



Traveler Demographics, Characteristics of Travel, Personal Protective Measure Use, Mosquito Exposure, and Chikungunya Seroconversion during the Outbreak in the Americas

David A. Lindholm, MD¹; Edward M. Grant, MPH²; Todd Myers, PhD³; Kalyani Telu, MS²; Mary Fairchok, MD^{2, 4}; Anuradha Ganesan, MD, MPH^{2, 5}; Mark D. Johnson, MD, MTM&H^{2, 6}; Anjali Kunz, MD^{2, 4}; David R. Tribble, MD, DrPH²; Tahaniyat Lalani, MBBS, MHS^{2, 7}; Heather C. Yun, MD^{1, 2}



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Correspondence:
David A. Lindholm, MD
david.a.lindholm4.mil@mail.mil
Phone: (210)-916-5554

Abstract

Background: Chikungunya (CHIKV) has emerged in the Caribbean and Central and South America, infecting more than one million people since 2013 and posing risk to travelers. We describe traveler demographics and personal protective measure (PPM) use, mosquito exposure, and CHIKV acquisition in a military-medical-system cohort.

Methods: TravMil is a prospective observational study enrolling subjects presenting to 5 military travel clinics. We analyzed surveys and paired sera from travelers to this region between December 2013 and May 2015. CHIKV acquisition was determined by enzyme-linked immunosorbent assay, plaque reduction neutralization test, and polymerase chain reaction.

Results: 277 travelers enrolled (51% male, median age 40 years, 43% active duty [AD]), including 10 who enrolled post-travel. The median trip duration was 11 days. 41% traveled to Mexico/Central America, 31% to South America, and 28% to the Caribbean. 51% traveled on vacation, 29% for missionary work, and 26% for a military purpose; 10% were visiting friends/relatives (VFR). 48% of travelers reported using *N, N*-diethyl-*m*-toluamide (DEET) often, 28.5% rarely, and 23.5% never; 11% used permethrin. 64% of travelers reported seeing mosquitoes; 47% reported no mosquito bites, while 6% reported >15 bites.

In a multivariate logistic regression model, AD status (odds ratio/OR 2.6 [1.3-5.4]) and increased frequency of DEET use (OR 3.3 [2.2-5.0]) were associated with seeing mosquitoes. Older age was associated with fewer mosquito bites (OR 0.98 [0.95-1.0]), whereas VFR (OR 3.5 [1.2-10.0]) and increased frequency of DEET use (OR 2.4 [1.3-4.4]) were associated with more mosquito bites in a separate multivariate logistic regression model.

Paired sera were available for CHIKV testing in 122 travelers. Six acquired CHIKV: 3 were asymptomatic; 3 enrolled as ill returning travelers. Five of the 6 were in higher exposure-risk groups (AD, VFR); PPM use was inconsistent.

Conclusions: Mosquito exposures are common in travelers to CHIKV-outbreak regions in the Americas; AD, younger travelers, and those who are VFR may be at higher exposure risk. Self-reported PPM use is suboptimal even after pre-travel counseling. Serological evidence of CHIKV infection was seen in both symptomatic and asymptomatic travelers, the majority of whom were in higher exposure-risk groups. Pre-travel counseling should target these higher risk groups.

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Background

- CHIKV is an emerging infectious disease in the Caribbean and Central and South America
- First autochthonous case in the Americas confirmed Dec 2013
- Pan American Health Organization reported nearly 1.4 million suspected and 32,000 confirmed cases between Dec 2013 and May 2015
- Arbovirus transmitted by the *Aedes* mosquito
- Characterized by fevers, headache, prostration, polyarthralgias, and rash
- Acute illness lasts 7-10 days, but recurrent arthralgias may persist for months to years
- Low rates of asymptomatic infection
- CHIKV poses risks to travelers and is a preventable illness
- We describe traveler demographics and personal protective measure (PPM) use, mosquito exposure, and CHIKV acquisition in a military-medical-system cohort

Methods

- TravMil is a prospective observational study enrolling subjects presenting to 5 military travel clinics
 - Retrospective component: post-travel enrollment of ill returning travelers
- Enrolled travelers to CHIKV-outbreak regions of the Americas between Dec 2013 and May 2015

Survey Data

- Pre- and post-travel surveys were assessed for demographics, travel characteristics, mosquito exposure, and PPM use
 - Post-travel surveys of those with laboratory-confirmed CHIKV were also assessed for associated symptoms

Laboratory Data

- Paired sera were screened for CHIKV IgM and IgG using enzyme-linked immunosorbent assay (ELISA)
- Confirmatory testing for IgM (+) pairs was performed using reverse transcriptase polymerase chain reaction (RT-PCR)
 - Pairs that were negative by RT-PCR were further assessed with plaque reduction neutralization test (PRNT)
- Confirmatory testing for IgG (+) pairs was performed using PRNT

Table 1. Characteristics of travelers (N = 277) to the Caribbean and Central and South America from Dec 2013 to May 2015

Characteristic	Number of travelers (%)		P value		OR (95% CI)
	No	Yes	Univariate	Multivariate	
Male gender	141 (51)				
Age, median years (IQR)	40 (29-60)				
Active duty military	118 (43)				
Post-travel enrollment	10 (3.6)				
Region of travel					
Caribbean	78 (28)				
Mexico/Central America	114 (41)				
South America	85 (31)				
Type of location					
Rural	138 (50)				
Peri-urban	78 (28)				
Urban	193 (70)				
Port	29 (10)				
Duration of travel, median days (IQR)	11 (8-17)				
Type of accommodation					
Military	33 (12)				
Dormitory	30 (11)				
Hotel	179 (65)				
Hotel w/o AC	32 (12)				
Purpose of travel					
Adventure	31 (11)				
Cruise	32 (12)				
Medical support	34 (12)				
Military	73 (26)				
Missionary	79 (29)				
Vacation	141 (51)				
VFR	28 (10)				
Saw mosquitoes	127 (64)				
Total mosquito bites					
0	95 (47)				
1-5	72 (36)				
6-10	17 (8.5)				
11-15	4 (2.0)				
>15	13 (6.5)				
PPM use					
Used DEET	101 (90)				
Frequency of repellent use					
Never	47 (24)				
Rarely	57 (29)				
Often/every day	96 (48)				
Treated outer clothing with a repellent	30 (11)				
Optimal PPM use	21 (11)				

Serologic Testing

- Paired sera from 122 travelers (44%) were screened with CHIKV ELISAs
 - 1 pair awaiting retesting due to shipping error
- 31 total travelers (+) CHIKV IgM
- 9 total travelers (+) CHIKV IgG
- 5 travelers (+) for both IgM and IgG
 - 4 of these were also (+) on confirmatory testing

Confirmatory Testing

- Of 10 CHIKV RT-PCRs run, only 1 was (+)
 - This traveler was also (+) by PRNT
- Of 12 CHIKV PRNTs run, 7 were (+)
 - 6 considered true (+)
 - 1 considered false (+) due to borderline result

Results

Table 2. Characteristics of travelers (N = 198) according to whether they saw mosquitoes while traveling

Characteristic	Saw mosquitoes, number of travelers (%)		P value		OR (95% CI)
	No	Yes	Univariate	Multivariate	
Gender					
Male	39 (39)	62 (61)			
Female	32 (33)	65 (67)			
Age, median years (IQR)	52 (34-66)	40 (29-56)	0.01	0.66	-
Active duty	19 (25)	56 (75)	0.016	0.008	2.6 (1.3-5.4)
Region of travel					
Caribbean	17 (33)	35 (67)			
Mexico/Central America	29 (34)	57 (66)			
South America	25 (42)	35 (58)			
Type of location					
Rural	33 (32)	70 (68)	0.24		
Peri-urban	21 (32)	44 (68)	0.47		
Urban	52 (36)	94 (64)	0.91		
Port	11 (52)	10 (48)	0.10	0.85	-
Duration of travel, median days (IQR)	11 (7-18)	12 (8-16)	0.57		
Type of accommodation					
Military	5 (28)	13 (72)	0.45		
Dormitory	6 (33)	12 (67)	0.82		
Hotel	54 (40)	80 (60)	0.06	0.33	-
Hotel w/o AC	10 (45)	12 (55)	0.32		
Purpose of travel					
Adventure	13 (57)	10 (43)	0.028	0.13	-
Cruise	11 (61)	7 (39)	0.019	0.24	-
Medical support	6 (25)	18 (75)	0.24		
Military	12 (27)	32 (73)	0.18		
Missionary	12 (22)	42 (78)	0.014	0.32	-
Vacation	47 (43)	63 (57)	0.024	0.57	-
VFR	7 (32)	15 (68)	0.68		
PPM use					
Used DEET	28 (28)	72 (72)	0.73		
Frequency of repellent use					
Never	31 (67)	15 (33)			
Rarely	23 (40)	34 (60)			
Often/every day	16 (17)	78 (83)			
Treated outer clothing with a repellent	6 (20)	24 (80)	0.049	0.69	-
Optimal PPM use	1 (5)	20 (95)	0.002	0.15	-

Characteristics of the 6 travelers with laboratory-confirmed CHIKV

- 3 (50%) male, median age 50 years
- 3 (50%) enrolled pre-travel; all were asymptomatic
- 3 (50%) enrolled as ill returning travelers
 - All of these traveled to the Caribbean and were VFR
 - 2/3 reported high-intensity bites
 - Each used some degree of repellent (no permethrin)
- 2 (33%) were active-duty (AD) military
 - Both were pre-travel enrollees
 - Both traveled for a military purpose (medical support/missions)
 - One did not use repellent, but one reported optimal PPM use
- 5 (83%) traveled to urban locations
- 4 (67%) reported repellent use often/every day, but only 1 (17%) reported optimal PPM use

Conclusions

- Mosquito exposures are common in travelers to CHIKV-outbreak regions
- Younger travelers, AD military, and those who are VFR may be at higher exposure risk
- Travelers with higher intensity exposures reported more frequent repellent use, which may reflect pre-travel anticipation of exposure vs an in-travel reaction to exposure
- Self-reported PPM use is suboptimal even after pre-travel counseling
- CHIKV acquisition was seen in both pre- and post-travel enrollees
 - 5/6 (83%) of cases were associated with higher-risk travelers (AD, VFR)
 - Infection may be asymptomatic
 - Travelers should be counseled that they can still acquire mosquito-borne illnesses in urban locations
 - Pre-travel counseling must be coupled with traveler adherence to mitigate risk of disease acquisition
- Pre-travel counseling should target higher exposure-risk groups