



Original article

Do alcohol-based hand rubs reduce the incidence of acute diarrhea during military deployments? A prospective randomized trial



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ABSTRACT

Background: Acute diarrhea remains a public health concern in armed forces deployed in tropical areas where access to water and soap is limited. This study aims to assess the effectiveness of alcohol-based hand rubs (ABHR) on incidence of diarrhea in poor hygiene conditions.

Method: A prospective randomized trial was conducted between November 2014 and January 2015 among French military troops deployed in Africa to compare a group of soldiers receiving usual hand hygiene recommendations (control group), to a group of soldiers who received ABHR in addition to usual hand hygiene recommendations (intervention group). Data on diarrhea and hygiene behaviors were collected using self-questionnaires. The incidence rate of diarrhea episodes in groups was compared.

Results: Participation rate was 59% (236/400). The proportion of individuals who used ABHR was 97% in the intervention group and 62% in the control group. The overall incidence rate of diarrheal episodes was observed to be in the region of 60 per 100 persons-month without any significant difference between groups after adjustment on confounding factors ($p = 0.93$). Handwashing with soap was used on average 4 times a day in the control group and twice a day in the intervention group ($p = 0.93$). It was the only significant protective factor for diarrhea ($p < 10^{-3}$).

Conclusion: Our results support that supplying soap and good quality water should be a priority on the field.

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1. Introduction

Acute diarrhea is one of the most important public health concern affecting travelers, especially in West-Africa, Central-Africa and South Asia [1]. Soldiers from industrialized countries deployed to lesser developed countries are particularly exposed to diarrheal infections [2,3]. In fact, diarrhea among military travelers deployed globally in conflict and peacekeeping activities remains one of the most important health threats [4], with an overall incidence ranging from 5 to 30 episodes p.100 person-months [5].

Although most often benign, diarrhea is a potential cause of

compromised military effectiveness during operational deployments [6]. In tropical countries, large outbreaks can occur [7] like the one affecting the French armed forces in April 2013 in Mali: over 5 weeks, 270 cases were reported, accounting to a 16% attack rate [8]. Investigations revealed a multifactorial origin of this outbreak: hazardous eating behaviors, hard operational conditions leading to a lack of safe water and soap supply and basic hygiene breaches. The importance of person-to-person transmission of diarrhea was also demonstrated, as already published elsewhere [7,9]. Other published studies performed among troops in operations highlighted that time spent out of the barracks, consumption of local products and ice cubes were associated with an increased risk of diarrhea [10–12]. Conversely, rinsing or washing hands can reduce gastro enteritis in a military population deployed in West Africa [13]. In addition, use of alcohol-based hand rubs (ABHR) is highly acceptable by travelers and is associated with a reduction in the incidence of travelers' diarrhea [14]. Their small volume should

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facilitate logistic supply. ABHR effectiveness has already been demonstrated among healthcare workers and in general population [15–17]. In addition, two studies measured the impact of collective use of ABHR in the US Army to prevent infectious diseases [18,19]. These studies, performed among troops in barracks in the USA, showed a decrease in respiratory and gastro-intestinal infections when using ABHR. One study did not show any significant difference in reducing incidence of diarrhea between clean and dirty or oily hands among participants with hands artificially contaminated [20]. Therefore, the primary objective of the present study was to assess the effectiveness of ABHR to reduce acute diarrhea among military troops deployed in Africa.

2. Methods

2.1. Study population, design, and data collection

A multicenter prospective randomized trial was conducted from November 2014 to January 2015 to compare a group of soldiers receiving usual hand hygiene recommendations about using water and soap (control group) to a group of soldiers receiving ABHR in addition to usual hand hygiene recommendations (intervention group).

This trial was conducted among the six French military camps located in Chad and East Niger. These locations were chosen because the epidemiological surveillance system already highlighted high incidences of diarrhea within French troops there [7]. Each camp was composed of 2–4 platoons of about 30 soldiers. For this study, the target population was composed of all the 400 French military personnel present in Chad and East Niger in November 2014. ABHR were assigned to platoons (and not individuals) by random in order to prevent from ABHR exchanges between individuals belonging to different randomization groups within the same platoon. Promotion of hygiene, information about the trial, consents and questionnaires were provided before randomization so that the local investigator was blinded during the hygiene promotion session. Then, written consents were obtained from volunteers and three ABHR bottles of 118 mL distributed to the individuals of the intervention group. The ABHR provided was Purell® advanced hygienic hand rub (Gojo Industrie, Inc.) composed of ethanol (70%).

Data were collected using anonymous standardized self-questionnaires distributed to the volunteers at the beginning of the study. Participants were interviewed about individual data, food habits, life conditions and medical history from the beginning of the mission (especially about diarrhea and compliance with doxycycline as malaria chemoprophylaxis) to the day of inclusion. They were also asked to complete, prospectively, over the 40 days of the follow-up, a diary noting the daily number of hand wash episodes with soap and/or ABHR, the occurrence of diarrhea and the daily number of stools in case of diarrhea occurrence. At the end of the study, medical staff reviewed the diaries and obtained additional information from participants at personal interviews.

The study was approved by the local ethics committee in August 2014. It fits the code of ethics of the World Medical Association.

2.2. Statistical analysis

Incidence rates of diarrheal episodes were calculated in both groups and compared to assess the effectiveness of use of ABHR in preventing diarrhea. A diarrheal episode was defined as period from the day of liquid stool onset to three days after the last liquid stool. The denominator was the total number of persons-days at risk of diarrheal episode. Rates were compared using a mixed effect Poisson regression model including a random effect using the

platoon as grouping variable to take into account intra-platoons and intra-locations correlations. Univariate analysis selected variables for the model (variables associated to the variable of interest with a p value lower than 0.20). Then, a step-backward procedure was carried out for the multivariate analysis.

A complementary study was performed using frequency of ABHR use as variable of primary interest (calculating the average number of ABHR use per day).

For statistical analyses, the significance level was set at 5%. The analyses presented here include missing data, but results were similar with imputed and complete data. All statistical analyses were performed using SAS v. 9.3 (SAS Institute Inc, Cary, North Carolina).

3. Results

3.1. Study population and living conditions

This trial was conducted among the French military personnel of five stated camps in Chad and Niger, and one itinerant mission in Niger. According to questionnaires, living conditions were precarious in the itinerant mission, intermediate in Niger and quite comfortable in the three camps in Chad. All French military ($n = 400$) present in these camps between November 2014 and January 2015 were included equally in both groups but 147 did not answer and 17 were excluded due to illegible questionnaire. Therefore, the statistical analyzes covered 236 (59%) individuals (122 in CG and 114 in IG; Table 1). Participation rates (64% in CG vs. 55% in IG, $p = 0.06$) and average monitoring duration (38 days, $p = 0.09$) were not statistically different between groups.

In the IG, 97% of individuals (110/113) used ABHR with an average frequency of four times per day. Because some ABHR were available in the restrooms of several camps and because half of participants from the CG had their own ABHR bottles, 62% (73/117) in CG did not respect the protocol and used ABHR with an average frequency of twice a day. Average frequencies of ABHR use were statistically different between groups ($p < 10^{-4}$).

3.2. Incidence rate of diarrheal episodes

In total, 34% (80/236) of the included individuals reported at least one diarrheal episode. Overall 176 diarrheal episodes were recorded corresponding to an incidence of 65 p.100 persons-month, not statistically different between the two groups (respective incidence: 71 p.100 persons-month in the CG vs. 58 p.100 persons-month in the IG, $p = 0.16$). After adjustment on confounding factors, incidence remained comparable between groups ($p = 0.93$; rate ratio = 1.03, 95% confidence interval [CI_{95%}]: 0.55–1.93). As well in the complementary study, after adjustment on confounding factors, the rate ratio was 0.99 (95% CI: 0.90–1.09), showing no significant decrease of the incidence rate of diarrheal episodes when the average frequency of use of ABHR increased ($p = 0.82$).

Multivariate analysis showed that after adjustment, history of diarrhea between start of the mission and start of the study, type of accommodation and number of handwashing with soap per day were associated with incidence rate of diarrheal episodes (Table 2). Particularly, the number of hand washing episodes with soap was inversely associated with significantly different incidence rate ($p < 10^{-3}$; rate ratio = 0.81, CI_{95%}: 0.72–0.91).

4. Discussion

In the present study, the incidence of diarrheal episodes was estimated around 65 cases p.100 persons-months. This was far

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