

# The usefulness of hand washing during field training to prevent acute respiratory illness in a military training facility

Ho Seung Kim, MD, MS<sup>a</sup>, Ryoung Eun Ko, MD, MS<sup>b</sup>, Misuk Ji, MD, MS<sup>c</sup>, Ju-Hyung Lee, MD, PhD<sup>d</sup>, Chang-Seop Lee, MD, PhD<sup>e</sup>, Hyun Lee, MD, MS<sup>f,\*</sup>

## Abstract

Hand washing plays a key role in preventing respiratory infection in many clinical settings. However, its effectiveness in preventing acute respiratory illness (ARI) during field training in military training facilities has been not studied.

A quasi-interventional study was performed to evaluate the prevalence of ARIs over 4 weeks in a Korean army training center in South Korea from January 2009 to February 2009. A total of 1291 recruits participating in military training for 4 weeks were randomly distributed to 2 battalions (one with 631 and the other with 660). After noticing there is a difference between the 2 battalions in terms of the development of ARIs at the end of 2 weeks of training, we conducted interviews with the battle commanders to determine factors that may be related to one battalion having a higher incidence of ARI. Thereafter, we performed an intervention, which consists of instructing the battalion having a higher incidence of ARI to implement field hand washing from the third week. Following the intervention, we compared the cumulative rate of ARI during 4 weeks of training.

The interviews revealed that there were no major differences between the 2 battalions in terms of the training schedules, living environments, or indoor hand washing methods. However, there was difference in terms of hand washing during field training for the first 2 weeks; whereas one battalion (the early hand washing group) implemented hand washing during field training starting in the first week, the other battalion did not implement hand washing for the first 2 weeks but instead began in the third week (the late hand washing group). The cumulative incidence rate of ARI during 4 weeks of training was significantly lower in the early hand washing group (13.0%, 95% confidence interval [CI]: 10.6%–15.9%) than in the late hand washing group (28.0%, 95% CI, 24.7%–31.5%).

Our study suggests that outdoor hand washing during field training may be an effective precaution for reducing ARI incidence among recruits participating in military training.

**Abbreviations:** ARI = acute respiratory illness, CI = confidence interval.

**Keywords:** hand hygiene, infection control, military facilities, respiratory tract infection

Editor: Anser Azim.

HSK and REK contributed equally to this work.

The authors declare no conflicts of interest.

ORCID

Ho Seung Kim <http://orcid.org/0000-0002-7378-0584>

Ryoung Eun Ko <http://orcid.org/0000-0003-4935-5623>

Misuk Ji <http://orcid.org/0000-0001-5292-5185>

Ju-Hyung Lee <http://orcid.org/0000-0003-2487-4098>

Chang-Seop Lee <http://orcid.org/0000-0002-2897-2202>

Hyun Lee <http://orcid.org/0000-0002-1269-0913>

This study was supported by the research fund of Hanyang University (HY-2018).

<sup>a</sup> Department of General Surgery, Armed Forces Capital Hospital, Gyeonggi-do, <sup>b</sup> Division of Pulmonary and Critical Care Medicine, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, <sup>c</sup> Department of Laboratory Medicine, Veterans Health Service Medical Center, Seoul, <sup>d</sup> Department of Preventive Medicine, <sup>e</sup> Department of Internal Medicine, Chonbuk National University Medical School, Research Institute of Clinical Medicine of Chonbuk National University-Chonbuk National University Hospital, Jeonju, Korea, <sup>f</sup> Division of Pulmonary Medicine and Allergy, Department of Internal Medicine, Hanyang University College of Medicine, Seoul, South Korea.

\* Correspondence: Hyun Lee, Division of Pulmonary Medicine and Allergy, Department of Internal Medicine, Hanyang University College of Medicine, 222 Wangsimni-ro, Seongdong-gu, Seoul, 04763, South Korea (e-mail: [namuhanayeyo@hanyang.ac.kr](mailto:namuhanayeyo@hanyang.ac.kr)).

Copyright © 2018 the Author(s). Published by Wolters Kluwer Health, Inc.

This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

Medicine (2018) 97:30(e11594)

Received: 17 December 2017 / Accepted: 25 June 2018

<http://dx.doi.org/10.1097/MD.00000000000011594>

## 1. Introduction

Acute respiratory illnesses (ARIs) occur very commonly among young adults, and the frequency within this group is significantly higher than that of the general population.<sup>[1]</sup> Young adults who live in groups (eg, military facilities or dormitories) have a particularly high risk of ARI due to close contact, crowded spaces, and stressful environments.<sup>[2–6]</sup>

It has been shown that young adults with ARIs experience a negative impact on their work; ARIs impede academic performance and attendance among college students<sup>[7,8]</sup> and have a substantial impact on military missions, including basic training. In particular, ARIs are responsible for decreased job performance, loss of work-time, and hospitalization, which seriously impact unit readiness.<sup>[5,6,9–12]</sup> Therefore, decreasing ARI incidence may help improve training accomplishments and trainees' health.

Hand washing is the most effective method to prevent transmission of infectious disease.<sup>[13–15]</sup> Improvement of hand hygiene has been demonstrated to reduce the incidence of respiratory infection in hospitals,<sup>[16]</sup> nursing homes,<sup>[17]</sup> and common work environments.<sup>[18]</sup> In military environments, adopting simple hand washing programs that mandate hand washing at least 5 times daily significantly reduces the incidence of respiratory illness.<sup>[12]</sup>

Despite the importance of hand washing for the prevention of ARIs, performing hand washing during field training might not be feasible under certain circumstances related to water shortage, that is, field training during a very cold winter season. However, a few data are available on whether adopting hand washing during field training can reduce ARIs among trainees participating in basic military training. Therefore, the authors hypothesized that implementation of hand washing during field training can reduce ARI incidence of military trainees. The aim of the study was to evaluate the effects of hand washing during field training on ARI outbreaks in an army training center.

## 2. Subjects and methods

### 2.1. Population and settings

A quasi-interventional study was conducted at a Korean army training center located in Nonsan-si, Chungcheongnam-do, South Korea from January 2009 to February 2009. First, a total of 1500 new recruits were randomly distributed into 2 battalions. After 209 individuals returned home because of personnel and health problems, 1291 new recruits (one battalion with 630 recruits and the other with 661 recruits) began basic military training for 4 weeks.

During the 4 weeks of training, recruits were allowed to visit the medical office freely under the guidance of squad commanders. During field training, a temporary medical office was built near the field training ground, and thus, there was no limit in the use of medical services during field training. The present study protocol was reviewed and approved by the institutional review board of Armed Forces Medical Command (IRB No. AFMC-17015-IRB-17-015).

### 2.2. Interview methods

After noticing there is a difference between the 2 battalions in the development of ARIs at the end of 2 weeks of training, we interviewed the battalion commanders to determine any factors that may be related to one battalion having a higher incidence of

ARI. We evaluated whether there are differences in the training schedules, living environments, and hand washing methods in the barracks and during outdoor activities.

### 2.3. Intervention and main outcome

At the time of the interviews, we planned to perform an intervention for the battalion with a higher incidence of ARI if we were able to determine modifiable factors that may have affected the presumed higher ARI incidence. The main outcome was the cumulative incidence rate of ARI during basic military training for 4 weeks following intervention. ARI was defined as the recent onset of respiratory symptoms with or without elevation in body temperature and at least one of the following: rhinorrhea or nasal congestion, sore throat, cough, or sputum.

### 2.4. Data collection and identification of ARI cases

During the study period, all medical events were recorded using a paper chart. During field training, medical events were also recorded in the temporary medical office. In the Korean army training center, the number of patients with ARIs was reported to the commander on a daily basis for the purposes of shriveling widespread ARIs among trainees. Accordingly, the data regarding the number of patients who were diagnosed with an ARI were all prospectively collected by reviewing the medical charts daily. For the purposes of this study, all ARI cases were retrospectively reviewed (by HL) to determine whether these cases fulfill the definition of ARI.

### 2.5. Statistical analysis

We calculated the cumulative incidence rate according to the cases with ARI divided by the total number of military trainees of each group. In order to compare the cumulative incidence between the control group and the interventional group, we performed a test for 2 proportions and calculated the 95% confidence intervals (CIs). To evaluate the effect size, the difference between the 2 sample proportions, that is, the proportions of ARIs at week 4 between early and late hand washing groups, was calculated. Effect sizes near 0.2, 0.5, and 0.8 are regarded as a small, medium, and large, respectively.<sup>[19]</sup> All statistical analyses were performed using the STATA 11.0 software (STATA Corporation, College Station, TX). All tests were 2-sided and a  $P < .05$  was considered to be statistically significant.

## 3. Results

### 3.1. Interview results and impact of intervention

The interviews with the battle commanders revealed that there were no differences in the training schedules, living environments, or indoor hand washing methods. The hand washing method and cough etiquette were instructed to all trainees as a common curriculum, and bulletin board postings entitled "Hand Washing Method" were also displayed in the barracks and bathrooms of both groups.

However, there was a significant difference in terms of hand washing during outdoor activities. While one battalion (the early hand washing group) performed hand washing during field training beginning in the first week, the other battalion did not perform hand washing during field training for the first 2 weeks. Beginning from the third week of training, we implemented the

same hand washing methods for the late hand washing group that had not implemented it in the first 2 weeks.

It was impossible to implement the same hand washing methods during field training as those performed in the barracks due to the lack of available tap water. Because of this, the hand washing method was modified as follows: water and basins for washing hands were provided via military trucks. Four wash basins were provided to each squad (about 10 trainees each). Wash basins were located in a row. The wash basin in the first row was filled with soapy water (a piece of soap was dissolved in about 4 liters of water) and the others were filled with only tap water. Under supervision of the squad commander, every trainee in each squad washed their hands in a line one after the other. After washing in the 4 basins, the squad commander distributed a bucket of water to each trainee. Hand washing was generally performed 3 times during field training: once in the morning after training for 2 hours, again before lunch, and again after training for 3 hours in the afternoon during field training.

### 3.2. The cumulative incidence of ARIs during the 4 weeks of training and during the last 2 weeks of training after intervention

During the 4 weeks of training, 267 personnel were identified as having ARIs, including 82 in the early hand washing group and 185 in the late hand washing group. The overall cumulative incidence rate of ARI during those 4 weeks was significantly lower in the early hand washing group (13.0% [82/631], 95% CI=10.6%–15.9%) than in the late hand washing group (28.0%, [185/660] 95% CI=24.7%–31.5%,  $P < .001$ ) (Fig. 1). The effect size was from small to medium, taking a value of 0.38.

During the last 2 weeks of training, 186 personnel were identified as having ARIs, including 54 in the early hand washing group and 132 in the late hand washing group. The overall cumulative incidence of ARI during the last 2 weeks after intervention was significantly lower in the early hand washing group (9.0% [54/603], 95% CI=6.8%–11.5%) than late hand washing group (21.7% [132/607], 95% CI=18.5%–25.2%,

$P < .001$ ). The effect size was from small to medium, taking a value of 0.35.

## 4. Discussion

This study shows that hand washing during field training at basic military training facilities significantly reduces ARI incidence. The implementation of early hand washing reduced the ARI rate by 15.0%. Although there have been a few studies that show hand washing reduces respiratory infection in military settings,<sup>[12,20]</sup> there have been no studies showing that hand washing performed during field training further decreases ARI. Thus, this study carries considerable weight in this field.

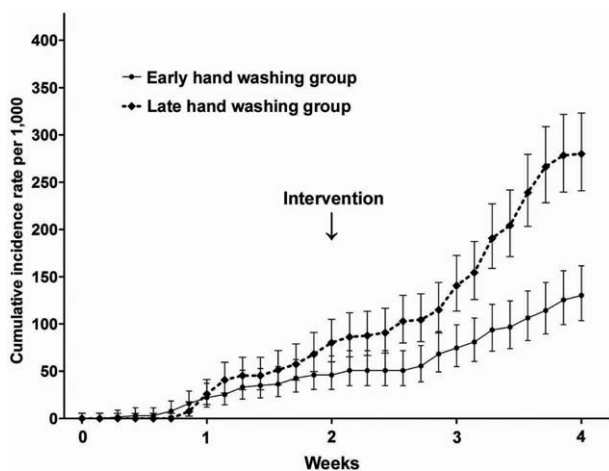
Hand washing is one of the most important methods to prevent infection.<sup>[21,22]</sup> The transmission of infection can easily occur in basic training centers due to the close contact of trainees in group life. Moreover, the probability of transmission of viruses will be higher during training because trainees use the same training tools in order, typically while standing in a line. If an individual trainee was infected with a virus, that virus would be transmitted to other trainees via hand-to-hand contact when sharing training tools.<sup>[23]</sup> Therefore, hand washing is very important during field training at basic training centers.

In this view, our study is well designed to show the importance of hand washing along with its preventive role of ARIs during outdoor activities. Furthermore, this study was relatively well controlled because the environments of the 2 groups were almost the same, with the exception of their hand washing regimens. The lower rate of ARI prevention in the late hand washing group may be attributed to the ineffectiveness of hand washing when the pathogen is already widely spread throughout a group. Thus, our study suggests that hand washing during outdoor activities should be emphasized as early as possible, especially to those who live in groups in which endemic viral infections are expected. We also suspect this can be applied to the general population.

There are several limitations to this study. First, we did not obtain information about the individual behavior of hand washing. Therefore, there might be lack of observed compliance with the hand washing technique described. However, since the hand washing in the field was performed under the control of a squad commander, this effect might not be significant. Another limitation is that this study was not fully controlled. For ethical reasons, we did not compare either hand washing group to a strictly non-hand washing group; specifically, after noticing that hand washing during field training was only implemented in 1 battalion, we implemented hand washing in the other battalion beginning from the third week. Therefore, in the near future, we will need a well-controlled and better designed prospective study at military training centers. Last, due to lack of tap water, we modified the hand washing methods used during field training. Recently, more convenient methods such as alcohol-based hand cleansing have been adopted and have shown their effectiveness in many clinical settings, including those at military training facilities,<sup>[8,20,24–27]</sup> and may be applicable to our study population. Thus, future studies are needed to demonstrate whether other methods such as alcohol-based hand cleansing during field training further decrease ARI incidence at military training facilities.

## 5. Conclusion

The current study shows that early hand washing implemented during outdoor activity may prevent ARIs during basic military training.



**Figure 1.** The cumulative incidence rate of acute respiratory illness of the study population. The error bar means that the 95% confidence interval of each incidence rate. If the incidence rate was zero, the confidence interval was calculated for one-sided and 97.5%. Early hand washing group ( $n=630$ ) had started the hand washing during field training from January 15, 2009, while late hand washing group ( $n=661$ ) had started from January 29, 2009 (arrow).

## Author contributions

**Conceptualization:** Ho Seung Kim, Ryoung Eun Ko, Hyun Lee.

**Data curation:** Ho Seung Kim, Ryoung Eun Ko, Misuk Ji, Hyun Lee.

**Data acquisition:** Ho Seung Kim, Ryoung Eun Ko, Hyun Lee.

**Data analysis:** Ju-Hyung Lee, Hyun Lee.

**Data interpretation:** Ho Seung Kim, Ryoung Eun Ko, Misuk Ji, Ju-Hyung Lee, Chang-Seop Lee, Hyun Lee.

**Study Design:** Ju-Hyung Lee, Chang-Seop Lee, Hyun Lee.

**Supervision:** Hyun Lee.

**Writing – original draft:** Ho Seung Kim, Ryoung Eun Ko, Chang-Seop Lee, Hyun Lee.

**Writing – review & editing:** Misuk Ji, Ju-Hyung Lee.

## References

- [1] Barker J, Stevens D, Bloomfield SF. Spread and prevention of some common viral infections in community facilities and domestic homes. *J Appl Microbiol* 2001;91:7–21.
- [2] Sun Y, Wang Z, Zhang Y, et al. In China, students in crowded dormitories with a low ventilation rate have more common colds: evidence for airborne transmission. *PLoS One* 2011;6:e27140.
- [3] Cross ER, Hermansen LA, Pugh WM, et al. Upper respiratory disease in deployed U.S. Navy shipboard personnel. *Mil Med* 1992;157:649–51.
- [4] Gray GC, Callahan JD, Hawksworth AW, et al. Respiratory diseases among U.S. military personnel: countering emerging threats. *Emerg Infect Dis* 1999;5:379–85.
- [5] Soltis BW, Sanders JW, Putnam SD, et al. Self reported incidence and morbidity of acute respiratory illness among deployed U.S. military in Iraq and Afghanistan. *PLoS One* 2009;4:e6177.
- [6] Gray GC, Callahan JD, Hawksworth AW, et al. Respiratory diseases among US military personnel: countering emerging threats. *Emerg Infect Diseases* 1999;5:379.
- [7] White C, Kolble R, Carlson R, et al. The impact of a health campaign on hand hygiene and upper respiratory illness among college students living in residence halls. *J Am Coll Health* 2005;53:175–81.
- [8] White C, Kolble R, Carlson R, et al. The effect of hand hygiene on illness rate among students in university residence halls. *Am J Infect Control* 2003;31:364–70.
- [9] Sanders JW, Putnam SD, Frankart C, et al. Impact of illness and non-combat injury during operations Iraqi freedom and enduring freedom (Afghanistan). *Am J Trop Med Hyg* 2005;73:713–9.
- [10] Paparello SF, Garst P, Bourgeois AL, et al. Diarrheal and respiratory disease aboard the hospital ship, USNS Mercy T-AH 19, during Operation Desert Shield. *Mil Med* 1993;158:392–5.
- [11] Lim M, Gabele S, Wallace M, et al. Upper respiratory tract infections (URI). *Mil Med* 2004;169:xxv–10.
- [12] Ryan MA, Christian RS, Wohlrahe J. Handwashing and respiratory illness among young adults in military training. *Am J Prev Med* 2001; 21:79–83.
- [13] Curtis V, Cairncross S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *Lancet Infect Dis* 2003; 3:275–81.
- [14] Freeman MC, Stocks ME, Cumming O, et al. Hygiene and health: systematic review of handwashing practices worldwide and update of health effects. *Trop Med Int Health* 2014;19:906–16.
- [15] Burton M, Cobb E, Donachie P, et al. The effect of handwashing with water or soap on bacterial contamination of hands. *Int J Environ Res Public Health* 2011;8:97–104.
- [16] Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HIPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Am J Infect Control* 2002;30:S1–46.
- [17] Chami K, Gavazzi G, Bar-Hen A, et al. A short-term, multicomponent infection control program in nursing homes: a cluster randomized controlled trial. *J Am Med Dir Assoc* 2012;13: 569.e9–17.
- [18] Savolainen-Kopra C, Haapakoski J, Peltola PA, et al. Hand washing with soap and water together with behavioural recommendations prevents infections in common work environment: an open cluster-randomized trial. *Trials* 2012;13:10.
- [19] Cohen , Jacob . *Statistical Power Analysis for the Behavioral Sciences*. 2nd edition Lawrence Erlbaum, Hillsdale, NJ:1998.
- [20] Mott PJ, Sisk BW, Arbogast JW, et al. Alcohol-based instant hand sanitizer use in military settings: a prospective cohort study of Army basic trainees. *Mil Med* 2007;172:1170–6.
- [21] Seto W, Tsang D, Yung R, et al. Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS). *Lancet* 2003;361: 1519–20.
- [22] Liu M, Ou J, Zhang L, et al. Protective effect of hand-washing and good hygienic habits against seasonal influenza: a case-control study. *Medicine (Baltimore)* 2016;95:e3046.
- [23] Galton J, McLaws ML, Rawlinson WD. Personal clothing as a potential vector of respiratory virus transmission in childcare settings. *J Med Virol* 2015;87:925–30.
- [24] Schweon SJ, Edmonds SL, Kirk J, et al. Effectiveness of a comprehensive hand hygiene program for reduction of infection rates in a long-term care facility. *Am J Infect Control* 2013;41:39–44.
- [25] Lucet JC, Rigaud MP, Mentre F, et al. Hand contamination before and after different hand hygiene techniques: a randomized clinical trial. *J Hosp Infect* 2002;50:276–80.
- [26] Pittet D, Dharan S, Touveneau S, et al. Bacterial contamination of the hands of hospital staff during routine patient care. *Arch Intern Med* 1999;159:821–6.
- [27] Girou E, Loyeau S, Legrand P, et al. Efficacy of handrubbing with alcohol based solution versus standard handwashing with antiseptic soap: randomised clinical trial. *BMJ* 2002;325:362.