

Analysis of Medical Interventions at the Start-Finish Medical Post of an International Running Event in Rural Thailand

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Abbreviations:

DNF: Did Not Finish
EMS: Emergency Medical Service
KKIM: Khon Kaen International Marathon
MSK: Musculoskeletal

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Abstract

Introduction: Increasing numbers of marathon running events are taking place around the world. The difficulty encountered in the management of mass gatherings, especially running in marathons, is how emergency services can deliver treatment in a timely manner. Therefore, for this kind of situation, preparation is the key to success in terms of patient management.

Study Objective: The aim of this study was to describe the presentation of cases at a start-finish medical post in an international marathon race set in a rural area.

Methods: All medical record forms were collected from the start-finish medical post of the Khon Kaen International Marathon (KKIM) 2020. The race took place on January 26, 2020. The data were coded by two authors, and in the case of different codes, the final codes were determined by discussion.

Results: The total number of participants in this event was 16,489. Participants who used the start-finish medical post numbered 74 (44.8 people per 10,000). More than one-half of patients were male (41; 56.9%), while 31 (34.0%) were female. The age range of the casualties was from 17 to 88 years old. The rate of incidence for those who used this post was 44.8 per 10,000 participants. The greatest density of users was at 3.40 hours after the marathon had started. The common symptoms which were found consisted of 17 soft tissue injuries (23.0%), 15 instances of cramps (20.3%), and 11 musculoskeletal (MSK) injuries (14.9%). Almost all patients were discharged, and only two of the cases were actually admitted to the hospital. No statistical significance between males and females was found (OR = 0.81; 95% CI, 0.51-1.3). However, marathon and half-marathon runners had a higher risk of being casualties (OR = 3.49; 95% CI, 1.71-7.15 and OR = 3.51; 95% CI, 1.79-6.88).

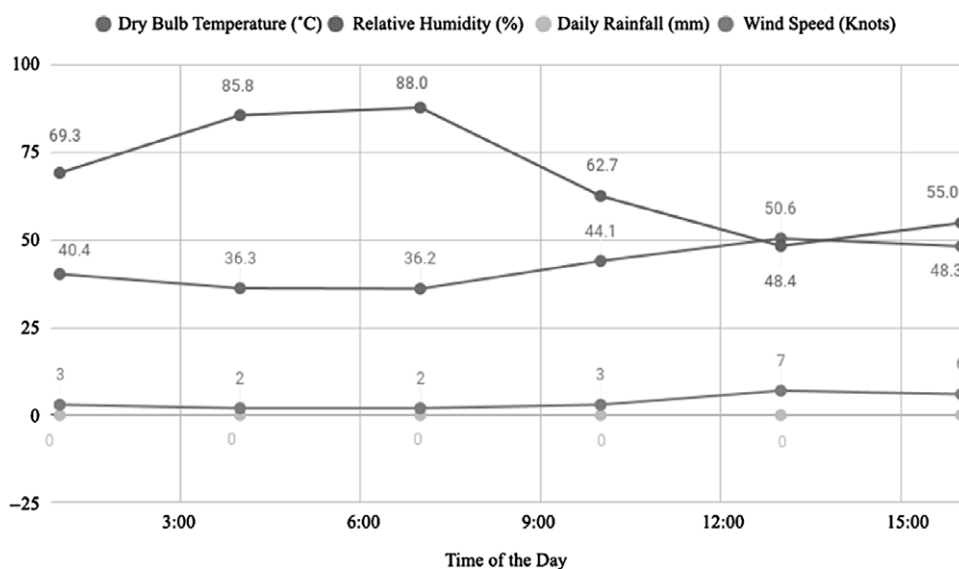
Conclusion: The injuries of most of the patients who used the medical post at a start-finish point were mild. Distances which are longer than 20km increase the risk for getting injured. However, a prospective study and multi-session interpretation is recommended.

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Introduction

Presently, running events are being held around the world. The rate of arranging running events continues to rise by 24.54% per year, which makes the assumption that the numbers of people who take up running is growing every year.¹ According to an annual report, the numbers of running participants continuously increased until reaching a peak in 2016, with the total number of runner participants amounting to 9.1 million globally.² In fact, the number of running participants declined by 13% in 2019. Total number of participants still remains high as a record number of 7.9 million participants are joining running events, which means that the recorded figure has doubled in the past 10 years. However, between the years of 2017-2018 in Thailand, the rate of those races continued to grow at 166.7%.³

Marathons have been categorized as Level III Mass Gatherings. The movement of many participants in an unbound event makes medical assessment more challenging. As the evidence suggests, an ambulance should be at the scene in order to treat patients within eight minutes. Each race has specific factors needed for successful operation. Without the use of alcohol or drugs, the mood of the crowd tends to be healthier. This event has runners of



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Figure 1. Weather Condition.

various ages. Aspects of the weather, such as the temperature, the amount of rain, and the humidity are very important, as well as the difficulty of running route. Moreover, injury rates will vary in accordance with the distance and the time.⁴

As mentioned above, the numbers of running participants in Thailand are increasing, and creating disease-specific Emergency Medical Services (EMS) in developing countries is new.⁵ Therefore, given that these events are growing, EMS need to become more involved. For events in which masses of people gather, preparation is the key to success when managing the EMS. Nonetheless, information on case series can help to develop an even more efficient system. Normally, there are multiple medical posts along races. However, the start-finish medical post usually has the highest numbers of patients.^{6,7} Moreover, this start-finish medical post can reduce variation in medical searches due to the difficulty of the terrain.

Therefore, this study has focused upon describing the cases treated in the start-finish medical post from one international marathon in a rural area, Khon Kaen International Marathon (KKIM) 2020 in Thailand. Its aim has been to define common cases and to guide the medical preparations for further races.

Methods

This study has been based on a review of medical records at the start-finish medical post. The race was arranged on Sunday, January 26, 2020 in Khon Kaen, Thailand. This event is certified by the International Association of Athletics Federations (IAAF; Monaco), and the course of the race is on the road. The starting time for full marathon race was 4:00AM, for the half-marathon the time was 5:00AM, and for the mini-marathon, the starting time was 5:45AM. The total number of participants was 16,489. The full-marathon had 3,635 participants, and 2,873 of those participants were male (79.0%).⁸ The half-marathon had 5,248 participants, and 3,171 of those were male (50.4%).⁹ The mini-marathon had 7,616 participants, and 4,165 of those were male (60.6%).¹⁰ First marathon runner finished the full-marathon race in 2.02.17.3 hours. The winner of the half-marathon finished the race in 1.03.07.3 hours, while the winner of the mini-marathon

finished the race in 34.59.7 minutes. In addition, the cut-off times for each of the distances was 7.00 hours, 3.30 hours, and 1.45 hours for the full-marathon, half-marathon, and mini-marathon, respectively.

The weather report was provided by the Thai Meteorological Department (Mueang Khon Kaen, Khon Kaen, Thailand). During the time of the race, the temperatures ranged from 24.0° Celsius at 4:00AM to 34.0° Celsius at 1:00PM with an average temperature of 27.25° Celsius. The average humidity on that day was 62.5%, while the average heat index was 28.7° Celsius. There was no rain, and the wind was light at 2.0-7.0 knots. All of the weather conditions are shown in Figure 1.

All of the medical records from the start-finish medical post were collected and analyzed. The exclusion criteria included cases without any statement of chief complaint, or non-medical chief complaint. The particulars of the data collection contained each individual's age, sex, distance of the run, the time of visit, the time after the full-marathon had started, and the type of problem that had caused them to come to the post. The doctors recorded the symptoms, managed the problems, and made suggestions, as well as carried out treatments and plans for disposition. The collected data were read and coded by two authors. After the coding had been completed, the two sets of data were matched and the differences were corrected. In case there were any cases of mis-matched coding, the medical records were then reviewed, and two authors discussed the issue in order to reach an agreement. If more than one complaint had been noted, then the symptoms which had been more related to the treatment delivered were recorded as the participant's presentation.

Descriptive statistical analysis was used to define the prevalence of each diagnosis and demographic data. An odds ratio (OR) was calculated in order to evaluate the factors associated with the illnesses, such as the gender or the distances, while a 95% CI was also used to infer the data. The accepted statistically significant value was determined to be at a P value $\leq .5$. All analyses were performed using RStudio Version 1.2.5033 (R Foundation for Statistical Computing; Vienna, Austria).

This project was approved by institutional review board (Study ID HE631248). Moreover, the medical record forms used in this study were not related to the patients' identification or their hospital records. Therefore, informed consent could be waived.

Characteristics	Prevalence (N = 74)
Distance (n = 61)	n (%)
Full-Marathon	20 (32.8)
Half-Marathon	29 (47.5)
Mini-Marathon	12 (19.7)
Gender (n = 72)	n (%)
Male	41 (56.9)
Female	31 (34.0)
Age (n = 61, Mean (SD))	41.64 (SD = 15.90)
Age range (n = 73)	n (%)
< 20	7 (9.59)
21-30	18 (24.66)
31-40	18 (24.66)
41-50	11 (15.07)
51-60	12 (16.44)
61-70	5 (6.85)
71-80	1 (1.37)
> 80	1 (1.37)
Time of Finishing (Gun Time, % from Cut-Off Time)	
(n = 57)	
Full-Marathon	4:53 (69.7)
Half-Marathon	2:32 (72.0)
Mini-Marathon	1:40 (94.8)
Finish Race (n = 61)	
Finish	57 (93.4)
DNF	4 (6.6)
Vital Signs	
HR (Mean (SD), n = 41)	94.27 (21.2)
SBP (Mean (SD), n = 49)	115.60 (19.4)
DBP (Mean (SD), n = 48)	76.48 (11.9)
RR (Mean (SD), n = 10)	21.20 (2.7)
CBG (mg/dl)	
Participant 1	125
Participant 2	114
Participant 3	110
Participant 4	151

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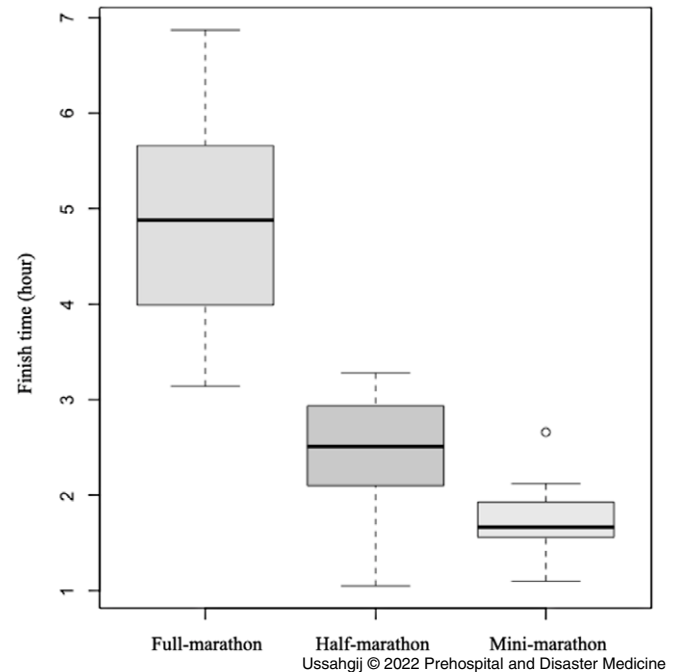
Table 1. Demographic Data

Note: There are some incomplete data. The total number of each parameter is mentioned in the parenthesis.

Abbreviations: DNF, did not finish; HR, heart rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; RR, respiratory rate; CBG, corticosteroid-binding globulin.

Results

Total number of casualties was 74 (41 males [56.9%] and 31 females [34.0%]). No record met the exclusion criteria. The mean age of the casualties was 41.64 (SD = 15.90) with the lowest age being 17 years and the highest being 88 years. The users who presented at the medical post averaged 44.8 people per 10,000 participants. Those percentages of the participants who had used the start-finish medical station for the three races were: 32.8% from the full-marathon, 47.5% from the half-marathon, and 19.7% from the mini-marathon (Table 1).

**Figure 2.** Participants' Finishing Times.

Most of the users had been finishers (n = 57; 93.4%). There were only four participants who were recorded as "Did Not Finish" (DNF). Three of them were full-marathon participants, and one of them was from the half-marathon. All of the DNF participants had been men. Cramps were the reason why two of the DNF users had come to the medical post. The other problems consisted of a soft tissue injury and a previous illness. The racing times ranged from 1.03.07 hours to 6.54.35 hours, which was based on the time of the starting gun. Separated by distances, the finishing time of participants using the station ranged from 44.8% to 98.1% at the cut-off time of the full-marathon, 30.0% to 99.4% for the half-marathon, and 62.9% to 152.0% for the mini-marathon (Figure 2). There were five participants who ran the mini-marathon longer than cut-off time, and as a result, they were considered to be "non-finishers" by the KKIM rules and regulations. The estimated greatest density of patients was around 7:40AM. The median time of finishing for the marathon group was 4.53 hours (IQR 3.59 - 4.53), while the median finishing times for the half-marathon group and mini-marathon group were 2.32 (IQR 2.06 - 2.56) and 1.40 (1.34 - 1.54), respectively (Figure 3).

The three most common problems among users were soft tissue injuries (n = 17; 23.0%), cramps (n = 15; 20.3%), and musculoskeletal (MSK) injuries (n = 11; 14.9%). Moreover, there were five people who visited that had low blood pressure (SBP < 90). Most cases visited the station to treat problems that had occurred during their runs or after they had just finished (n = 66; 89.1%). Nevertheless, there were three cases who came in before starting the race: one participant came to check his blood pressure because he had underlying hypertension, and the other two came for reassurance about their current health status, making sure they were safe enough to run (Figure 4).

The treatments given at the start-finish medical post were related to patients' presentations. The main procedures had been dressing wounds (n = 20; 27.8%), hydration (n = 15;

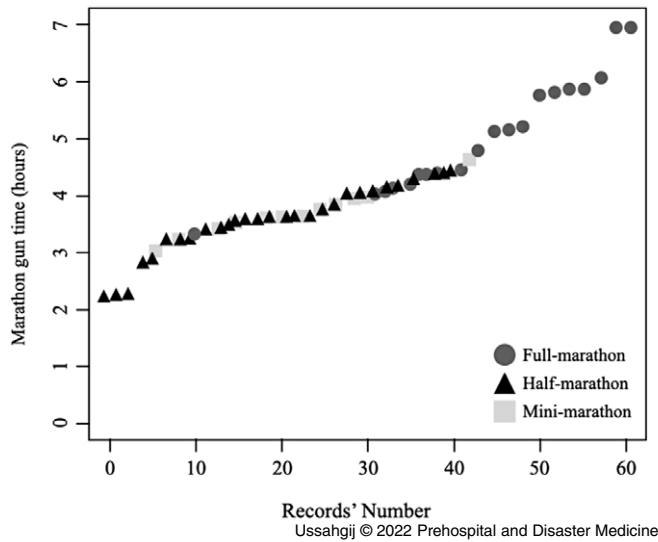


Figure 3. Distribution of Casualties.

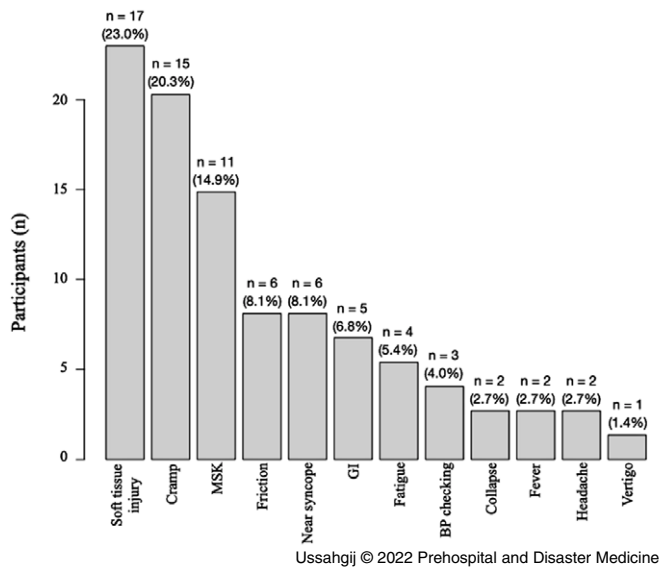


Figure 4. Participants' Presentations. Abbreviations: MSK, musculoskeletal; GI, gastrointestinal; BP, blood pressure.

20.9%), and oral pain controls (n = 14; 19.3%). In the participants treated by hydration, nine cases were treated by oral fluids, while six patients were treated using intravenous fluids. Moreover, one user was given intravenous glucose. Almost all of the patients were managed at the site, except for two patients, who came to the medical post because they were experiencing severe cramps. Those two patients, who were later admitted to the hospital, also stated that this had been their first marathon (Table 2).

The risk factor of being a participant who had used this service post was fewer males than females (OR = 0.81; 95% CI, 0.51 - 1.30). However, this was not statistically significant. The marathon runners had used the medical post at 55 per 10,000 participants, which was the same as the half-marathon runners. Although, mini-marathon runners had used the medical post at 16 per 10,000 participants, the odds ratio between the distance

Management	N (%) (N = 74)
Treatment	
Dressing	20 (27.8)
Hydration	15 (20.9)
Oral Hydration	9 (12.5)
IV Hydration	6 (8.3)
MSK ^a	14 (19.4)
Pain Medication	11 (15.3)
Oral Medication ^b	6 (8.3)
Reassure	3(4.2)
Rest	2 (2.8)
IV Glucose	1 (1.4)
Other	2 (2.8)
Admission	
Yes	2 (2.7)
No	72 (97.3)

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Table 2. Patient Management

Abbreviations: IV, intravenous; MSK, musculoskeletal.

^aMSK = muscle stretching, bandage, cold compression, and massage.

^bOral medication = other medication not including pain medication, such as oral rehydration salt (ORS) and dimenhydrinate.

and the patients was 0.60 (95% CI, 0.34 - 1.07) for the half-marathon and 3.49 (95% CI, 1.71 - 7.15) for the mini-marathon as compared to the full-marathon. The number showed that the half-marathon runners had been more likely to be injured than the marathoners, but this was not significant. When analyzing the odds ratio between half-marathon runners and mini-marathon runners, an OR = 3.51 (95% CI, 1.79 - 6.88) was found. This supported the statement that marathon runners and half-marathon runners had a higher risk for injuries compared to mini-marathon runners.

Discussion

For this running event, the casualties who had visited the start-finish medical post numbered 44.8 people per 10,000. When this figure was compared to studies conducted in Minnesota and in Maryland in the United States for 42-kilometer races, the prevalence of injuries had been 178 people per 10,000 and 151 people per 10,000, respectively, which shows that the prevalence of using a medical post in this study was lower.^{7,11} However, there was a big physical therapy station at the start-finish point, and some of those patients having MSK problems had visited that station instead of going to the medical service. Nevertheless, the prevalence of using medical post at the start-finish of the half-marathon groups is higher than has been recorded in other studies: 16.9 - 26.0 casualties and 11.9 - 22.1 casualties per 10,000 participants.^{6,12}

The age of users ranged from 17 to 88 years old, and the average age was 41.64 years. This covers the lowest and highest age categories. Some studies have shown that lower age is a risk factor that increases the rate of injury.⁶ The proportion of males and females was 56.9% and 34.0%. The distribution of gender in the participants was 79.0% male. It would appear that being a female is a factor that is associated with injury during the race, although no statistical significance of this was shown in this study. Other studies have indicated that gender is not related.^{11,12} However, there is a

study that has shown that the male gender has a higher risk for cardiac arrest.¹³ Nonetheless, there were no cardiac arrests during this race.

The majority of the users came from the half-marathon and full-marathon races and did not have significantly different injury rates. This might be because some patients dropped out of the race before they were finished, and as a result, they were not transferred to this medical station. Although three patients came to this station for some treatment procedure, many DNF runners could have been treated at the scene. A few patients were treated by intravenous medications, such as glucose and benzodiazepine,¹² while only two patients had needed to be admitted.

The rate of admission indicated that most of the casualties had been minor injuries. The common problems had been falls, cramps, muscle pains, and friction injuries. Because the weather conditions during this race were hot and humid, the numbers of patients who presented with heat-related injuries was high. Although there had been only 2.7% collapse, the illnesses included cramps, near syncope, and fatigue, as well as hypotension - all of which were higher than many studies.^{6,7} Environmental factors can affect the numbers of casualties. Higher temperatures increase the risk of injury, as well as worsen the runners' performances.^{11,14-16} The rate of use of the medical post at the start-finish did not show many differences from other studies of races run under cold conditions. Nevertheless, acclimatization for a rapid change of environment is recommended. Regarding the types of injuries, MSK treatments and pain medications had played an important part in the services administered. Only 20.9% of patients had received hydration therapy, while the studies from the United States showed a higher number of dehydrated patients.^{7,11,12}

The average finish time of the users was close to the average finish time for each race.¹⁷⁻¹⁹ Therefore, the highest density of the use of the medical post had been the same time that finishers were densely approaching the finish line.⁶ However, as previously noted, there were three users who came before their races had even started.

The medical service plan can be guided by those common presentations. All resources must be sufficiently prepared, such as cooling sprays and wound cleansers. On the other hand, resuscitative equipment should be prepared in order to treat cardiac arrest, heat injuries, and severe collapse. Moreover, the working hours of the medical staff members can be shifted in accordance with the expected crowds.

Limitations

Regarding the limitations of this study, this study was carried out by summarizing the data from the medical record forms as mentioned above, which was not so rigid. Therefore, some data were not written on the forms, which meant that missing data were the main problem of this study. Moreover, these records were written as the doctors were working in the medical post. This led to a situation of uncertain operations in which some records were written roughly, while others were addressed precisely. This study was conducted at only one medical post at the start-finish point. The information gathered from other medical posts during the race was limited. Therefore, some associated factors were not evaluated (ie, the elevation gain and the length of the race at the time of injury).

In regard to the suggestions for further research studies, a prospective study is recommended. In order to reduce the missing data, an event record form should be created as a checklist. In order to determine the factors that increase the rate of illnesses, such as duration of exercise and the environmental conditions, it is suggested to conduct multi-centered research or to study multiple races. In addition, en route medical posts should be included in further studies.

Conclusion

Most patients who had used the medical post at the start-finish point were able to be treated at the scene. There were no incidences of cardiac arrest. The main problems that were treated had been wound and MSK problems. Approximately one out of five visitors had needed hydration therapy. However, the relationship between the weather and the injuries could not be explored. Distances of longer than 20 kilometers are considered to be a risk factor for injury. Before the race started, the EMS were at work, and also, the rate of the users was related to the time of gathering. However, at approximately two-thirds of the cut-off time, there was a higher probability of having more patients.

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