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Knowledge in pre-hospital emergency and risk management among outdoor adventure practitioners in East Africa afro-alpine mountains

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ABSTRACT

Introduction: The enjoyment of nature and other benefits of outdoor activities happen amid inherent hazards. This calls for knowledge and competency in emergency and risk management. Practitioners in outdoor activities, such as mountaineering, thus need to be knowledgeable on how to manage risks and attend to emergencies in their practice. The study sought to establish the preparedness of East African mountaineering practitioners in prehospital emergency and risk management. It sought to establish their knowledge on prehospital emergency and risk management, based on their age, gender, level of education and refresher training.

Methods: The study purposively sampled one hundred and thirty six ($N = 136$) outdoor adventure practitioners from the Afro-alpine mountain areas in East Africa. It was hypothesized that there would be no significant relationship between the outdoor practitioners' knowledge in prehospital emergency risk management and their age, gender, level of education, refresher training. Somers' d was used to test the hypotheses.

Results: It was established that the knowledge scores of prehospital emergency and risk management for the mountaineering practitioners was low. It was also established that the knowledge scores of outdoor practitioners were not dependent on their age, gender, and work experience. However, there was a significant relationship between the outdoor adventure practitioners' knowledge scores and their highest level of education as well as refresher training.

Conclusions: The study concluded that there were gaps in the knowledge of prehospital risk management of the East African Afro-alpine mountaineering practitioners. It recommends frequent and regular training and re-certification among outdoor adventure practitioners in order to raise the knowledge in prehospital emergency risk management.

African relevance

- Identifying prehospital emergency care knowledge by African outdoor practitioners can guide planning for training.
- Prehospital emergency care is not emphasized in the outdoor adventure practice in many African settings.
- With inaccessible health care in African outdoors, there is need for knowledge in prehospital emergency risk management.

Introduction

Outdoor adventure activities create challenge and excitement by deliberately exposing participants to elements of risk [1]. Most of these activities, however take place in remote locations like mountains, which are far from medical facilities. In the event of incidences such as illnesses and injuries, it would be expected that the practitioners in the outdoor adventure settings are knowledgeable in prehospital emergency and risk management in order to manage the situations before reaching a medical facility [2]. Prehospital emergency and risk management (PHERM) for the outdoor adventure practitioners involves the assistance provided to injured or ill persons in order to save life or prevent further escalation of the situation before professional medical care is available [3].

Due to the inherent risks of injuries and illnesses during outdoor adventure pursuits, there is need for sufficient knowledge in PHERM. Society's growth in interest in outdoor adventure activities, demands for safety concerns in the industry [4,5]. The safety challenge lies in the unavailability of medical professionals in the outdoor wilderness environments [6]. This is likely to happen as professional medical service is rarely prioritized on outdoor adventure leadership activities [7].

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Mountaineering expeditions planning should have a consideration for an expedition doctor [8]. It is however, acceptable that mountaineering leaders and practitioners have a role to play in emergency care before casualties are transferred to health facilities, hence their need to have knowledge in PHERM [9]. It is also possible that anyone doing mountain climbing, including the medical personnel, can be incapacitated due to high altitude mountain conditions [8] thus creating a medical response gap. The balance for this gap is that mountaineering leaders and practitioners should ensure that they get sufficient knowledge in PHERM through training. Training in wilderness PHERM is held with the same standard as the mainstream medical- related training, whereby the need for continuous education is emphasized [10]. Therefore, practitioners in wilderness mountain adventure are expected to do refresher courses to ensure their knowledge is up to date.

Mountaineering offers a unique environment, of which the outdoor adventure industry considers wilderness first aid to be the minimum standard of training in prehospital emergency care for practitioners [9,11,12]. In East Africa, the afro-alpine mountains areas include Mt. Kilimanjaro, Mt. Kenya, and the Rwenzori Ranges with elevations of 5895 m (19,341 ft), 5199 m (17,057 ft) and 5109 m (16,762 ft) above sea level, respectively. In order to handle wilderness and extreme exertion of mountain peaks, practitioners need to be knowledgeable in mountaineering expedition issues like high altitude physiology and illness, exposure injuries, and trauma care [13,14].

For mountain expeditions, there are a number of minimum PHERM requirements guidelines that have been provided [9,15]. These guidelines expect practitioners to be knowledgeable in specific injuries and illnesses management in mountaineering. The East African Afro-alpine mountains areas do not have available minimum guidelines for curriculum of wilderness PHERM as is the case in the developed countries. Therefore, in East African Afro-alpine regions, wilderness PHERM courses are offered by international institutions, usually with local East African franchises, such as Sentinel Outdoor Institute, Stonehearth Open Learning Opportunities (SOLO) Wilderness Medical School, and National Outdoor Leadership School (NOLS) Wilderness Medicine Institute. Such courses include wilderness first aid, and wilderness first responder. For advanced wilderness emergency training, like wilderness emergency medical technician course, the East African mountain climbing practitioners would have to get training from international institutions outside East Africa.

Being knowledgeable in PHERM helps in the mitigation of negative consequences and managing of outdoor environments effectively during occurrences of incidents [16]. There is need to ensure retention of core knowledge of safety measures by practitioners in mountain climbing so that they respond well to the safety of the clients [17,18]. Studies have investigated knowledge in wilderness prehospital care, using varied tools [19–21]. But there is dearth of information on how wilderness emergency care is practised by the local mountaineering practitioners in the East Africa afro-alpine mountains. This paper, therefore, does a base-line assessment of the mountaineering practitioners' knowledge in prehospital emergency and risk management in East Africa. The paper considered practitioners whose main activity was to take clients to the East Africa afro-alpine mountain peaks of Rwenzori Ranges, Mt. Kilimanjaro and Mt. Kenya. Thus, the objective of this study was to investigate the knowledge in various types of injuries/illnesses among the East Africa Afro-alpine mountains outdoor adventure practitioners. The study also sought to find out whether there were relationships between the practitioners' knowledge in prehospital emergency risk management and their gender, age, level of education, and up-to-date refresher training.

Methods

The findings in this paper are based on data collected in a larger research study, which was a cross sectional descriptive survey, aimed at establishing the outdoor adventure practice in the Afro-Alpine mountain areas in East Africa. This paper assesses the knowledge of PHERM by outdoor adventure mountaineering practitioners in East Africa. Ethical approval for conducting the study was obtained from Kenyatta University Ethics Review Committee, Ref. No: KU/ERC/APPROVAL/VOL. 1(34). Permission to conduct the study was also sought from park authorities and various outdoor adventure leadership institutions which are involved in mountain climbing in East Africa. Informed consent to get involved in the study was sought from each respondent after a detailed explanation of the nature and expectations of the study.

The study targeted local East African mountaineering leaders and practitioners operating in the three afro-alpine East African mountains. The respondents included practitioners such as outdoor adventure teachers, outdoor adventure facilitators, team-building instructors, porters, guides, park and forests authorities. The study also comprised organization's decision makers such as programme supervisors, departmental heads, directors, trustees and management. The dependent variable was the mountaineering practitioners' knowledge in PHERM and the independent variables were the age, gender, experience, and years back of refresher training of practitioners. The study excluded health care professionals like medical doctors, clinical officers and nurses. The study also excluded foreign mountaineering trip leaders and practitioners who were handling international clients only.

The study used snowballing sampling technique to identify and trace the respondents. This sampling procedure was suitable to select mountaineering practitioners from all groups and designations of respondents since there were no documented records indicating the population size. Once the practitioners were identified, sampling continued until a criterion of adequacy was met. This criterion of adequacy was met at the point at which successive sampling gave the same leaders and practitioners. This ultimately resulted in a convenience sample, (n = 136) which was an appropriate sample based on the researchers' needs.

The data collection instrument was a written assessment that tested the mountaineering outdoor adventure practitioners' knowledge in PHERM. They responded to a 21-question test-type assessment that was based on The Boy Scouts of America curriculum, 2017 edition, NOLS wilderness medicine practice test, and Wilderness first responder minimum guidelines [11,15,22]. The instrument was pre-tested with seven randomly selected outdoor practitioners who were frequent East African mountain adventure leaders. These were not used for the final data collection. The test-retest method was used to determine the questionnaire's reliability index. A reliability index of 0.8 and above would be accepted [23]. The responses were correlated for reliability using Cronbach's alpha reliability correlation analysis. This gave a correlation coefficient of 0.972, which was high enough and acceptable.

The questionnaire involved respondents providing their choice of answers to a 21-multiple choice questions which determined their knowledge in selected wilderness emergency care issues. The questionnaire also found out the following demographic details of the respondents: age, gender, level of education, and refresher training in PHERM. The total questionnaire was scored out of 21 maximum scores. This was then converted to a percentage per respondent as follows: 21 to 17 scores ranged from 100% to 80%; 16 to 11 scores ranged from 79% to 50% and 10 to 0 scores ranged from 49% to 0%. This was converted to ‘Good’, ‘Average’ and ‘Poor’ respectively. This was the score awarded to each respondent for the total questionnaire. However, for each injury questionnaire item, the responses were graded as either knowledgeable for correct answer or not knowledgeable for the wrong answer.

The survey was conducted between November 2017 and November 2018, in various institutions and organizations within East Africa that were involved in mountaineering in the Rwenzori ranges, Mt. Kilimanjaro, and Mt. Kenya. These included the parks management, the porters and guides associations, and outdoor leadership institutions that took clients for mountaineering at the time of the study. All these

institutions and mountain regions were surveyed randomly since the aim of the study was not to compare among countries but considered East Africa as a block. This is because these are the same practitioners who lead mountain expeditions in the three study locations. To conduct the survey, members of the research team visited the various areas where it was possible to find the local leaders and practitioners in mountaineering. These were the wildlife services where the three East African mountains are located; Nyakalengija gate at the Rwenzori ranges, Marangu gate at Mt. Kilimanjaro, and Naro-moru gate at Mt. Kenya. Porters and guides were also identified through their associations. Local facilitators and teachers who were actively taking clients for mountaineering at the time of data collection were also traced through snowballing technique. The questionnaire was a researcher-administered tool. The respondents filled the questionnaires at various identified locations where researchers travelled to meet them.

Data entry and analysis was performed using Statistical Package for Social Sciences software package, version 22 [24]. Somers' delta (Somers' *d*), a nonparametric measure of the strength and direction of association that exists between an ordinal dependent variable and an ordinal independent variable, was used to find out the association of socio demographic variables with the knowledge regarding PHERM. $p < 0.05$ was taken as statistically significant association.

Results

The study collected the participants' socio-demographic information in order to adequately describe the study sample (Table 1). Most (54; 39.76%) of the respondents were in the age category of 30–39 years, with majority (125, 91.1%) as males. Most (76, 55.9%) of the respondents had worked for seven years and above while 60; 44.1% of the respondents had worked for six years and below in the mountaineering adventure practice. A considerable number of them (67, 49.2%) had college/university education up to postgraduate degree level while 34; 25% of the respondents had up to primary school education.

Knowledge of PHERM by outdoor adventure practitioners

The assessment of the overall knowledge obtained a score for each respondent, as an indicator of knowledge in PHERM. The scores were categorized as Good (80–100%), Average (50–79%) and Poor (0–49%). As presented in Table 2, 52.9% of the respondents had a poor score, indicating that the knowledge of PHERM by the outdoor practitioners at the East Africa Afro-alpine Regions was wanting.

Table 1
Characteristics of respondents ($N = 136$).

Characteristics		F (%)
Age of respondent	Below 30	31 (22.8)
	30–39	54 (39.7)
	40–49	39 (28.7)
	50–59	12 (8.8)
Gender	Male	125 (91.9)
	Female	11 (8.1)
Years of working experience	Below 2 years	23 (16.9)
	2-6 years	37 (27.2)
	7-11 years	24 (17.6)
	12-16 years	25 (18.4)
	Above 16	27 (19.9)
Highest education level	No formal education	1 (0.7)
	Primary school	14 (10.3)
	Completed pry school	20 (14.7)
	Completed sec school	34 (25.0)
	Completed college cert/dip	20 (14.7)
	Completed bachelor's degree	35 (25.7)
	Completed postgraduate degree	12 (8.8)

Table 2
Knowledge scores of PHERM by outdoor adventure practitioners ($N = 136$).

Knowledge scores	Frequency (f)	Percent (%)
0–49% poor	72	52.9
50–79% average	60	44.1
80–100% good	4	2.9
Total	136	100.0

Table 3
Knowledge of PHERM per injury/illness.

Illness/injury	Knowledgeable f (%)	Not knowledgeable f (%)	Total f (%)
Allergies	58 (42.6)	77 (56.6)	135 (99.3)
Assessment of casualty	35 (25.7)	101 (74.3)	136 (100)
Bleeding	16 (11.8)	120 (88.2)	136 (100)
Choking	61 (44.9)	74 (54.4)	135 (99.3)
CPR	44 (32.4)	91 (66.9)	135 (99.3)
Drowning	27 (19.9)	108 (79.4)	135 (99.3)
Epilepsy	100 (73.5)	35 (25.7)	135 (99.3)
Fainting	74 (54.4)	61 (44.9)	135 (99.3)
Handling and movement	19 (14.0)	116 (85.3)	135 (99.3)
Mountain sickness	101 (74.3)	34 (25.0)	135 (99.3)
Musculo-skeletal tissue injuries	25 (18.4)	111 (81.6)	136 (100)
Poisons	88 (64.7)	47 (34.6)	135 (99.3)
Snake bite	77 (56.6)	58 (42.6)	135 (99.3)
Soft tissue injuries	17 (12.5)	119 (87.5)	136 (100)

Knowledge scores versus types of injuries and illnesses

The study analyzed the respondents' scores, per injury/illness type, whereby, in terms of each question item, a correct score was 'knowledgeable' and 'not knowledgeable' in case of a wrong score. Some of the responses had missing data, or invalid responses hence the less than the hundred percent total in Table 3. Knowledge scores varied from highest to lowest respondents' frequencies as follows: Mountain sickness, 101 (74.3%); Epilepsy, 100 (73.5%); Poisons, 88 (64.7%); Snake bite, 77 (56.6%); Fainting, 74 (54.4%); Choking, 61 (44.9%); Allergies, 58 (42.6%); CPR, 44 (32.4%), Assessment of casualty, 35 (25.7%), Drowning, 27 (19.9%); musculo-skeletal tissue injuries, 25 (18.4%); Handling and Movement, 19 (14.0%); Soft tissue injuries, 17 (12.5%); and Bleeding, 16 (11.8%), respectively.

Association of knowledge scores of PHERM with various respondents' demographic characteristics

Somers' *d* was run to determine the association between PHERM knowledge scores and the respondents' age, gender, work experience, education level and the years back since their last refresher courses (Table 4). There was a weak positive correlation between knowledge scores and respondents' age, which was not statistically significant ($d = -0.113$, $p = 0.104$). This meant that regardless of the respondents' age categories, the knowledge scores of the mountaineering practitioners was the same across board. There was a weak, negative correlation between knowledge scores and respondents' gender, which was not statistically significant ($d = 0.253$, $p = 0.173$). This meant that the respondents had similar knowledge scores across gender.

Somers' *d* also gave a negative correlation between knowledge scores and respondents' work experience, which was statistically significant ($d = -0.152$, $p = 0.010$). Having many years of experience at work did not translate to being knowledgeable in PHERM. The study found a positive correlation between knowledge scores and respondents' education level, which was statistically significant ($d = 0.225$, $p = 0.000$). This meant that as respondents' education level increased, their knowledge score of PHERM also increased. But, there

Table 4
Association of knowledge score of PHERM with various respondents' demographic characteristics ($N = 136$).

Variables	Options	PHERM Knowledge scores				
		Poor (0–49%)	Average (50–79%)	Good (80–100%)	Total f (%)	d and p value
Age of respondents	Below 30	11 (81)	17 (12.5)	3 (2.2)	31 (22.8)	$d = -0.113$
	30–39	33 (24.3)	21 (15.4)	0 (0.0)	54 (39.7)	p value = 0.104
	40–49	20 (14.7)	18 (13.2)	1 (0.7)	39 (28.7)	
	50–59	8 (5.9)	4 (2.9)	0 (0.0)	12 (8.8)	
Gender	Male	68 (50)	55 (40.4)	2 (1.5)	125 (91.9)	$d = 0.253$
	Female	4 (2.9)	5 (3.7)	2 (1.5)	11 (8.1)	p value = 0.173
Years of working experience	Below 2 years	8 (5.9)	14 (10.3)	1 (0.7)	23 (16.9)	$d = -0.152$
	2-6 years	17 (12.5)	18 (13.2)	2 (1.5)	37 (27.2)	p value = 0.010
	7-11 years	15 (11.0)	9 (6.6)	0 (0.0)	24 (17.6)	
	12-16 years	14 (10.3)	10 (7.4)	1 (0.7)	25 (18.4)	
	Above 16	18 (13.2)	9 (6.6)	0 (0.0)	27 (19.9)	
Highest education level	No Formal Education	1 (0.7)	0 (0.0)	0 (0.0)	1 (0.7)	
	Primary School	8 (5.9)	6 (4.4)	0 (0.0)	14 (10.3)	$d = 0.225$
	Completed Pry School	12 (8.8)	8 (5.9)	0 (0.0)	20 (14.7)	p value = 0.000
	Completed Sec School	27 (19.9)	7 (5.1)	0 (0.0)	34 (25.0)	
	Completed college Cert/Dip	10 (7.4)	10 (7.4)	0 (0.0)	20 (14.7)	
	Completed Bachelor's Degree	12 (8.8)	19 (14.0)	4 (2.9)	35 (25.7)	
	Completed Postgraduate Degree	2 (1.5)	10 (7.4)	0 (0.0)	12 (8.8)	
Refresher (years back)	< 2	32 (23.5)	33 (24.3)	4 (2.9)	69 (50.7)	$d = -0.166$
	2–4	10 (7.4)	11 (8.1)	0 (0.0)	21 (15.4)	p value = 0.012
	4–6	3 (2.2)	6 (4.4)	0 (0.0)	9 (6.6)	
	Over 6	18 (13.2)	7 (5.1)	0 (0.0)	25 (18.4)	
	Not trained	9 (6.6)	3 (2.2)	0 (0.0)	12 (8.8)	

was a negative correlation between knowledge score and respondents' years back in refresher training, which was statistically significant ($d = -0.166$, $p = 0.012$). The lesser the years back since the last training, the higher the knowledge score in PHERM was. However, the increases were not clearly distributed.

Discussion

The findings of this study indicate knowledge gaps in PHERM among outdoor practitioners. Despite medical emergency issues being an important matter in mountaineering expeditions, a range of 74.3% to 14% being knowledgeable (Table 3) on how to handle mountain sickness to bleeding respectively, implies that there is a gap in how cases of emergencies would be handled by mountaineering practitioners. This raises concern given that lack of knowledge on how to handle injuries and illnesses is one of the main factors that cause deaths in mountaineering practice [9,21,25]. This may not be impressive considering that the practitioners who lead mountain climbers should be well prepared to handle emergencies. This is due to the fact that hospital care is quite a distance in time and location from the outdoor adventure mountaineering venues.

Concerning CPR, the study established that 32.4% of the respondents were knowledgeable. Various authors have argued that the importance of the knowledge and commencement of CPR in such extreme cases is considered psychological, for both care givers and survivors, in order for the practitioners to do anything they could have done to save life [9,13,14,26]. This is because there is a likelihood that medical scenarios in extreme wilderness like in mountaineering that require CPR would have poor outcome and also CPR may not be appropriate considering the accessibility to scenarios like the mountain peaks [9]. However, mountaineering environments also expose people to traumatic events. CPR intervention has been important for traumatic cardiac arrest situations such as lightning strikes and drowning, of which CPR has been associated with a good functional recovery as opposed to non-traumatic cardiac arrests victims [9]. With only 32.4% of respondents who were knowledgeable in CPR, in the current study, and with the same being a topic covered in various wilderness emergency care training curriculum and guidelines, there is room for improvement for the outdoor mountaineering practitioners in East Africa [9,15,16,22,27].

Various studies have emphasized that continued refresher training helps in the knowledge retention of various practitioners in PHERM [28–31]. A study done in Uganda showed that first aid trainees effectively retained knowledge for at least six months [19]. However, another study, showed poor retention of patient assessment skills in WFA course participants [20]. It could be that the difference in retention of skills or knowledge is the time between refresher trainings. The retention could be high within six months but keep deteriorating with passing time, hence the need for refresher training.

The results also indicate that the knowledge score of PHERM was not dependent on practitioners' gender, age, work experience, and injury/illness type. Practitioners across all the groups in gender, age, and work experience scored low knowledge scores in PHERM. The only respondents who scored highly, with a score of 'good' are the practitioners who had less than two years of refresher training. The longer practitioners had taken without going for refresher courses in PHERM, the lesser their knowledge scores. This agrees with the study findings that wilderness first aid students' effectiveness in applying their learning decreased as time from the last training increased [20]. Worse still, written scores do not match competence in performing practical skills in an emergency situation, with written knowledge being retained longer than practical skill [20–22]. This is a concern when the knowledge scores are low, as this study found.

The role of providing wilderness emergency care in mountaineering may fall to either medically qualified professionals or to other practitioners within the mountaineering adventure practice [9]. For industry growth and development, it is important to have formal trainings and courses. This is as noted by Anderson and Leisey who reported that majority of their study respondents indicated that their knowledge of wilderness and outdoor safety came from formal education courses [32]. Thus, there is indeed, need for refresher courses, for knowledge of PHERM by outdoor adventure practitioners in East Africa to remain high [18].

The study had several limitations. It was limited by the use of snowball sampling which represents some bias in representativeness and generalizability. It had a sample selection bias because it relied on a

convenience sample, whereby those with many contacts were more likely to be included in the sample. A lack of recorded information about the various categories of practitioners in the mountaineering outdoor adventure made it impossible to construct a sampling frame. However, to reduce the bias, the researchers sought after respondents who were stratified into categories of various mountaineering practitioners. The researchers were also deeply involved in managing the progress of the sample.

Another limitation relates to the questionnaire in terms of testing varied items in test-type assessment. The full questionnaire used in this study was not subjected to additional validation test, however, the questions included had originated from other three sets of validated sources. It is also noted that skills and competency are usually lower than the theoretical knowledge. However, the study forms a base-line survey of the status of knowledge in PHERM by the mountaineering practitioners. A possible approach, after ascertaining the knowledge scores, in the future, will be to do observational surveys and reports to ascertain the PHERM competency and skill levels of the mountaineering practitioners in East Africa.

Conclusion

This study found that the mountaineering practitioners' knowledge in PHERM was low, though those who had up-to-date training were better off in the PHERM knowledge scores. It should however, be noted that for the East African mountaineering practitioners, recommendation for refresher training is not enough. This should be backed up by regulations and legislation set by government agencies. There is no policy or legislation that provides for regulations of outdoor instructors or facilitators at the mountain parks in addition to having an up to date training in PHERM. This has led to the current lack of re-certifications and low scores of knowledge in outdoor wilderness PHERM. There is need for the East African practitioners to come together and have a conversation on safety guidelines, with representations from various stakeholders from professional medical personnel, outdoor adventure teachers in schools, bureau of standards, outdoor adventure instructors, facilitators, guides, porters, and the wildlife services. This should be geared towards ensuring that practitioners are empowered to be highly knowledgeable in wilderness PHERM.

Dissemination of results

Results from this study were presented at the Kenya Wildlife Service (KWS), Mt. Kenya headquarters, in a training workshop for porters, guides and KWS wardens. Results were also presented in Nairobi, in a training workshop for outdoor adventure facilitators, and teachers.

CRediT authorship contribution statement

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: NM and LW contributed 37.5%, each, and WS contributed 25%.

All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declared no conflicts of interest.

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