Common Causes of Collapse in Endurance Events

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Objectives

- Learn a simple approach to the collapsed runner
- Recognize the most common and occasional causes of collapse in runners
- Develop a triage and treatment system for collapsed runners

I. Introduction
  A. Medical aspects of marathon racing
    1. Administrative and logistical issues
    2. Medical protocols
  B. Marathon medical encounters
    1. Incidence varies from 8 to 100 per 1000 entrants (Figure 1)
      a. TCM average is 19 per 1000 entrants (12 years)
      b. Hot or warm weather conditions increase encounters
        (1) TCM is about 30 per 1000 entrants above 55 ^{o}F
        (2) Houston average is 60 per 1000 entrants above 60 ^{o}F
        (3) Boston 62 per 1000 finishers with start temp of 80 ^{o}F
        (4) Pittsburgh 100 per 1000 entrants in hot conditions
    2. Marathon Injury Classification see Table 1
    3. Twin Cities Marathon injury distribution see Tables 2 & 3b
      a. Vast majority of injury is self limited
    4. Rare severe injury or illness
  C. Running environment and marathon injury
    1. Ideal conditions
      a. 40 - 50's ^{o}F
      b. Sky cover
        (1) Cloud cover for elite
        (2) Sun for slowest runners
      c. Wind
        (1) None to light
    2. Heat and humidity
      a. See Figure 1
    3. Cold and wet
      a. Increases hypothermia especially in slower runners
      b. Inadequate metabolic heat to maintain body temperature
  D. Dealing with collapse during and after the marathon (medical conditions)
    1. Cardiac arrest and sudden cardiac death
    2. Exertional hyponatremia
    3. Hyperthermia and exertional heat stroke
    4. Normothermic exercise associated collapse
    5. Exercise associated muscle cramping
II. Cardiac arrest and sudden cardiac death associated with marathon racing
  A. Risk low
    1. Cardiac arrest

a. 1 in 44,000 finishers of Twin Cities & Marine Corps Marathons
b. 1 in 30,000 male finishers at TCM

2. Sudden cardiac death
a. 1in 220,000 finishers if TCM/MCM
b. 1 in 150,000 entrants at TCM
c. 1 in 90,000 male finishers at TCM
d. 1 in 100,000 finishers of London and New York Marathons

B. High visibility event
1. Sensational coverage in media

C. Male runners more frequently involved
1. Unexpected collapse
2. Ignored symptoms
a. Occasional history consistent with “angina” prior to arrest

D. Mechanism of onset
1. Plaque rupture
a. Sudden occlusion without collaterals
2. Arrhythmia

E. Recognition
1. Sudden collapse common marathon presentation
2. History chest pain, pressure, loss of exercise capacity

F. Preparation
1. Rapid response times
2. Automatic external defibrillators

G. Treatment
1. CPR with modifications
a. Increased compressions & decreased mouth to mouth
b. “Plunger”
c. “Air flow block”
2. Rapid defibrillator application and use
a. 200 compressions between shocks

H. Disposition
1. Hospital transfer
2. Public relations plan

III. Exertional heat stroke

A. Problem definition
1. Exertional heat stroke is an elevated core temperature > 104 ºF associated with CNS symptoms and other organ dysfunction
2. Elevated core temperature causes malfunction of cells and organ tissues
3. Usually a “short” race, fast pace problem
4. Increased risk if personal or family history of malignant hyperthermia

B. Risk
1. < 0.005% of entrants in “favorable” long road race conditions
a. Twin Cities Marathon about 1 in 10,000 entrants (24 years)
(1) Most from years with start temperature >55 ºF
(2) Exertional hyperthermia about double
2. Warm and humid conditions
a. 1 per 10,000 entrants at Twin Cities Marathon under white flag conditions
b. 5 per 10,000 entrants at Twin Cities Marathon under green flag conditions
3. TCM/MCM/Chicago 2003-2005
a. About 30 EHS in 210,000 entrants

(1) No EHS deaths
(2) 3-5 hospitalized

C. Mechanism of onset
1. Body temperature rises above critical levels
a. Too much heat generated by fast pace in warm conditions
b. Inadequate heat loss exercising in hot, humid conditions
2. Organ dysfunction and shut down

D. Basic pathophysiology of exertional heat illness
1. Body heat is distributed in the core and shell of the body
a. Body core is the essential organs at a minimum
b. Shell is the surface
(1) Heat exchange with the environment
(2) Expands and contracts to dissipate or conserve body heat
c. For field care of athletes
(1) Rectum is in the core
(2) Ear, ear canal, tympanic membrane, TAT, oral cavity, and axilla are in the shell
2. Core temperature is sum of body heat gained and lost during activity
a. Metabolic heat is produced during activity
(1) Intensity of exercise increases metabolic rate
(a) Fast pace of “shorter” distance races increases risk of EHS
(b) Finish line push in the marathon
(2) Duration of exercise
(a) Longer exposure at high intensity increases risk
(b) If duration of activity slows the pace
i) May decrease risk
(c) Pace of the last 5 to 10 km often determines risk in marathon
b. Environmental heat added during activity
(1) Ambient temperature greater than skin temperature will add heat to core
(2) Radiant heat gain from sun and surroundings
c. Heat lost to the environment
(1) High humidity limits evaporation
(a) Environment stress measurement
i) WBGT (wet bulb globe temperature)
ii) WBGT = 0.7 WB + 0.2 BG + 0.1 DB

E. Recognition
1. Assessment parameters
a. Signs and symptoms
b. Core body temperature measurement
c. CNS status
d. Field labs
2. Exertional hyperthermia is an elevated core temperature > 40 ºC (104 ºF)
a. No CNS symptoms
b. Some form of “collapse”
3. Exertional heat stroke
a. Symptoms
(1) Fatigue
(2) Impaired judgment
(3) Weakness

(4) Flushing
(5) Chills
(6) Hyperventilation
(7) Dizziness
(8) Intense thirst (in some)

b. Vital signs
(1) Elevated body temperature >40 ºC
(a) <40 ºC if spontaneous cooling has occurred or found late
(2) Increased pulse rate >100 bpm
(a) 100-120 bpm is common early
(b) 120-180 as heart fails
(3) Decreased blood pressure
(a) Systolic <100 mmHg
(4) Increased respiratory rate
(a) Do not assume “hyperventilation syndrome”

c. CNS depression signs
(1) Most easily recognized marker of exertional heat stroke
(2) Bizarre behavior
(a) Often first sign
(3) Lucid interval
(a) May seem OK to “stranger”
(b) Subtle personality changes
(4) Memory loss
(a) Often from time of critical body temperature elevation
(5) Loss of lower limb function
(a) Unable to walk alone
(b) Comparative physiology is loss of hind limb function in quadrupeds
(6) Collapse
(a) May get up again (part of “lucid interval”)
(b) Functional abilities usually decreased
(7) Delirium
(8) Stupor
(9) Coma
(10) Seizure
(a) If rectal temp not elevated, think hyponatremia

d. Skin signs
(1) Skin color ashen in appearance
(a) Circulatory collapse
(b) Shock
(2) Sweaty and wet skin
(a) Can be cool to touch
(3) Dry and hot skin
(a) Rare early in athlete collapse
(b) Implies hypothalamic failure
(c) May be marker of dehydration
(d) Non-exertional classic heat stroke presentation

F. Treatment
1. On-site first aid
a. Discontinue activity to stop excess intrinsic heat production

b. Move to cooler environment to stop extrinsic heat accumulation
   (1) Shade
   (2) Air conditioned building, vehicle, or shelter
c. First aid cooling
   (1) Ice packs to neck, axilla, and groin
   (2) Wet cool towels
   (3) Garden hose “immersion”

2. On-site treatment for rectal temperature > 104 ºF and CNS changes
   a. Ice water tub immersion
      (1) Cooling rate of 17 ºF/hr with legs out of tub
      (2) Rapid conduction of heat from body to fluid
         (a) Trunk isolated or trunk and limbs in tub
         (b) Increased cooling rate with legs in tub
      (3) Hydrostatic pressure supports blood pressure
      (4) Equipment
         (a) Tubs
            i) Rubbermaid™ tub
            ii) Bath tub
            iii) Whirlpool tub
            iv) Wading pool
            v) Inflatable raft
         (b) Ice
         (c) Water source
         (d) Disinfectant spray
      (5) Clean tub for re-use with bleach solution and rinse
   b. Rapidly rotating ice water towels with ice packs in neck, axilla, and groin
      (1) Cooling rate 15 ºF/hr
      (2) Equipment
         (a) Ice water bucket or cooler
         (b) 8-10 towels
      (3) Procedure
         (a) Dunk towel and wring out extra water
         (b) Place on body to cover legs, arms, trunk, & head.
         (c) Rotate towels (one person on each side of body)
         (d) Ice packs to neck, axillae, and groin
   c. Monitor and record rectal temperature, CNS & respiratory status, vital signs every 10 minutes
   d. Usual end point for active cooling is 39 ºC (102 ºF)
      (1) Prevent over-cooling
      (2) Monitoring every 10 minutes for temperature rebound
      (3) Should casualties be over cooled to 95-97 ºF similar to MI?
         (a) TCM protocol now stops at 100 ºF

3. Hydration
   a. Careful fluid replacement until cooled
      (1) Body fluid returns to intravascular space during cooling
      (2) Hydrostatic pressure of immersion along with vasoconstriction from cold will usually improve hypotension associated with heat stroke
   b. Consider intravenous fluids
      (1) If vomiting, poor response to cooling, or dropping BP while cooling

(2) Limit to 1 liter in first hour unless severe dehydration suspected
(a) Consider NS at higher volumes if signs of shock to protect organs
(3) Recommended fluid types
(a) $D_{5\%}$ NS or NS
(b) After first liter consider NS

4. Medications used in exertional heat stroke to relieve muscle cramping or treat seizure
a. Diazepam 1-5 mg IV push (off label)
b. Midazolam 1-3 mg IV push (off label)
c. Magnesium sulfate 1-5 g IV (off label)
d. Dantrolene in future?

G. Disposition
1. Release from medical area if CNS clear, VS stable, and normal temperature
a. Follow up instructions for status changes
b. Follow up for SGOT next day (?)
2. Transfer to emergency facility
a. Not responding to treatment
b. Complicating factors
c. Not "comfortable" with release from medical area

IV. Exertional hyponatremia
A. Problem description
1. Serum Na^+ < 135 mmol/L
a. Overhydration during marathons combined with poor water clearance
(1) Slow runners on course for > 4 hrs
(a) Can ingest too much hypotonic fluid
(2) More fatalities in women
(3) Overzealous fluid intake can over-hydrate smaller body sizes
(4) Some cases in runner who stay neutral or have slight weight loss
b. Na^+ losses in sweat minimal contribution to hyponatremia in marathon runners
(1) More significant in Ironman Triathlon who do not retain sweat sodium
2. Marathon data from multiple sites
a. Marathon finish times >4 hrs
b. Large fluid volume intakes
c. Female > male in symptomatic and fatal cases
3. Can present with cerebral and pulmonary edema
4. Dehydration occurs during marathon races; seldom "life threatening"
5. Both low and high sodium prolong stay in medical tent
6. Pre-race, race, and post -race hydration recommendations
a. Keep urine pale yellow like lemonade color pre race
b. Replace no more that sweat losses during the race
(1) Individualized fluid intake is best
(a) Pre and post run weights
(b) Calculate fluid needs for pace and conditions
c. Recent data from Houston implies safest to lose a pound or two

during the marathon race
- d. "Drink when thirsty" to avoid too much fluid, but "do not ignore thirst" to avoid dehydration
- e. Sports drinks may delay onset but do not prevent dilutional hyponatremia
- f. Post-race drink salty fluid like chicken broth, then fluid of choice

B. Mechanism of hyponatremia onset in marathon road racing
1. Water intoxication due to hypotonic fluid intake greater than sweat rate water loss without renal free water clearance
2. Salt depletion from sweat losses is unlikely component of hyponatremia during marathons
   a. May be a factor in longer events like the Kona Ironman Triathlon

C. Recognition
1. Symptoms /Signs
   a. Early
      (1) Lightheaded
      (2) Dizzy
      (3) Headache
      (4) Nausea
   b. Middle
      (1) Vomiting
      (2) Dyspnea
      (3) Muscle cramps
      (4) Confusion
      (5) "Puffy"
      (6) BP, HR, and RR rate usually normal
   c. Late
      (1) Cerebral edema
         (a) Prolonged seizure
         (b) Obtundation
      (2) Pulmonary edema
         (a) Respiratory distress
      (3) Shock
         (a) Ashen, gray appearance
2. Lab
   a. Na^+ < 135 mmol/L
      (1) Mean Na^+ in obtunded patients 121±3 mmol/L
      (2) Range 111 to 127 mmol/L
   b. Hct/BUN
      (1) Decreased in over hydration (BUN <15)
      (2) Increased in dehydration (BUN >15)
   c. O2 sat < 94 %?
      (1) Decreased with impending pulmonary edema?
   d. Glucose
      (1) Pseudohyponatremia picture with hyperglycemia
   e. Urine sodium
      (1) > 30 in SIADH
      (2) < 30 in polydipsia
      (3) < 20 in depletional hyponatremia
      (4)

D. Diagnosis and clinical course
1. Na^+ levels range from 110 to 135 mmol/L

2. May be asymptomatic or minimally symptomatic for several hours
3. May present with muscle cramping or severe headache
4. May present with "flu" symptoms, especially later in hotel
5. Rapid deterioration, progressing to seizure, respiratory distress, and coma due to worsening pulmonary and cerebral edema

E. Treatment
1. Initial Na^+ level < 135 mmol/L and fluid overloaded
a. If asymptomatic, allow natural diuresis to remove excess water
(1) Close observation
(2) Consider PO hypertonic solution
(a) 4 bouillon cubes in 4 oz water
b. If symptomatic, especially with encephalopathy (usually <125)
(1) 100 ml 3% saline IV over 10 minutes
(2) Follow with 3% saline IV at 30-70 ml/hr until sodium normalizes or symptoms abate
(3) Slow replacement to avoid crenation not considered risk in rapid onset hyponatremia
2. Serum Na^+ of 125-135 mmol/L and clinical signs of dehydration
a. Rehydration with normal saline in the medical tent
b. Check electrolyte levels after each liter of IV fluid
c. If encephalopathy use 3% saline as outlined above
d. Serum Na^+ of <125 mmol/L use same hydration protocol but consider hospital setting on a case by case basis

F. Disposition
1. Transfer of care to an emergency facility
a. Initial Na^+ <125 mmol/L and not responding
b. Initial Na^+ level <130 mmol/L, obviously fluid overloaded, and not responding
c. Unresponsive to initial therapy
d. Worsening sodium levels
e. No diuresis
f. Unable to continue medical observation
2. Discharge with responsible adult
a. Stable CNS and vital signs
b. Chemical parameters normal

V. Normothermic exercise associated collapse
A. Problem definition
1. An athlete requiring assistance during or after endurance activity
a. Normal body temperature
b. Exercise exhaustion (heat exhaustion)
2. Excludes
a. Orthopedic problems
b. Dermatologic problems
c. Cardiac arrest
d. Chest pain
e. Insulin shock
f. Asthma
g. Anaphylaxis
h. Seizure disorder
i. Hyponatremia
j. Trauma

B. Mechanism of onset

1. Multiple variable hypotheses
    a. Loss of the muscle pump when stopped running
    b. Vasovagal response
    c. Dehydration
    d. Depletion of muscle energy store
    e. Internal fluid shifts
    f. Temporary malfunction of temperature regulation
    g. Central nervous system failure (neural origin)

C. Recognition
1. Presence of any signs or symptoms
2. Major criteria (Table 3a)
    a. Body temperature
        (1) Temperature related complaints do not always reflect the rectal temperature
    b. Mental status
    c. Ambulation status

D. Clinical picture in EAC
1. Derived from clinical presentations of TCM casualties
2. Symptoms
    a. Exhaustion
    b. Fatigue
    c. Hot
    d. Cold
    e. Nausea
    f. Stomach cramps
    g. Lightheaded
    h. Headache
    i. Leg cramps
    j. Palpitations
3. Signs
    a. Abnormal body temperature
    b. Unconscious
    c. Altered mental status
    d. CNS changes
    e. Unable to walk unassisted
    f. Leg muscle spasms
    g. Tachycardia
    h. Vomiting
    i. Diarrhea
    j. “Hyperventilation”
4. Key history before or during race
    a. Fluid ingested
    b. Urine passed
    c. Vomiting or diarrhea
    d. Carbohydrate ingested
    e. Drugs taken
    f. Recent or current illness
    g. Heat acclimatization
    h. Training schedule
    i. Distance training
5. Key exam points
    a. Level of consciousness and mental status

b. Hydration state
c. Rectal temperature
d. Heart rate and blood pressure
(1) Supine
(2) Erect or sitting

6. Field lab
a. Blood glucose
b. Serum Na^+
c. BUN
d. Hct
e. O_2 sat

E. Treatment
1. Fluid redistribution
a. Improve circulation with ambulation to promote the "muscle pump" in mild casualties
(1) Augments return flow to the heart
(2) Supports systemic circulation
b. Redistribute fluid with supine position and elevation of the legs and buttocks if unable to ambulate
(1) Restore pooled blood to the circulation
(2) Improves the medical status of a majority of casualties

2. Fluid replacement for signs of dehydration
a. Oral fluid administration is the preferred method of rehydration
(1) All mild and moderate casualties who can tolerate oral intake
b. IV fluid administration is necessary when casualties are unable to tolerate oral intake (at minimum for medication access)
(1) Most severe cases
(2) Moderate cases
(a) No response to oral fluids
(b) Unable to tolerate oral fluids
(c) Extra fluid losses
i) Vomiting
ii) Diarrhea
(3) IV fluid cautions
(a) Consider dropping dextrose from the IV solution after one liter of fluid to avoid hyperglycemia
i) Monitor with a home glucose monitor
c. Who gets an IV for fluid replacement (TCM protocol)
(1) Criteria
(a) No improvement after 10-30 minutes leg elevation
i) May take 30 minutes to resolve
(b) BP < 100 systolic
i) Orthostatic BP drop after leg elevation
(c) Pulse >100
(d) Temp >104 or <95
(e) Severe spasms
(f) Anorexia, nausea, diarrhea
(g) Hypoglycemia with glucose <60
(h) Confused
(i) "Not doing well" and hyponatremia ruled out
(2) IV Types

(a) D5% NS
(b) NS
(3) Glucose
(a) Hyperglycemia can cause pseudohyponatremia
d. Recommended fluids for EAC casualties
(1) Oral
(a) Initial fluid high salt
i) Chicken bullion broth
ii) Sports drink with extra salt
(b) Simple sugar-electrolyte drinks
(c) Fruit juices
(d) Water
(2) Intravenous
(a) Dextrose 5% - normal saline ($D_{5\%}$ NS)
(b) Normal saline (NS)
3. Maintain body temperature
a. Monitor rectal temperature if not improving
b. Warm if cold
c. Cool if warm

F. Disposition
1. Discharge from the race medical facility
a. Clinically stable, normothermic, and ambulatory
b. “Sit test”
(1) Move to sitting position
(2) Check for orthostatic reaction
c. Discharge instructions
(1) Continue fluid and energy replacement
(2) Provide criteria for re-evaluation
(3) Follow-up recommendations for severe casualties

VI. Exercise associated muscle cramping

A. Problem definition
1. Involuntary muscle spasms after or during exercise

B. Mechanism of onset
1. Triad of muscle fatigue, dehydration, and salt loss
a. Not PLASMA sodium level, but extracellular sodium bathing neurons and muscles
b. Fast twitch fibers are especially rich in sodium channels
c. Action potential starts with an inrush of sodium (as K+ exits)
d. An excess of sodium OUTSIDE the neuron (compared to cations inside) is what keeps the cell membrane potential "negative" (minus 70 mV)
e. If the sodium level outside the neuron drops, the membrane potential becomes "less negative," which may trigger the neuromuscular unit to fire too fast or too often or when you do not want it to contract
(1) Less sodium rushing into the muscle may also impair molecular contraction or relaxation forces in the muscle cell
f. Result: Cramping
2. Recent evidence also suggests a possible neural etiology
3. Can occur with hyponatremia
4. Often seen in athletes who are not acclimated or who have salty sweat

C. Recognition
   1. Painful, palpable spasm
   2. Normal sodium level
D. Treatment
   1. Neuroinhibition techniques
      a. Prolonged stretch
      b. Deep pressure
   2. Oral fluid, glucose, and salt replacement with high risk or active cramping rather than water alone
      a. Sports drinks (10-21 mEq/L) with additional tsp. salt added / liter
      b. Rehydratlye (Ross) has 75 mEq Na/L
      c. Pickle juice
      d. Chicken bullion broth
      e. Pedialyte (Ross) with 45 mEq Na/L
      f. Alka-seltzer 2 tabs in water
   3. Assisted walking
   4. Avoid massage until well hydrated
   5. Intravenous fluids
      a. Normal saline or $D_{5\%}NS$
      b. Medications
         (1) Consider midazolam 1-3 mg IV push (off label)
         (2) Consider diazepam (off label)
            (a) Central muscle relaxing action
            (b) 1-5 mg IV push
         (3) Consider Mg^{++} Sulfate (off label)
            (a) 1-5 grams IV loading dose
E. Disposition
   1. Home when spasm controlled
   2. Longer observation if medications used
F. Prevention
   1. Salted fluids

VII. Summary
   A. Generally limited differential diagnosis for collapsed athlete
   B. Prepare protocols and equipment in advance
   C. Educate volunteers and runners
   D. Expect the common problems
   E. Prepare for the rare life threatening problems

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Table 1: Injury/Illness Classification for Marathon Race Participants

- Medical
  - Exercise Associated Collapse
    - Hyperthermic
    - Normothermic
    - Hypothermic
    - No temperature measured
  - Chance Medical Emergencies
    - Cardiac arrest
    - Insulin shock
    - Asthma
    - Anaphylaxis
    - Hyponatremia
    - Rhabdomyolysis
- Trauma
  - Macrotrauma
    - Musculoskeletal
      - Sprains
      - Strains
      - Fractures
    - Vascular
    - Head & neck
    - Visceral organs
  - Microtrauma
    - Tendinitis
    - Fasciitis
    - Stress fracture
  - Dermatologic
    - Blisters
    - Abrasions
    - Lacerations

Table 2: Twin Cities Marathon Medical Encounters Classified by Diagnosis (includes primary and secondary diagnosis)

Skin trauma diagnoses

	Number	% injured runners	Injury rate (per 1000 entrants)
Abrasions	27	1.9%	0.35
Blisters	289	19.9%	3.8
Total	316	21.6%	4.1

Bone, joint, and connective tissue diagnoses

	Number	% injured runners	Injury rate (per 1000 entrants)
Muscle Strain*	207	14.3%	2.7
Sprain	19	1.3%	0.25
Stress fracture (suspected)	13	0.89%	0.17
Fasciitis	11	0.75%	0.14
Knee pain**	3	0.2%	0.04
Other***	4	0.28%	0.05
Total	257	17.6%	3.35

*Includes tendinitis and low back pain
**Includes 1 post-op meniscus surgery
***Includes Plica, Bursitis, Hematoma, Casted arm fracture

Medical Diagnoses

	Number	% injured runners	Injury rate (per 1000 entrants)
Exercise associated collapse	863	59.4%	11.25
Muscle cramps	89	6.1%	1.2
Severe medical events*	2	0.14%	0.03
Other medical events**	7	0.48%	0.09
Total	961	65.8%	13.7

*Cardiac arrest - 1; Insulin shock - 1
**Migraine headache - 1; Diabetic problems - 1; Hyperventilation - 1; Sinus arrhythmia - 2; Drug reaction - 1; Asthma - 1

Table 3

3a: Exercise Associated Collapse Classification Matrix

	Mild	Moderate	Severe
Hyperthermic	T > 103 ºF (39.5 ºC)	T >105 ºF (40.5 ºC)	T >106 ºF (41 ºC)
Normothermic	97 ºF <T <103 ºF	97 ºF < T <103 ºF	97 ºF < T <103 ºF
Hypothermic	T <97 ºF (36 ºC)	T < 95 ºF (35 ºC)	T < 90 ºF (32 ºC)
Key Sx & signs	*Any symptom or sign* *Walk with or without assistance* *Alert* *Syst BP >100 mm Hg* *Heart rate <100 bpm* *Weight loss <5%*	*No oral intake* *Extra fluid loss* *Unable to walk* *Severe muscle spasm* *Weight loss 5-10%*	*CNS changes* *Unconsciousness* *Syst BP <100 mm Hg* *Heart rate >100 bpm* *Weight loss >10%*

3b: TCM Exercise Associated Collapse Casualties by Temperature Classification & Severity

	Mild (male / female)	Moderate (male / female)	Severe (male / female)	Total (% male / % female)*
No temperature Recorded	*506* *(405 / 101)*	*32* *(21 / 11)*	*1* *(1 / 0)*	*539* *(38% / 39%)*
Normothermic	192 (143 / 49)	59 (50 / 9)	3 (2 / 1)	254 (17% / 19%)
Hypothermic	28 (16 / 10)	16 (15 / 1)	2 (2 / 0)	46 (3% / 3%)
Hyperthermic	6 (3 / 3)	7 (4 / 3)	10 (7 / 2)**	23 (1% / 3%)

* % of injured male and female runners

**Gender not specified for 1 casualty