' age, number of children, place of residence, ethnicity, and sub-country regions. This result suggested that the power to make health care decisions, which may directly implicate sanitation facilities, is less important in this case than the more general power to allocating household financial resources, potentially toward a relatively expensive sanitation facility. The interaction effect of healthcare and purchasing decisions is not statistically significant in all of the models. For control variables, respondents' age was positively associated with improved sanitation, and women in Central and Northeastern Provinces were less likely to have improved sanitation facilities than those in Nairobi. Compared to Embu ethnicity, Luo had a lower probability of having improved sanitation facilities by 0.18.

As in the bivariate analysis, the probability of possessing an improved sanitation facility relative to those with no education was estimated to be higher at all other educational levels in Model 2. The magnitude of these effects remains relatively unchanged compared to the zero-order model. Importantly, educational attainment explained a substantial part of the association between households' purchasing influence and use of an improved facility. Though still statistically significant, the independent association of within household purchasing power was reduced in magnitude. This suggests that educational differences partially, but not completely, account for the association between women's economic decision making power and improved sanitation. Having at least some primary, secondary, and higher education is associated with higher probabilities of using improved sanitation facilities than that of women without any formal education. A pairwise comparison between women with at least some secondary education and higher education, however, suggested that the probability was not significantly different.

In Model 3, employment status was no longer significantly associated with the presence of improved sanitation facilities. This result suggests that the independent effect of women's current employment status was collectively

Table 3 | Nested logistic regressions of sanitation facility type on household decision making power and other independent variables in marginal and discrete change in probability evaluating other covariates at their means

	Model 1	Model 2	Model 3	Model 4	Model 5
Decision making power					
Health care	-0.019	-0.033	-0.019	-0.021	-0.035
Major purchases	0.068***	0.043*	0.067***	0.047**	0.035*
Respondents' education					
At least some primary		0.119***			0.096***
At least some secondary		0.240***			0.178***
At least some higher		0.491***			0.380***
Respondents working			0.005		-0.012
Socioeconomic status					
Poorer				0.040*	0.035
Middle				0.129***	0.123***
Richer				0.281***	0.247***
Richest				0.326***	0.224***
Model Fit					
F-statistic	5.10	9.72	4.90	9.04	11.77
df	(25, 359)	(28, 356)	(26, 358)	(29, 355)	(33, 351)

Kenya, 2008/2009. $n = 4,556$.

Source: Kenya DHS 2008/2009.

Note 1: One-tailed tests at * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note 2: Each model controlled for respondents' age, sub-country region, ethnicity, number of children, and place of residence.

mediated by the control variables. As in Model 1, an independent effect associated with women's purchasing decision making power remained significant.

As in the zero-order results, each wealth quintile was significantly more likely to have an improved facility compared to the poorest quintile in Model 4. All of the pairwise comparisons between the adjacent quintile groups also confirmed that individuals in each successive wealth quintile are significantly more likely to have an improved facility than those less wealthy than themselves. As in Model 2 concerning education, socioeconomic status slightly reduced the marginal association of women's purchasing decision making power and facility type, which remained statistically significant. This result suggests that socioeconomic status only partially explains the effect of women's decision making power for major household purchases.

Controlling for other independent variables and confounders in this model, women's sole or shared decision making power concerning major household purchases was

still significantly and independently associated with a difference in the probability that household members used improved sanitation facilities in Model 5. While the coefficients for level of education were attenuated in this model, those for socioeconomic status remained robust relative to previous specifications. This, in combination with the remaining independent effect of household decision making autonomy, suggests that much of the mediating effect of education on the relationship between purchasing autonomy and sanitation facilities is explained by the association between education and wealth at least in this context. Based on the adjusted Wald test, this model was the most parsimonious model and explained the variance in the sanitation outcome most efficiently.

DISCUSSION

The main objective of this study was to examine if women's decision making power in the household predicts use of

improved sanitation facilities in Kenya. While past research has addressed psychological, economic, social, and environmental determinants of improved sanitation (Jenkins & Scott 2007; Mara *et al.* 2010), interpersonal or familial factors have not been extensively studied in sanitation research. Thus, the present study contributed to a body of sanitation research and programs by demonstrating the extent to which women's decision making power, an interpersonal factor, could facilitate the adoption of improved sanitation practice. Given that recent sanitation interventions often focus on developing people's motivation for improved sanitation at household and community levels (Mara *et al.* 2010), the findings could also be useful to improve future sanitation promotion programs at the household level.

The present study suggests that women's decision making power on major household purchases is an influential determinant of sanitation improvement. Women's involvement in the decision making process for their health care, however, was not a significant predictor in our models. Although the marginal effects were substantially smaller than those of education and socioeconomic status, the multivariate models consistently indicated this type of decision making power had a significant, independent association with facility type. Education and socioeconomic status both partially accounted for the zero-order association of women's decision making power on sanitation improvement, but not completely. Respondents' employment status, however, did not alter the independent effects of the decision making power to a substantive extent.

Education and socioeconomic status were consistently identified as significantly associated with improved sanitation in bivariate and multivariate analyses, but the marginal effects of education substantially declined in the final model. Respondents' socioeconomic status was likely to be responsible for this reduction. Given that monetary constraints can determine to what extent people receive formal education, the independent effects of education on the sanitation outcome declined after controlling for socioeconomic status and other independent variables. This finding is in accordance with the previous studies that indicated affordability as a key issue for the adoption of improved sanitation facilities (Cairncross 2003; Mara *et al.* 2010). Socioeconomic status maintained a similar level of marginal effects in both bivariate and multivariate analyses

except for the richest class. A large reduction of the independent effect associated with the richest class in the final model suggests that availability of additional financial resources after the threshold does not necessarily lead to sanitation improvement. The results suggest that sanitation improvement can be effectively facilitated by removing monetary constraints and enhancing women's education.

The present study includes at least three notable limitations. First, owing to the cross-sectional study design, temporality between women's decision making power and use of improved sanitation facilities among household members could not be definitively established. It is reasonable to assume however, that decision making autonomy is relatively constant, a product of both cultural factors and the relationship between a woman, her spouse and other household members. A drastic change of women's decision making power in Kenya has not been reported, at least for the recent years. This makes the likelihood of reverse causation less plausible, and no evidence of such an effect has been found in the empirical literature. Second, the present study could not directly assess women's decision making power on sanitation practice because DHS has not included this question. While sanitation improvement can be framed as a major purchase for the household, women's purchasing power in the household needs to be carefully interpreted and considered as a proxy measure. Lastly, this study included all of the currently married and cohabiting women in the analysis without separating respondents in monogamous and polygamous marriages. Women's ability to influence household decision making may differ between these two types of marriage practices. Future studies may conduct additional investigations on the implication of different marriage relationships on women's ability to influence sanitation practice.

Previous studies in Benin and Ghana have suggested women's motivation for improved sanitation as a key determinant of sanitation behavior (Jenkins & Curtis 2005; Jenkins & Scott 2007). While decision making autonomy may well be a mediating factor in this relationship, the DHS does not include measurement of such motivations. To the extent that decision making power over household purchases, seen to be significantly associated with facility type here, would have a greater influence when such motivation exists, we might expect the association of this type of

intra-household power to be even more strongly associated with facility type in interaction with measures of motivation. Future research should extend the present study by including an analysis of women's autonomy and motivations as they may influence sanitation and other health practices. By translating such research findings to sanitation programs, adoption of improved sanitation facilities can potentially be accelerated.

CONCLUSION

Women's decision making power in the household has been demonstrated to be positively associated with improved sanitation in Kenya. As with socioeconomic and demographic drivers, interpersonal factors, particularly the gendered division of power and autonomy in the household, can be considered an influential determinant of sanitation practice. This finding highlights the importance of women's involvement with sanitation interventions to facilitate the adoption of improved sanitation facilities in the household. Few studies, however, extensively explored potential determinants of improved sanitation in this country or examined the role of women's decision making autonomy on sanitation practice. Although the present study was only able to use a proxy measure of women's decision making power on sanitation practice, future research may directly measure women's ability to influence sanitation behaviors in the household. Additional studies also remain essential to better understand if, and to what extent, women's decision making autonomy is associated with people's sanitation behavior in other countries in the Sub-Saharan African region. By ameliorating extreme poverty and enhancing women's education, global efforts to increase ownership and use of improved sanitation facilities in the household can be further accelerated.

REFERENCES

- Acharya, D. R., Bell, J. S., Simkhada, P., Van Teijlingen, E. R. & Regmi, P. R. 2010 *Women's autonomy in household decision-making: a demographic study in Nepal*. *Reproductive Health* 7, 15.
- Becker, S., Fonseca-Becker, F. & Schenck-Yglesias, C. 2006 *Husbands' and wives' reports of women's decision-making power in Western Guatemala and their effects on preventive health behaviors*. *Social Science & Medicine* 62, 2313–2326.
- Cairncross, S. 2003 *Sanitation in the developing world: current status and future solutions*. *International Journal of Environmental Health Research* 13, S123–S131.
- Cairncross, S., Hunt, C., Boisson, S., Bostoen, K., Curtis, V., Fung, I. C. & Schmidt, W. P. 2010 *Water, sanitation and hygiene for the prevention of diarrhoea*. *International Journal of Epidemiology* 39, i193–i205.
- Dodoo, F. N. 1998 *Men matter: additive and interactive gendered preferences and reproductive behavior in Kenya*. *Demography* 35, 229–242.
- Esrey, S. A., Potash, J. B., Roberts, L. & Shiff, C. 1991 *Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma*. *Bulletin of the World Health Organization* 69, 609–621.
- Fewtrell, L., Kaufmann, R. B., Kay, D., Enanoria, W., Haller, L. & Colford Jr, J. M. 2005 *Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis*. *Lancet Infectious Diseases* 5, 42–52.
- Frankenberg, E. & Thomas, D. 2001 *Measuring Power*. Food Consumption and Nutrition Division Discussion Paper No. 113. International Food Policy Research Institute, Washington, DC.
- Gwako, E. L. 1997 *Conjugal power in rural Kenya families: its influence on women's decisions about family size and family planning practices*. *Sex Roles* 36, 127–147.
- Hindin, M. J. 2000 *Women's power and anthropometric status in Zimbabwe*. *Social Science & Medicine* 51, 1517–1528.
- Jenkins, M. W. & Curtis, V. 2005 *Achieving the 'good life': why some people want latrines in rural Benin*. *Social Science & Medicine* 61 (11), 2446–2459.
- Jenkins, M. W. & Scott, B. 2007 *Behavioral indicators of household decision-making and demand for sanitation and potential gains from social marketing in Ghana*. *Social Science & Medicine* 64, 2427–2442.
- Kar, K. & Chambers, R. 2008 *Handbook on Community-Led Total Sanitation*. Plan International, London.
- Kenya National Bureau of Statistics, ICF Macro 2010a *Kenya Demographic and Health Survey 2008-09*. [Dataset] KNBS and ICF Macro, Calverton, MD, USA.
- Kenya National Bureau of Statistics, ICF Macro 2010b *2008-09 Kenya Demographic and Health Survey: Key Findings*. KNBS and ICF Macro, Calverton, MD, USA.
- Lennon, S. 2011 *Fear and anger: Perceptions of risks related to sexual violence against women linked to water and sanitation in Delhi, India*. Retrieved November 4, 2014, from http://www.sharesearch.org/LocalResources/VAW_India.pdf.
- Lim, S., Vos, T., Flaxman, A. D., Danaei, G., Shibuya, K., Adair-Rohani, K. et al. 2012 *A comparative risk assessment of burden of disease and injury attributable to 67 risk factors*

- and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet* **380**, 2224–2260.
- Mahon, T. & Fernandes, M. 2010 Menstrual hygiene in South Asia: a neglected issue for WASH (water, sanitation and hygiene) programmes. *Gender & Development* **18**, 99–113.
- Mara, D., Lane, J., Scott, B. & Trouba, D. 2010 Sanitation and health. *PLoS Medicine* **7**, e1000363.
- Mason, K. O. 1987 The impact of women's social position on fertility in developing countries. *Sociological Forum* **2**, 718–745.
- Rustin, S. O. & Johnson, K. 2004 *DHS Comparative Reports No. 6: The DHS Wealth Index*. ORC Macro, Calverton, Maryland.
- Sara, S. & Graham, J. 2014 Ending open defecation in rural Tanzania: which factors facilitate latrine adoption? *International Journal of Environmental Research and Public Health* **11**, 9854–9870.
- WHO/UNICEF 2014 Progress on drinking water and sanitation: 2014 update. Retrieved November 7, 2014 from http://www.who.int/water_sanitation_health/publications/2014/jmp-report/en/.
- Ziegelbauer, K., Speich, B., Mausezahl, D., Bos, R., Keiser, J. & Utzinger, J. 2012 Effect of sanitation on soil-transmitted helminth infection: systematic review and meta-analysis. *PLoS Medicine* **9**, e1001162.

First received 1 September 2015; accepted in revised form 28 December 2015. Available online 6 February 2016