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Original Research Article

Heat waves and health: an observational study on heat related illnesses among medical students in north Karnataka

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ABSTRACT

Background: Heat-related illnesses (HRIs) are a critical public health issue in India, particularly as increasing temperatures and routine heat waves which occur as a result of climate change exacerbate the situation. In recent years, Karnataka has experienced an increase in the frequency and intensity of heatwaves. The aim was to assess the perceptions on HRIs in medical students of Karnataka as they are prone to heat related illness while on family adoption programme field visits, field survey and field data collection activities.
Methods: it was a cross-sectional study, done on 325 medical students of Vijayapura District from April to May 2024. The participants were chosen using simple random sampling technique. Data was obtained using a structured questionnaire, that assessed the knowledge, attitude, and practice on HRIs, which was distributed via Google forms.
Results: The mean score based on knowledge was 14.12 (with range =4-18, SD=2.652), mean attitude and practice score was 1.81 (range =0-4, SD=1.194).
Conclusions: Study revealed that 83% of medical students recognized the risk posed by heat related illnesses and that it can lead to fainting while on field work. Considering the proportion of the level of KAP, 52% had good knowledge, 36% had average and 12 % had poor knowledge. Only 31% had good attitude, 24% had average knowledge and 45% had poor attitude. 34% had poor practice, 38% had average practice, and 28% had poor practice with respect to heat related illnesses.

Keywords: Climate change, Environment, Heat stress, Heat waves

INTRODUCTION

Heat related disorders, which can vary from minor ailments like heat cramps to deadly conditions like heat stroke, pose a major threat to millions of people worldwide. Heatstroke, a more serious condition, is indicated by a body temperature of 40-degree Celsius or above along with CNS dysfunction. Among its potentially fatal symptoms include multiorgan failure, hypotension and tachycardia. Moreover hallucinations, seizures and delirium are also symptoms associated with HRIs.[1]

According to World Health Organization, if a stations temperature hits 40 degree Celsius or higher for the plains and 30 degrees Celsius for the hilly areas, a heat wave is declared in India. In India, heatwaves usually last from March to June, and they can occasionally last up to July. The country's northern regions experience five to six heat wave episodes annually on average.[2] A recently developed area of study within the subject of research on climate change that is highly relevant to society as a whole is heat wave research.[3]

Globally there is an increasing concern about extreme weather occurrences particularly heat waves. Recent weather events have exceeded earlier predictions that global warming would reach 1.5-degree Celsius higher than pre industrial levels from 2030 to 2052. The

worldwide average temperature threshold briefly went above the 1.5-degree Celsius threshold for the first time in 2024, according to data from world meteorological organisation and Copernicus climate change service. The negative impacts of heat waves are exacerbated by their persistence, which has direct and cumulative effects on human health.[4]

Over 166,000 people died as a result of heatwaves globally between 1998 and 2017, with roughly 70,000 of those deaths occurring in Europe and roughly 55,000 in Russia in 2010. Globally, the number of individuals exposed to heatwaves increased by over 125 million between 2000 and 2016. Heat waves increase risk to public health by exacerbating pre-existing chronic ailments like cardiovascular, respiratory, renal, diabetic, and mental health disorders in addition to their direct effects like heatstroke.[5]

Even though there are many studies on the health risks of heatwaves around the world there is still a lack of studies in India, particularly in the state of Karnataka, and a substantial information gap about the precise effects of heatwaves on public health exists.[6] Family adoption program (FAP) is suggested by the (NMC) which is the National Medical Commission of India as part of the MBBS curriculums competency based medical education (CBME). Through community involvement, students can observe directly the conditions of living in those they treat as hospital patients. Additionally, students learn how different health issues affect patients in real world situations.[7] During these outreach programs like FAP, surveys, field visits medical students are vulnerable to heat stress and heat related illnesses. This study was designed to elicit the perception regarding heat related illness among medical students.

METHODS

Study area

This study was done among medical students in BLDE (DU) Shri B. M. Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, India.

Study period

The study was done for a period of 2 months from April 2024 to May 2024.

Study design and participants

The study design involved a cross-sectional study and was done among medical students. The sample size was determined based on mean±SD of Knowledge score of heat related illness among military personnel 9.04±1.832 with reference to a study done by Al Johani et al.[1] considering 95% confidence interval and 0.2 precision. The sample size obtained was 325 medical students.

Inclusion criteria

Medical students who consented to participate were recruited in this study and who had completed at least 6 months of MBBS course in this study area were chosen.

Exclusion criteria

Medical students who were did not consent to be part of the study were excluded. Medical students who already had dermatological problems and any form of physical disability were also excluded.

Data collection

A semi-structured, self-administered questionnaire was used to gather data, which assessed the perception regarding heat stress and heat related illness, among medical students and the questionnaire was distributed as a Google form. We collected data from 325 medical students and the students were selected using simple random sampling technique.

Before commencing data collection, the recruits were given a briefing regarding the purpose of the study, its objectives, benefits. An informed verbal consent was obtained from each participant who volunteered to be part of this study. Socio demographic profile, knowledge, attitude and practice regarding HRIs was gathered from medical students.

Data analysis

The data was represented using numbers, percentages and chi square tests. The results were presented in tabular form and in figures for clarity and ease of representation. The key to data analysis was the statistical package for the social sciences software (IBM SPSS Statistics for windows, IBM Corp. version 26.0)

Ethical clearence

BLDE (DU) Shri B. M. Patil Medical College Hospital Vijayapura provided institutional ethical clearance with IEC number BLDE (DU)/IEC/1100/2023-24.

RESULTS

The sociodemographic profile of the 325 MBBS students is shown in Table 1. Most participants were in the age group 22 to 25 years (n=233, 71.7%) and majority of the participants were females (n=172, 52.9%). The major share of the medical students hailed from urban area of residence (n=286, 88%). Second year (MBBS) medical students accounted for the maximum number of participants who willingly enrolled for this study (n=91, 28%). Religious classification of the students revealed that Hindus were the predominant group (n=282, 86.8%).

Table 1: Sociodemographic profile of participants (n=325).

Sociodemographic profile		N	%
Age (years)	18-21	87	26.8
	22-25	233	71.7
	26-29	5	1.5
Gender	Female	172	52.9
	Male	153	47.1
Residence	Rural	39	12.0
	Urban	286	88.0
Year of study	1st year	82	25.2
	2nd year	91	28
	3rd year	79	24.3
	4th year	73	22.5
Religion	Christian	10	3.1
	Hindu	282	86.8
	Muslim	27	8.3
	Others	6	1.8

Medical students' responses to questions about their understanding of this topic are shown in Table 2. The study revealed that 83% of medical students recognized the danger of heat related illnesses and that it can lead to fainting while on field work.

Eighty three percent of respondents agreed that patients suffering from heat exhaustion or heat stroke were treated with icepacks, fluids, transportation to a colder location.

More than 81% of MBBS students opined that the common symptoms of heat exhaustion or heat stroke were fever, fatigue and chest pain. According to over 81% of MBBS students, fever, weariness, and chest pain are typical signs of heat exhaustion or heat stroke. The percentage of responders who thought that wearing thick garments avoided heat exhaustion or heat stroke was just 22%. According to three-quarters of the respondents, if heat stroke is suspected, the victim should be moved to a colder location before an ambulance is dispatched. When working in the field, 82% believe that muscle contractions can occur due to heat related illnesses. Heat exhaustion or heat stroke can be averted by cooling the body as opined by the majority 83%. Seventy five percent of respondents believed that residing in cold climates could prevent heat stroke. According to 91% of respondents said that perspiration did, in fact, reduce body temperature. Just 28% of respondents agreed that only physically weak individuals were vulnerable to heat related illnesses during heavy field work, while 72% disagreed. When asked if heat related illnesses may cause a quick death when working in the field areas, 74% of research participants agreed, while 24% disagreed. 75% of medical students correctly identified a body temperature exceeding 40-degree Celsius as the cause of heat exhaustion or heat stroke.[1]

The participants identified sweating (62%), lack of sweating (32%), defecation (6%) as symptoms of HRI's that were commonly seen during field work. Medical students selected oral rehydration solution (78.5%), water (19%) and soft drinks (2.5%) as the preferred drink to give to a person exhausted due to heat or heat stroke. The following risk factors were enlisted by the participants which accentuates heat related illnesses during field duty, such as drinking alcohol (43.1%), age factor (28.6%), weight gain (19.4%), not drinking enough fluids (8.9%). To protect themselves from heat related illnesses during field work, the medical students advocated drinking enough fluids (79.7%), wear thick and dark clothes, use sunscreen (14.5%). When asked what kind of thermal disease was the most dangerous, the replies varied like, heat stroke (74.5%), heat exhaustion (11.6%), thermal fainting (10.5%), and heat cramps (3.4%) (Table 2).[1]

When the medical students were asked if they would take preventive measures against heat cramping, heat exhaustion and heat stroke before and during field work if a high temperature warning was sounded, the response was as follows, sometimes (51.1%), much 43.1%), not at all (5.8%). As to how concerned were they about the risk of heat illness during field work, 44% were very concerned, 37.8% was a little concerned and 4% was not at all concerned. When the subjects were asked if they considered themselves sensitive to extreme heat, 45.2% were somewhat concerned, 32% were very much concerned, 13.5% didn't know, 6.5% said not at all and 2.8% said too little concerned. Whether they thought that doctors were raising sufficient awareness of the risk of heat related diseases, 54.5% thought that just enough awareness was raised, whereas 37.8% didn't know and 7.7% opined that too much awareness was raised by concerned doctors (Table 3).[1]

Only 43.7% of medical students were of the opinion that authorities managed field activities at a relatively cooler time when a temperature warning was issued. 46.8% of students said that before going out for field visits, the

college authorities or teachers told them of ways to protect against heat related illnesses. Medical students were asked if their teachers or staff members prepare adequately to treat heat related illnesses when they went for field work, only 47.4% replied in the affirmative. Surprisingly only 16.3% of the medical students paid attention to the signs and symptoms of heat cramps, heat exhaustion and heat stroke. Alarmingly only 26.8% of medical students drank water when they felt thirsty during field visits. One fifth of the students, 22.8% were prepared well to treat heat related illnesses with resources such as fluids, when they went for field visits (Table 3).[1]

Table 2: Response to knowledge questions.

Responses to knowledge questions		N	%
1. Can fainting due to heat-related illnesses occur while working in the field?	No	54	16.6
	Yes	271	83.4
2. Is heat exhaustion/heat stroke treated by transporting the victim to a cold environment, drinking fluids, ice packs and ventilation?	No	55	16.9
	Yes	270	83.1
3. Are fever, fatigue and chest pain common symptoms of heat exhaustion/heat stroke?	No	63	19.4
	Yes	262	80.6
4. Can wearing thick clothing prevent heat exhaustion/heat stroke?	No	254	78.2
	Yes	71	21.8
5. When heat stroke is suspected, should you transfer the victim to a cold environment and then call an ambulance?	No	80	24.6
	Yes	245	75.4
6. Can muscle contraction due to heat-related illnesses occur while working in the field?	No	60	18.5
	Yes	265	81.5
7. Can body cooling prevent heat exhaustion/heat stroke?	No	55	16.9
	Yes	270	83.1
8. Is it possible to protect against heat stroke by staying in cold regions?	No	81	24.9
	Yes	244	75.1
9. Is dehydration a symptom of heat exhaustion/heat stroke?	No	28	8.6
	Yes	297	91.4
10. Does sweating lower body temperature?	No	21	6.5
	Yes	304	93.5
11. Are only physically weak people susceptible to heat-related illnesses during field work?	No	235	72.3
	Yes	90	27.7
12. Can heat-related illnesses lead to a rapid loss of life while working in the field?	No	83	25.5
	Yes	242	74.5
13. Is heat exhaustion/heat stroke known as a body temperature above 40 degrees?	No	83	25.5
	Yes	242	74.5
14. Please identify the symptoms of heat-related illnesses that you consider severe during field work	Lack of sweating	106	32.6
	pooping	19	5.8
	Sweating	200	61.5
15. Which drink do you prefer to give a person with heat exhaustion/heat stroke?	Oral dehydration treatment solution	255	78.5
	Soft drink	8	2.5
	Water	62	19.1
16. Which of the following factors increases the risk of heat-related illnesses during field work?	Aging	93	28.6
	Drink enough fluids	29	8.9
	Drinking alcohol	140	43.1
	Weight gain	63	19.4
17. How can I be protected against heat-related illnesses during field work?	Drink enough fluids	259	79.7
	Use sunscreen	47	14.5
	Wear thick and dark clothing	19	5.8
18. What kind of thermal disease is the most dangerous?	Heat cramping	11	3.4
	Heat exhaustion	38	11.7
	Heat stroke	242	74.5
	Thermal fainting	34	10.5

Table 3: Response to attitude and practice questions.

Responses to attitude and practice		N	%
1. Will you take preventive measures against heat cramping, heat exhaustion and heat stroke before and during field work if a high temperature warning is issued?	Much	140	43.1
	Not at all	19	5.8
	Sometimes	166	51.1
2. How concerned are you about the risk of heat illness during field work?	I don't know	46	14.2
	Little concern	123	37.8
	Not at all	13	4.0
	Very concerned	143	44.0
3. Do you consider yourself sensitive to extreme heat?	I don't know	44	13.5
	Not at all	21	6.5
	Somewhat	147	45.2
	Too little	9	2.8
	Very much	104	32.0
4. Do you think doctors are raising sufficient awareness of the risk of heat disease?	I don't know	123	37.8
	Just enough	177	54.5
	Too much	25	7.7
5. Do your employer/authorities manage field activities at a relatively cooler time when a temperature warning is issued?	No	142	43.7
	Yes	183	56.3
6. Before going out for field work, do your employer tell you ways to protect against heat-related illness	No	152	46.8
	Yes	173	53.2
7.When you go out for field work, does your employer prepare good measures to treat heat-related illnesses?	No	154	47.4
	Yes	171	52.6
8.Do you pay attention to the signs and symptoms of heat cramps, heat exhaustion and heat stroke?	No	53	16.3
	Yes	272	83.7
9. Do you only drink water when you feel thirsty during field work?	No	87	26.8
	Yes	238	73.2
10. When you go out for field work, are you prepared with good measures to treat heat related illnesses, such as fluids etc?	No	74	22.8
	Yes	251	77.2

Total KAP score was calculated from a minimum score of 7 and a maximum of 27, with mean of 19.43 and a standard deviation of 3.676. Knowledge score, minimum score was 4, whereas the maximum score was 18, mean 14.12 with a standard deviation of 2.652. Attitude score, minimum was 0, maximum score was 4 with a mean of 1.81 and standard deviation of 1.194. Practice score, minimum score was 0, maximum was 6, mean of 3.50 and standard deviation of 1.535 (Table 4).

Table 4: Mean KAP score.

	Min.	Max.	Mean	SD
Total KAP score	7	27	19.43	3.676
Knowledge score	4	18	14.12	2.652
Attitude score	0	4	1.81	1.194
Practice score	0	6	3.50	1.535

A score of more than or equal to 80% was considered good, whereas a score less than 80% to more than or equal to 50% was deemed poor and a score of less than 50% was recorded as poor.

Considering the proportion of the level of KAP, 52% had good knowledge, 36% had average and 12% had poor knowledge. Only 31% had good attitude, 24% had average attitude and 45% had poor attitude. 34% had poor practice, 38% had average practice, and 28% had poor practice with respect to heat related illnesses.

On studying the association between sociodemographic profile age with knowledge score with respect to age, p value was 0.603 and was not statistically significant. Gender with knowledge score p value was 0.04* which is statistically significant. Residence to knowledge score association, p value was 0.1. Association between knowledge score and education was 0.02*. Association between attitude score and age, p value was 0.063. Association between gender and attitude score, p value was 0.006*. Association between residence and attitude score, p value was 0.86. Education and attitude association, p value was 0.01*. Age to practice score, p value was 0.764, knowledge score to gender p value was 0.03*. Residence to practice score, p value was 0.81. Education to practice score, p value was 0.02* (Table 5).

Table 5: Association of sociodemographic profile with knowledge score.

	Demographic characteristics	Good	Average	Poor	P value
Knowledge score	**Age in years**				
	18-21	41	33	13	0.603
	22-25	123	82	28	
	26-29	4	1	0	
	Gender				
	Male	66	64	23	0.04*
	Female	102	52	18	
	Residence				
	Urban	155	100	31	0.1
	Rural	13	16	10	
	Education (MBBS)				
	1st Year	40	30	12	0.02*
	2nd Year	51	33	7	
	3rd Year	43	23	13	
	4th Year	34	30	9	
Attitude score	**Age in years**				
	18-21	21	20	46	0.063
	22-25	77	57	99	
	26-29	4	0	1	
	Gender				
	Male	35	38	80	0.006
	Female	67	39	66	
	Residence				
	Urban	91	68	127	0.86
	Rural	11	9	19	
	Education (MBBS)				
	1st Year	23	16	43	0.01
	2nd Year	28	23	40	
	3rd Year	23	20	36	
	4th Year	28	18	27	
Practice score	**Age in years**				
	18-21	28	35	24	0.764
	22-25	78	87	68	
	26-29	3	1	1	
	Gender				
	Male	51	67	35	0.03
	Female	58	56	58	
	Residence				
	Urban	99	68	84	0.81
	Rural	100	9	9	
	Education (MBBS)				
	1st Year	25	36	21	0.02
	2nd Year	33	32	26	
	3rd Year	26	35	18	
	4th Year	25	20	28	

*Statistically significant.

DISCUSSION

Considering the proportion of the level of KAP, 52% of medical students who participated in this study had good knowledge, 36% had average and 12% had poor knowledge. Only 31% had good attitude, 24% had average attitude and 45% had poor attitude. 34% had poor practice, 38% had average practice, and 28% had poor practice with respect to heat related illnesses.

In a study done by Al Johani et al in Saudi Arabia among military personnel, the sample size was 168.[1] They had

good knowledge (mean 9.04/13), 81% had good attitude, 75.6% were attentive to symptoms, mean knowledge score was 9.04±1.83, mean attitude score was 9.61±2.41, mean practice score was 3.39±1.70. 89.9% participants drank enough fluids. 64.9% felt that the awareness given by doctors regarding heat related illnesses was insufficient.

In a study conducted by Wang et al in China among 640 military personnel who were exposed to hot climate during their training, had a mean knowledge score of 10.37 (range 3-13: SD 1.63, mean attitude score of 7.76 (range 0-16; sd 2.65), mean practice score 3.80 (range 1-6:SD 1.12).[8] Overall knowledge score was high, had very poor score on exertional heat stroke.

A study by Alebaji et al with 402 participants 58% drank water only when thirsty.[9] 32% was unaware of the harm posed by heat stroke. 44% were unaware that water should be given to victim.

In a study done by Ramakrishnan et al, a study done among brickkiln workers in Puducherry India, 68.2% of subjects never had any heat related illnesses, whereas 11.4% had experienced HRIs.[10] Knowledge score, attitude score and practice scores were 13.5 (SD±4.01), 4.21(SD±2.17), and 4.23 (SD±1.99).

In a study conducted by Sharma et al, in Nepal, just over half (57%) of the study's participants were men, and their average age was 37.2 years (SD±10.5). They had worked outside for an average of 10.7 years (SD±10.5). They had worked outside for an average of 10.7 years (SD±8.6). Of all participants, 86.2% were aware of heat related incidents, 43% had heard of heatwaves, and 78.6% had firsthand experience with them. For the entire sample, awareness of heatwaves was positively correlated with heat protective practices (practice score =1.46, p=0.001). Heat protection practices were found to be inversely correlated with age (practice score =-0.03, p=0.001). Males practiced less heat prevention than females (practice score =-0.97, p<0.001).[11]

Another cross-sectional study done in China by Zhang et al, from December 10th 2023 to march 21st 2024 in Ningbo city, the survey revealed several significant gaps in knowledge of specific risk factors and preventive actions, even though Ningbo population had adequate overall comprehension of heat stroke. The results recommended customised health education programs to encourage community wide awareness and prevention, especially for youth and communities with lower levels of education.[12]

In another study done by Hasan et al, the conclusion was that heat action plans, which involve establishing early warning systems, developing local capacity to recognise, prevent, or treat and manage heat related illnesses, and disseminating information. Have demonstrated encouraging outcomes in lowering heat related mortality and morbidity.[13]

In a study by Xu et al, the results showed that the general public has adequate knowledge, proactive behaviours, and active attitudes towards heatstroke. To further improve their KAP toward heatstroke, educational programs and interventions must be developed and put into action.[14]

In a study by Li et al, in order to help kids and their parents better adapt to heatwaves and climate change, a primary school heat and health education program was a successful strategy. Heatwaves and other extreme weather or climate events in the context of climate change, as well as other emergent situations or public health education, such as the control and prevention of COVID-19.[15]

Nowrouzi-Kia et al, in a study mentions that results from south Australia show that there is a four-to-seven-fold increase in claims for occupational heat illness during heatwaves compared to non-heatwave periods.[16]

This study has some limitaions. This study was done in single centre, which was a tertiary care centre. Sample size was calculated based on a similar study and was 325 participants. More samples would have made the study more generalizable. The study group was medical students and we could have included other medical professionals like nursing, working doctors, post graduates and allied health students. The level of exposure to heat related illnesses during field visits varied between the phase of MBBS the students were involved in.

CONCLUSION

Considering the proportion of the level of KAP, 52% of medical students who participated in this study had good knowledge, 36% had average and 12% had poor knowledge. Only 31% had good attitude, 24% had average attitude and 45% had poor attitude. 34% had poor practice, 38% had average practice, and 28% had poor practice with respect to heat related illnesses. Precise protocols and guidelines need to be developed to improve the readiness in tackling heat related illnesses. Feedback from students need to be collected by the administration to enact new policies that can ensure that field visits are rescheduled based on climate warnings. Greater synergy between medical students, community medicine department staff and medical college administration in enacting proper environment friendly practices and adopting uniforms that are protective against extreme heat.

Recommendations

Proper scheduling of field visits for community medicine students who are participating in family adoption programme must be scheduled based on the weather

reports. Heatwaves and extreme weather conditions should make the authorities reschedule the field visits to more environment friendly timescale. Proper arrangements for transportation in buses should be arranged and students should be advised to wear uniforms that offer protection from heat. Wearing hats should be made mandatory; students should be advised to carry umbrellas and have sufficient clean drinking water. Medical treatment should be given to students who faint or show signs of heat stress. Emergency medical kits should be available for prompt use in case of emergencies. More studies should be conducted regarding heat related illnesses among varied sections of the society.

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