Risk Factors Associated with Exertional Heat Related Illness in Recruits of Nepal Army during Training Period: A Case Control Study

Bikal Shrestha,1 Naveen Phuyal,1 Lee Budhathoki,1 Chiranjibi Pant,2 Raj Kumar3

1Department of Community Medicine, College of Medicine NAIHS, Kathmandu, Nepal
2Department of Internal Medicine, College of Medicine NAIHS, Kathmandu, Nepal
3Department of Community Medicine, Armed Forces Medical College, Pune, India

ABSTRACT

Introduction: Prevention is an important strategy to reduce the incidence of Exertional heat-related illnesses (EHRI) during training. It comprises a group of symptoms that occur in response to heat accumulation in the body caused by exercise or work in a hot and humid environment for a long period of time until the body is unable to regulate its temperature. The aim of the study is to find out associated risk factors and factors contributing EHRI especially in recruits of Nepal Army.

Methods: A case control study was conducted in recruit training center of Nepal army from June to September of 2017 using a Semi-structured questionnaire after taking ethical approval from IRB. All EHRI cases were included during data collection. The risk factors were analyzed with controls from the same center. 36 cases and 84 controls were taken. We computed the odd ratio (OR), corresponding 95% confidence interval (95% CI), Chi-Square test and Binary Logistic Regression test with SPSS version 20 software.

Results: 85% were wearing army uniform with camouflage vest during the exertional phase of training which was identified as noticeable risk factor with odd ratio (OR) of 13.26 with 95% CI: 5.05 – 34.84 in comparisons to controls. Fear from instructors and seniors in following rules were the protective factors for EHRI (P<0.05).

Conclusions: Wearing camouflage vests and previous history of EHRI were significant risk factors associated with EHRI during training period. Proper clothing protocol and identifying vulnerable groups by the commanders and trainees may prevent EHRI in future.

Keywords: exertional phase; camouflage; risk factors; instructors.

INTRODUCTION

Exertional Heat Related Illness (EHRI) continues to be a military problem during training and operations especially in summer. It is the important cause of morbidity and mortality among trainees.1 The effects of heat illness range from mild symptoms such as muscular weakness and headache, to severe manifestation including collapse, come and death.2,3 General internal risk factors include poor physical fitness, previous history of EHRI, lack of heat acclimatization, excessive or inappropriate clothing, inadequate sleep, poor education about EHRI.4

Correspondance:
Dr. Bikal Shrestha,
Department of Community Medicine, College of Medicine NAIHS, Kathmandu, Nepal.
Email: bikal2034@gmail.com,
Phone: +9779841262421

Commanders whether at the garrison or deployments are expected to identify risk factors in advance that might enhanced susceptibility to heat illness in their troops in order to prevent them. Due to lack of knowledge and awareness in different levels of commanders and trainees, various form heat illness occurs in military organizations. The aim of the study is to find out the risk factors associated with Exertional Heat Related Illness in Recruits of Nepal Army during the Training Period.
METHODS

This was a case control study conducted in the training centers located in Terail belt. Study was conducted from June to September of 2017. There are total ten recruits training centers in Nepalese Army on different geographic location of Nepal. Geographically four of them are located in Terai belt and six of them in hilly areas. There are two session of training enrollment in a year, one begins at the month of May and other starts at the month of August. In each batch there are 100 recruits enrolled. Since most of the heat illnesses in recruits are reported from training centers located in Terai belt which has tropical climate, cases were selected from one of the centers suited in that region.

Case is defined as the recruit who had the known clinical features of EHRI [EHRI types and criteria for diagnosis adapted with permission from Howe] during the exertional phase of training and was taken to Medical Inspection (MI) room for treatment. All the trainees with clinical features of EHRI during the study period were taken as cases. Controls comprise 84 trainees from the same training center undergoing same training module and who did not have symptoms of EHRI after the exertional phase of training. In order to increase the statistical precision of the finding the ratio of case to control was taken more than two. Controls were randomly selected from the register of daily attendance excluding the cases.

Same protocols were used to collect data from cases and controls. Data were collected by a semi-administered questionnaire and verbal follow up for clarification and completeness. Questionnaire collected information on socio-demographic variables and risk factors like previous history of heat illness, morbidity history, habits of smoking, alcohol, tobacco chewing, water intake per liter/day, BMI, sleep per hour per night, training and family stress, fear from instructor senior and colleague, awareness of symptoms of heat illness, type of clothes worn during physical test.

Total 38 cases with feature of EHRI between the month of May and September from the register of Medical Inspection (MI) Room were taken. Two cases referred to tertiary care center of Nepali Army with suspicion of heat stroke were excluded due to unavailability of data. Rest 36 cases completed the questionnaire. All 84 controls were administered with the same semi-structured questionnaire. The results presented are based upon voluntary responses to a semi structured questionnaire that distributed and collected.

We computed the odd ratio (OR), corresponding 95% confidence interval (95% CI), Chi-Square test Binary Logistic Regression test with SPSS version 20 software. The risk factors of interests were categorized into dichotomous responses and appropriate cut points where necessary. We also assessed the potential confounding effect of wide range of factors include age and BMI. Ethical clearance was taken from the IRC of Nepalese Army Institute of Health Sciences.

RESULTS

The mean age of cases and controls were 20.25±1.16 and 20.32±1.07 respectively. Majority of cases were from caste category chetteri 15 (41%) and similar was seen in controls 29(34.5%) whereas least were from caste Newar 2.8% and 2.4% respectively. Most of the cases 25(69.4%) and controls 61 (72.6%) had done secondary level of education. 58.3% and 65.5% of cases and controls were from Hilly area respectively (Table 1).

Table 1. Demographic characteristic of heat illness cases and controls (n= 120)

| Demographic characteristics | Cases (n=36) | Controls (n= 84) |
|-----------------------------|-------------|-----------------|
| Age                         | 20.25±1.16  | 20.32±1.07      |
| Caste category              |             |                 |
| • Brahmin                   | 5(13.9%)    | 7(8.3%)         |
| • Chetteri                  | 15(41%)     | 29(34.5%)       |
| • Dalits                    | 8(22.2%)    | 12(14.3%)       |
| • Newar                     | 1(2.8%)     | 2(2.4%)         |
| • Tarai/Madhesi             | 2(5.6%)     | 15(17.9%)       |
| • Janjati                   | 5(13.9%)    | 19(22.6%)       |
The odds of EHRI among recruits wearing uniform along with the camouflage vest was 13.26 times more than recruits wearing uniform without vest during exertion with 95% CI: 5.05-34.84 (P < 0.05). Binary logistic regression was applied for same and it fitted into the model with predictive probability of 78%. Odds of EHRI among recruits having previous history of HRI was 8 times more than the recruits without the history with 95% CI: 4.71-13.58 (P < 0.05). Factors like fear from instructors, fear from seniors and training stress were found to be protective for recruits from EHRI with OR < 1.

The majority of cases (85%) and controls (89%) were aware of Heat Related Illness (Table 3). 100% of cases and 97.6% controls said that they sleep less than six hours a night on an average during their training phase. The BMI of 27.7% of cases and 20.3% of controls was more than or equal to 23. 75% of cases and 86% of controls said that the availability of drinking water during the training was not sufficient. Most of the cases and controls said that they drank more than 3 liters of water per day during their training. Factors like training stress, fear from instructors and fear from seniors were significantly associated with EHRI in controls in comparison to cases (P < 0.05).

Table 3. Distribution of risk factors in cases and controls

| Risk factors | Cases | Controls | Odds Ratio (OR) | 95% CI | P value |
|--------------|-------|----------|----------------|--------|---------|
| Awareness regarding HRI | | | | | |
| Yes | 7 | 9 | 0.19 | 2 | 11.00-44.01 |
| No | 29 | 75 | | | |
| Sleep | | | | | |
| < 6 hours | 36 | 82 | | 0.35 | |
| 6-8 hours | 0 | 2 | | | |
| BMI category | | | | | |
| < 23 | 26 | 67 | 0.36 | 0.66 | 0.17-0.40 |
| ≥23 | 10 | 17 | | | |
| Training stress | | | | | |
| Yes | 2 | 27 | 0.00 | 0.12 | 0.00-0.00 |
| No | 34 | 57 | | | |
### DISCUSSION

The risk of EHRI is high in tropical and subtropical areas of the world but it can occur even in temperate climates when internal heat generation is substantial, clothing is not optimal and effective cooling mechanism are not available. Recruits who wore army uniform along with camouflage vest during the exertional period of training had significantly suffered with EHRI than ones with uniform without camouflage vest. The use of vest had led to increased heat conservation and sweating in the affected populations. In a cross-sectional study conducted in Washington crops workers, EHRI was shown to occur even in temperate climates when internal heat generation is substantial and clothing is not optimal. Though inappropriate clothing worn during hot and humid weather is well proven risk factor for EHRI no study has been carried out about the type of fabric used during training. So the fabric that is used to prepare camouflage vest should be studied in details. In our study, recruits who had a previous history of EHRI were found to be at higher risk for EHRI. This study finding was supported by other studies conducted in different parts of the world.

Recruit training in military is quite difficult in comparison to other non-military trainings. Recruits tend to stress themselves to achieve best results among peers. The training stress, fear from instructor and fear from senior batches with respect to following proper rules were found to be protective factors for EHRI. Those recruits who were sincere and more career oriented coped with the instructors and seniors well. This might be the possible reasons for controls who didn’t suffer from EHRI. This statement however needs to be proven from the cohort and experimental design.

In our study, association between the BMI and EHRI was found to be not significant. This was in contrast to the finding of a study where BMI > 30 kg/M2 was found to be significant during training in Thailand. Since none of our trainees had BMI above 30, the effect was most likely not seen. The findings of the study mentioned above were interpreted with caution, because of the relatively small number of respondents taken and only single recruit training center was included.

Our study has some limitations. The study was conducted only in one recruit training center. Cases were taken on the clinical classification observed by the medical personnel in the training center which was not confirmed by lab investigations. The validity of information gathered through questionnaire can be an issue where trainees remain stressed throughout the training period.

### CONCLUSIONS

Recruits wearing army uniform with camouflage vest and previous history of HRI were identified as risk factors associated with EHRI. Research with robust study design can be done to evaluate fabric used in the camouflage vest. Stress felt by recruits during their training, fear subjected in recruits from instructors and their senior batches in the training phase were analyzed to be protective factors from EHRI. Cohort study needs to carry out involving larger number of recruit training center of Nepal Army in order to confirm the associated risk factors that have come significant in this study. Cloth that is used in manufacturing the camouflage vest needs to be surveyed in detail.
evaluated. Since the summer months especially from April to July in Terai belt of Nepal are much hotter and more humid, temperature and relative humidity has to measure by Weight Bulb Globe Thermometer in order to identify dangerous level for physical training.

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CONFLICT OF INTEREST: None

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