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Why are some latrines cleaner than others? Determining the factors of habitual cleaning behaviour and latrine cleanliness in rural Burundi

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ABSTRACT

Access to improved sanitation is fundamental for the prevention of diarrhoea and other diseases. However, for a sanitation facility to be safe, its cleanliness must be assured. The aim of the present study was, first, to assess how cleaning behaviour, household characteristics and infrastructural factors influenced latrine cleanliness and, second, to assess which psychological factors influenced cleaning behaviour. In a study in rural Burundi, 762 standardised household interviews with the primary household caregiver were carried out to assess habitual cleaning behaviour and psychological factors according to behaviour change models. In addition, the characteristics and cleanliness of the latrine were observed, and two multiple linear regressions were performed to analyse predictors of latrine cleanliness and of cleaning behaviour. Latrine cleanliness was determined by cleaning behaviour, the possibility of locking the door, the height of the superstructure, the material of the superstructure and the availability of an even slab. The number of households or people sharing the latrine was not influential. Commitment to cleaning, satisfaction with the cleanliness of the latrine and self-efficacy determined habitual cleaning behaviour. Interventions focussing on commitment, self-efficacy and satisfaction with a clean latrine like public commitment or guided practice interventions are recommended to promote cleaning behaviour.

Key words | behaviour change, Burundi, cleaning, diarrhoea, sanitation, sub-Saharan Africa

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INTRODUCTION

Diarrhoea is preventable, but remains one of the main causes of death in under-five-year olds in developing countries (Chopra *et al.* 2013; WHO/UNICEF 2013). Along with improved hygiene practices and access to safe water, sanitation is fundamental for the prevention of diarrhoea. Access to sanitation is estimated to reduce diarrhoea incidence by more than 30% (Montgomery & Elimelech 2007; Curtis *et al.* 2011; Brown *et al.* 2013).

The benefits of sanitation are not only limited to health. In Benin and Ghana it was found that prestige, well-being and situational goals were more important than the expected health gains (Jenkins & Curtis 2005; Jenkins & Scott 2007). Similarly, Diallo *et al.* (2007) found that the main perceived benefit of newly installed pit latrines in Niger was not health gains but easy access and privacy. Research has also indicated the subjective importance of latrine cleanliness to users. Tumwebaze *et al.* (2013) found that most latrine users in Kampala slums were dissatisfied with their sanitation facilities due to low cleanliness and over-demand. In a project in Ghana, cleanliness was mentioned as the main advantage of latrines besides health benefits and convenience (Rodgers *et al.* 2007).

Of even greater significance than the subjective importance of latrine cleanliness are the health hazards associated with the use of dirty toilets (Sijbesma 2008). Importantly, the World Health Organization (WHO) has acknowledged the importance of latrine cleanliness by

designating latrines as improved only if they are properly maintained as well as clean (WHO/UNICEF 2012).

Despite its relevance, the number of studies concerning correlates or predictors of latrine cleanliness is still limited. Recently, Günther et al. (2012) found a negative correlation between the cleanliness of a latrine and the number of households or people sharing it. Tumwine et al. (2003) found latrine cleanliness to be correlated with the profession of the household head, the presence of a door, lid and concrete wall and floor, and the disposal of waste water in the latrine. Tumwebaze et al. (2014) found importance of using a clean toilet, efforts involved in cleaning the toilet, disgust felt from using a dirty toilet and cleaning habits as the main determinants of the intention to clean shared toilets.

This study aims to identify factors that influence latrine cleanliness. Several 'structural factors' have conceivable influences: the first is the number of households and people per latrine. Furthermore, the type of slab or the existence of a cover plate, for example, could influence latrine cleanliness in terms of ease or difficulty of cleaning. Users might also be influenced by the quality of the superstructure of the latrine, taking more or less care when using it. The presence of a door could influence how safe or hurried people feel when using the latrine. A lock on the door could limit access, especially to careless strangers, further resulting in higher levels of cleanliness. Differences between cleaning methods could also result in different levels of cleanliness.

The most obvious, though not necessarily effective, predictor of latrine cleanliness is not structural but simply how often the latrine is cleaned. Verplanken & Wood (2006) further emphasised the importance of habits, especially in health-related contexts because impact is most acute with daily, habitual cleaning. A new concept of 'habitual behaviour', which includes both behaviour and habit, has already been proposed and tested in Bangladesh (Inauen et al. 2013a).

Assuming that habitual cleaning behaviour is an important predictor of latrine cleanliness, it is crucial to understand which socio-cognitive factors predict this practice. The Risk, Attitudes, Norms, Abilities and Self-regulation (RANAS) model of behaviour was especially developed to predict health behaviour in developing countries (Mosler 2012). It consists of a comprehensive description of psychological factors derived from well-established health models. The model groups the various factors into five blocks: risks, attitude factors, norm factors, ability factors and self-regulation factors. Risk factors pertain to all factors that address an individual's understanding and awareness of the health risk. Attitudinal factors express a positive or negative stance towards the behaviour. Norm factors represent convictions in relation to the incidence of behaviour and how a social network thinks about behaviour. Abilities represent aptitudes that an individual believes he or she must have to acquire behaviour. Finally, self-regulation addresses the continuation and maintenance of behaviour.

The present study

A cross-sectional study was conducted in three rural provinces in Burundi. This study is part of a larger study on hygiene and sanitation practices in rural Burundi. The focus of this paper lies on latrine cleanliness and the psychological determinants of habitual cleaning behaviour. The paper aims to answer the following research questions:

- What are the environmental conditions and practices concerning sanitation and latrines?
- What are the determinants of latrine cleanliness? To what extent is it about habitual cleaning behaviour and to what extent does it concern structural factors?
- What are the psychological determinants of habitual cleaning behaviour?

MATERIAL AND METHODS

Research area

Burundi is rated as one of the 10 countries with the lowest human development index worldwide. The mortality rate amongst under-fives is 142 per 1,000 births (UNDP 2013). The Republic is divided into 17 provinces, which are further divided into 117 communes. On the lowest administrative level are the collines, which is French for 'hills', and refers to the nature of Burundi's landscape.

Sample frame

The study was conducted in three of the 17 provinces of Burundi, namely, Bururi, Kirundo and Ruyigi. All three provinces are rural and people rely on self-sustaining farming. In each of the three provinces, two communes were randomly selected. In addition, the collines closest to and farthest from the commune's chief village were chosen, resulting in 12 collines. The villages were not part of any specific programme on hygiene or sanitation. Caretakers of children under the age of five were interviewed.

Survey deployment

The random route method was applied for selecting approximately 60 households per colline. A total of 762 households were surveyed, 250 in Bururi, 255 in Kirundo and 257 in Ruyigi. Structured face-to-face interviews and spot-check observations on hygiene were conducted. Spot checks are short observations where the interviewer fills out a checklist about the conditions he or she encounters. A team of ten local students or social workers balanced by gender and ethnic group was recruited as interviewers. They were trained over 8 days on the questionnaire, with a focus on bias issues and on social skills. Ethical approvals were given by the Burundian authorities and the affiliated university of the authors.

Questionnaire

The questionnaire was simultaneously developed in English and French. It was professionally translated from French to Kirundi, the local language, and re-translated into French for verification. Spot-check observations of various features of the latrine, like its cleanliness, the availability of a slab and the quality of the superstructure were conducted (Table 1). Objective criteria were given to the interviewers. A latrine was defined as clean if the floor was well swept and no faeces were observable.

The psychological variables were measured quantitatively as proposed by the RANAS model. Unipolar questions were measured with 5-point Likert scales and bipolar questions with 9-point Likert scales (Table 2).

Since the question about monthly income could not be answered by more than half of the households, proxy measures were used to assess household wealth. The interviewers noted the quality of the roofing material of the dwelling and asked whether anyone in the household owned a mobile phone. Interviewees were further asked about their education and if they had ever received sensitization about open defecation. These questions acted as control variables (Table 3).

Data analysis

We calculated Cronbach's alpha to assess the reliability of 'habitual cleaning behaviour'. With $\alpha = 0.77$, it was

Table 1 │ Variables used for regression analysis on latrine cleanliness

Variable name	Scale	Lowest value	Highest value	Collection
Latrine cleanliness	3 pts.	−1 = dirty	1 = clean	Spot check
Household size				Question
Private/shared	2 pts.	0 = shared	1 = private	Question
Cover plate	2 pts.	0 = no cover plate	1 = cover plate	Spot check
Slab availability	2 pts.	0 = no slab	1 = wooden or cement slab	Spot check
Height of superstructure	2 pts.	0 = waist high	1 = man high	Spot check
Material of superstructure	2 pts.	0 = straw, banana leaves or wood	1 = clay	Spot check
Possibility to lock	3 pts.	0 = no door (.5 = door without lock)	1 = door with lock	Spot check
Cleaned with water	2 pts.	0 = no mention of water	1 = mention of water	Question
Cleaned with broom	2 pts.	0 = no mention of broom	1 = mention of broom	Question
Cleaned with ashes	2 pts.	0 = no mention of ashes	1 = mentions ashes	Question

Table 2 | Variables used for regression analyses on habitual cleaning behaviour

Factor block	Variable name	Wording	Scale	Lowest value	Highest value
Behavioural Factors	Habitual cleaning behaviour (3 questions)	How often do you clean the latrine?	5 pts.	0 = never	1 = daily
		How often does it happen that you forget to clean the latrine?	5 pts.	0 = almost each time	1 = almost never
		To what extent do you feel that you clean the latrine as a matter of habit?	5 pts.	0 = not a habit	1 = a very strong habit
Risk Factors	Perceived vulnerability of child	How high do you feel is the risk that your child gets diarrhoea?	5 pts.	0 = no risk	1 = high risk
	Risk perception	How likely is it that you get diarrhoea if you don't use a clean latrine for defecation?	5 pts.	0 = no risk	1 = high risk
	Perceived severity of child	Imagine your child contracted diarrhoea; how severe would that be?	5 pts.	0 = not severe at all	1 = very severe
Attitudinal Factors	Instrumental beliefs: effort	Do you think that cleaning the latrine is effortful?	5 pts.	0 = not effortful	1 = very effortful
	Instrumental beliefs: health	How certain are you that cleaning the latrine prevents you from getting diarrhoea?	5 pts.	0 = not certain	1 = very certain
	Likes cleaning	How much do you like or dislike cleaning the latrine?	9 pts.	−1 = dislike it very much	1 = like it very much
	Likes to use clean latrine	How much do you like or dislike using a clean latrine?	9 pts.	−1 = dislike it very much	1 = like it very much
	Disgust when using dirty latrine	Do you think it is disgusting to use a dirty latrine?	5 pts.	0 = not disgusting	1 = very disgusting
	Satisfaction with cleanliness	How satisfied are you with the average cleanliness of the latrine?	5 pts.	0 = not satisfied	1 = very satisfied
Norm Factors	Descriptive norm	How clean are the other latrines in your community?	5 pts.	0 = very dirty	1 = very clean
	Injunctive norm	People who are important to you, do they rather think you should or you should keep the latrine clean?	9 pts.	−1 = nearly all disapprove	1 = nearly all approve
	Personal norm	Do you feel a personal obligation to clean the latrine?	5 pts.	0 = no personal obligation	1 = strong personal obligation
Ability Factors	Self-efficacy	Do you think you are always able to keep the latrine clean?	5 pts.	0 = not able	1 = very able
	Perceived behavioural control	How difficult is it to always keep the latrine clean?	5 pts.	0 = not difficult	1 = very difficult
	Maintenance self-efficacy	How confident are you that you can clean the latrine even if you have a lot of other things to do or even if you don't feel like cleaning it?	5 pts.	0 = not confident	1 = very confident
	Recovery self-efficacy	Imagine you have stopped cleaning the latrine for a long time. How confident would you be to start over?	5 pts.	0 = not confident	1 = very confident
S–R Factors	Coping planning	How do you ensure that the latrine is always kept clean?	2 pts.	0 = no plan	1 = has plan
	Commitment	Do you feel committed to cleaning the latrine?	5 pts.	0 = not committed	1 = very committed

Note: Original scales ranging from 0 to 4, resp. −4 to 4 were transformed to scales ranging from 0 to 1, resp. −1 to 1.

Table 3 | Control variables

Variable name	Scale	Lowest value	Highest value	Collection
Education mother	2 pts.	0 = primary school not completed	1 = primary school completed	Question
Mobile phone ownership	2 pts.	0 = no one in household owns mobile phone	1 = at least one person in household owns mobile phone	Question
Dwelling's roofing material	2 pts.	0 = roof of dwelling is made of low quality material (e.g. straw or bananaleafs)	1 = roof of dwelling is made out of corrugated iron or tiles	Spot check
Sensitization open defecation	2 pts.	0 = Does not recall ever having received sensitization on open defecation	1 = recalls having received sensitization on open defecation	Question

considered reliable to combine the single items into one variable. To answer the two research questions, we calculated two simultaneous multiple regressions to identify significant determinants of habitual cleaning behaviour and latrine cleanliness. Assumptions of linearity, homoscedasticity, independent and normally distributed errors and multicollinearity were met for both regressions.

RESULTS

Descriptive statistics

Female respondents made up 99.6% of the sample, and in the majority of cases, they were married (76.2%) or cohabiting (13.9%). The mean number of people living in a household was 5.89 (SD = 2.12), ranging from two to 16. Only 18% of the sample completed primary school. Participants were mostly Catholic (57.4%) or Protestant (40.1%), and the remainder were either Muslim or atheist. The main livelihood of the vast majority was farming and/or livestock production (95.0%). The two proxy measures for household wealth revealed that in 31.9% of the household's someone owned a mobile phone. The roofs of the dwellings were mostly (80.3%) made out of corrugated iron or tiles. Further, 62.3% of the interviewees recalled having been sensitized on open defecation.

General results regarding the sanitary situation

Access to latrines was high (95.7%), and 80.9% of the household having access to sanitation had private latrines. Most of the shared latrines (80.5%) were shared by only two households. Participants reported a very high frequency of latrine use; 86.0% 'always' used it, while 13.0% used it 'often'. The reported use for participants' children was much lower: 45.9% reported that their children 'always' used the latrine, while 35.1% reported that their children used it 'often'. Interviewers tried to verify latrine use by checking the surroundings of the houses for faeces. In most cases (76.6%), no faeces were found. Interviewers reported that mostly children's faeces were found, thereby reaffirming the reported lower use by children. More faeces were found close to households not having access to sanitation (54.5%) than close to households having access to sanitation (21.9%). Further faeces were detected less often 15.9% in households reporting that their children 'always' used the latrine (15.9%) than in of the household reporting lower use (27.8%).

All latrines were pit latrines; most were rudimentarily covered with wooden sticks and soil (75.1%); some had cement slabs (12.0%), others had wooden slabs (8.4%), and some were simply open pits (2.7%). Cover plates on latrines were very rare, and only 7.5% of latrines had one; 4.2% of latrines had no superstructure, and if there was one, it was more often waist-high (56.8%) than human-height (38.9%); 30.7% of latrines had superstructures made out of clay, 29.0% made of straw, 26.6% made of banana leaves, and 7.3% made of wood; most latrines (88.0%) had no door, some had a door without a lock (4.7%), while others had a door with lock (7.2%).

In most cases, interviewers rated latrine cleanliness as mediocre (47.3%), dirty (26.4%) or clean (26.3%). When asked who normally cleaned the latrine, respondents stated that most often, they did it themselves (80.3%). Otherwise, 'all the women in the family' (7.5%), 'no one' (3.4%), 'all the sharing households' (3.0%), 'everyone' (2.6%) and

'others' (3.2%) were given as responses. Respondents stated that most often, they cleaned the latrine everyday (41.9%), otherwise, they cleaned it twice weekly (22.3%), once weekly (13.3%), fortnightly (7.6%) or practically never (10.5%). Respondents were asked how they cleaned their latrine (multiple answers were possible). They mostly reported that they cleaned with a broom or hoe (91.7%),

but that they also cleaned with ashes (36.1%) and water (29.4%).

Habitual cleaning behaviour and psychological factors

Table 4 presents descriptive statistics of all variables used for the regression analyses. Generally, respondents reported a

Table 4 │ Means and frequencies of variables used for regression analyses

Factor Block	Item/Factor	n	Min.	Max.	M	SD
Variables for first regression						
	Latrine cleanliness	697	−1	1	0.00	0.73
Structural Factors	Household size	762	2	16	5.89	2.12
	Private/shared	738	0	1	0.81	0.39
	Cover plate	697	0	1	0.07	0.26
	Slab	728	0	1	0.20	0.40
	Height of superstructure	699	0	1	0.41	0.49
	Material of superstructure	751	0	1	0.30	0.46
	Possibility to lock	718	0	1	0.10	0.27
	Cleaned with water	762	0	1	0.29	0.46
	Cleaned with broom	762	0	1	0.91	0.29
	Cleaned with ashes	762	0	1	0.36	0.48
Variables for second regression						
	Habitual cleaning behaviour	730	0	1	0.69	0.23
Risk Factors	Perceived vulnerability of child	762	0	1	0.71	0.34
	Risk perception	761	0	1	0.76	0.22
	Perceived severity of child	762	0	1	0.95	0.10
Attitude Factors	Instrumental beliefs: effort	728	0	1	0.15	0.27
	Instrumental beliefs: health	729	0	1	0.32	0.25
	Likes to clean	730	−1	1	0.63	0.25
	Likes using clean latrine	729	−1	1	0.73	0.20
	Disgust when using dirty latrine	729	0	1	0.83	0.21
	Satisfaction with cleanliness	729	0	1	0.64	0.21
Norm Factors	Descriptive norm	726	0	1	0.54	0.19
	Injunctive norm	722	−1	1	0.68	0.23
	Personal norm	729	0	1	0.73	0.22
Ability Factors	Self-efficacy	728	0	1	0.60	0.25
	Perceived behavioural control	729	0	1	0.18	0.27
	Maintenance self-efficacy	727	0	1	0.72	0.15
	Recovery self-efficacy	729	0	1	0.77	0.13
S–R Fact.	Coping planning	724	0	1	0.60	0.49
	Commitment	728	0	1	0.69	0.21
Control variables						
	Sensitization open defecation	757	0	1	0.63	0.48
	Education mother	759	0	1	0.18	0.39
	Mobile phone ownership	762	0	1	0.32	0.47
	Dwelling's roofing material	762	0	1	0.80	0.40

Note: theoretical *MIN* and *MAX* values of variables are provided.

high level of habitual cleaning behaviour (Mean $[M] = 0.69$). Psychological factors recorded positive means towards cleaning. The very low perceived vulnerability of getting diarrhoea ($M = 0.30$) stood in contrast with the very high perceived severity of getting diarrhoea ($M = 0.91$). The majority of respondents reported that they had become sensitised to getting diarrhoea (63%) and to the effects of open defecation (63%). Arrangements with other users about cleaning (36%) existed, and arguments about cleaning (35%) occurred, but were not the norm. The mean of the frequency of communication ($M = 0.60$) reflected that respondents talked approximately weekly about hygiene related matters.

Predictors of latrine cleanliness

To answer the research question on the predictors of latrine cleanliness, we conducted a linear regression analysis (Table 5). All variables in the model are spot check observations except habitual cleaning behaviour which is self-reported. The model displays a mediocre explanation of variance (adj. $R^2 = 0.323$). Five predictors were found to be significant: 'habitual cleaning behaviour' ($\beta = 0.299$), 'possibility to lock' ($\beta = 0.190$), 'height of superstructure' ($\beta = 0.171$), slab ($\beta = 0.098$) and 'material of superstructure' ($\beta = 0.088$). Habitual cleaning behaviour was the strongest predictor; the higher peoples' habitual cleaning behaviour, the cleaner were their latrines. Additionally, the better the possibility of closing or locking latrines, the cleaner they were. If they had a human-height superstructure, they were cleaner compared to waist-high superstructures. Further, if the superstructure was made of clay or mud, rather than straw or banana leaves, the latrines were cleaner. Lastly, if latrines had a slab, they were more likely to be clean.

Education of the interviewee had no influence. Whereas 'dwelling's roofing material' was a significant predictor for latrine cleanliness 'mobile phone ownership', the other proxy for household wealth was not significant. No differences of cleanliness of the latrines were found during different periods of the day.

Predictors of habitual cleaning behaviour

To answer the research question on the predictors of habitual cleaning behaviour, linear regression analyses (Table 5)

Table 5 │ Linear regression analyses for latrine cleanliness and habitual cleaning behaviour

Variable	B	SE B	β
Regression on latrine cleanliness[a]			
(Constant)	− 1.030	0.150	
Habitual cleaning behaviour	0.995	0.121	0.299[b]
Household size	− 0.006	0.012	− 0.018
Private/shared	0.058	0.065	0.031
Cover plate	0.121	0.096	0.044
Slab availability	0.174	0.066	0.098[c]
Height of superstructure	0.251	0.055	0.171[b]
Material of superstructure	0.134	0.058	0.088[d]
Possibility to lock	0.496	0.099	0.190[b]
Cleaned with water	− 0.005	0.057	− 0.003
Cleaned with broom	− 0.127	0.118	− 0.037
Cleaned with ashes	0.049	0.052	0.033
Education mother	− 0.057	0.064	− 0.031
Mobile phone ownership	− 0.015	0.054	− 0.010
Dwelling's roofing material	0.243	0.068	0.125[b]
Regression on habitual cleaning behaviour[e]			
(Constant)	0.013	0.067	
Perceived vulnerability of child	0.027	0.017	0.039
Risk perception	− 0.030	0.025	− 0.028
Perceived severity of child	− 0.062	0.052	− 0.027
Instrumental beliefs: effort	− 0.040	0.021	− 0.046[f]
Instrumental beliefs: health	− 0.024	0.021	− 0.026
Likes to clean	0.054	0.027	0.058[d]
Likes to use clean latrine	0.049	0.031	0.041
Disgust when using dirty latrine	− 0.016	0.026	− 0.014
Satisfaction with cleanliness	0.200	0.029	0.181[b]
Descriptive norm	0.094	0.029	0.075[c]
Injunctive norm	0.014	0.025	0.014
Personal norm	0.065	0.025	0.061[d]
Self-efficacy	0.132	0.026	0.144[b]
Perceived behavioural control	− 0.036	0.025	− 0.040
Maintenance self-efficacy	− 0.062	0.044	− 0.040
Recovery self-efficacy	− 0.004	0.050	− 0.002
Coping planning	0.001	0.012	0.002
Commitment	0.560	0.036	0.492[b]
Sensitization open defecation	0.034	0.011	0.069[c]
Education mother	0.006	0.013	0.010
Mobile phone ownership	0.013	0.011	0.026
Dwelling's roofing material	0.025	0.013	0.042[f]

Note: [a]adjusted $R^2 = 0.323$, [b]$p < 0.001$, [c]$p < 0.01$, [d]$p < 0.05$, [e]adjusted $R^2 = 0.677$, [f]$p < 0.1$, a forced entry method was used for the calculation.

were performed. The model displays a high explanation of variance (adj. $R^2 = 0.677$). Six psychological factors significantly influenced habitual cleaning behaviour ($p < 0.05$). The three factors with the strongest influence were 'commitment' ($\beta = 0.492$), 'satisfaction with cleanliness' ($\beta = 0.181$) and 'self-efficacy' ($\beta = 0.144$). People who felt committed to cleaning their latrines, those who were more satisfied with its cleanliness, and those who felt confident about their ability to clean ('self-efficacy') recorded higher levels of habitual cleaning behaviour. There were three additional factors whose influence was notably smaller: 'perceived vulnerability of child' ($\beta = 0.039$), 'likes to clean' ($\beta = 0.058$) and 'personal norm' ($\beta = 0.061$). It has to be noted that commitment correlated strongly with 'likes to clean' ($r = 0.53$), self-efficacy ($r = 0.52$) and maintenance self-efficacy ($r = 0.50$). Therefore, these factors might have had a stronger influence on their own, even though they may not have recorded significant results in the final regression analyses.

Of the control variables entered to the regression, the two variables 'sensitization open defecation' ($\beta = 0.069$) and 'dwellings roofing material' ($\beta = 0.042$) had some weak influence. People who recalled having received sensitization on open defecation had a somewhat stronger habitual cleaning behaviour as did people with a higher household wealth indicated by having a roof of better quality on the dwelling. However, the ownership of a mobile phone by someone in the household, the second proxy for household wealth, had no influence and neither did the education of the interviewee.

DISCUSSION

The aim of the present study was to analyse sanitary conditions in three provinces in rural Burundi. Of primary interest were questions relating to latrine cleanliness. We determined predictors of latrine cleanliness as well as of habitual cleaning behaviour.

General sanitary situation

The results showed that while latrine access was almost universal, there were serious deficits in terms of their cleanliness and how they were built. Open defecation was only a marginal problem for adults, but children routinely practised it. It is understandable why small children often did not use latrines. Falling into the pit posed serious risks; most latrines were not equipped with a cover plate and were rudimentarily covered with wood. Open defecation by children is not negligible, as there is evidence that it poses a health risk (Tumwine *et al.* 2002; Buttenheim 2008). Further, only one-tenth of the latrines had cement slabs and could be considered improved by WHO (WHO/UNICEF 2012) standards.

Latrine cleanliness

Latrine cleanliness was generally mediocre; only one-quarter of the latrines sampled were rated as clean, while the remainder was rated as average or dirty. The strongest determinant of latrine cleanliness was the habitual cleaning behaviour of the caretaker. This result is very important because it meant that caretakers had a certain control over the cleanliness of their latrines, and therefore, interventions aimed at improving habitual cleaning behaviour could potentially be successful in increasing latrine cleanliness. Further, latrines with a door, or a door with a lock, were cleaner than latrines without these features. This result is consistent with Tumwine *et al.* (2003) who also found that latrines with doors were more likely to be clean. This could be due to the resulting limited latrine access, especially of careless strangers. Latrines were also cleaner when the superstructure was human-height rather than only waist-high; if they had an even slab made of cement or wood and if the walls were made of clay rather than straw or banana leaves. Latrines with even slabs might be cleaner because people take more care when using them or because they are easier to clean. This is also one reason why they are promoted, for example, by UNICEF (Brandberg 1996; Yepdujo *et al.* 1999).

Considering the fact that only unshared sanitation has been categorised as improved due to a fear of unhygienic conditions (WHO/UNICEF 2012), it is somewhat surprising that neither a shared latrine nor the number of people using it has an influence on its cleanliness. However, it must be noted that shared latrines are mostly shared by two households only. This is clearly under the threshold proposed by Günther *et al.* (2012), who recommend a maximum of four households per latrine to still be acceptable or improved.

The different cleaning techniques (using a broom, water or ashes) had no effect on cleanliness. It appeared that each technique could be efficient if it was carried out properly. It should be noted that with the rather low R^2, not much of the variance in latrine cleanliness could be explained. This indicates that some important predictors were missing from the model. The care of users is one factor, which we suspect might be essential but which was not measured. Another reason for the low explained variance was our measurement. Even though no correlation between time of the day and cleanliness was found it is probable that latrine cleanliness fluctuated over the course of the day. Our measurement represented a momentary state rather than the permanent state of latrine cleanliness. Indeed, Ruel & Arimond (2002) recommend multiple measurements in their review of the spot-check literature.

The results were controlled for education, the ability to recall previous sensitization and household wealth. Education had no influence. People who could recall having been sensitized about open defecation had cleaner latrines. The data indicated that household wealth influences cleanliness to a certain extent. Interestingly, whether or not a household owned a mobile phone did not influence cleanliness whereas whether or not the roofing of the dwelling was of high quality did. Presumably, those two proxies measure different aspects of household wealth. The quality of the roofing is an investment for the wellbeing of the whole family whilst the mobile phone is mostly an investment of one person of the household only. Thus, it could be speculated that latrine cleanliness is not so much related to the households wellbeing but more to the willingness to invest in wellbeing in a way that makes the whole family benefit.

Habitual cleaning behaviour

Participants recorded high levels of habitual cleaning behaviour. In terms of explained variance, the RANAS model seems to be suitable because nearly 70% of the variance of habitual cleaning behaviour could be explained. Altogether, the three most important predictors of habitual cleaning behaviour were commitment to cleaning, satisfaction with the cleanliness of the latrine and self-efficacy. As Cialdini (2007) notes, individuals who are committed to a certain behaviour are more likely to perform that behaviour because they do not want to be inconsistent. Similarly, in Kampala slums personal norm, which is very similar to commitment, was the most important predictor of cleaning intentions (Tumwebaze et al. 2014). The result of commitment being a predictor of cleaning behaviour is also in line with research in Ethiopia and Bangladesh where commitment was found to be an important predictor of choosing a safe water option (Huber & Mosler 2013; Inauen et al. 2013b).

Satisfaction with the cleanliness of the latrine was a strong predictor of habitual cleaning behaviour. However, as our study is only cross-sectional, causalities were unclear. It seems most plausible that people who report a higher level of habitual cleaning behaviour are more satisfied with the cleanliness of their latrine. Yet, especially in the longer term, the opposite also seems to hold. For instance, satisfaction was found to be a fundamental predictor of whether change in health behaviour was maintained (see Baldwin et al. (2006) for smoking cessation or Finch et al. (2005) for weight loss). There could be a positive feedback loop between satisfaction with the cleanliness of the latrine and habitual cleaning behaviour. In sanitation research, the importance of satisfaction has been stressed in the context of decision-making towards improving sanitary situations (Tumwebaze et al. 2013; Van Minh et al. 2013).

The last important predictor of habitual cleaning behaviour was self-efficacy. As stated by Bandura (2010), self-efficacy is an important determinant of behaviour. Similar to our results, self-efficacy was positively correlated with hand-washing behaviour in Haiti and the choice of a safe water option in Bangladesh (Mosler et al. 2010; Contzen & Mosler 2013).

The risk factors were irrelevant, only the perceived vulnerability of children had a small influence on habitual cleaning behaviour. So the individual understanding or awareness of health risks, in this case diarrhoea, had no impact on behaviour. This is in line with various studies on health behaviour in developing countries (Huber et al. 2012; Contzen & Mosler 2013; Inauen et al. 2013a; Tamas et al. 2013).

Socio-economic variables could explain only very few of the differences in habitual cleaning behaviour: there was a very weak influence of recalling having been exposed to sensitization and of one of the two proxy measures for household wealth. In addition, the education level had no influence, which stands in contradiction to a study

conducted in Ghana where education was the most important factor for good childcare practices (Armar-Klemesu et al. 2000).

It should be noted that causality statements could not be made in connection with this study because it was only cross-sectional. Longitudinal data are needed to show whether the predictors causally influenced latrine cleanliness and habitual cleaning behaviour over time.

Implication for practice and conclusion

Gaining knowledge of specific situations and circumstances in relation to sanitation is essential for practitioners. There was no need to make interventions to prevent open defecation by adults in the three Burundian provinces of the study, whereas open defecation by children was still frequent. The promotion of potties, as proposed by Curtis et al. (2011), would be a solution. Further, latrine standards and their overall cleanliness should be tackled. Habitual cleaning behaviour best explained latrine cleanliness. Moreover, certain structural factors, such as the existence of a door and lock, the height of the superstructure, the quality of the material of the superstructure and the existence of a slab, also proved to be important. Higher latrine standards seem to have positively influenced cleanliness. However, as already noted, the data is correlative and not causal. The core predictors of habitual cleaning behaviour were commitment, satisfaction with cleanliness and self-efficacy. Interventions should therefore aim at these factors rather than at risk factors, which had no influence. In a public commitment intervention, participants would pledge to clean regularly; additionally, a highly visible sign of commitment, such as a flag for their roof, could be given to them. Emphasising satisfaction regarding latrine cleanliness can be very useful when creating persuasive messages for multimedia campaigns. To improve self-efficacy, guided practice interventions can be conducted and participants can be encouraged to visit and help each other to instil social help.

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