



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



ELSEVIER

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief Report

Knowledge, attitudes, and practices around hand drying in public bathrooms during the COVID-19 pandemic in the United States



Perrine Marcenac PhD^{a,b,*}, Sunkyung Kim PhD^a, NoelleAngelique Molinari PhD^a, Margaret Person MPH^a, Rebekah Frankson MPH^{a,c}, David Berendes PhD^a, Christina McDonald MPH^c, Jonathan Yoder MPH^{a,c}, Vincent Hill PhD^a, Amanda Garcia-Williams PhD^{a,c}

^a Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, US Centers for Disease Control and Prevention (CDC), Atlanta, GA

^b Epidemic Intelligence Service, CDC, Atlanta, GA

^c CDC COVID-19 Response Team, Atlanta, GA

Key words:

Handwashing
Hand drying methods
SARS-CoV-2

A B S T R A C T

Hand drying is the critical, final step of handwashing. A cross-sectional survey of U.S. adults assessed self-reported hand drying practices in public bathrooms and found increased preference for using electric hand dryers, wiping hands on clothing, and shaking hands and decreased preference for using paper towels during the COVID-19 pandemic relative to before. Respondents expressed concerns about contacting SARS-CoV-2 when touching surfaces in public bathrooms which may be influencing self-reported drying method preference.

Published by Elsevier Inc. on behalf of Association for Professionals in Infection Control and Epidemiology, Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

BACKGROUND

Frequent handwashing with soap and water is an important nonpharmaceutical intervention promoted during the COVID-19 pandemic.¹ Because microbes transfer more easily to and from wet hands,² drying hands is critical to effective handwashing,³ yet most messaging has not focused on this important final step.⁴ We analyzed data from an Internet panel survey of U.S. adults to summarize information on knowledge, attitudes, and practices (KAP) related to hand drying in public bathrooms after handwashing, and to determine whether self-reported choice of drying method preference has changed during the COVID-19 pandemic relative to before. Results of this study could provide communicators with strategic information to identify and mitigate deficits in hand drying KAP among U.S. adults.

MATERIALS AND METHODS

On October 13–15, 2020, Porter Novelli (PN) Public Services⁵ and ENGINE Insights conducted a PN View 360 opt-in Internet panel survey among U.S. adults ≥ 18 years old ($n = 502$) via the Lucid platform.⁶ Quota sampling and statistical weighting were used to balance the sample toward representativeness of the U.S. population by gender, age, region, race/ethnicity, and education. Descriptive analyses with 95% confidence intervals (CI) were conducted in R (version 4.0.3) using the “survey” package.⁷ Unadjusted weighted logistic regressions estimated any prevalence differences for preferred hand drying methods before vs. during the pandemic. This activity was reviewed by the U.S. Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy.*

RESULTS

When asked to select their single preferred hand drying method after washing their hands in public restrooms, respondents showed

* Address correspondence to Perrine Marcenac, PhD, US Centers for Disease Control and Prevention, 1600 Clifton Rd NE, Atlanta, GA 30330.

E-mail address: pmarcenac@cdc.gov (P. Marcenac).

Conflicts of interest: The authors declare there are no conflicts of interest.

* 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

Table 1

Preference for hand drying methods after washing hands in a public bathroom before and during the COVID-19 pandemic, PN View 360 Survey, October 2020

Hand drying method	Before the COVID-19 pandemic Weighted % (95% CI)	During the COVID-19 pandemic Weighted % (95% CI)	P-value*
Electric hand dryer	31.4 (26.7–36.1)	36.9 (32.0–41.8)	<0.01
Paper towels	56.5 (51.5–61.4)	44.5 (39.6–49.4)	<0.001
Wiping hands on clothing	3.8 (2.0–5.6)	6.9 (4.2–9.6)	0.006
Shaking hands dry	5.9 (3.6–8.2)	8.9 (6.2–11.6)	0.036
Other	0.3 (–0.1–0.6)	0.3 (–0.3–1.0)	0.788
No preference	2.2 (0.8–3.6)	2.4 (0.9–3.9)	0.701

*P-values: P in bold are significant ($P < 0.05$).

increased self-reported preference for using electric hand dryers during compared to before the pandemic (Table 1). They also preferred wiping hands on their clothing during compared to before the pandemic and shaking their hands dry during compared to before. Fewer respondents reported using paper towels as their preferred drying method during the pandemic.

Factors found to be associated with choice of drying method included method availability (weighted % [95%CI]: 46.5% [41.6%–51.4%]), what method minimizes contact with surfaces (42.8% [37.9%–47.6%]), bathroom cleanliness (42.3% [37.5%–47.2%]), perceived method cleanliness (35.4% [30.6%–40.2%]), and speed of method (29.8% [25.4%–34.2%]).

When asked about perceived risks of exposure to Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), the virus that causes COVID-19, in public bathrooms (Table 2), a similar proportion of respondents reported feeling that they were less likely to be exposed to virus if they used paper towels to dry their hands instead of electric hand dryers as respondents reporting they were less likely to be exposed using electric hand dryers instead of paper towels. Nearly a quarter of respondents disagreed with the statement that not fully drying hands could spread SARS-CoV-2 and over one third were neutral. Respondents expressed concern of the risk of SARS-CoV-2 transmission from surfaces—or fomites—with the majority agreeing that touching public bathroom surfaces could spread SARS-CoV-2. Most respondents reported that they preferred drying their hands with paper towels in public bathrooms because they could use them to avoid SARS-CoV-2 when touching surfaces. Nearly two-thirds felt that they would be more likely to use an electric hand dryer if it were touchless.

Respondents wanted more information about hand drying and risks of SARS-CoV-2 exposure in public bathrooms than they currently received: 43.5% (38.7%–48.4%) wanted information on the most hygienic drying method; 30.4% (25.9%–34.9%) on health risks of touching surfaces in public bathrooms; and 29.6% (25%–34.1%) on germs on wet hands.

Table 2

Knowledge and attitudes on hand drying methods and the risks of exposure to SARS-CoV-2 in public bathrooms, PN View 360 Survey, October 2020

	Disagree*	Neutral	Agree*
	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)
I am less likely to be exposed to SARS-CoV-2 in a public bathroom if I use paper towels to dry my hands instead of using an electric hand dryer	32.3 (27.7–36.9)	28.5 (24.2–32.9)	39.2 (34.4–43.9)
I am less likely to be exposed to SARS-CoV-2 in a public bathroom if I use an electric hand dryer to dry my hands instead of using paper towels	31.0 (26.5–35.4)	27.9 (23.5–32.4)	41.1 (36.3–45.9)
Not fully drying my hands in public bathrooms can spread SARS-CoV-2	23.2 (19.1–27.2)	37.4 (32.7–42.2)	39.4 (34.6–44.2)
Touching surfaces such as faucets and door handles in public bathrooms can spread SARS-CoV-2	6.8 (4.4–9.2)	12.6 (9.4–15.8)	80.6 (76.8–84.5)
I prefer to dry my hands with paper towels because I can use them to avoid SARS-CoV-2 when touching other surfaces in public bathrooms	17.5 (13.8–21.1)	22.4 (18.3–26.5)	60.1 (55.4–64.9)
I would be more likely to use an electric hand dryer if it were touchless	15.0 (11.6–18.3)	19.0 (15.2–22.9)	66.0 (61.4–70.6)

*Questions utilized a 5-point Likert scale: strongly disagree, somewhat disagree, neutral, somewhat agree, and strongly agree. Respondents selecting “strongly disagree” and “somewhat disagree,” and “strongly agree” and “somewhat agree” were combined into “disagree” and “agree” categories, respectively, to create a 3-point scale.

DISCUSSION

Survey respondents self-reported preference for using electric hand dryers, wiping hands on clothing, and shaking hands dry during the pandemic compared to before, while preference for using paper towels decreased. Despite this decreased preference for using paper towels, the majority agreed with a statement indicating preference for paper towels because they could be used to avoid touching other surfaces in public bathrooms. Although the observed increase in respondents choosing to wipe their hands on clothing during the pandemic was small, it suggests that people may be adopting potentially less hygienic drying practices in order to avoid touching bathroom surfaces. The data of this survey suggest that the primary concern for respondents in selecting hand drying methods in public bathrooms during the pandemic may be avoiding contacting SARS-CoV-2 on surfaces. As studies to date have found low risk of SARS-CoV-2 transmission from fomites,^{8,9} the public could benefit from targeted handwashing messaging highlighting this low relative transmission risk.

This study has several limitations. Since data were self-reported, they are subject to social desirability bias (e.g., over-reporting of handwashing and drying). Second, the data are cross-sectional (i.e., collected at a single point in time) and as such reflect bias when used to assess behavioral changes over time. Finally, despite weighting to balance the data to the U.S. population, results may not be representative of all U.S. adults.

Although there were limited differences in perceived risk of exposure to SARS-CoV-2 between using paper towels vs. electric hand dryers, a large proportion of respondents wanted more information on relative hygiene effectiveness of different drying methods and were unsure whether not fully drying hands could spread SARS-CoV-2. While there is some evidence that using paper towels to dry hands may reduce the spread of bacteria relative to electric hand dryers in healthcare facility bathrooms,¹⁰ it is still an area of debate, particularly as the relative hygiene

effectiveness of different hand drying methods has not been assessed in public, non-healthcare settings, nor has it been studied with SARS-CoV-2. More research is required to determine whether risks of SARS-CoV-2 exposure differ across drying methods available in public bathrooms. Many microbes transfer more easily to and from wet hands,² and while we do not know if this is the case with SARS-CoV-2, current public health messaging should include consideration of the importance of properly washing hands with soap and water and fully drying hands.³

Acknowledgments

Deanne Weber, Porter Novelli Public Services; Fred Fridinger, CDC. The authors completed this work in the course of their regular duties for their affiliated institutions and received no additional funding.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the U. S. Centers for Disease Control and Prevention.

References

1. Centers for Disease Control and Prevention, National Center for Immunization and Respiratory Diseases, Division of Viral Diseases. How to Protect Yourself & Others. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>. Accessed February 21, 2021.
2. Patrick DR, Findon G, Miller TE. Residual moisture determines the level of touch-contact-associated bacterial transfer following hand washing. *Epidemiol Infect.* 1997;119:319–325.
3. CDC. When and How to Wash Your Hands. Available at: <https://www.cdc.gov/handwashing/when-how-handwashing.html>. Accessed January 13, 2021.
4. Gammon J, Hunt J. The neglected element of hand hygiene - significance of hand drying, efficiency of different methods and clinical implication: a review. *J Infect Prevent.* 2019;20:66–74.
5. P Novelli. PN view. Available at: <http://styles.porternovelli.com/pn-view-panels/>. Accessed January 13, 2021.
6. Coppock A, McClellan OA. Validating the demographic, political, psychological, and experimental results obtained from a new source of online survey respondents. *Res Polit.* 2019;6.
7. Lumley T. Survey: analysis of complex survey samples. R package version 4.0; 2020.
8. Colaneri M, Seminari E, Novati S, et al. Severe acute respiratory syndrome coronavirus 2 RNA contamination of inanimate surfaces and virus viability in a health care emergency unit. *Clin Microbiol Infect.* 2020;26. 1094.e1–1094.e5.
9. Pitol AK, Julian TR. Community transmission of SARS-CoV-2 by surfaces: risks and risk reduction strategies. *Environ Sci Technol Lett.* 2021;8:263–269.
10. Best E, Parnell P, Couturier J, et al. Environmental contamination by bacteria in hospital washrooms according to hand-drying method: a multi-centre study. *J Hosp Infect.* 2018;100:469–475.