HHS Public Access

Author manuscript

Int J Public Health. Author manuscript; available in PMC 2018 March 01.

Published in final edited form as:

Int J Public Health. 2017 March ; 62(2): 317–325. doi:10.1007/s00038-016-0881-1.

Environmental and occupational health needs assessment in West Africa: opportunities for research and training

Edrisa Sanyang,
Department of Public and Environmental Health, School of Medicine and Allied Health Sciences, The University of The Gambia, Brikama Campus, P.O. Box 5330, Serrekunda, Gambia, Department of Occupational and Environmental Health, College of Public Health, The University of Iowa, 4261 Westlawn, Iowa City, IA 52242, USA

Jaime Butler-Dawson,
Department of Occupational and Environmental Health, College of Public Health, The University of Iowa, 4261 Westlawn, Iowa City, IA 52242, USA

Marek A. Mikulski,
Department of Occupational and Environmental Health, College of Public Health, The University of Iowa, 2213 Westlawn, Iowa City, IA 52242, USA

Thomas Cook,
Ponseti International Association, University of Iowa, Healthcare, 118 College of Medicine Administration Building, Iowa City, IA 52242, USA

Rex A. Kuye,
Department of Public and Environmental Health, School of Medicine and Allied Health Sciences, The University of The Gambia, Brikama Campus, P.O. Box 5330, Serrekunda, Gambia

Kristina Venzke, and
Department of Occupational and Environmental Health, College of Public Health, The University of Iowa, 4261 Westlawn, Iowa City, IA 52242, USA

Laurence J. Fuortes
Department of Occupational and Environmental Health, College of Public Health, The University of Iowa, 2207 Westlawn, Iowa City, IA 52242, USA

Abstract

Objectives—Data are lacking on environmental and occupational health risks and resources available for the prevention of related diseases in the West African subregion.

Correspondence to: Laurence J. Fuortes.

Compliance with ethical standards

Conflict of interest Edrisa Sanyang declares he has no conflict of interest to declare. Jaime Butler-Dawson declares she has no conflict of interest to declare. Marek Mikulski declares he has no conflict of interest to declare. Thomas Cook declares he has no conflict of interest to declare. Rex Kuye declares he has no conflict of interest to declare. Kristina Venzke declares she has no conflict of interest to declare. Laurence Fuortes declares he has no conflict of interest to declare.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Methods—A needs assessment survey was conducted to identify environmental and occupational health concerns, and needs and strategies for skills training in the region. The survey was followed by a consensus-building workshop to discuss research and training priorities with representatives from countries participating in the study.

Results—Two hundred and two respondents from 12 countries participated in the survey. Vector-borne diseases, solid waste, deforestation, surface and ground water contamination together with work-related stress, occupational injury and pesticide toxicity were ranked as top environmental and occupational health priorities, respectively, in the region. Top training priorities included occupational health, environmental toxicology and analytic laboratory techniques with semester-long Africa-based courses as the preferred type of training for the majority of the courses. Major differences were found between the subregion's three official language groups, both in perceived health risks and training courses needed.

Conclusions—The study results have implications for regional policies and practice in the area of environmental and occupational health research and training.

Keywords

Occupational health; Environmental health; Needs assessment; West Africa

Introduction

Environmental factors are attributed to an estimated 24 % of the disease burden and 23 % of all deaths globally. Diseases with the largest environmental contributions include diarrhea, lower respiratory infections, unintentional injuries such as workplace hazards and industrial accidents, and malaria (Prüss-Üstün and Corvalän 2006). In Africa, 28 % of the disease burden is caused by environmental issues. Continuing environmental challenges in the region include access to safe drinking water, sanitation and hygiene facilities, waste disposal, air pollution, deforestation, loss of soil and soil fertility, and disease vectors (World Health Organization 2010a). Hazardous working conditions also pose a public health challenge in Africa (Siziya et al. 2013). In the World Health Organization (WHO) Africa Region, it is estimated that annually at least 43,000 people die from diseases and injuries associated with hazardous working conditions, particularly accidents and airborne particulates (World Health Organization 2010b).

With an average life expectancy of 51 years (Central Intelligence Agency 2014), Sub-Saharan countries including the West Africa region are experiencing an increase in the burden of chronic diseases such as diabetes, hypertension, cardiovascular disease, and cancers (Abegunde et al. 2007). An estimated one-third of the disease burden in this region can be attributed to environmental hazards that have historically included water quality, waste systems, and poor sanitation (Prüss-Üstün and Corvalän 2006). Economic development, urbanization, and continuing industrialization are also increasingly putting large segments of the population at risk for adverse health effects from a new set of hazards, including toxicological and work-related hazards (Nweke and Sanders 2009).

The population of West Africa is estimated at between 300 and 350 million people in 18 countries (Economic Community of West African States 2014). The region has experienced high burdens of acute infectious diseases with episodic rapid spread between countries (most recently Ebola) as a result of regional conflicts, porous borders, differing languages and traditions, floods, and generalized poverty (Saker et al. 2004; Mboera et al. 2014; Alexander et al. 2015). The public health foci of the West African Health Organization (WAHO), the health arm of the Economic Community of West African States (ECOWAS), a group of 15 West African countries, has traditionally been the prevention of infectious diseases such as malaria, human immunodeficiency virus (HIV), tuberculosis, yellow fever, cholera, and eye diseases; maternal and child health initiatives including nutrition and vaccination programs have also been focused upon. Data are lacking on the emerging environmental and occupational health risks and the resources available for the prevention of related diseases in this West African subregion.

This study reports on the results of an environmental and occupational health needs assessment in the ECOWAS subregion. The needs assessment, including an environmental and occupational health needs assessment survey and subsequent consensus-building workshop, was conducted by a team from the University of The Gambia (UTG), Banjul, The Gambia, in collaboration with the University of Iowa (UI), Iowa City, USA, as part of the Global Environmental and Occupational Health (GEO-Health) projects R24-TW009564 and R24-TW009571, funded by Fogarty International Center of the National Institutes of Health. The objectives of this project were to identify environmental and occupational health hazards in the subregion and to explore opportunities for improved research and training in the broad discipline of public health.

Methods

The environmental and occupational health needs assessment survey was developed to identify and prioritize the occupational and environmental health concerns, as well as the perceived needs and strategies for public health training in the subregion. Personal visits by the GEOHealth project team were conducted preceding the survey to establish contact and exchange ideas on research and training collaborations in environmental and occupational health. The survey included a broad range of questions on issues including waste, water contamination, disease vectors, air pollution, erosion, and biodiversity loss; work-related injuries and hazards; and training needs and strategies in public health. It was distributed by email to government and academic institutions, non-governmental organizations (NGOs), and private sector and international agencies, all with the main scope of activities in environmental and occupational health practice and training and identified with the help of regional experts.

The survey was developed in English and translated into French and Portuguese, the three official ECOWAS languages of the ECOWAS subregion. Respondents were asked to rank risks according to environmental and occupational health priorities in their countries, i.e., “no priority/no need for action” versus “low, medium or high risk/top priority”. Responses were collected over a period of 8 months and, for the purpose of analysis, missing responses were coded as “no priority/no need for action.” Analysis including calculation of frequencies

and distribution of survey responses by respondent's characteristics was completed in Microsoft Excel 2013.

Results from the survey were shared with participants in a 2-day consensus-building workshop held in Banjul, The Gambia, May 22 and 23, 2014. Those invited were selected by the National Ministries of Health and Environment to be the project points-of-contact for each country's task teams. Representatives from ten ECOWAS countries (Table 1) participated in the workshop together with the GEOHealth project team members from the Universities of The Gambia and Iowa. During the workshop, participants were divided into regional language groups to discuss individual country needs and opportunities in environmental and occupational health. WAHO was consulted throughout the study and its representatives participated in the consensus-building workshop.

Results

Table 2 presents the distribution of survey responses by country, official language, and the institution of the respondent. Respondents from 12 ECOWAS countries participated in the survey. Benin, Ghana, and Togo were not represented due to lack of contact and/or limited time to conduct the survey. Two hundred and two questionnaires ($N = 202$) were received. The majority of the respondents reported employment in academia (37.0 %) and government (33.3 %), followed by research (19.6 %), NGOs (7.4 %), and private sector (2.7 %). Fifteen respondents reported employment with more than one institution including: academic and research ($n = 8$); academic and NGO ($n = 1$); academic, research and NGO ($n = 1$); academic, government and research ($n = 1$); government and NGO ($n = 1$); government and private sector ($n = 1$); and government and research ($n = 2$).

Ranking of environmental health priorities by each official ECOWAS language group is presented in Table 3. Over three-quarters of all survey respondents ranked vector-borne disease and solid waste as environmental health priorities in the region. These hazards outranked deforestation and surface and groundwater contamination. Major differences were observed between language groups with half to three-quarters of Portuguese-speaking (Luso-phone) respondents ranking drought, erosion, and human excreta as environmental health priorities compared to less than half of the French- (Francophone) and English- (Anglophone) speaking respondents. On the other hand, hazards such as toxic waste and groundwater contamination were reported as a higher priority by Francophone respondents than the other language groups. Electronic waste and indoor air pollution were ranked as higher priorities in Anglophone than in Lusophone and Francophone countries.

Work-related stress, occupational injuries, and pesticide exposure and toxicity were ranked as top occupational health priorities in all countries (Table 4). These hazards outranked (minimally) job-related indoor air pollution and traffic injuries. Nearly all occupational health priorities were ranked higher by respondents from Anglophone and Francophone countries than Lusophone countries, with the exception of traffic-related injuries that were closely ranked between the Francophone and Lusophone respondents. Also, major language group differences were observed in the ranking of pesticide exposure and toxicity: over 50.0 % of Francophone respondents ranked this area as a top priority for action in

occupational health compared to 27.2 % of Anglophone and 12.5 % of Lusophone respondents.

The ranking of public health training area priorities is presented in Table 5. Occupational health training was ranked as the top priority, followed by environmental toxicology and analytic laboratory techniques. Lusophone respondents ranked injury epidemiology and health policy as top priorities for training (85 and 100 %, respectively), compared to 48 and 50 % of Anglophones and 25 and 58 % of Francophones, respectively. On the contrary, only 12.5 % of Lusophone respondents ranked environmental toxicology, biostatistics and ergonomics as highly needed training areas compared to 62, 39, and 32 % of Franco-phone and 57, 48, and 24 % of Anglophones, respectively.

Ranking of training priorities by the type of training is presented in Table 6. Africa-based semester-long training was the top-ranked training type for the majority of the training courses. Respondents preferred out-of-Africa semester-long training for biostatistics, analytic laboratory techniques, geographic information systems (GIS), and data management and preferred an Africa-based short, 2- to 3-week course for grant-writing strategies.

Discussion

The purpose of this needs assessment study was to identify environmental and occupational health concerns and training priorities in the ECOWAS subregion. The survey and the consensus-building workshop focused on pertinent health risk factors including the effects of climate change, water pollution, air pollution, pesticide exposure, waste management, work practices and associated health risks, and the training priority areas to address them. The study results are intended to explore opportunities for improved research and training specific to the needs in the region.

Traditional environmental health hazards including poor sanitation continue to be the major contributing factors to most of West Africa’s chronic disease burden (Nweke and Sanders 2009). However, with development and industrialization, other environmental factors such as sea-level rise, toxic waste, pesticide toxicity, and traffic-related injuries are becoming increasingly important contributors to the region’s disease burden. Our survey indicates that vector-borne diseases and solid waste remain the top priority environmental health challenges identified in the region. Although most of the countries are undergoing disease transition, vector-borne diseases such as malaria continue to pose a major public health problem. Consequently, highly toxic and ecologically dangerous pesticides such as DDT are being applied for vector control. Continuous pesticide applications for vector control and agricultural use result in ongoing and potentially increasing human exposure.

From the survey, delineations of different environmental health concerns across language groups in the region have been suggested. For example, Lusophone countries overwhelmingly reported concerns over drought and erosion, while Francophone countries prioritized toxic waste and pesticide toxicity. E-waste and indoor air pollution were evident priorities in Anglophone countries. There are likely associations between a country’s official post-colonial languages, geographic and climactic factors, industrial activities, and economic

resources that may potentially affect occupational and environmental health risks (Laitin and Ramachandran 2014). While this survey is not a random sample across professional status groups, countries or language groups in the region, given the limited number of respondents from Francophone and specifically Lusophone countries, these differences do suggest region-specific strategies for skills transfer and response to regional and country-specific threats

Toxic waste and pesticides exposures are major public health challenges across the subregion (Ogri et al. 2009; Murphy et al. 2012; Fasinu and Orisakwe 2013). Mining is a common industrial activity in West Africa. Ghana and Mali are leading exporters of gold, while Guinea Conakry leads in the production of bauxite. Toxic wastes from mines continue to have potentials for adverse health effects and environmental degradation. Although most countries in the subregion recognize the need to reduce pollution, environmental controls either do not exist or are inadequate (Ogri et al. 2009). Most industries discharge effluents into the environment without any prior treatment, and the manufacturing of products may place both workers and nearby residents at risk due to lack of strict controls. Even where controls exist on paper, they are difficult to enforce amidst limited resources (Ogri et al. 2009). Pollution levels in many West African countries are at critical points, as the current levels of many metals in water, fish, soils, vegetables, and food animals exceed international limits (Ogri et al. 2009; Yabe et al. 2010; Rezaie-Boroon et al. 2011; Fasinu and Orisakwe 2013). This increases the odds of unfavorable health and economic outcomes.

Additionally, West Africa faces a rising tide of e-waste from aged, donated, or discarded electrical and electronic equipment. In a recent study in five West African countries, Schluep and colleagues found that between 650,000 and 1,000,000 tons of domestic e-wastes are generated each year (Schluep et al. 2012). Although the majority of the imported equipment is destined for re-use after testing and repair, there are significant volumes of unrepairable equipment that further add to local e-waste generation. This study further found that the sale of used electrical and electronic equipment is an important economic activity in the two bigger Anglophone West African Countries, Ghana and Nigeria (Schluep et al. 2012). This trade may likely continue to grow in these countries and other countries in the subregion, thereby continuing to impact negatively on the health of the population.

Work-related stress and road traffic injuries were the two top occupational health priorities identified for the region in this study. Although there are no data suggesting that job stressors cause adverse health effects in the subregion, the indirect evidence is strongly suggestive of a work-related stress effect. This evidence comes from different occupational studies that show differences in health and mortality that are not easily explained by other factors and studies that demonstrate a causal effect of work experiences on physiological and emotional responses (Ganster and Schaubroeck 1991; Ganster and Rosen 2013). While the share of the world’s poorest countries in world trade has decreased, workers in these countries increasingly find themselves in insecure, poor-quality jobs, often involving technologies which are obsolete. Those outside the workplace can also be affected through work-related environmental pollution and poor living conditions.

As the burden of environmental, occupational, and chronic disease in general increases in West Africa, the numbers and skill sets of health personnel are not keeping pace. In sub-Saharan Africa, for example, the estimated health workforce is 1.3 % of the world's health workforce and are responsible for addressing the health-care needs of over 25 % of the world's burden of disease (Anyangwe and Mtonga 2007). Therefore, training and continuing education of health professionals remain a priority to all ECOWAS member countries, which carry most of the disease burden.

The results of this survey indicate the need to improve the capacity in the areas of occupational health, environmental toxicology, and analytic laboratory techniques. Since 2004, the WHO African region has expressed a need for occupational health and safety services to reduce the rates of work-related diseases and injuries. This is aimed at extending the public health agenda to the workplace. There is an upsurge in the handling of toxic waste (including toxic waste dumping by foreign entities) which calls for the need to increase the capacity of analytic techniques, including environmental toxicology, analytic laboratory techniques, and biostatistics. Scientists in the region may be lacking either laboratory infrastructure or the analytic skill sets to conduct the research required to guide the development of national policies and regulations through local evidence.

One of the goals of this study was to identify gaps in environmental and occupational health training and identify preferences in training strategies to address these gaps. Africa-based semester-long training was identified as the preferred training modality for most of the topical areas. However, the preferred training modality for more analytical and computational courses such as biostatistics, analytic laboratory techniques, geographic information systems, and data management was out-of-Africa-based training. These analytical public health fields are growing in depth, breadth, and complexity as show the examples from other countries (Paccaud et al. 2013; Vukovic et al. 2014). They are cross-cutting and several essential services can benefit from such work force development (Bjegovic-Mikanovic et al. 2012). Based on the reported environmental and occupational health priorities, training of a pool of motivated experts in these domains will contribute greatly to addressing the challenges of the subregion (Siron et al. 2015).

This needs the assessment survey to be limited in the selection of respondents. The project team was based in The Gambia and The Gambia being one of the smaller countries in the region had, respectively, the highest number of respondents. There are two Lusophone countries in the region compared with five Anglophone and eight Francophone countries. Moreover, the response rates from the Lusophone respondents were low compared to those from other language groups and these may affect the generalizability of the findings. The study team, however, decided it was important to present the responses by language groups, given the observed differences and implications for subregional policies.

Another limitation is the lack of information on the educational background of the respondents and their length of experience in environmental and occupational health practice. This study was intended as a needs assessment for the region and collected information on participants' employment in major institutions, all with environmental and occupational health focus on practice and training, as more relevant to the assessment of the

needs in major areas of public health. Those institutions were selected with the help of WAHO and other practitioners in the field. It is possible that these may not be representative of the entire environmental and occupational health practice in the studied countries and furthermore their perceptions may be limited to the historical scope or mandate of their particular agencies or posts.

To the best of our knowledge, this is the very first regional survey to assess the environmental and occupational health needs in the WAHO member countries that also identified and prioritized the training needs for the subregion. The results have great implications for public health practice, because three language groups have identified different training modalities to address cross-cutting environmental and occupational health risk factors. This speaks for the need for the coordination of regional efforts to address environmental and occupational health risk factors. The work will be very useful to WAHO and other regional, bilateral, and multilateral agencies as well as in-country agencies as the basis for prioritizing environmental and occupational health interventions, including training, to strengthen the abilities of public health professionals and institutions and prevent disability and death due to environmental and occupational hazards.

Acknowledgments

The authors thank the West African Health Organization (WAHO), Prof. Muhammadou M.O. Kah, former president, University of The Gambia, and Prof. Ousman Nyan, Provost, School of Medicine and Allied Health Sciences, The University of The Gambia, for their valuable guidance and championing this subregional effort.

Funding This study was part of the Global Environmental and Occupational Health (GEOHealth) Projects R24-TW009564 and R24-TW009571 and was funded by Fogarty International Center of the National Institutes of Health.

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Table 1

Participants in the GEOHealth consensus-building workshop, 2014

Country	Institution	Representatives (*N*)	Type of institution
Burkina Faso	West African Health Organization (WAHO)	1	International Agency (Health)
	Centre Muraz	1	Research (Health and Environment)
Gambia	Ministry of Health and Social Welfare	1	Government Agency (Health)
	The University of The Gambia (UTG)	4	Academic (Medicine and Public Health)
	Center for Innovation Against Malaria (CIAM)—Public Health Research and Development Centre	1	NGO Health
Liberia	Ministry of Health and Social Welfare	1	Government Agency (Health)
Nigeria	Environmental Health Officers Registration Council (EHORECON)	1	Government Agency (Policy and Enforcement)
	American University of Nigeria	1	Academic (Environment)
	Kwara State University	1	Academic (Environment)
Sierra Leone	Njala University	1	Academic (Community and Agricultural Health)
Ivory Coast	Universite Felix Houphouet-Boigny	1	Academic (Pharmacy)
Mali	National Research Institute in Public Health	1	Government Agency (Research)
Senegal	Gaston Berger University	1	Academic (Nutrition)
Cape Verde	Associação para a Defesa do Ambiente e Desenvolvimento (ADAD)	1	NGO (Environment)
Guinea Bissau	Ministry of Health	1	Government Agency (Health)
USA	The University of Iowa	3	Academic (Occupational and Environmental Health)

Table 2

Distribution of needs assessment survey responses by country, official language, and institution employed (2013–2014)

Country (*N*)	Institution/agency					
	Academic	**Government**	**Research**	**NGO**	**Private sector**	**Total responses**
Anglophone						
Gambia (*N* = 86)	46	23	13	3	2	87 (39.7)
Liberia (*N* = 11)	1	10	1	1	–	13 (5.9)
Nigeria (*N* = 24)	9	11	1	2	1	24 (11.0)
Sierra Leone (*N* = 4)	2	2	–	1	–	5 (2.3)
Francophone						
Burkina Faso (*N* = 9)	2	5	2	–	–	9 (4.1)
Guinea Conakry (*N* = 9)	–	1	2	6	–	9 (4.1)
Ivory Coast (*N* = 37)	16	12	15	1	3	47 (21.5)
Mali (*N* = 9)	1	1	9	1	–	12 (5.5)
Niger (*N* = 3)	1	2	–	–	–	3 (1.4)
Senegal (*N* = 2)	2	–	–	–	–	2 (0.9)
Lusophone						
Cape Verde (*N* = 3)	–	3	–	–	–	3 (1.4)
Guinea Bissau (*N* = 5)	1	3	–	1	–	5 (2.3)
Total surveys (*N* = 202)	81 (37.0)	73 (33.3)	43 (19.6)	16 (7.4)	6 (2.7)	*N* = 219

Table 3

Top-ranked priorities for action in environmental health by countries' official language (2013–2014)

Country [*N* (%)]	Priorities for action									
	Disease vectors	**Solid waste**	**Deforestation**	**Surface water contamination**	**Ground water contamination**	**Outdoor air pollution**	**Toxic waste**	**Biodiversity loss**	**Erosion**	**Human excreta**
Anglophone (*N* = 125)	96 (76.8)	92 (73.6)	74[a] (59.2)	45[a] (36.0)	53 (42.4)	59 (47.2)	49 (39.2)	51 (40.8)	59 (47.2)	52[a] (41.6)
Francophone (*N* = 69)	55[a] (79.7)	53[a] (76.8)	47[a] (68.1)	48[a] (69.6)	38[a] (55.1)	32[a] (46.4)	42[a] (60.9)	35 (50.7)	23 (33.3)	27[a] (39.1)
Lusophone (*N* = 8)	6 (75.0)	8 (100.0)	5 (62.5)	4 (50.0)	2 (25.0)	2 (25.0)	1 (12.5)	5 (62.5)	4 (50.0)	4 (50.0)
Total surveys (*N* = 202)	157 (77.7)	153 (75.7)	126 (62.4)	97 (48.0)	93 (46.0)	93 (46.0)	92 (45.5)	91 (45.1)	86 (42.6)	83 (41.1)

Country [*N* (%)]	Priorities for action								
	Drought	**Indoor air pollution**	**Soil degradation**	**Floods**	**Marine pollution**	**Electronic waste**	**Sea level rise**	**Animal excreta**	**Saline intrusion fresh water**
Anglophone(*N* = 125)	39[a] (31.2)	56 (44.8)	39 (31.2)	42 (33.6)	37 (29.6)	48 (38.4)	27 (21.6)	26 (20.8)	27 (21.6)
Francophone(*N* = 69)	30[a] (43.5)	16 (23.2)	29[a] (42.0)	25 (36.2)	26 (37.7)	9 (13.0)	16 (23.2)	15 (21.8)	10 (14.5)
Lusophone (*N* = 8)	6 (75.0)	1 (12.5)	2 (25.0)	2 (25.0)	3 (37.5)	1 (12.5)	1 (12.5)	2 (25.0)	3 (37.5)
Total surveys (*N* = 202)	75 (37.1)	73 (36.1)	70 (34.7)	69 (34.2)	66 (32.7)	58 (28.7)	44 (21.8)	43 (21.3)	40 (19.8)

[a]Includes institutional responses—Centre Muraz and Department of Environmental Health (Burkina Faso) and Ministry of Health and Social Welfare (Liberia)

Table 4

Top-ranked priorities for action in occupational health by countries' language (2013–2014)

Country [*N* (%)]	Priorities for action						
	Stress	Occupational injuries	Pesticide exposure and toxicity	Indoor air pollution (job related)	Traffic Injuries (job related)	Metals exposure and toxicity	Musculoskeletal injuries
Anglophone (*N* = 125)	55 (44.0)	52 (41.6)	34 (27.2)	48 (38.4)	51 (40.8)	29 (23.2)	37 (29.6)
Francophone (*N* = 69)	25[a] (36.2)	22 (31.9)	40[a] (58.0)	25 (36.2)	20[a] (29.0)	34[a] (49.3)	17 (24.6)
Lusophone (*N* = 8)	2 (25.0)	1 (12.5)	1 (12.5)	1 (12.5)	2 (25.0)	–	–
Total surveys (*N* = 202)	82 (40.6)	75 (37.1)	75 (37.1)	74 (36.6)	73 (36.1)	63 (31.2)	54 (26.7)

[a]Includes institutional responses—Centre Muraz and Department of Environmental Health (Burkina Faso) and Ministry of Health and Social Welfare (Liberia)

Table 5

Distribution of training priorities by countries' language (2013–2014)

Country [*N* (%)]	Training priorities								
	Occupational health	Environmental toxicology	Analytic lab techniques	Health systems management	Epidemiology	Health policy	Grant writing	Health education	Agricultural health
Anglophone (*N* = 125)	86[a] (68.8)	71[a] (56.8)	74[a] (59.2)	69 (55.2)	70 (56.0)	62[a] (49.6)	65[a] (52.0)	63 (50.4)	66[a] (52.8)
Francophone (*N* = 69)	41[a] (59.4)	43[a] (62.3)	35[a] (50.7)	37[a] (53.6)	34[a] (49.3)	40[a] (58.0)	38[a] (55.1)	41[a] (59.4)	39[a] (56.5)
Lusophone (*N* = 8)	5 (62.5)	1 (12.5)	6 (75.0)	6 (75.0)	7 (87.5)	8 (100.0)	6 (75.0)	4 (50.0)	3 (37.5)
Total surveys (*N* = 202)	132 (65.3)	115 (56.9)	115 (56.9)	112 (55.4)	111 (54.9)	110 (54.5)	109 (54.0)	108 (53.5)	108 (53.5)

Country [*N* (%)]	Training priorities							
	Industrial hygiene	Data management	Health informatics	Behavioral health	GIS	Biostatistics	Injury epidemiology and prevention	Ergonomics
Anglophone (*N* = 125)	70 (56.0)	70 (56.0)	66 (52.8)	61[a] (48.8)	59[a] (47.2)	60[a] (48.0)	60 (48.0)	30 (24.0)
Francophone (*N* = 69)	32 (46.4)	29[a] (42.0)	22[a] (31.9)	29 (42.0)	29[a] (42.0)	27[a] (39.1)	17[a] (24.6)	22 (31.9)
Lusophone (*N* = 8)	2 (25.0)	5 (62.5)	6 (75.0)	4 (50.0)	4 (50.0)	1 (12.5)	7 (87.5)	1 (12.5)
Total surveys (*N* = 202)	104 (51.5)	104 (51.5)	94 (46.5)	94 (46.5)	92 (45.5)	88 (43.6)	84 (41.6)	53 (26.2)

[a]Includes institutional responses—Centre Muraz and Department of Environmental Health (Burkina Faso) and Ministry of Health and Social Welfare (Liberia)

Table 6

Distribution of training priorities by type of training (2013–2014)

Type of training *N* (% of responses)	Training priorities								
	Epidemiology	Health systems management	Environmental toxicology	Health education	Health policy	Behavioral health	Agricultural health	Occupational health	Analytic lab techniques
Africa-based semester/long term	87 (43.3)	87 (41.6)	83 (39.7)	82 (39.8)	80 (38.5)	83 (40.5)	76 (38.0)	74 (35.9)	71 (33.8)
Out-of-Africa semester/long term	65 (32.3)	60 (28.7)	69 (33.0)	33 (16.0)	47 (22.6)	27 (13.1)	35 (17.5)	62 (30.1)	87 (41.4)
Africa-based short term (2–3 weeks)	33 (16.4)	37 (17.7)	35 (16.7)	62 (30.1)	49 (23.6)	62 (30.2)	69 (34.5)	47 (22.8)	30 (14.3)
Distance/computer based	7 (3.5)	19 (9.1)	19 (9.1)	22 (10.7)	28 (13.5)	24 (11.7)	12 (6.0)	21 (10.2)	15 (7.1)
No need for training	9 (4.5)	6 (2.9)	3 (1.4)	7 (3.4)	4 (1.9)	9 (4.4)	8 (4.0)	2 (1.0)	7 (3.3)

Type of training *N* (% of responses)	Training priorities							
	Injury epidemiology and prevention	Industrial hygiene	GIS	Grant writing	Health informatics	Ergonomics	Biostatistics	Data management
Africa-based semester/long term	66 (33.3)	64 (32.0)	63 (30.9)	60 (28.4)	58 (29.3)	55 (28.2)	52 (26.1)	46 (22.5)
Out-of-Africa semester/long term	46 (23.2)	47 (23.5)	69 (33.8)	43 (20.4)	56 (28.3)	49 (25.1)	61 (30.6)	54 (26.5)
Africa-based short term (2–3 weeks)	51 (25.8)	59 (29.5)	27 (13.2)	81 (38.4)	35 (17.7)	45 (23.1)	54 (27.1)	51 (25.0)
Distance/computer based	27 (13.6)	26 (13.0)	37 (18.1)	23 (10.9)	45 (22.7)	30 (15.4)	18 (9.0)	51 (25.0)
No need for training	8 (4.0)	4 (2.0)	8 (3.9)	4 (1.9)	4 (2.0)	16 (8.2)	14 (7.0)	2 (1.0)