

在炎熱天氣下 進行體育活動之安全考慮 Safety Concerns When Exercising in Hot Weather

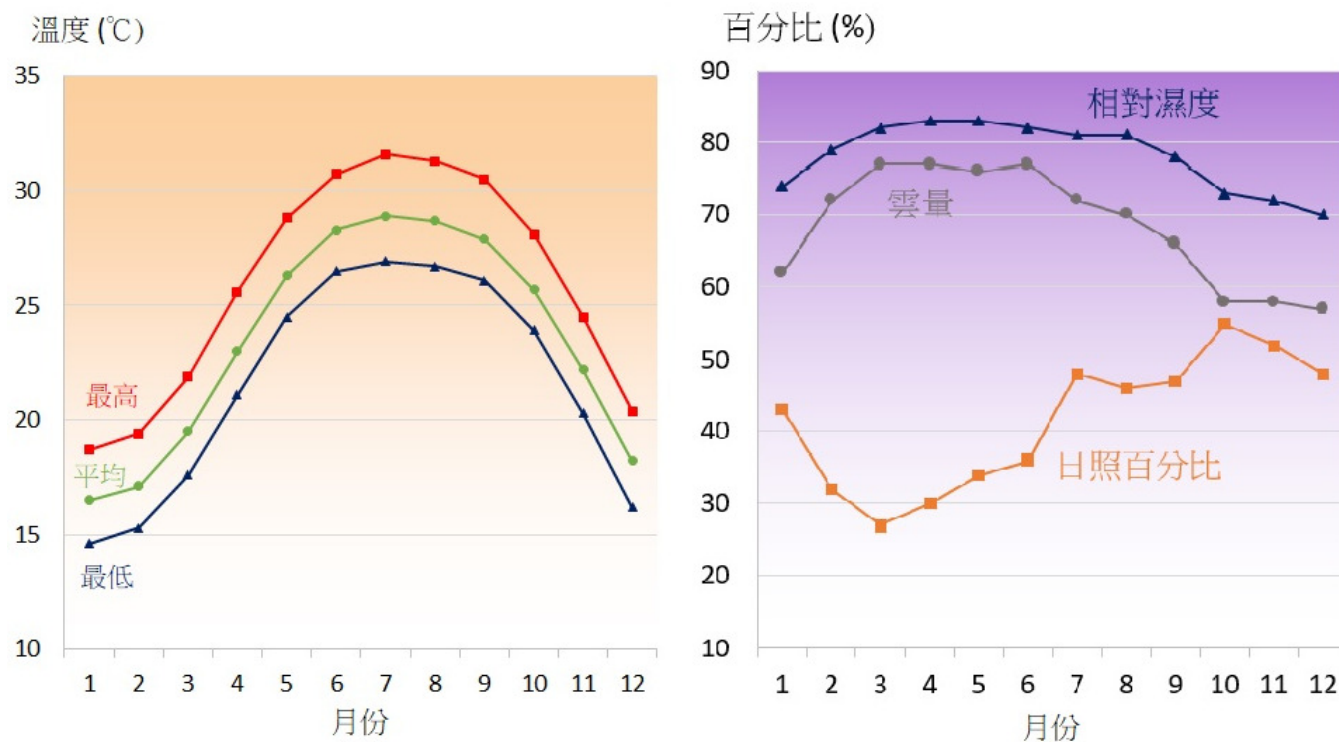
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Content

1. Thermoregulation system
2. Physiological response under the heat
3. Factors that increase the risk of heat illness
4. Different methods and strategy to exercise in hot environment

Hong Kong Climate



1991-2020年天文台錄得之日最高、平均及最低氣溫(左圖)、
相對濕度、雲量及京士柏錄得之日照百分比(右圖)的月平均值

<https://www.hko.gov.hk/tc/cis/climahk.htm>

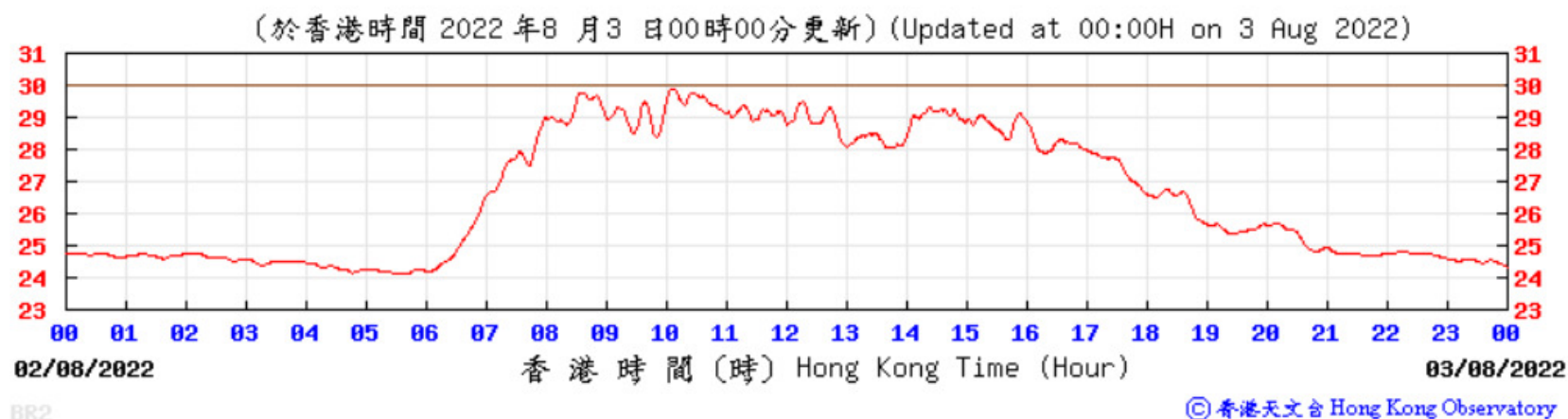
綜合溫度熱指數(WBGT)

$$WBGT = 1T_d + 7T_{nw} + 2T_g$$

WBGT	Risk of Heat Illness	Recommended management for sports activities
<20	Low	Heat illness can occur in distance running. Caution over-motivation.
21 - 25	Moderate to High	Increase vigilance. Caution over-motivation. Moderate early pre-season training. Reduce intensity and duration of play/training. Take more breaks.
26-29	High – very high	Uncomfortable for most people. Limit intensity, take more breaks. Limit duration to less than 60 minutes per session.
30 and above	Extreme	Consider postponement to a cooler part of the day or cancellation.

Hong Kong Heat Index

2 Aug 2022 (Tuesday)



Hong Kong Heat Index

was calculated from the measured Natural Wet Bulb Temperature (T_{nw}), Globe Temperature (T_g) and Dry Bulb Temperature (T_a). Its value is given by $0.05T_g + 0.80T_{nw} + 0.15T_a$.

Where

T_g = Globe thermometer temperature (measured with a globe thermometer, also known as a black globe thermometer)

T_{nw} = Natural wet-bulb temperature (combined with dry-bulb temperature indicates humidity)

T_a = Dry-bulb temperature (actual air temperature)

https://www.hko.gov.hk/en/wxinfo/ts/display_element_hkhi.htm

Hot Weather

Heat Stress = Metabolic heat + **Environmental heat**

→ Heat Stress

- Heat Cramps 抽筋
- Heat Exhaustion 熱衰竭
- Heat Stroke 中暑
- Sunburn 曬傷

Heat balance in human body

Heat Production

■ Metabolic Heat Production

Production of heat

(↑ with intensity of exercise can up to 25 time of RMR)

Heat Exchange

■ Conductive 傳導

Physical contact with objects resulting in

Heat Loss / Gain

■ Convective 對流

Body heat can be Lost or Gain depending on Circulation of Medium

■ Radiant 輻射

Comes from Sunshine and cause ↑ in temperature

Heat Loss

■ Evaporative

Sweat glands allow water transported to surface
Evaporation of water takes heat with it.

Radiant Heat / Environment Temp are > Body Temp
→ Loss of heat through Evaporation is KEY

Relative Humidity of 65% → Impairs Evaporation
Relative Humidity of 75% → Stops Evaporation

Thermoregulation

Factors affecting body temperature

- Heat gain $>$ heat loss
Body Temp \uparrow
- Heat gain $<$ heat loss
Body Temp \downarrow
- Heat gain = heat loss
Body Temp unchanged

How do our body regulate under the heat?

1. Thermoregulation

- Blood supply is redirected to the skin & away from the muscles for heat loss
- Cold fluid injection and lower the gastrointestinal and core temperature
Eg. Cold Pack, Cold Air ventilation, Hand Cooling device, Water Spray, Ventilation Vest, Cooling Garment

2. Feedback Loop from hypothalamus(Median preoptic nucleus)

- Receive information regarding skin temperature and influence body temperature
- Get cold of the mouth of the brain region
Eg. Cold Pack, Cold Air ventilation, Hand Cooling device, Water Spray, Ventilation vest, Cooling Garment, Cold Fluid injection

Factors that increase the risk of heat illness:

1. Lack of fitness OR Inadequate sleep/rest.
2. Previous history of heat illness or heat intolerance
3. Illness and medical conditions (e.g. current or recent infectious illness or chronic health disorders at any age)
4. Overweight
 - Death from heat stroke increase 4:1 as body weight increases
 - Reduced skin area to mass ratio (eg, large muscle mass, obesity)
5. Age - Infants and children up to four years of age, people 65 years of age and older are at higher risk due to their age. Elderly have lower rate of recovery from dehydration
6. High exercise intensity and duration (Increase too much metabolic rate)

<https://www.cdc.gov/disasters/extremeheat/faq.html>

<https://publications-aap-org.eproxy.lib.hku.hk/pediatrics/article/128/3/e741/30624/Climatic-Heat-Stress-and-Exercising-Children-and?searchresult=1>

(Con) Factors that increase the risk of heat illness:

7. High air temperature and high humidity...

8. No Wind...

9. Prolonged exposure to hot conditions, heavy clothing and protective equipment that does not allow the body to release enough heat.

- Wear light color with loose fit (long sleeve & pants if appropriate)
- Wear Hat, under the cover (umbrella)
- More break

(Con) Factors that increase the risk of heat illness:

10. Lack of acclimatization to being active in warm and humid conditions.

- 80% of acclimatization by first 5 – 6 days with 60 mins, with moderate exercise (30 - 50% of VO₂ Max), 7 – 14 days period of maximum acclimatization totally.

After Acclimatized

- ↑ Increase cutaneous blood flow for transports the metabolic heat from deep tissue
- Start of sweating earlier for evaporation
- ↑ Increase sweat output
- ↓ Decrease sweat's salt concentration to preserve electrolyte

11. Dehydration

- Inadequate water intake before exercise and during activity longer than 60 minute
- **Feel Thirsty → 1-2% drop in body weight (due to dehydration) → Too Late!~~**
- **↓ Plasma Volume, Blood Pressure, Blood Flow to muscle & Skin; Sweating Rate, Ability of Thermoregulation**
- **↑ Heart Rate**
- **If > 5% drop in body weight, the function of sweating will totally lost!~~~**

HOW MUCH Fluid we should drink?

(1) Pre event 1 - 2 hour:

(Endurance event) by 500 – 600ml of fluid / water

(2) Pre-event 1 hour

350ml of fluid

(3) During Event

Drink fluid with electrolyte every 15 mins by 50 – 250ml of fluid

Depends on the exercise intensity, how hot, humid & your sweat rate!

An acclimatized person can lost 3L of sweat per hour

An elite marathon runners can sweat more than 5L of sweat during competition, which is about 6-10% of body weight!

(4) After Event

Replenish your total body loss x 1.5 gradually

Remarks:

- Electrolyte : Small amounts of sodium help in retention of water
- Optimal Carbohydrate level is 14g (6%) per 225g of water
- More CHO results in slower absorption

Any Other concerns?

Get cold of the mouth!

→ Protect our important organs!

Fluid Temperature

→ 5 - 14 degree

More Frequent Drinking time interval



Any Other concerns?

Conduct Event for competition and training

1. Time of Day

Avoid the hottest part of the day (usually 11 am-3 pm).

2. Local Environment

- Type of exercise surface
- A hot indoor venue or outdoor venue without shade cannot be considered an acceptable environment.
- Airflow should be considered
- Alternative training times and venues during hot weather.

Event for competition and training

- ▶ The greater **the Intensity & Duration** of the exercise
→ the greater the risk of heat related symptoms
- ▶ Player and official rotation may also be considered
- ▶ Reducing playing time
- ▶ Dividing games into shorter playing periods rather than halves to allow for extra breaks.
- ▶ Extending rest periods with opportunities to rehydrate during the event.
- ▶ Provision of extra water for wetting face, clothes hair is also important. (evaporation effect).
- ▶ A fan to enhance air movement would be beneficial.
- ▶ Prepare Ice for gradually cool down extremities of the body.
- **5 min rest can cause a significant reduction in core temperatures.**

Any Other concerns?

- Applied 15 – 30 BEFORE exposure (Lip as well)
- Re-applied every 2 hours / after exposure to water, excess sweating, rubbing skin with clothing or towel.
- UV index > 3 need → use sun cream
- SPF15 → absorb UVB rays.
- PA+ → protect from UVA rays

Recommends using a combination of the five sun protection
Slip, Slop, Slap, Seek, Slide

Summary

- ▶ Identifying Susceptible Individuals
- ▶ Identifying Exercise Intensity and Duration
- ▶ Allow gradual acclimatize the hot environment if possible
- ▶ Prepare better event arrangement (Venue, Break, Shadow Area, Duration, Ventilation, Facilities, EMS)
- ▶ Good Clothing, Protection, Hydration Plan with Proper Methods
- ▶ Understand your limit, exercise with friends, and have a backup plan!

End

