

Microbial contamination of hands with or without the use of electric toilet seats with water spray (bidets) after defecation

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Abstract

Objective: Electric toilet seats with water spray (bidets) are gaining in popularity all over the world. However, the extent of reduction in microbial contamination of hands with the use of bidets after defecation is not known. **Methods:** The microbe contamination of hands with and without the use of bidets after defecation with the participation of 32 nursing students was studied. Double gloves were worn on the dominant hand and four layers of toilet paper were used to wipe the buttocks after defecation and the microbe contamination of the second glove (outer glove) of the double gloves was examined. The volunteers were free to select flow volume, wash time of the bidet and even the type of bidet for use was left up to the individual. **Results:** Without the use of a bidet, the average value \pm standard deviation of the number of microbe attached to the gloves was $39,449.3 \pm 77,768.3$ colony forming units (cfu) / glove; however, it was $4,146.9 \pm 11,427.7$ cfu / glove when a bidet was used. The number of microbe adhering to gloves was significantly reduced when a bidet was used ($p < 0.0001$, Wilcoxon signed-rank test). **Conclusion: It was discovered that reduction of microbe contamination of hands was possible with the use of bidets after defecation.**

INTRODUCTION

Electric toilet seats with water spray (bidets) were developed in Japan and the use of bidets is spreading throughout the world. However, it has not been made clear on whether the use of bidets has any effect on the hygiene of hands. Studies on the effectiveness of bidets in the prevention of microbial contamination of hand after defecation have been done only with *in vitro* experiments.¹ Therefore, this experiment examined the microbial contamination of the hands of 32 volunteers after defecation with and without the use of bidets.

METHODS

The number of microbe adhering to gloves after defecation of 32 nursing students (17 males and 15 females) with and without the use of bidets was examined. Double gloves (Plastic Glove No. 2500 Kyowa Ltd., Osaka, Japan) were worn and the number of microbe adhering to the gloves after wiping with four layers of toilet paper was examined. Four sheets of toilet paper were used because a survey conducted by the Japan Sanitary Equipment Industry Association with 1,748 subjects on the number of sheets and the length of toilet paper for wiping revealed that 4 sheets of toilet paper was the most frequently used amount.² The outer gloves of the double gloved hands that held the toilet paper were peeled and placed into bottles containing 200 mL of normal saline and were subjected to sonication at 36 kHz (Since Sonic 100, Ikemoto Scientific Technology Co., Ltd., Japan) for 5 min.^{3,4} Each sample was diluted 10-fold, 100-fold and 1000-fold in sterile saline; four aliquots (0.25 mL each) of each dilution and of an undiluted sample were plated on four trypticase soy agar (TSA). In addition, the remaining saline sample (*ca.* 200 mL) in the bottle was filtered through a 0.22micrometer membrane filter (diameter, 5 cm; Nippon Thermo Scientific, Wilmington, NC, USA), which was placed on TSA plates.⁴ These TSA were cultured aerobically at 35 for 48 hr. In the case where the undiluted inocula on TSA became less than 5 colony forming units (cfu), the cfu with the

membrane filtration technique on TSA were counted. This experiment was conducted with the participation of volunteer nursing students from the Ube Frontier University (Ube City, Yamaguchi Prefecture). Therefore, permission was obtained from the Ube Frontier University Ethics Review Committee (Title: Hands and finger contamination after defecation - comparison of use with and without warm water washing toilet seats (bidets) -, Approval date; November 8, 2017, Examination certificate management number; 17007).

RESULTS

In the pre-experiment (5 subjects), when the cfu of microorganism attached to gloves after defecation cultured aerobically with TSA and anaerobically with GAM agar were compared, all five individuals had more cfu with TSA. Therefore, in this experiment, anaerobic culture with GAM agar was not performed, and only aerobic culture with TSA was performed.

Table 1 shows the number of microbe attached to gloves after defecation with and without the use of bidets. The average \pm standard deviation of the colony forming units (cfu) attached to gloves after defecation without using a bidet was $39,449.3 \pm 77,768.3$ / glove, however, it was $4,146.9 \pm 11,427.7$ / glove when a bidet was used. The amount of microbe adhering to the glove after defecation was significantly reduced when a bidet was used ($p < 0.0001$, Wilcoxon signed-rank test) (Table 1).

DISCUSSION

We have already reported the effectiveness of bidets with *in vitro* experiments. Namely, a model of the buttocks was smeared with artificial diarrheal feces containing *Serratia marcescens*, and wiped by the participants wearing disposable gloves with 4 sheets of toilet paper after the use and non-use of bidets. Subsequently, the presence of *S. marcescens* on the surface of the gloves was quantified. After using the bidets, the mean count \pm standard deviation of *S. marcescens* was 0.067 ± 0.249 cfu/ glove, and it was $4,275 \pm 6,069$ cfu/ glove when bidets was not used. The results obtained were that the cfu of *S. marcescens* was significantly lower when the bidets were used ($p < 0.00001$) prior to wiping the artificial diarrheal feces. Although the effect of bidets in this fieldwork was not as significant as that of the previous *in vitro* experiment, the effectiveness of bidets was confirmed as in the previous *in vitro* experiment. It is estimated that microbial contamination from feces of hand after defecation has a major impact on the spread of intestinal infections such as norovirus gastroenteritis, *Clostridioides difficile* related infections, and enterohemorrhagic *Escherichia coli* infections.⁵⁻¹⁰ For example, outbreaks resulting from food handlers who are infected or subclinical infected with the norovirus and does not sufficiently wash or disinfect their hands after using the toilet, then handling food.¹¹⁻¹⁴ Accordingly, hand hygiene after defecation is of course important,¹⁵ but it is also important to prevent fecal contamination of the hand after defecation as much as possible. In this experiment, the use of bidets was found to be effective in reducing microbial contamination of fingers after defecation. Although bidets were originally developed for medical use, they are presumed to be also effective in the prevention of spreading intestinal infections.

In conclusion, the use of electric toilet seats with water spray (bidets) was an effective method in reducing faces adhering to hands at the time of defecation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS CONTRIBUTIONS

SO developed the design of the study, participated in date collection, planned and performed date analysis, drafted the article. MS participated in the design of the study, participated in date collection and analysis, critically revised the article.

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Table 1. Contamination of hand after defecation with or without the use of toilet seats with water spray (bidets)*

Experiment participant no.	Colony forming units (cfu)/glove		Sex
	When bidet not used	When bidet used	
1	4.1×10^5	5.4×10^4	Male
2	1.7×10^5	664	Male
3	1.0×10^5	3.4×10^4	Male
4	8.5×10^4	2.4×10^4	Male
5	7.8×10^4	131	Male
6	7.2×10^4	115	Female
7	7.1×10^4	328	Female
8	5.6×10^4	38	Female
9	2.4×10^4	310	Male
10	2.4×10^4	720	Male
11	2.2×10^4	5	Male
12	2.1×10^4	7.2×10^3	Male
13	1.8×10^4	352	Female
14	1.7×10^4	816	Female

Experiment participant no.	Colony forming units (cfu)/glove	Colony forming units (cfu)/glove	Sex
15	1.7×10^4	4.8×10^3	Male
16	1.5×10^4	1.0×10^3	Male
17	1.4×10^4	420	Male
18	1.1×10^4	66	Male
19	1.0×10^4	134	Male
20	7.0×10^3	1.5×10^3	Female
21	5.0×10^3	848	Female
22	4.0×10^3	172	Female
23	4.0×10^3	360	Male
24	2.0×10^3	38	Male
25	2.0×10^3	15	Female
26	2.0×10^3	63	Male
27	1.0×10^3	29	Female
28	1.0×10^3	265	Female
29	320	97	Female
30	244	18	Female
31	228	124	Female
32	184	75	Female
Mean \pm standard deviation **	$39,449.3 \pm 77,768.3$	$4,146.9 \pm 11,427.7$	

* Wiped with 4 layers of toilet paper.

** $p < 0.0001$ (Wilcoxon signed-rank test)