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# Handwashing Compliance Rates and Predictors in a College Town Environment

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**HANDWASHING COMPLIANCE RATES AND PREDICTORS IN A COLLEGE TOWN ENVIRONMENT**

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**ABSTRACT**

Handwashing fights disease and infection. Many do not wash their hands when the behavior in which they engage would warrant such; most handwashing research has taken place in high traffic environments such as airports and public attraction venues and has established a persistent gender difference in handwashing compliance. This research replicates earlier work within a college town environment, extends our understanding of handwashing behaviors, notes differences in handwashing rates across establishments, and establishes several environmental and demographic predictors of handwashing compliance. The results can help increase handwashing rates at hospitality establishments and increase public health.

**Key Words:** Handwashing, observational study, college environment, infections

## **INTRODUCTION**

Many individuals take handwashing for granted and do not consider how essential handwashing is in the prevention of infections and disease. Thus they often fail to wash their hands when they engage in activity that would warrant or require handwashing. Research has established that people generally overstate the degree to which they wash their hands, that women are much more likely to wash their hands than men, and that while handwashing compliance has increased in recent years there is still much room for growth. For example, according to the CDC, failure to wash, or insufficiently washing hands, contributes to almost 50 percent of all foodborne illness outbreaks. At the same time, we do not know why people fail to wash their hands at recommended rates and in the proper fashion. This research attempted to establish predictors of handwashing that can be used to induce higher rates of handwashing compliance.

## **CURRENT HANDWASHING PRACTICES**

Recent surveys establish that U.S. adults claim that they wash their hands after using public restrooms at very high rates. In 2009, 94 percent (N=2,516) suggested they consistently wash their hands (Are Americans, 2009), while in 2010, 96 percent (N=1,006) state that they always wash their hands after using a public restroom (Survey of Handwashing Behavior, 2010). These high self-report rates are somewhat balanced by 48 percent of the 2009 sample suggesting that less than 50 percent of all adults wash their hands after using a restroom. Observational research suggests these high handwashing rates are overstated, indicating that only 85 percent wash their hands consistently (Survey of Handwashing Behavior, 2010).

While there is a discrepancy between the self-reported handwashing data and that which was obtained observationally, it is important to note that handwashing rates have trended upwards in recent years. The American Society for Microbiology and the American Cleaning Institute have studied handwashing practices since 1996. In recent years they report on handwashing in restrooms at public attraction in five cities across the United States. The restroom locations include "Turner Field in Atlanta, the Museum of Science and Industry and Shedd Aquarium in Chicago, Penn Station and Grand Central Terminal in New York, and the Ferry Terminal Farmers Market in San Francisco" (Survey of Handwashing Behavior, 2010). All locations are frequented on a high volume daily, which include a variety of random participants. At the composite level, the 2010 data (N=6,028) establishes that 85 percent of the observed adults wash their hands after using a public restroom, an increase from 77 percent in 2007 (N=6,076) which was somewhat lower than the 2005 rate of 83 percent (N=6,336). With the exception of the Shedd aquarium, which has seen a 3 percent dip in handwashing rates since 2005, all the venues saw a slight upward trend in observed handwashing rates (Public Handwashing, 2010). In 2003, handwashing rates were also observed at airports across 6 North American airports, averaging 74 percent (N=4,046). The highest handwashing rates were obtained in Toronto with 95 percent while Chicago had the lowest rate at 62 percent (Another U.S. Airport Travel Hazard, 2003).

The research is very consistent in finding a gender bias in handwashing practices. Women wash their hands more frequently than men. In the 2003 (Another U.S. Airport Travel Hazard) study it was observed that 83 percent of women washed their hands after using the restroom whereas only 74 percent of the men did so. In the multi-year study across public attractions (Survey of Handwashing Behavior, 2010) women consistently out-wash men across all years and venues. The average observed handwashing rates for women were 93 percent in 2010, 88 percent in 2007, and 90 percent in 2005. The equivalent rates for men were 77 percent, 66 percent, and 75 percent, respectively. Guinan, McGuckin-Guinan, and Sevareid (1997) report on a study of 120 secondary school students, finding that 58 percent of female students and 48 percent of male students washed their hands after using the restroom; 28 percent of the female students and 8 percent of the male students used soap. In a study in a university campus public restroom (Johnson, Sholosky, Gabello, Ragni, & Ogonosky, 2003), 61 percent of women and 37 percent of men (N=175) were observed washing their hands, while the handwashing rate climbed to 97 percent for women and fell to 35 percent of men when a sign was introduced to encourage handwashing. Similarly, in a British study of highway service station restrooms over 32 days (N=198,000) observing entry and soap used with electronic sensors, it was found that 65 percent of women and 32 percent of men washed their hands, but that the handwashing rate increased to as much as 71 percent for women and 35 percent for men when messages designed to encourage

handwashing were displayed using electronic dot matrix screens (Judah, Auger, Schmidt, Michie, Granger, & Curtis, 2009).

Although the emphasis of research included centers around the handwashing practices of individuals in a public restroom setting, research has also taken place in other environments. Thumma, Aiello, and Foxman (2008) studied the handwashing practices of university students living in a dormitory and report that women wash their hands after urinating 69 percent of the time and after bowel movements 84 percent of the time, whereas the corresponding figures for males were 43 percent and 78 percent. In a study of restaurant food workers, Green et al. (2006) report that the food handlers only washed their hands 32 percent of the time when their behaviors made such handwashing required. Guzewich and Ross (1999) reviewed the literature on food-borne disease outbreaks from 1975 to 1998 and identified 81 foodborne disease outbreaks involving 14,712 people; 93 percent of these foodborne outbreaks involved food workers who were infected and the majority of the pathogens were transmitted to the food by the hands of food workers. Hayes (2002) observed 80 women in a bar bathroom and found that only 40 percent washed their hands; when the researcher engaged the subject and modeled handwashing, the handwashing rate increased to 56 percent, while it was only at 27 percent when such modeling and engagement did not take place. Hayes (2002) also reports that the women were less likely to wash their hands later in the night than earlier in the evening ( $r = -.44$ ,  $p < .01$ ).

In sum, it is evident from the research reviewed that there is room for improvement in handwashing practices, and additional research is needed to further understand how and why handwashing rates differ and if such rates can be influenced by environmental factors within the restroom. For example, we know that gender is associated with marked differences in handwashing rates. Is it possible that other demographic variables such as age could also be associated with handwashing rates? Furthermore, there is evidence that environmental variables, such as signage, influences handwashing rates. Is it possible that other environmental variables, such as sink conditions, type of faucet, and the type and availability of drying mechanisms impact handwashing rates? Finally, research has established different handwashing rates at different types of establishments. Does the handwashing rate at foodservice establishments differ from that of other establishments?

## **METHODS**

### **Participants and procedures**

Direct and unobtrusive observations of handwashing behaviors and restroom environments were conducted in restrooms, located in a college town environment by seven research assistants (4 females; 3 males). Observers were instructed to disguise their observation of handwashing behaviors and to be as unobtrusive as possible. To ensure accurate measurement and promote coding consistency of handwashing behaviors, each of the observers met researchers individually as well as attended training meetings as a group. The training meetings provided them with the following information and explanations: 1) the main purposes of this observation study, 2) proper handwashing steps, accompanied by graphical pictures from a ServSafe textbook, 3) the coding schemes and categories, and 4) instructions for keeping subjects unaware of being observed.

All observations were recorded according to the coding form. The coding form consists of the subject ID, date, subject's age group, observation time, gender, handwashing behaviors, the type and availability of drying mechanisms (not available, hot air, paper towel, or both), types of establishments, type of faucet (standard faucet vs. motion detection), and the cleanliness of sink conditions. To reduce potential observation errors, each coding form includes explanations of all coding categories. Due to the unobtrusive nature of our observations, the subject's age group was estimated using the trained observers' subjective evaluations. The observation time was recorded on the coding form, and then three groups (morning, afternoon, and evening) were formed for the purpose of analyses. Age group initially had three categories such as younger than college, college group and older than college groups, but was divided into two groups (college groups and younger vs. older than college groups) for further statistical analyses. The cleanliness of sink conditions had three categories including dirty, reasonable, and clean, which also had to rely on subjective evaluation of observers. Washing behaviors were recorded into three categories: no washing (leaving the restroom without washing or rinsing their hands), attempted handwashing (wetting hands with soap), and proper handwashing (washing hands with soap). Observers also discreetly measured a total length of time in terms of the number of seconds subjects' hands were placed under running water during washing, lathering,

and rinsing. The presence of a handwashing sign was added to the coding form later from the follow-up research meeting with observers.

**Statistical Analysis**

Descriptive data were compiled, using the SPSS program to calculate means and standard deviations for continuous variables and frequencies and percentages for categorical data. The data were further statistically analyzed using a Chi-square analysis and an analysis of variance (ANOVA). More specifically, Chi-square analysis was used to identify statistically significant differences in subjects’ demographics, environmental variables in the restrooms (such as gender, age, time of observation, establishment types, faucet, sink condition, on-campus vs. off-campus setting, presence of hand-washing sign), and among handwashing behaviors (no washing, attempted washing, and proper washing). ANOVA was used to establish mean differences in the length of time hands were placed under running water across the above specified variables.

**FINDINGS**

Of the 1,279 subjects observed, more than 70 percent of observation took place on-campus. Approximately 30 percent of observations were conducted in foodservice establishments. Of all subjects, approximately 70% were women. Overall, approximately 64% of subjects engaged in proper handwashing behavior, indicating handwashing with soap and using a paper towel or hot air to dry their hands. About 24 percent of subjects attempted to wash their hands (wetting hands without soap) while a total of 11 percent of subjects did not wash their hands at all after using the bathroom. Nearly all bathrooms had a mechanism of drying hands, except two percent of locations. Seventy-five (75) percent of locations provided single-use paper while 17 percent of the locations provided both paper and hot air drying. Approximately 54% of bathrooms included in the study provided a sign encouraging handwashing. Seventy-seven (77) percent of bathrooms had standard faucet while 23 percent had motion detection faucets. While the CDC recommends that people should rub their hands for 15 to 20 seconds, before rinsing thoroughly, the averaged length of handwashing time observed was 6.73 (SD = 4.64) seconds. In fact, our measure included the length of time placed under running water while subjects were washing, rubbing, and rinsing their hands.

**Results from Chi-square analysis**

The Chi-square analysis revealed statistically significant differences in time of observations, gender, type of establishments, availability of drying mechanisms, sink condition, and setting for the subjects’ handwashing behaviors, as shown in Table 1. For example, subjects who were observed during evening (15.7%) washed their hands significantly less than those observed during mornings (9.9%). The gender difference was confirmed in the study, with women engaging in *proper* handwashing behavior significantly more (72.1%) than men (49.1%). About 15 percent (15.2%) of the women and 9.2% of the men did not wash their hands at all, while 18.7% of the women and 35.7% of the men attempted to wash their hands, i.e., they wet their hands without adding soap. Proper handwashing behaviors were observed significantly more in restrooms providing paper towels for drying (64.1%) than in restrooms providing hot air drying (53.3%). Subjects engaged in proper handwashing behavior significantly more in public bathrooms (69.2%) than in bathrooms located in foodservice establishments (55.7%). There were no statistically significant differences in handwashing behavior in terms of age group, type of faucet, and presence of handwashing sign for the subjects’ handwashing behaviors.

**Table 1**  
**Chi-square test: Comparison of hand washing behavior by demographics and restroom settings (n=1,279)**

Independent variables	Not washing	Wet hands without soap	Washing with soap	Total	$\chi^2$
	11% (n=141)	23.8% (n=305)	65.1% (n=833)	100% (n=1,279)	
	% (n)	% (n)	% (n)	% (n)	
Time					15.0**
Morning	9.9 (29)	20.5 (60)	69.6 (204)	22.9 (293)	
Afternoon	9.2 (60)	24.1 (158)	66.7 (437)	51.2(655)	
Evening/night	15.7 (52)	26.3 (87)	58.0 (192)	25.9 (331)	4

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Gender					63.9**
Male	15.2 (59)	35.7 (139)	49.1 (191)	30.4 (389)	
Female	9.2 (82)	18.7 (166)	72.1 (642)	69.6 (890)	
Age					1.5
College age or younger	11.5 (102)	23.0 (204)	65.5 (580)	69.3 (886)	
Adults	9.9 (39)	25.8 (101)	64.3 (252)	30.7 (392)	
Establishment types					22.0**
Food service	13.0 (102)	31.3 (204)	55.7 (580)	30.0 (384)	
Public	10.2 (91)	20.7 (185)	69.2 (619)	70.0 (895)	
Dry					80.2**
Not available	65.2 (15)	21.7 (5)	13.1 (3)	1.8 (23)	
Only paper	10.7 (14)	23.8 (25)	64.1 (46)	74.5 (953)	
Only air dryer	36.5 (92)	10.2 (217)	53.3 (644)	6.6 (85)	
Both paper & air dryer	9.2 (20)	23.2 (58)	67.6 (140)	17.0 (218)	
Faucet					1.4
Standard faucet	11.0 (108)	23.1 (227)	65.9 (648)	76.9 (983)	
Motion detection	11.1 (33)	26.4 (78)	62.5 (185)	23.1 (296)	
Sink condition					23.0**
Dirty	20.4 (20)	26.5 (26)	53.1 (52)	7.7 (98)	
Ok	11.4 (59)	27.7 (144)	60.9 (316)	40.6 (519)	
Clean	9.4 (62)	20.3 (134)	70.3 (465)	51.7 (661)	
Setting					13.4**
On-campus	10.7 (97)	21.2 (192)	68.1 (616)	70.8 (905)	
Off-campus	11.8 (44)	30.2 (113)	58.0 (217)	29.2 (374)	
Sign					2.3
Handwashing sign	7.6 (131)	23.1 (188)	69.3 (358)	54.4 (677)	
No sign	10.4 (126)	19.8 (161)	69.8 (315)	45.6 (602)	

Note: \*\* p<.01

### Results from ANOVA

The results of an analysis of variance (ANOVA) demonstrated statistically significant differences in the length of washing time in terms of the time of observation, gender, availability of drying mechanism, type of faucet, sink condition, type of establishments, and presence of handwashing sign. Pairwise analysis of the means revealed that subjects observed during evening spent significantly less time washing their hands ( $M = 6.4$  seconds), compared to those observed during mornings ( $M = 7.76$  seconds) and afternoons ( $M = 7.44$  seconds). In particular, while the absence or presence of the sign in the bathroom was not associated with handwashing behaviors from the Chi-square analysis, the findings of ANOVA indicated that the length of washing time was statistically associated with presence of sign ( $M=8.47$  versus  $M=7.13$ ). In terms of the sink condition, subjects significantly spent more time washing their hands when the sink condition was clean ( $M= 7.47$  seconds), compared when the sink appeared dirty ( $M = 5.84$ ) and reasonable ( $M= 6.89$ ). A handwashing sign in the bathroom also increased handwashing compliance. The

average washing time for men and women were 6.4 and 7.42 seconds respectively, showing that women spent significantly more time washing their hands than did men. There were no statistically significant differences in age group and type of establishments for the mean differences of washing time.

**Table 2**  
**Multi-way ANOVA: Hand washing time by demographics and restroom settings (n=1,279)**

Independent variables	Hand washing time		F	$\eta^2$
	Mean (seconds)			
Time			12.14**	.019
Morning (n=293)	7.76			
Afternoon (n=655)	7.44			
Evening/night (n=331)	6.40			
Gender			11.70**	.009
Male (n=390)	6.40			
Female (n=889)	7.42			
Age			1.25	.002
Young adults (n=886)	7.20			
Adults (n=393)	6.87			
Establishment types			.40	.000
Food service (n=385)	6.97			
Public (n=894)	7.16			
Dry			18.56**	.042
Not available (n=23)	2.87			
Only paper (n=952)	6.83			
Only air dryer (n=85)	6.58			
Both (n=218)	8.99			
Faucet			60.74**	.045
Standard faucet (n=982)	6.53			
Motion detection (n=297)	9.01			
Sink condition			5.67**	.009
Dirty (n=99)	5.84			
Ok (n=520)	6.89			
Clean (n=660)	7.47			
Setting			25.40**	.020
On-campus (n=905)	6.67			
Off-campus (n=373)	8.17			
Sign			11.09**	.016
Handwashing sign (n=677)	8.47			
No sign (n=602)	7.13			

Note: \*\* p<.01

## DISCUSSIONS

The observations undertaken for this study provided detailed information about how long and in what environments different groups engaged in handwashing behaviors. To our knowledge, this study was the first study to focus on hand washing behaviors and the length of time spent washing while incorporating environmental factors and the duration of wash time. According to the findings, the observed hand washing behaviors and length of time washing hands do relate differently to different factors. In general, the findings support recent studies suggesting men are less prone to wash their hands than women. Most interestingly, however, the percentage that made an attempt at washing their hand, but did so without soap was significantly higher for men (35.7%) than for women (18.7%). Although this current study did not find that the presence of sign made a difference in adopting a *proper* handwashing behavior, it did establish that the length of washing time increased when there was a handwashing sign in the restroom.

The findings of this study showed that it is important for establishments to maintain clean sink conditions, since the clean sink condition in bathroom promoted proper hand washing as well as increased the length of time washing hands. When sinks are dirty, some people choose not to wash their hands, perhaps even when they know they should wash their hands. It was also interesting to find that proper handwashing behaviors were more prevalent on-campus (68.1%), compared to those observed off-campus (58%). An interactive effect between setting (on-campus vs. off-campus) and type of establishments (foodservice establishments vs. public bathrooms) may need to be explored further, since the finding of this study suggested that subjects engaged in proper handwashing behavior significantly more in public bathrooms than in bathrooms located in foodservice establishments. Considering the effect that time of day had on handwashing behavior, this study showed the subjects increasingly chose not to wash their hands as the evening progressed. Additionally, in terms of the length of time washing hands, subjects observed during evenings spent significantly less time washing their hands compared to those observed during mornings and afternoons

In sum, it appears that higher handwashing rates could be induced by monitoring sink conditions and keeping the sinks clean, by the provision of a paper drying medium alone or in addition to hot-air dry mechanisms, and by including signage that encourages proper handwashing behaviors.

## Limitations and Future Research

The data from this study are informative, but it should be noted that they are not representative of the entire population, since observations took place in one college town environment. While we made attempts to be as unobtrusive as possible to overcome potential observation errors, several previous studies have shown that the visible presence of another person in a restroom increases hand washing rates overall (Drankiewicz & Dundes, 2003; Edwards et al., 2002; Nalbone, Lee, Suroviak, & Lannon, 2005) and this may have led to handwashing rates that are higher than they would otherwise be. While we attempted to investigate the role that a sign encouraging handwashing would have on handwashing behavior, we did not ask participants whether they recalled seeing the handwashing sign nor did we track message content or form. This study did not explicitly seek effective interventions to increase handwashing behaviors. Such research is needed.

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