Am. J. Trop. Med. Hyg., 91(2), 2014, pp. 281–286
doi:10.4269/ajtmh.13-0763

Awareness of Meningococcal Disease among Travelers from the United Kingdom to the Meningitis Belt in Africa

Anna L. Goodman,* Cristina Masuet-Aumatell, Jay Halbert, and Jane N. Zuckerman

Department of Infection and Immunity and World Health Organization Collaborating Centre for Reference, Research and Training in Travel Medicine, University College London, London, United Kingdom; International Health Centre, Preventive Medicine Department, Bellvitge Hospital, L'Hospitalet De Llobregat, Barcelona, Spain; Department of Paediatrics, University College London Hospitals, London, United Kingdom

Abstract. Meningococcal disease causes considerable morbidity and has a high case-fatality rate. In the United Kingdom, the meningococcal quadrivalent vaccine is recommended for travelers visiting the meningitis belt of Africa. We analyzed 302 responses to a cross-sectional study conducted in 2010 of travelers who had visited the meningitis belt recently or were shortly due to travel there. Using the results of an online questionnaire, we assessed knowledge and understanding of meningococcal disease and likelihood of uptake of meningococcal immunization before travel. Meningococcal vaccine uptake was 30.1%. Although global scores in the questionnaire did not correlate with vaccine uptake, knowledge of the meningitis belt and knowledge of certain key symptoms or signs were statistically associated with high vaccine uptake. We conclude that improved education of travelers may improve vaccine uptake before travel to the meningitis belt in Africa.

INTRODUCTION

Meningococcal disease causes vaccine-preventable travel-related ill health[1] and the risk is increased, particularly for persons visiting areas with a higher incidence of disease and during outbreaks.[2] The estimated incidence of meningococcal infection in travelers is 0.04 cases/100,000 persons per month of stay, but the incidence can be as high as 200–640/100,000 per month of stay in high-risk groups, such as travelers to Mecca during an outbreak.[3,4] Case-fatality rates have been as high as 4.9% in the United Kingdom[5] and at similar or higher levels in Africa.[6,7] Uptake of vaccination remains low and the severity of the disease is underestimated.[8] The meningitis belt of sub-Saharan Africa involves 21 countries (Figure 1) and stretches from Senegal in the west across to Ethiopia in the east. In this region, meningitis is endemic and travelers are recommended to receive a meningococcal vaccine before travel.

Meningococci are classified into serogroups according to the immunologic reactivity of their capsular polysaccharides. In the United Kingdom, the meningococcal quadrivalent vaccine is recommended for travelers to the meningitis belt in Africa because it provides protection against meningococcal serogroups A, C, W135 and Y (Men ACWY).[9] Serogroup B is not common in the meningitis belt and the new vaccine against this serogroup is not yet widely available. The quadrivalent vaccine is particularly recommended for long-stay travelers and high-risk travelers, such backpackers and travelers living or working in close proximity with the local population.[9] In the United Kingdom, infants are currently immunized against meningitis serogroup C (MenC) as part of their childhood immunization schedule, along with vaccines against other causes of bacterial meningitis (*Streptococcus pneumoniae* and *Haemophilus influenzae*); since 2013, a booster immunization has been offered to persons 14 years of age. Adults in the United Kingdom would not have received a vaccine at birth but instead may have received immunization against MenC during a catch-up campaign. Therefore, at the time of this study in 2010, only persons < 33 years of age would have been offered MenC as part of their routine immunizations if they had been living in the United Kingdom during childhood.

Although studies have been performed to assess travelers' knowledge, attitudes, and practice with respect to vaccination, these studies have not previously focused specifically on meningococcal meningitis.[8] This study sought to determine awareness of meningitis in travelers from the United Kingdom who visited the meningitis belt, and whether awareness of symptoms, strains, and mode of transmission might predict likelihood to receive a meningococcal vaccine before travel.

The aim of the study was to explore the factors that predict meningococcal immunization uptake before travel. The primary objective was to determine if an increased knowledge of meningitis in travelers was associated with increased likelihood of meningococcal vaccine uptake before travel. Secondary objectives were to determine features that limited access to vaccination and to determine the impact of demographic features on the likelihood of meningococcal vaccine uptake.

MATERIALS AND METHODS

Study design. A cross-sectional study was conducted by using an online questionnaire-based survey of British travelers. The questionnaire was designed by Novartis (New York, NY) and was distributed to participants by Lightspeed Market Research Company (Wimbledon, United Kingdom) and their online panel members in the United Kingdom during a seven-day period in February 2010. The online panel consists of persons who had previously registered as interested in participating in such online surveys. The Lightspeed online panel identified travelers who had traveled to at least one country in the meningitis belt of Africa within the last three years, or planned to do so within the next six 6 months. The survey was sent to these members and no financial incentives were provided to panel members and their participation in the survey was voluntary. Panelists provided signed informed consent to take part in the study and the data was anonymized and analyzed by the authors.

Questionnaire. The online questionnaire was designed to collect information regarding the travelers background socio-demographics; their awareness of the risks of meningococcal

*Address correspondence to Anna L. Goodman, Department of Infection and Immunity, University College London, London WC1E 6JF, United Kingdom. E-mail: anna.goodman@nhs.net

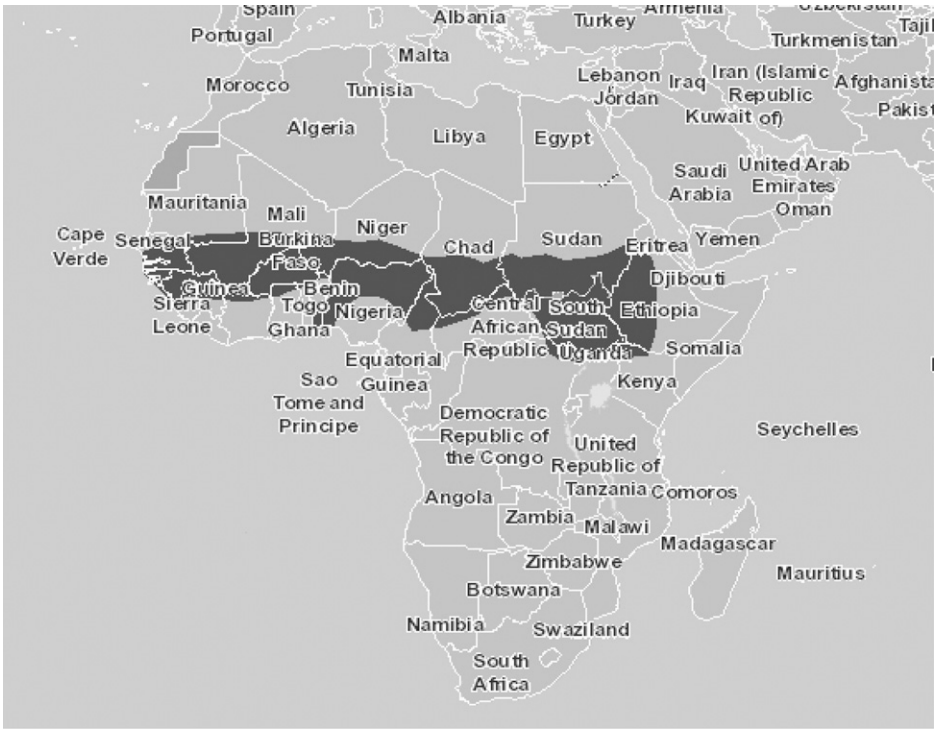

FIGURE 1. Meningitis belt and areas at high epidemic risk in 2012. Meningitis belt is shown in dark grey. Extracted from http://apps.who.int/ithmap/. Reproduced with kind permission of the World Health Organization.

disease; whether and where they sought pre-travel health advice; and their destination, duration and purpose of travel. Possible responses were dichotomous to increase response rate and question comprehension. Travelers' awareness of the risks of meningococcal disease were assessed through questions assessing their knowledge of potential disease symptoms, methods of transmission, risk factors, and geographic distribution. A global knowledge score was calculated based upon 11 of the questions; each question scored one point. Social class was classified by using the Registrar General occupational classes I to V, in which I is the highest and V is the lowest.[10]

Statistical analysis. Tests of normality (Kolmogorov–Smirnov test) were applied to the data. Parametric or non-parametric analyses were then performed according to these results. The chi-square test was used for qualitative comparisons with normal distribution data, or Fisher's exact test when required. To adjust for potential confounders, the demographic covariates age and reason for travel, which were found to be significantly associated ($P < 0.05$) with the dependent variable (meningitis vaccination) in the bivariate analysis, were considered for inclusion in the binary logistic regression analysis. Only statistically significant variables without interactions were then included in the final model. Age was stratified in the bivariate analysis to facilitate interpretation.

The magnitude of the association between the outcome (meningitis vaccination) and the explanatory variables was measured by chi-square or Fisher's exact tests, as appropriate The model's ability to discriminate between groups was assessed with the area under the curve; the model's calibration was examined by using the Hosmer and Lemershow tests. All tests were two-tailed, and a P value < 0.05 was defined as statistically significant. All analyses were conducted using SPSS software version 12.0 (SPSS, Chicago, IL).

RESULTS

Demographic profile. Responses were received from 302 British travelers visiting the meningitis belt from England (83.8%), Scotland (8.6%) and Wales (7.6%). Those persons who responded to the survey were predominantly male (53.6%); 35–64 years old (68.6%); belonged to social classes I and II (56.3%); employed (80.3%); traveling for a resort or safari holiday (57.3%); traveling for a duration of 7–14 days (62.9%); and had previous travel experience to Africa (62.9%). One participant stated their purpose of travel was employment as a health care worker.

The gender distribution of the group that responded to the survey was not significantly different from the expected population in the United Kingdom 15–65 years of age.[11] The population that responded to the survey were of a more affluent social class, with more respondents in class I and II than the UK population, as determined by comparison with an IPSOS MORI (London, United Kingdom) survey of travelers ($P < 0.0001$, by chi-square test) and were more affluent than found in a previous survey of travelers to malaria-endemic regions ($P < 0.0001$).[12] This finding may be caused by the considerable costs of travel from the United Kingdom to the meningitis belt of Africa, and in the survey of travelers to malaria-endemic areas, such travelers were found to have a higher median income that those who had not traveled to such areas.

Reasons for travel were similar in our survey than in those seen in the survey of travelers to malaria-endemic regions.[12] There was no statistical difference in overall reason for travel (business or leisure), but significantly less of our population traveled to visit friends and relatives than those visiting malaria-endemic regions ($P < 0.001$). The most common country in Africa that the travelers in our study had visited within the previous three years or were planning to visit in the next six months was Kenya (46% and 35%, respectively), followed by the Gambia (19%, 11%), Nigeria (13%, 12%), Ghana (11%, 12%) and Uganda (10%, 10%). Underlying health co-morbidities were not ascertained.

Sources of travel advice. More than two-thirds (71.2%) of the travelers had consulted their general practitioner (GP) for travel health advice. Others had consulted travel clinics (8.9%) and the internet (12.3%) for travel health information. Only 7.6% of respondents reported seeking no travel health advice.

Travelers who were visiting friends and relatives (n = 67, 22.2%) tended to travel for a longer duration ($P = 0.001$); consulted their GP or travel clinics for travel health advice less frequently ($P = 0.046$); and had made more prior visits to Africa ($P = 0.002$) than other types of travelers. Travelers who were backpackers (n = 28, 9.3%) were more likely to be male ($P = 0.026$), younger ($P < 0.001$), and seek travel health information from travel clinics ($P = 0.014$) or the internet ($P = 0.002$) than other types of travelers.

Meningococcal vaccination. Most (n = 157, 52%) travelers did not plan to be immunized against meningococcal meningitis before travel. However, 36 participants (22.9%) reported that they had previously received an effective vaccine (Figure 2). These 36 participants were therefore subsequently included in the vaccinated group. Meningococcal vaccination uptake by travelers before travel to the meningitis belt (or the intention to receive the vaccine before travel for travelers planning to travel to the meningitis belt within the next six months) was 30.1% (n = 91). The remaining 17.9% (n = 54) of travelers could not recall if they were vaccinated before travel or were unsure if they were planning to be vaccinated. The rate of uptake of vaccination was highest in travelers < 35 years of age, backpackers, business travelers, and those who had previously traveled to a country in Africa. The strength of relationship between these demographic categories and vaccine uptake is shown in Table 1. Vaccine uptake was increased in those with knowledge of the geographic distribution of meningococcal disease.

Meningococcal vaccine acceptability. Among those 157 travelers who were not vaccinated and who did not intend to be vaccinated, the reasons given included that the participant had previously received the vaccine, which remained effective; the GP and/or travel medicine specialist did not recommend the vaccine; the traveler did not consider the vaccine to be necessary; the traveler had previously been immunized against meningitis; the traveler decided to take a risk; the traveler did not feel there was sufficient time to be immunized before travel; and the traveler considered the vaccine too expensive (Figure 2).

Disease attitudes and knowledge. We assessed travelers' awareness of potential infectious disease risks during a trip to Africa. Travelers considered risks to include malaria (89%), yellow fever (73%), rabies (47%), and dengue fever (41%).

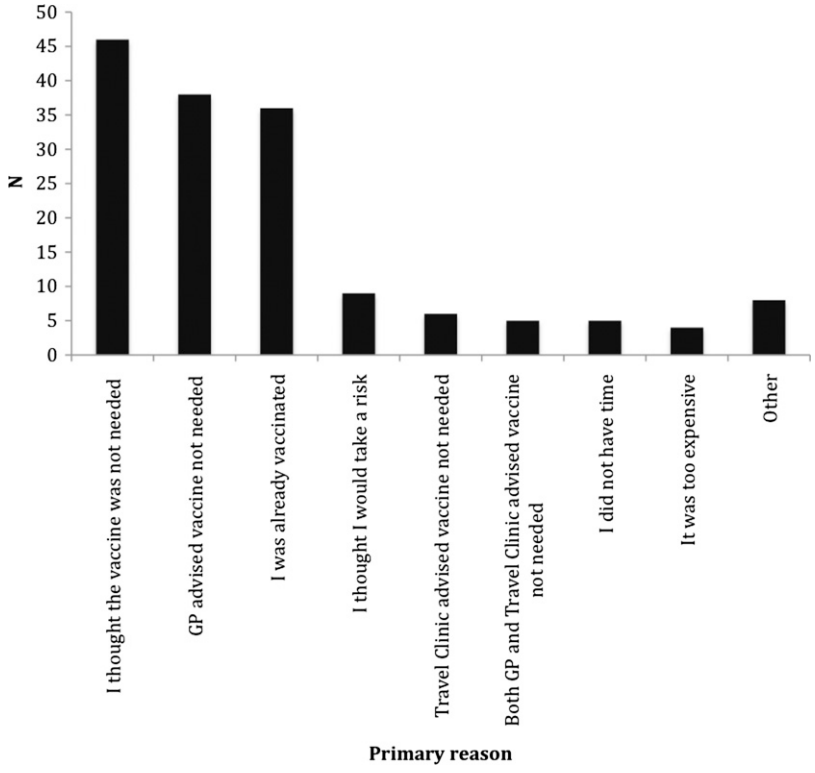

FIGURE 2. Reasons given by participants to not receive quadrivalent vaccination against *Neisseria meningitidis* serotypes ACWY (n = 157). This chart depicts reasons selected by those who chose not to be vaccinated before (n = 157). Data shown are number (N) of survey respondents and the graph shows their primary reason for not receiving or planning to receive a vaccine before travel. GP = general practitioner.

TABLE 1
Demographic information and association with meningitis vaccination status (n= 302)*

Chacteristic	Specific factor	Meningitis vaccination not given or status not known (n = 211) No. (%)	Meningitis vaccination given or planned (n = 91) No. (%)	P†
Age, years	16–24	12 (52.2)	11 (47.8)	< 0.001
	25–34	34 (55.7)	27 (44.3)	
	35–44	58 (73.4)	21 (26.6)	
	45–54	45 (69.2)	20 (30.8)	
	55–64	54 (85.7)	9 (14.3)	
	≥ 65	8 (72.7)	3 (27.3)	
Sex	M	106 (65.4)	56 (34.6)	0.071
	F	105 (75.0)	35 (25.0)	
Social class	I	71 (73.2)	26 (26.8)	0.548
	II	42 (57.5)	31 (42.5)	
	III non-manual	40 (76.9)	12 (23.1)	
	III manual	14 (70.0)	6 (30.0)	
	IV	3 (75.0)	1 (25.0)	
	V	41 (73.2)	15 (26.8)	
Purpose of trip	Business	24 (53.3)	21 (46.7)	0.003
	VFR	46 (68.7)	21 (31.3)	
	Backpacking	16 (57.1)	12 (42.9)	
	Resort based	72 (79.1)	19 (20.9)	
	Safari	38 (70.4)	16 (29.6)	
	Volunteer work	4 (66.7)	2 (33.3)	
	Other	11 (100.0)	0 (0.0)	
Length of trip, days	< 7	9 (60.0)	6 (40.0)	0.908
	7–14	133 (70.0)	57 (30.0)	
	15–30	55 (74.3)	19 (25.7)	
	> 30	14 (60.9)	9 (39.1)	
Previous trip to Africa	No	83 (74.1)	29 (25.9)	0.218
	Yes	128 (67.4)	62 (32.6)	

*Data are no. (%) of patients, unless otherwise indicated. VFR = visiting friends and relatives.
†*P* value obtained by χ^2 test or Fischer exact test as appropriate.

Only one-third of travelers agreed that there was a risk of meningitis when traveling to Africa. This knowledge was increased among those who had visited Africa previously (41%), traveled/were traveling for durations > 14 days (43%), and those who were vaccinated or planned to be vaccinated against meningitis (59%).

A total of 60.8% of our sample of travelers had never previously heard of the meningitis belt. Travelers were less likely to have heard of the meningitis belt if they had not been vaccinated (73%) and/or had not previously visited Africa (70%). Approximately one-third of those questioned (32.8%) stated that they had heard of the meningitis belt but were unable to name a single country in the region.

Knowledge of meningococcal meningitis was analyzed. Most travelers questioned were aware of the symptoms and signs of spots/rash and fever (73%), neck stiffness (66%), and photophobia (62%). Few travelers were aware of shortness of breath (21.8%) as a possible symptom of disease.

More than one-third (37.4%) of respondents were aware of the presence of multiple strains of *Neisseria meningitidis*. Fifty-seven percent of travelers were aware of the risk of invasive infection or carriage and the risk of transmission to family and friends on returning home.

Travelers' global knowledge of meningitis was similar in vaccinated and unvaccinated groups ($P = 0.563$). Vaccinated travelers' knowledge regarding meningitis was greater than that of unvaccinated travelers' concerning the potential symptoms of spots, breathlessness and cold hands ($P < 0.001$); different microbiologic strains ($P = 0.009$); and the risk of exposure to meningitis in Africa ($P < 0.001$).

Persons visiting friends and relatives had a similar global knowledge of meningitis to other types of travelers ($P = 0.724$) though they had lower levels of knowledge regarding potential symptoms and risk of transmission or carriage ($P = 0.020$). Persons visiting friends and relatives had a similar uptake of meningitis vaccine to other types of travelers (37.5%; $P = 0.094$).

Backpackers had a similar global knowledge of meningitis compared with other types of travelers ($P = 0.709$), including the risk of transmission or carriage ($P = 0.511$). However, they had statistically significantly higher levels of knowledge regarding symptoms of meningitis (breathlessness $P = 0.001$, cold hands $P = 0.003$, spots $P = 0.002$); the different meningococcal strains (strain W135; $P = 0.024$); and risk of exposure in Africa ($P = 0.028$). They were more likely to be vaccinated than other groups of travelers (50.0%; $P = 0.003$). In this cohort, 39% of travelers traveling to the meningitis belt for > 30 days were vaccinated in comparison to 29.4% of travelers who traveled for < 30 days ($P = 0.328$).

DISCUSSION

The objective of this study was to investigate the knowledge, attitudes, and practice of immunization against meningococcal disease in travelers to the meningitis belt of Africa. This study demonstrated that knowledge regarding meningococcal infection in travelers was low: mean score of 6.96 (63.3%) of 11 on a questionnaire. Such low levels of awareness were similar to those described in other studies.[13,14] Lack of knowledge occurred even among those at particular risk of meningococcal infection, such as travelers who are travelers visiting friends and relatives, backpackers, and adolescents (14–25 year old).

Traveler's awareness of the risk of contracting meningococcal disease[13] is low, particularly when compared with their understanding of other travel-related infections, such as malaria and yellow fever, and these findings were confirmed by this study.[14] Travelers visiting friends and relatives often have a poor understanding of their risk of infection during travel.[15] This study demonstrated that travelers visiting friends and relatives, in particular, were less likely to seek pre-travel health advice, although they were no less likely than other travelers to seek vaccination against meningitis. Other studies have found that travelers visiting friends and relatives were less likely to seek pre-travel health advice and receive travel vaccinations, and yet are more likely to be at increased risk of exposure to infections because of their staying in closer proximity to local communities for longer durations in developing countries.[16] Meningococcal vaccines are administered less frequently in travelers visiting friends and relatives than in tourist travelers.[15]

Although global knowledge scores did not correlate with likelihood of immunization, awareness of meningitis was associated with increased vaccine uptake. Knowledge of only the symptoms of breathlessness, spots, or rash that does not fade and cold hands or feet appeared to be associated with vaccine uptake. The knowledge of spots or rash may be a result of public health campaigns in the United Kingdom

highlighting the dangers of meningitis that were associated with photographs of such a rash. It is surprising that knowledge of breathlessness and cold hands or feet were associated with likelihood of vaccination but symptoms of stiff neck and fever were not. An association was found between a lack of knowledge of the meningitis belt and lack of awareness of the possibility of exposure in Africa, and a failure to seek vaccination. A logistical regression model was able to predict vaccine uptake by including the following factors: age; those who had not heard of the meningitis belt; those who were not aware they could be exposed to meningitis in Africa; and those who answered symptom questions about breathlessness, rash, and cold hands incorrectly. It is not possible to prove causation for any of the questions included and it is possible that those vaccinated were educated about meningitis and provided with an explanation as to why they were being vaccinated at the time of immunization.

In this study, only 30.1% of travelers were vaccinated or intended to be vaccinated against meningococcal meningitis. A further 11.9% of travelers believed that they did not require immunization because they had already been vaccinated against meningitis. These participants were included as vaccinated in our analysis but it is possible that they had previously received MenC. MenC would provide the traveler with some protection against meningitis but only serogroup C, and a traveler immunized against this type might not appreciate the difference between meningitis vaccines and may therefore believe they do not require a further meningitis vaccine before to travel. In this study, only 37.5% of travelers were aware of the presence of multiple strains of *N. meningitides*. A total of 37.5% of travelers visiting friends and relatives travelers were vaccinated or intended to be vaccinated before travel. Previous studies conducted with travelers visiting friends and relatives showed a misperception of disease risk and limited availability of funds to pay for the vaccine among immigrant families in comparison to other tourists,[15,17] and such factors may have contributed to the limited uptake in our study. Another risk factor increasing risk of infection is prolonged duration of travel, and travelers visiting friends and relatives in this study were found to take longer trips abroad than other travelers. Although the overall percentage of susceptible travelers vaccinated was low, we were encouraged by the non-significant increase in vaccine uptake seen in those traveling for longer periods (> 30 days).

This study had certain limitations, which included potential selection bias because no information was received as to how many participants were invited to be in the survey, and who did not respond and why. When compared with the background population in the United Kingdom, our population belonged to a more affluent social class, as might be expected for those purchasing expensive air travel. However, when compared with a population of travelers to malaria-endemic area, this difference remained, which suggested possible selection bias for more affluent travelers. The overall reasons for travel (business or leisure) were comparable with those traveling to malaria-endemic areas, although our population included less travelers visiting friends and relatives than expected.[12] The survey was only applied once in 2010 and for a limited time frame. Although it is likely that the results remained relevant for subsequent years, it is possible that public health campaigns at the time affected the results and results now would differ. The uptake of vaccination in children was also not investigated. There is potential confounding in that those that had been vaccinated may have been advised about the risk of infection with meningococcal meningitis when they were vaccinated. It therefore cannot be inferred that the absence of advice caused lack of immunization though an association was found. The presence in of immunodeficiencies and asplenia in travelers was not assessed, which would have increased the risk of contracting meningitis. It is assumed that travelers with such co-morbidities would be more likely to have been immunized previously.

All travelers in this study should have received advice regarding the risks of meningococcal disease and been offered vaccination if there were no contraindications because of their destination of travel to a country in the meningitis belt. Despite 50 million persons[18] traveling to developing countries and between 22% and 64% of travelers self-reporting some health problems as a consequence of such travel,[1,18] knowledge and understanding of travel-related infections remains limited.[8] Awareness of the symptoms and signs of meningococcal disease are important to ensure those affected seek help rapidly. Vaccination is the most effective preventive strategy[19] and advice regarding the risks of meningococcal disease and a risk-assessment for the individual traveler should be conducted during a travel health consultation to ensure protection of a traveler against a serious communicable disease.

Our study demonstrates that greater knowledge of the meningitis belt and awareness of meningococcal disease is associated with increased uptake of meningococcal vaccination to prevent disease. We conclude that improved education of travelers may improve vaccine uptake before travel to the meningitis belt in Africa. Our study supports the need for both public health campaigns to increase awareness of meningococcal disease and effective communication with travelers regarding the risks to which they may be exposed, and how these exposures might be prevented.

Received December 23, 2013. Accepted for publication April 22, 2014.

Published online June 2, 2014.

Financial support: Novartis Pharmaceutical supported this work by commissioning the survey and providing data.Disclosure: Novartis Vaccines commissioned the survey from which these data were taken, but have had no editorial input into this report.

Authors' addresses: Anna L. Goodman, Department of Infection and Immunity, University College London, London WC1E 6JF, United Kingdom, E-mail: anna.goodman@nhs.net. Cristina Masuet-Aumatell, Bellvitge Hospital, International Health Centre, Preventive Medicine Department, Antiga Escola d'Enfermeria, 4[a] Planta, Feixa Llarga s/n, L'Hospitalet de Llobregat 08907, Barcelona, Spain, E-mail: cmasuet@bellvitgehospital.cat. Jay Halbert, Department of Paediatrics, University College London Hospitals, London WC16JJ, United Kingdom, E-mail: l j.halbert@nhs.net. Jane N. Zuckerman, World Health Organization Collaborating Centre for Reference, Research and Training in Travel Medicine, University College London Medical School, London NW3 2PF, United Kingdom, E-mail: j.zuckerman@ucl.ac.uk.

REFERENCES

1. Boggild AK, Castelli F, Gautret P, Torresi J, von Sonnenburg F, Barnett ED, Greenaway CA, Lim PL, Schwartz E, Wilder-Smith A, Wilson ME, 2010. Vaccine preventable diseases in returned international travelers: results from the GeoSentinel Surveillance Network. *Vaccine 28:* 7389–7395.

2. Wilder-Smith A, 2007. Meningococcal vaccine in travelers. *Curr Opin Infect Dis 20:* 454–460.
3. Koch S, Steffen R, 1994. Meningococcal disease in travelers: vaccination recommendations. *J Travel Med 1:* 4–7.
4. Moore PS, Harrison LH, Telzak EE, Ajello GW, Broome CV, 1988. Group A meningococcal carriage in travelers returning from Saudi Arabia. *JAMA 260:* 2686–2689.
5. Goldacre MJ, Maisonneuve JJ, 2013. Mortality from meningococcal disease by day of the week: English national linked database study. *J Public Health (Oxf) 35:* 413–421.
6. Norheim G, Rosenqvist E, Aseffa A, Yassin MA, Mengistu G, Kassu A, Fikremariam D, Tamire W, Hoiby EA, Alebel T, Berhanu D, Merid Y, Harboe M, Caugant DA, 2006. Characterization of *Neisseria meningitidis* isolates from recent outbreaks in Ethiopia and comparison with those recovered during the epidemic of 1988 to 1989. *J Clin Microbiol 44:* 861–871.
7. Boisier P, Mainassara HB, Sidikou F, Djibo S, Kairo KK, Chanteau S, 2007. Case-fatality ratio of bacterial meningitis in the African meningitis belt: we can do better. *Vaccine 25 (Suppl 1):* A24–A29.
8. Toovey S, Jamieson A, Holloway M, 2004. Travelers' knowledge, attitudes and practices on the prevention of infectious diseases: results from a study at Johannesburg International Airport. *J Travel Med 11:* 16–22.
9. Public Health England, 2013. *Immunisation against Infectious Disease*. The Green Book: Chapter 22. Meningococcal. London.
10. Office of Populations, Censuses, and Surveys, 1991. *Standard Occupational Classification*. London: HMSO 3.
11. Office of National Statistics UK, 2011. *Population Estimates for UK, England and Wales, Scotland and Northern Ireland, Mid-2010*. London.
12. Behrens RH, Alexander N, 2013. Malaria knowledge and utilization of chemoprophylaxis in the UK population and in UK passengers departing to malaria-endemic areas. *Malar J 12:* 461.
13. Wilder-Smith A, 2009. Meningococcal vaccines: a neglected topic in travel medicine? *Expert Rev Vaccines 8:* 1343–1350.
14. Black S, 2010. Travelers' protection against meningococcal disease: a new vaccine option. *J Travel Med 17 (Suppl):* 18–25.
15. Hagmann S, Benavides V, Neugebauer R, Purswani M, 2009. Travel health care for immigrant children visiting friends and relatives abroad: retrospective analysis of a hospital-based travel health service in a US urban underserved area. *J Travel Med 16:* 407–412.
16. Leder K, Tong S, Weld L, Kain KC, Wilder-Smith A, von Sonnenburg F, Black J, Brown GV, Torresi J, 2006. Illness in travelers visiting friends and relatives: a review of the GeoSentinel Surveillance Network. *Clin Infect Dis 43:* 1185–1193.
17. Angell SY, Cetron MS, 2005. Health disparities among travelers visiting friends and relatives abroad. *Ann Intern Med 142:* 67–72.
18. Gautret P, Schlagenhauf P, Gaudart J, Castelli F, Brouqui P, von Sonnenburg F, Loutan L, Parola P, 2009. Multicenter EuroTravNet/GeoSentinel study of travel-related infectious diseases in Europe. *Emerg Infect Dis 15:* 1783–1790.
19. Steffen R, 2010. The risk of meningococcal disease in travelers and current recommendations for prevention. *J Travel Med 17 (Suppl):* 9–17.