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The impact of gender and physical environment on the handwashing behaviour of university students in Ghana

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Abstract

OBJECTIVES To establish levels of handwashing after defecation among students at the University of Cape Coast in Ghana, and to test hypotheses that gender and washroom environment affect handwashing behaviour.

METHODS Data on students' handwashing behaviour after defecation were collected by structured observations in washrooms. Eight hundred and six observations were made (360 female students and 446 males) in 56 washrooms over 496 observation periods. Observers recorded gender, duration of handwashing, use of soap, and physical characteristics of the washroom (cleanliness, availability of soap, tap flow and presence of handwashing posters).

RESULTS Fewer than half the students observed washed their hands or bathed after defecation. Of these, only two-thirds washed both hands and a minority (20%) used soap; only 16 students (all men) washed their hands for the recommended 15 s or longer. Female students were more likely to wash their hands at all, and were more likely to wash both hands, than males. Cleanliness of the washroom was strongly associated with improved handwashing behaviour for both women and men, as was tap flow quality for female students.

CONCLUSIONS Handwashing behaviour is generally poor among UCC students, mirroring results from North American Universities. The findings underline the plasticity of handwashing behaviour among this population, and highlight the need for ensuring that the physical environment in washrooms on university campuses is conducive to handwashing.

keywords handwashing, gender, environmental factors, behaviour, observational study, Ghana

Introduction

The promotion of safe hygiene, of which handwashing is a key component, is now widely recognised to be one of the most cost-effective means of preventing infectious disease (Curtis 2003; Curtis & Cairncross 2003; Jamieson *et al.* 2006; Curtis *et al.* 2011a). Handwashing with soap (HWWS) reduces the incidence of diarrhoeal disease among both children and adults (Curtis & Cairncross 2003; Lorna *et al.* 2005; Luby *et al.* 2005), and is protective against respiratory infections including pneumonia (Luby *et al.* 2005) and H1N1 influenza (Talaat *et al.* 2011). Recommendations for minimum duration of HWWS range from 15 s (UK National Health Service, n.d.) to 20 s (Global Handwashing Day 2009).

However, HWWS promotion remains a serious public health challenge. Based on a review of 13 observational studies in low-income countries, Curtis *et al.* (2009) reported an average rate of HWWS after defecation of just 17%. Rates of HWWS in Ghana appear to be particularly low: Scott *et al.* (2007) reported national survey data indicating that only 4% of mothers washed their hands with soap after defecation. Understanding motivating and constraining factors for HWWS is thus an important area of public health research. Curtis *et al.* (2009) identified three kinds of psychological influences on handwashing behaviour: *habit* (learned, automatic behaviour triggered by a particular cue), *motivation* (including feelings of disgust, status, comfort and fear) and *planning* (longer term goals such as family health). Accordingly, Curtis *et al.* (2009) proposed interventions aimed at changing habits (cuing HWWS with handwashing notices, or locating handwashing facilities within sight of toilets) and motivations, for example, exploiting the 'disgust' motivation – an approach which has been shown to be effective in a recent Australian study (Porzig-Drummond *et al.* 2009; Curtis *et al.* 2011b). Psychological influences may be subject to wider enabling or constraining factors, including the

physical environment (proximity of handwashing facilities, availability of soap) socio-cultural factors (local beliefs, traditions and norms) and time constraints (Curtis *et al.* 2009). In particular, lack or shortage of soap and water after toileting can be a serious constraint on HWWS in poorer households in low-income countries (Luby *et al.* 2009a, 2010; Schmidt *et al.* 2009; Aunger *et al.* 2010; Pickering *et al.* 2010).

Several recent studies in North America have observed handwashing behaviour in universities, where effective HWWS has been shown to lower the incidence of upper respiratory tract infections and reduce illness-related absenteeism by almost 50% (Moe *et al.* 2001; Bliss *et al.* 2002; White *et al.* 2003, 2005). However, despite generally high levels of knowledge, North American students' handwashing practices remain poor. Only 17% of students in a Canadian university complied with handwashing recommendations during a norovirus outbreak (Surgeoner *et al.* 2009), and low rates of effective HWWS after toilet use have also been observed in US universities (Dankiewicz & Dundes 2003; Monk-Turner *et al.* 2005; Anderson *et al.* 2008). Female students in North America consistently wash their hands more often and more effectively than male students (Edwards *et al.* 2002; Monk-Turner *et al.* 2005; Anderson *et al.* 2008; Thumma *et al.* 2008). Research in other settings has also indicated that men and women might respond to different psychological cues to handwash (Judah *et al.* 2009). The presence of hand sanitiser gel and handwashing posters in university washrooms may be associated with improved hand hygiene practices (White 2003, 2005), but this has not been demonstrated consistently (Anderson *et al.* 2008).

To our knowledge, no research to date has looked at handwashing among university students in low-income countries. Understandably, perhaps, research in the developing world has focused on the highest risk groups: young children and their care-givers, mostly in poor/squatter communities. University students, as a relatively privileged group, have been ignored. However, apart from the potential consequences for student and staff wellbeing, reducing illness-related absenteeism in universities, which receive large amounts of public funding, should also be an important development goal.

This paper reports on an observational study of handwashing after defecation at the University of Cape Coast (UCC) in southern Ghana. In addition to establishing overall levels of handwashing (with and without soap) among the university students, the study addresses several related hypotheses generated from the North American studies: first, that female students wash their hands more often and more effectively (using soap, longer duration) after defecation than males; and second, that the physical environment affects handwashing behaviour. Specifically, we predict that effective HWWS will be associated with: (a) availability of soap, (b) degree of water availability (tap flow), (c) cleanliness and appearance of handwashing facilities, and (d) presence of handwashing posters.

Methods

Data on students' hand washing behaviour were collected through structured observation; a technique widely recognised to provide a more accurate measure of actual handwashing than self-report or other techniques (Dankiewicz & Dundes 2003; Biran *et al.* 2008). Three female and three male research assistants made observations in student toilet/washroom facilities around UCC campus in January–April 2010.

Observers stood in the washroom, as unobtrusively as possible. A structured observation checklist was used to record each student's handwashing behaviour after defecation: whether or not (both) hands were washed, use of soap, and duration of handwashing (using a wristwatch). Observations were restricted to students who had defecated (in Ghana, this is indicated by shutting/locking the toilet door, which is left ajar when urinating). Key information about each washroom and washbasin was also recorded along with each individual observation: overall cleanliness, availability of running water and soap, and the presence of handwashing notices. In several washrooms, taps were not flowing at all, thereby effectively prohibiting handwashing; these washrooms were excluded from the study.[1]

Observations were conducted in ten locations across the campus: four student halls of residence, and six faculty buildings. In each location, multiple student washrooms (2–12) were observed at different times of day. In total, 806 observations of individual handwashing behaviour after defecation were made (446 men and 360 women, aged mostly in their early 20s according to observers' estimates), in 56 washrooms over 496 discrete observation periods (i.e. observations carried out in one washroom on one occasion[2]) (Table 1). Just over half the observation periods (266) were in the morning, 114 were in the afternoon and 116 in the evening. All washrooms observed were single sex (23 women's washrooms; 33 men's).

[1]The number of washrooms excluded on this basis was not recorded. However, it is quite a common occurrence for taps not to be working when water tanks have not been filled. (Like most public institutions in Ghana, UCC relies on its own water tanks, rather than mains supplies.)

[2]When washroom 'conditions' change, a new 'observation period' was deemed to have started.

Table 1 Handwashing observations by location

Location	Number of washrooms	Number of washroom-observation periods	Number of individuals observed		
			Men	Women	All
Faculty of Social Sciences	3	25	18	20	38
Faculty of Arts	2	35	30	14	44
New Examination Centre	2	16	3	25	28
Large Lecture Theatre	2	36	17	60	77
Cafe Roof Top	2	19	22	1	23
Faculty of Science	3	16	24	2	26
Adehye Hall	11	53	0	143	143
Oguaa Hall	9	64	20	95	115
Valco Hall	12	114	177	0	177
Casford Hall	10	118	135	0	135
Total	56	496	446	360	806

Observers received training as follows: each observer was briefed about the purpose of the study and how to complete the checklists; each then conducted a trial set of observations, with SM or KH conducting observations in parallel, which were then compared and discussed in a debriefing session. Observation data were entered into SPSS and were cross-checked against original checklists by the first author. Ethical approval for the study was given by UCC.

The method has three potential weaknesses. Although the observers took care to be unobtrusive, there is a risk of reactivity and thus an over-estimate of handwashing prevalence (Edwards *et al.* 2002; Dankiewicz & Dundes 2003; Ram 2010). Second, because observations were conducted in multiple locations, it is possible that some students were counted twice. However, the large number of students at UCC (15 789) in comparison with the sample size for this study (n = 806), makes double counting relatively unlikely for more than a small proportion of the sample. Third, the evaluation of the cleanliness of washroom facilities and tap flow involved subjective judgments by observers. To mitigate this, two observers were asked to make independent assessments in a proportion of facilities (four per observer) and, in each case, there was agreement between observers.

Results

Washroom characteristics

The characteristics of observed washrooms by *observation period* are shown in Table 2. (It is not meaningful to present characteristics by *washroom* since cleanliness and availability of soap and water change over time.) As noted above, each 'observation period' represents one washroom observed on one occasion with all characteristics remaining constant.

Washrooms consist typically of a small number of toilet cubicles, a roughly corresponding number of washbasins plus, in halls of residence, one or two bathing cubicles, in which students take a 'bucket bath'.[3] As shown in Table 2, soap was rarely available in washrooms. In nearly half of observed cases, tap flow was poor (this excludes washrooms where observations were not undertaken because there was no running water). Although most facilities were judged by observers to be at least moderately clean, they were dirty in a sixth of cases. Very few washrooms (only 5%) had a handwashing notice on display; too few to permit analysis of the effect of notices on handwashing behaviour.

Handwashing behaviour of female and male UCC students

Only 275 (34%) students washed their hands in a washbasin after leaving the toilet. 101 (13%) went straight to take a (bucket) bath. The remaining 430 (53%) neither washed their hands nor took a bath. A higher proportion of female students than male students washed their hands (Table 3). Since it was not possible to observe the washing behaviour of students who bathed, and because their motivations may have been different, these 101 cases are excluded from subsequent analysis.

[3]The individual washes the full body using a bucket of water, usually with soap and a cloth.

Table 2 Characteristics of observed washrooms in the University of Cape Coast (each data-point represents one washroom during one discrete observation period)

Characteristics	Frequency	Percent
Availability of soap		
Yes – liquid	52	10
Yes – solid	19	4
No	425	86
Availability of water		
Good tap flow	259	52
Poor tap flow	237	48
Cleanliness of handwash basins		
Clean	85	17
Moderate	329	66
Dirty	82	17
Display of handwashing notice		
Yes	25	5
No	471	95
Total	496	100

Table 3 Handwashing of UCC students after defecation by gender

	Washed hands: number (%)		
Gender	Yes	No	Bathed
Male (n = 446)	116 (26%)	292 (66%)	38 (9%)
Female (n = 360)	159 (42%)	138 (38%)	63 (18%)
Total (n = 806)	275 (34%)	430 (53%)	101 (13%)

Of the 275 of students who washed their hands after defecation (henceforth 'handwashers'), only 55 (20%) used soap. As reported below, soap was not available in many of the washrooms. In line with predictions, a higher proportion of female handwashers used soap than males (Table 4).

More than a third (37%) of handwashers only washed one hand. Far more females than males washed *both* their hands (Table 4). Those not using soap were far more likely only to wash one hand only (97/220) than those using soap (6/55).

Table 4 Handwashing practices of female and male UCC students *who washed their hands after defecation* (n = 275)

		Female students (n = 159)	Male students (n = 116)	All students (n = 275)
Use of soap		46 (29%)	9 (8%)	55 (20%)
Washed *both* hands*		133 (84%)	39 (34%)	172 (63%)
Duration of handwashing*	<5 s	87 (55%)	71 (61%)	158 (58%)
	5–14 s	72 (45%)	29 (25%)	101 (37%)
	15+ s	0	16 (14%)	16 (6%)

*With or without soap.

Very few students washed their hands for long enough to meet current recommendations. Most washed their hands for less than 5 s. Only 16 altogether washed their hands for 15 s or more; in contrast with predictions, all of these were male (Table 4). All 16 washed their faces at the same time.

In summary, very few UCC students wash their hands after defecation in a way that meets current recommendations. There were substantial gender differences in handwashing behaviour. Only six of the 806 students observed washed their hands 'correctly' (washing both hands, with soap, for at least 15 s).

Impact of gender and washroom environment on handwashing behaviour

It was hypothesised that both gender and washroom environment would affect handwashing behaviour. Individual-level descriptive statistics of handwashing (at all) are shown for men and women by washroom characteristics (tap flow, soap availability and cleanliness) in Table 5. In most cases, the direction of the effects are in line with hypotheses: for example, nearly 70% of students in 'clean' facilities washed their hands, compared with 36% of those in moderately clean facilities and just 13% of those in dirty washrooms; and 45% of students encountering good tap-flow washed their hands compared with 31% of those faced with poor tap-flow.

As noted above, very few students washed their hands with soap: only 9 men and 46 women altogether. Poor soap availability was clearly a major constraining factor here (only three students brought their own soap where none was provided). We therefore prefer to use washing both hands as a proxy for 'good' handwashing behaviour (more than a token gesture). Again, the descriptive statistics indicate that both gender and washroom environment might be associated with washing both hands (Table 5).

However, washroom characteristics are clearly not independent of one another. 81% of 'very clean' facilities had 'good' tap flow, compared with 51% of 'moderately clean' and 28% of 'dirty' facilities ($p(\chi^2) < 0.0005$). However, there was no observed relationship between cleanliness and soap availability. Gender and washroom characteristics were also related: 35% of the women's washrooms observed (by observation period) were judged to be 'very clean', compared with only 8% for men's washrooms ($p(\chi^2) < 0.0005$). Soap was also more likely to be available in women's washrooms (35%) than men's (4%) ($p(\chi^2) < 0.0005$), although there was no observed

Table 5 Handwashing and handwashing with soap after defecation among female and male UCC students* by washroom characteristics: descriptive statistics

		% of students who washed hands *at all* after defecation			% of students who *washed both hands* after defecation		
Washroom characteristic		Females (n = 297)	Males (n = 408)	All (n = 705)	Females (n = 297)	Males (n = 408)	All (n = 705)
Tap flow	Good	63%	32%	45%	54%	12%	30%
	Poor	41%	23%	31%	32%	6%	17%
Soap availability	Soap	46%	69%	50%	42%	54%	43%
	No soap	58%	27%	38%	47%	8%	20%
Cleanliness appearance	Clean	69%	67%	69%	57%	30%	51%
	Moderate	52%	28%	36%	46%	10%	21%
	Dirty	15%	11%	13%	8%	0	3%
All		54%	28%	39%	45%	10%	24%

*Excludes those taking a bath immediately.

relationship between gender and tap flow. For this reason, multiple logistic regression analysis is used to test the hypotheses relating handwashing behaviour to gender and washroom environment.

Because the data are clustered by washroom and washroom period, we employ the Alternating Logistic Regression (ALR: Carey *et al.* 1993) to obtain robust standard errors for modelling handwashing behaviours and to estimate intra-washroom association for handwashing behaviours among the students. Unfortunately, the ALR could not be used for modelling washing both hands due to the relatively small numbers of observations per washroom period. We therefore employed the Generalised Estimating Equations (GEE) (Liang & Zeger 1986) for modelling 'washing both hands' accounting for dependency in the data when there was more than one observation per washroom period. The disadvantage of GEE is that no inference could be made about intra-washroom associations for washing both hands. Table 6 presents the analysis clustered by washroom-period (rather than washroom, since washroom characteristics changed over time).[4]

Most of the original hypotheses appear to be supported by this analysis. Gender is a highly significant predictor of handwashing behaviour: women are more likely to wash their hands at all, and to wash both hands, than men, controlling for washroom characteristics and clustering effects. Washroom cleanliness is a highly significant predictor of washing hands at all and washing both hands for both genders (because the subgroup data for washing both hands does not contain sufficient information to estimate the required parameters by GEE or ALR, it was not possible to analyse predictors of washing both hands for each gender separately). Good tap flow was associated with handwashing at all for both genders together, but the relationships were not statistically significant for each gender separately, or for washing both hands, when other factors were controlled for. Soap availability, on the other hand, was significantly associated with washing both hands for both genders together, but did not appear to exert a significant effect on handwashing at all, once other factors were controlled for. Finally, the association variable is worth noting, since it implies a statistically significant clustering effect by washroom period. Controlling for other variables, this would suggest that the odds of handwashing are increased when other washroom users are also washing their hands. (As noted above, the data did not permit this analysis to be performed for washing both hands.)

[4]The analysis was subsequently repeated clustering by washroom in cases where characteristics were unchanged between observation periods. The effect of this was to increase the standard errors slightly, but the relative odds and significance levels did not change.

Discussion

Like their North American counterparts, handwashing practices of students at UCC raise cause for concern. Fewer than half washed their hands or bathed after defecation. Of those (275) observed to wash their hands, only a fifth used soap, more than a third (37%) washed one hand only and only 16 (all men) washed their hands for at least 15 s. Altogether, only six students of the 806 observed washed their hands in a manner that meets current recommendations (washing both hands, with soap, for a minimum of 15 s). This has potentially important implications for health and illness-related absence.

As in North America, students' handwashing behaviour at UCC is strongly gendered. Females were more likely to wash their hands, and were more likely to wash *both* hands

Table 6 Multiple logistic regression analysis of handwashing behaviour by sex, washroom cleanliness, tap flow and soap availability (each column shows the log odds (B) and the standard error in brackets)

	Washing hands at all			Both hands
Independent variables	ALL	Male	Female	All
Intercept	−1.605 (0.364)	−2.358 (0.441)	−1.693 (0.572)	−0.878 (0.617)
Sex (*ref = female*)				
Male	−0.766 (0.215)[a]	NA	NA	−2.225 (0.330)[a]
Cleanliness (*ref = dirty*)				
Clean	2.315 (0.398)[a]	2.570 (0.596)[a]	2.240 (0.591)[a]	2.107 (0.754)[b]
Moderate	1.461 (0.0.335)[a]	1.462 (0.435)[b]	1.705 (0.554)[b]	2.190 (0.672)[b]
Tap flow (*ref = poor*)				
Good	0.424 (0.197)[c]	0.425 (0.257)[ns]	0.516 (0.307)[ns]	0.293 (0.356)[ns]
Soap availability (*ref = no*)				
Yes	0.137 (0.281)[ns]	0.946 (0.715)[ns]	−0.2283 (0.297)[ns]	1.349 (0.485)[b]
Association	1.735 (0.383)[a]	5.016 (0.847)[a]	0.668 (0.312)[c]	NA

[a]$P < 0.0005$.
[b]$P < 0.005$.
[c]$P < 0.05$.
[ns]$P > 0.05$.

than males. In contrast with predictions, however, the 16 who washed their hands for 15+ s were all male. Qualitative research is required to unravel the reasons behind these gender differences and to encourage better hand hygiene among male students in particular.

In line with Curtis *et al.*'s (2009) model, physical factors are important predictors of handwashing behaviour, with no clear gender differences in their effect. Washroom cleanliness was strongly associated with handwashing for both female and male students: very few (13%) of those encountering 'dirty' washbasins washed their hands after defecation, compared with more than a third (36%) of those in moderately clean facilities and more than two-thirds (69%) in very clean facilities. The regression analysis confirmed that washroom cleanliness is associated with handwashing at all *and* with washing both hands for both female and male students. Tap flow was also associated with increased likelihood of handwashing for female students, while soap availability increased the likelihood of washing both hands for both women and men. Lack of soap clearly constrains effective handwashing and is doubtless a major contributing factor to the low levels of HWWS among UCC students. Finally, there appears to be a significant clustering effect, such that handwashing behaviour is affected by the handwashing behaviour of others in the washroom at the same time.

These findings underline the plasticity of handwashing behaviour among this population. Far from being an automatic 'habit', students' handwashing behaviour is strongly influenced by the washroom environment. If facilities are clean, most students (female and male) wash their hands. Conversely, if they encounter dirty facilities, relatively few students wash their hands at all and, of those that do, many simply rinse one hand. This leads us to return to the relationship between 'disgust' and handwashing. While others have highlighted 'disgust' (of having dirty hands) as a motivation for handwashing (Curtis *et al.* 2009, 2011b; Porzig-Drummond *et al.* 2009), our work suggests that the disgust associated with encountering dirty washrooms might be an important barrier to handwashing. Despite evidence that handwashing efficacy is not significantly affected by water quality, etc., students at UCC appear reluctant to wash their hands in unhygienic facilities. Similarly with tap flow: although effective handwashing is still possible as long as some water is available, poor tap flow appeared to act as a deterrent to handwashing, independently of other factors.

Taken together, these findings highlight the need to ensure that the physical environment in washrooms on university campuses is conducive to handwashing. The clustering of handwashing behaviour suggests that a positive 'multiplier effect' might ensue: as more people wash their hands (because of improved washroom environment), others in the same washroom may feel encouraged to follow suit. Provision of soap is an obvious necessity and is widely used where available. But ensuring that facilities are kept clean may also be an important prerequisite for handwashing. Water flow is also important, and priority should be given to re-filling tanks regularly and positioning them correctly to ensure a good flow. (It should be recalled that several 'washrooms' were excluded from this study because there was *no* water

available.) An alternative is providing waterless hand sanitisers, shown to be an effective alternative to soap and water in intervention studies in schools in the West (Dyer *et al.* 2000) and in disadvantaged communities in low-income countries (Luby *et al.* 2010; Pickering *et al.* 2010); our findings suggest a potentially important role in university settings where water is constrained.

Duration of handwashing is another issue of concern. Very few students, male or female, washed their hands for 15+ s, and most washed for less than 5 s. More research is required to explore the reasons why students fail to wash their hands for long enough to remove pathogens effectively. Possible reasons are lack of awareness of the importance of extended handwashing, lack of time, or habit.

Conclusion

The handwashing behaviour of university students and its consequent impact on illness and related absenteeism is an issue of growing importance, for the students themselves and governments which fund higher education. Far from being an unconscious 'habit', handwashing practices at UCC were heavily influenced by the physical environment of washrooms, which were often dirty, with poor tap flow and no soap. As Curtis *et al.* (2009) have commented, a big push to increase schooling in the developing world has stretched the ability of schools to provide adequate hygiene facilities for pupils; we argue that the same might be true of universities. Given the increasing public health implications of this situation, it is time to address it more seriously.

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