Warm-ups and Prevention of Sports Injuries : A Medical Science Perspective

暖身活動與運動創傷的預防：醫學的觀點

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專題討論會 - 內容

- 背景介紹
- 青少年常見的運動創傷
- 青少年運動創傷的預防醫療考慮
- 暖身(熱身)活動對運動創傷 - 醫學科學的證據
- 將軍澳醫院舉辦之健康推廣計劃
- 回家信息

背景介紹 - 青少年運動

- Long-term public health consequences associated with cardiovascular disease, DM, HT,….
- Greater self-esteem, relaxation, socialisation, teamwork, fitness, academic support.

背景介紹 - 青少年運動創傷

- General public interest and concern.

背景介紹 - 青少年運動創傷

- In US alone, sports-related injuries account for *2.6 million visits* to the emergency room by aged *5-24 years*.
- Injuries in high-school athletes have resulted in *500,000* doctor visit, *30,000 hospitalizations* and a total cost of *US 2 billion / year*.

背景介紹 - 青少年運動創傷

Year	前十字韌帶膝創傷, *年齡 < 24*	前十字韌帶膝關節手術, *年齡 < 24*	前十字韌帶膝關節手術
2002	503	213 *(52.5%)*	408
2003	450	203 *(67.4%)*	301
2004	529	291 *(52.5%)*	554
2005	505	253 *(48.2%)*	525
2006	536	261 *(46.2%)*	565
2007	546	332 *(52.5%)*	632
2008	487	292 *(43.7%)*	669
Total	**3556**	**1845 *(50.5%)***	**3654**

資料來源醫院管理局 CDARS system

背景介紹 - 青少年運動創傷

- ***Direct medical costs***: treatment (in-patient or out-patient) and rehabilitation.

- ***Indirect economical costs***: parents taking time off for caring, academic influence, drop out of sporting activities, ….

背景介紹 - 青少年運動創傷

- ***Young vs mature***

  - young athletes ≠ small adult

- ***Skeletal maturity***

  - type of injury e.g. plastic deformation

  - potential for recovery (the less maturity means more potential & faster to heal up)

- ***Onset of puberty***

  - growth spurt

背景介紹 - 青少年運動創傷

- Psychological consideration – '*No pain, no gain'; 'No gain, no game'; 'No game, no pain'.*
- Compliance to instruction & treatment.
- Personal interpretation.
- Parental effects.
- Peers effects.
- Self-esteem.

背景介紹 - 運動創傷

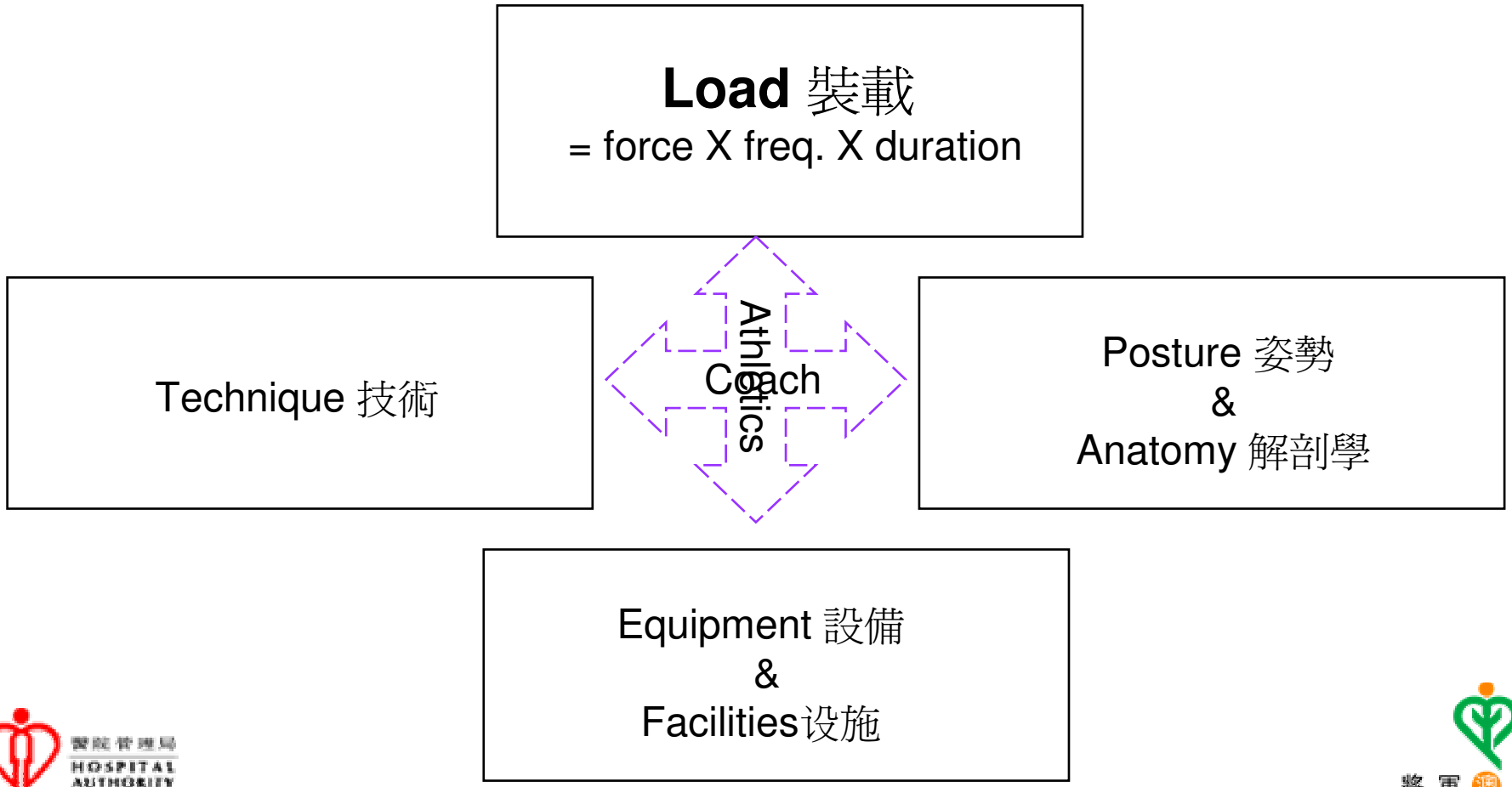
Mechanism of Sports Injury

$$P_{(Sports\ Injury)}$$

$$= P_{(random)} \times \left[\begin{array}{c} \text{Extrinsic Risk Factors} \\ \text{外在的風險要素} \\ + \\ \text{Intrinsic Risk Factors} \\ \text{內在的風險要素} \end{array} \right] \times \begin{array}{c} \text{Load} \\ \text{裝載} \end{array}$$

背景介紹 - 運動創傷

Mechanism of Sports Injury



運動創傷的風險要素

Extrinsic Risk Factors

外在的風險要素

Level of competition	Incidence of injury is greater during competition than practice. - More aggressive & risk taking behaviors.
Skill level	Higher skill level, higher injury rate - ? Increased exposure or more aggressive intensity at higher skill level.
Shoe type	Increased ankle injury with air cells - Decreased hindfoot stability.
Use of ankle tape or brace	Ankle brace or brace decreases the incidence of ankle injury. - Increased kinesthetic awareness & ankle support esp. inversion.
Playing surface	Increased incidence on artificial turf (人造的草皮) compared with grass and gravel (碎石鋪).

These factors can be modified

運動創傷的風險要素
Intrinsic Risk Factors
內在的風險要素

- Age
- *Sex*
- *Previous injury & inadequate rehabilitation*
- Aerobic fitness
- Body size
- Limb dominance
- *Flexibility*
- Limb girth
- Muscle strength
- Imbalance & reaction time
- Postural stability
- Anatomical alignment
- Foot morphology

運動創傷的風險要素

Intrinsic Risk Factors

內在的風險要素

Age	No association between age & injury.
Sex	Female athletes incur more knee injuries than male, esp. ACL. Unclear for other types of LL injury.
Previous injury & inadequate rehabilitation	Strong evidence for re-injury of the same type & location.
Aerobic fitness	Mild association between diminished aerobic fitness and sports injury.
Body size	No clear association.
Limb dominance	Unclear relationship.

運動創傷的風險要素

Intrinsic Risk Factors

內在的風險要素

Flexibility	Unclear relationship.
Limb girth	Unclear relationship.
Muscle strength	Need additional research
Imbalance & reaction time	Need additional research
Postural stability	Need additional research.
Anatomical alignment	No clear association
Foot morphology	No clear association

背景介紹 - 運動創傷

急性創傷

High loading X low freq. X short duration

= acute trauma

- e.g. acute trauma
  - fall in the game
  - direct contusion
    - acute strain

背景介紹 - 運動創傷

慢性創傷

Moderate loading X moderate freq. X moderate duration

= overuse syndrome

過度使用

e.g. stress fracture, bursitis, tendonitis, labral tears,…….

背景介紹 - 運動創傷

慢性創傷 - 損勞,退化

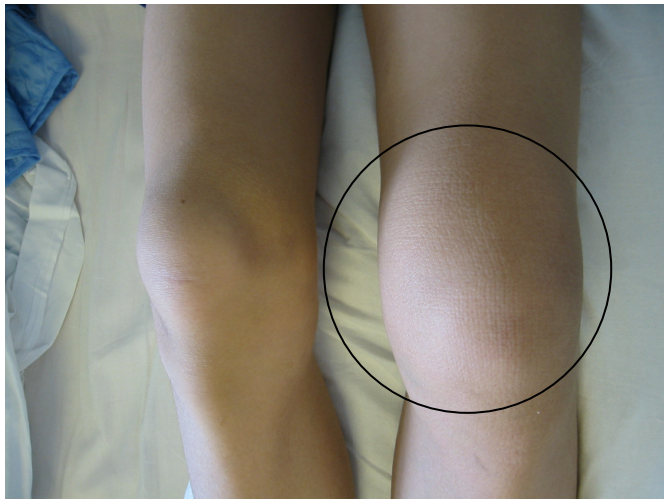
Low loading X high freq. X long duration

= wearing / degeneration

e.g. fatigue fracture, chondromalacia, osteoarthritis,……

青少年常見的運動創傷

- 關節扭傷 - 扭傷則是關節附近的韌帶及組織，突然受到扭曲或拉扯所造成。

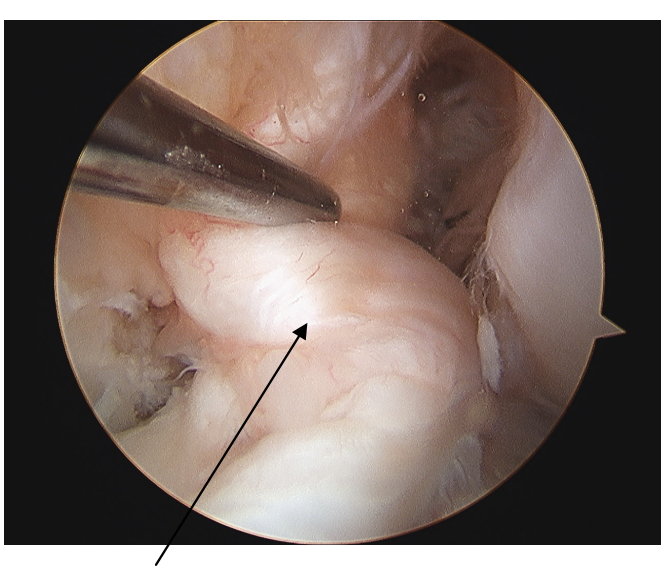


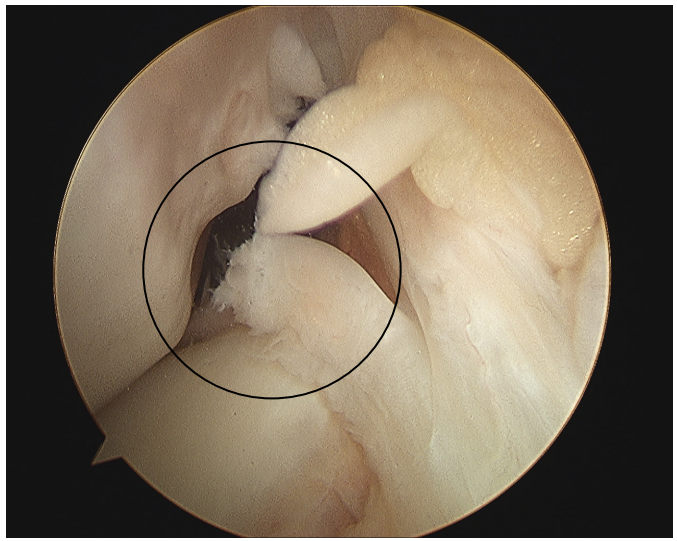
膝關節扭傷

踝節扭傷

青少年常見的運動創傷

- 韌帶撕裂

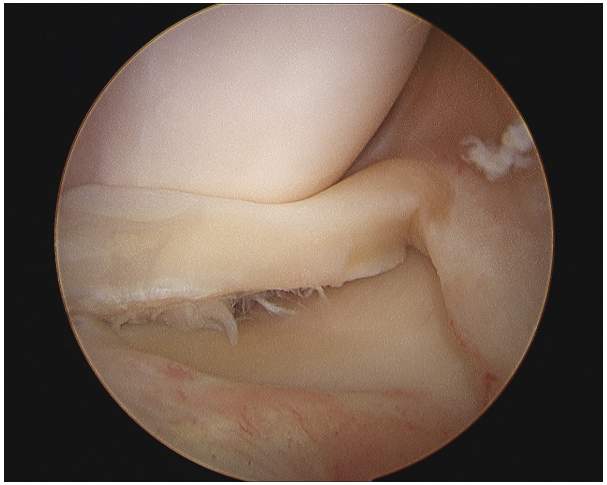


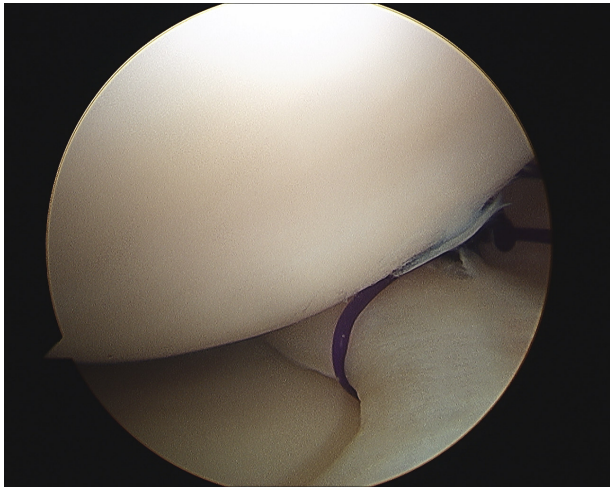


先前十字形韌帶撕裂

青少年常見的運動創傷

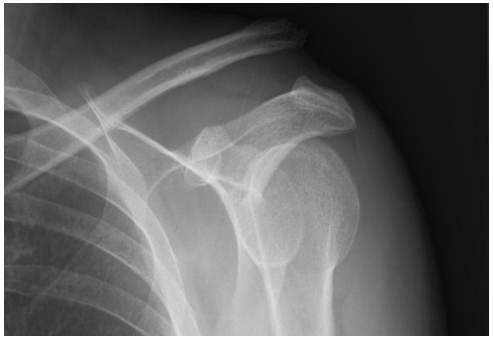
- 半月板撕裂



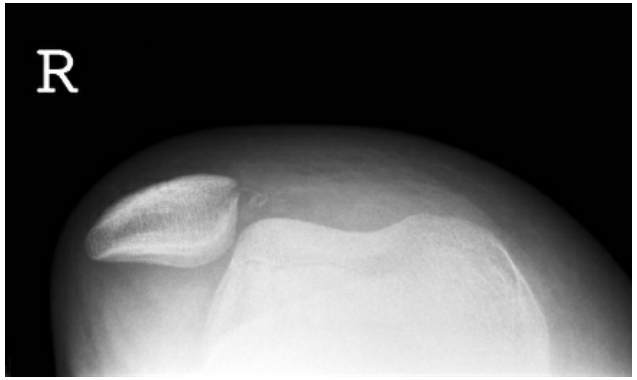


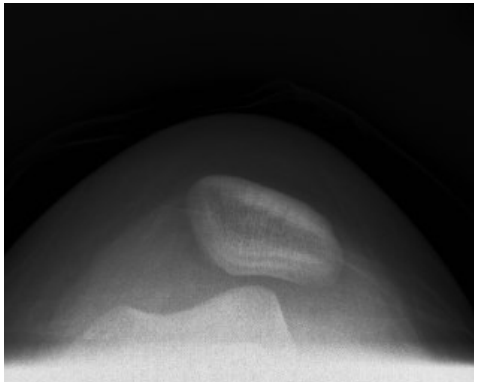
青少年常見的運動創傷

- 嚴重的運動創傷 - 脫臼



鎖骨關節脫臼





膝蓋關節脫臼

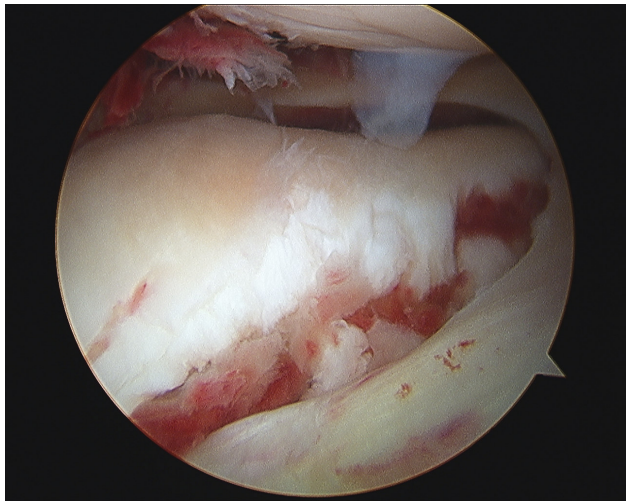
肩膀關節脫臼

青少年常見的運動創傷

- 嚴重的運動創傷 - 骨折

股骨骨折

脛骨骨折



膝蓋關節骨折

熱身活動身活動 - 定義

2 major functions

1. Improve a muscle's dynamic – less inclined to injury.
2. Prepare the athlete – demands of exercise.

- *1 ºC* rise in temperature – increase the length to failure of *rabbit* hind-limb muscles.

In general,

mild sweat without fatiguing the individual

熱身活動：類型

- ***Active warm-up*** : general & specific

1. General active warm-up – non-specific body movements e.g. jogging, cycling or callisthenics.
2. Specific active warm-up – activities & stretches that are specific to the sport which one is preparing.

熱身活動：類型

- ***Passive warm-up*** – muscle temperature or core body temperature is increased by external means e.g. hot shower, saunas or heating pads.

熱身活動：強度

- ***Experiences an increase in muscle temperature***
- But, does not experience a significant decrease in high-energy phosphate availability
- Should be tailored to each individual.
- *~ 40-60% VO_{2max}.*
- Light to mild sweating, without fatigue

熱身活動：生理變化

An increase in the speed & force of muscle contraction

- Speeds up metabolic processes
- Reduces internal viscosity
- Results in smoother contraction

熱身活動: 生理變化

An increase dissociation of oxygen from haemoglobin at higher plasma oxygen concentrations

- Provides more oxygen to working muscles

熱身活動：生理變化

An increase in speed of nerve transmission.

- Increases contraction speed
- An increase in vasodilatation
- Increase in blood flow to active tissues

熱身活動：生理變化

Provides protective mechanism to muscle

- Warmed muscles require a greater length of stretch & force to produce a tear.

伸展活動 - 定義

- Most of time ***subjective***
- ‘tightness without pain’, ‘gentle stretch’, ‘pulling sensation’, ‘stretching sensation’, ‘noticeable tension without pain’.
- Usually, maintained for *20 seconds* to facilitate connective tissue plastic elongation.

伸展活動 - 類型

- ***Dynamic, static & proprioceptive neuromuscular facilitation.***

1. Dynamic stretching – use of bouncing or jerking type motions to stretch a muscle group.
2. Static stretching – slow or passive stretching, maintained for approx. *20 sec*.

伸展活動 - 類型

3. Proprioceptive neuromuscular facilitation – combinations of a static stretch, an isometric contraction & relaxation and another static stretch.

伸展活動 - 擬訂規則

Study	Protocol	Type & result
Bixier & Jones (1992)	**Trunk twist:15 sec., hamstring, groin, quadriceps stretches: 25 sec. each**	**Static: protocol reduced injury.**
Sullivan et al (1992)	Hamstring only: 30 sec total (5 sec/each phase), 1 X 5 min session/day; 4 days/wk; 2 wk period	Static & PNF CRC method: NA
Rosenbaum & Henning (1995)	*2 lower-leg stretches: 30 sec. each, 3 reps*	*Static: NA*
Harting & Henderson (1999)	**Hamstring only, 5 X 30 sec. stretches, 3 session/day; 13 week**	**Static: protocol reduced lower extremity overuse injury.**
Pope et al (2000)	*1 X 20 sec stretch for each 6 major lower-limb muscle groups: 1 session/day; 12 week*	*Static: protocol did not significantly reduce total injuries.*
Amako et al (2003)	**4 upper body, 7 lower body, 7 trunk: 30 sec each, 1 x20 min. session/day; 12 week**	**Static: protocol limited the amount of muscle-related injury**
De Weijer et al (2003)	*Hamstring only, 1 X 30 sec. for each leg, 3 reps with 10 sec rest*	*Static: NA*
Verrall et al (2005)	**Hamstring stretches: 15 sec each with knee in 0, 10 & 90 deg. of flexion, utilising trunk flexion**	**Passive: protocol significantly reduction in injury.**

- ***No standard protocol.***

伸展活動：生理變化

- Elongation of soft tissues & muscles – time *(maintained for 24 hours)* & history dependent.
- An increase in flexibility – elastic & plastic (non-recoiling) stretching

BUT,

- *Excessive stretching may be detrimental to athletic performances.*

熱身活動

Traditionally, 3 major factors

1. A period of *aerobic exercise* to increase body temperature.
2. A period of *sport-specific stretching* to stretch the muscles to be used in the subsequent performance.
3. A period of *activity incorporating movements* similar to those to be used in the subsequent performance.

熱身活動

1. A period of *aerobic exercise (體能運動)* to increase body temperature.

熱身活動

2. A period of *sport-specific stretching (針對性伸展)* to stretch the muscles to be used in the subsequent performance.

熱身活動

3. A period of *activity incorporating movements (針對性熱身動作)* similar to those to be used in the subsequent performance.

熱身活動 – 醫學科學證據

Study & Country	Design	Participants	Warm-up practices	Outcome measurement
Bixier & Jones- USA (1992)	Controlled trial	5 high school American football teams	3 min warm-up :30 s light running + 30 s moderate running + 30 s jumping jacks + 15s trunk twist, 25 s hamstring stretch + 25 s groin stretch + 25 s quadriceps stretch.	No. of injuries, types & location of all injuries, quarter injury occurred. - Significant reduction
Van Mechelen et al – Netherlands (1993)	Randomised controlled trial	421 male recreational runners: 167 control, 159 interventional	19 min warm-up :6 min running + 3 min loosening + 10 min stretching	No. of injuries, types & location of all injuries, compliance with warm-up - No injury prevention benefit.
Wedderkopp et al _ Denamrk (1999)	Cluster randomised controlled trial	237 female European team handball players (16-18): 126 control, 111 interventional	10-15 min + 2 ex. Warm-up 10-15 min of an ankle disk + > 2 functional activities of all major muscle groups	No. of injuries, types & location of all injuries, injury severity, injury incidence per 1000 hr of match & practice. - Significant reduction.
Pope et al – Australia (2000)	Randomised controlled trial	1279 male army recruits: 656 control, 623 interventional	4 min 20 sec warm-up 20 s of stretch for each major muscles 4 min of jogging & side –stepping	No. of injuries, types & location of all injuries - Insignificant reduction.
Olsen et al – Norway (2005)	Cluster randomised controlled trial	1837 handball players (15-17): 879 control, 958 interventional	16-25 min warm-up 4-5 min ex. on ball, 4-5 min wobble board, 4-5 min balance net, 4-5 min other ex.	Rate of acute injury to knee or ankle, no. of lower limb injuries -At least 50% reduction of knee & ankle injuries.

熱身活動 – 醫學科學證據

- Rarely proved through randomized control trials.

Because,

- Difficult to define the intensity & duration of warm-up
- Difficult to classify the site & nature of injury
- Ethical problems for inducing injury in humans.

熱身活動 – 醫學科學證據

- Experimental research on animals suggests that warming up is likely to reduce the number of injuries.

BUT,

- *Stretching alone does not prevent injuries.*

熱身活動 –當前的醫學科學證據

- The weight of evidence is *in favour of warming up* which can decrease the risk of injury.
- The studies suggest a *protective effect* of warm-up focused on specific sports and homogenous populations.

熱身活動 –當前的醫學科學證據

- Recent studies introduce new warm-up programme – 3 keys elements + *additional training exercises* with progression for competent athletes.
- To improve *players' core stability, strength, proprioception, balance, dynamic stabilisation, eccentric hamstring strength,…*

熱身活動 –當前的醫學科學證據

- Each sport has its own unique qualities, it is possible that warming up may be a useful injury preventive tool for some sporting activities and not others.

熱身活動 – 將來的學術研究

- Focus on isolation of warm-up protocol and stretching protocol.
- Define the range of motion necessary for participation in different physical activities.
- Identify the flexibility or range of motion standards.
- Classify the different types of sports injury.
- Determine the potential effects of overstretching or over warm-up.

將軍澳醫院

矯形及創傷科 及 綜合服康部物理治療科

聯合舉辦之健康推廣計劃:

“熱身運動做一做，遠離膝傷做得到”

醫院管理局
HOSPITAL AUTHORITY

將軍澳醫院
Tseung Kwan O Hospital

序言

爲著面對將軍澳及西貢區的急速發展，本院擔當著社區醫院的角色，不單致力提供高質素的醫療服務，我們更銳意踏出社區，以參與及協助提升本區居民的健康意識。

計劃目的

有鑑於將軍澳及西貢區區內文娛及康樂設施的不斷落成，運動創傷的數字亦隨之而增加，而要動用上專科醫療服務的居民亦有不斷上升的趨勢。

年度	膝關節鏡檢查	前十字韌帶膝關節手術
2001	47	8
2002	55	22
2003	54	49
2004	79	66
2005	96	65
2006	100	89
2007	117	85

資料來源醫院管理局 CDARS system

計劃目的

爲著針對上述的現像，本院的矯形及創傷科及綜合復康部物理治療科決定攜手籌辦這項名爲“熱身運動做一做，遠離膝傷做得到”的社區健康推廣計劃。

計劃目的

我們希望藉此計劃，可望使區內居民認識或加深對運動安全的知識，並有助長遠控制或減低本區運動創傷的個案。

目標人物

- 從臨床觀察和實際的統計數字所分析，青少年是受到運動創傷的高危一族。

- 故是次健康推廣計劃的目標人物爲將軍澳及西貢區內的青少年。

計劃方法及內容

透過:

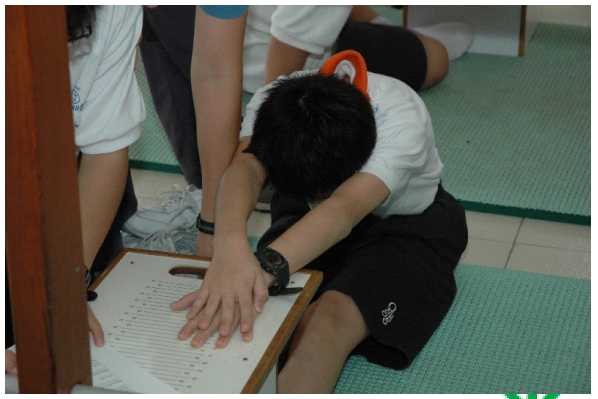
1. 健康普查

- 了解及分析一般中學生對運動創傷的知識和對熱身運動的看法和習慣。

計劃方法及內容

2. 體能測試

- 希望青少年對個人的身體狀況有更多的認識，從而使其在進行劇烈運動時能夠更有效地避免創傷。



計劃方法及內容

3. 健康講座

- 向同學講解預防運動創傷及有關熱身運動的知識。

計劃方法及內容

4. 海報和書籤

- 進一步加深青少年對預防運動創傷重要性的觀念。

計劃流程 (1)

- 經過多次磋商，本院的矯形及創傷科及綜合復康部物理治療科決定落實籌辦這項活動。
- 本計劃並得到將軍澳醫院行政部全力支持。
- 更鼓舞地獲得香港特別行政區政府食物及衛生局健康護理及促進基金，非研究性質促進健康計劃的一筆爲數達港幣二十萬零一千二百九十元的撥款，作爲是項爲期一年的計劃之基本開資。

計劃流程 (2)

- 我們首先發信給區內的各中學校，邀請參與是項計劃。

- 與同意參加是項計劃的專責老師商討有關拜訪個別學校的安排，並邀請專責老師協助向同學們派發及回收有關同學們過往因運動受傷及對熱身運動認知的問卷。

計劃流程 (3)

- 我們每次邀請約數十名經由各學校自行挑選而熱衷於運動的同學進行一系列有關膝關節及體能的測試，從中收集中學學生的體能及有關資料，加以分析及研究後，再向同學們發表。

- 資深的骨科專科醫生及物理治療師親自前往各學校向同學講解預防運動創傷及有關熱身運動的知識，並派發海報和書籤以作強化信息之用。

反應及成果

- 在二零零七年四月至二零零八年三月這一年間，我們先後到過十間將軍澳及西貢區區內中學校替四百六十六名同學進行有關膝關節及體能的測試，從而收集了一系列數據作分析及研究。

- 而在各老師們的鼎力協助下，我們更成功收集了一千二百多份健康普查問卷，從中獲得大量寶貴的資料，使我們在籌備往後的健康推廣及科學研究計劃上有著莫大裨益。

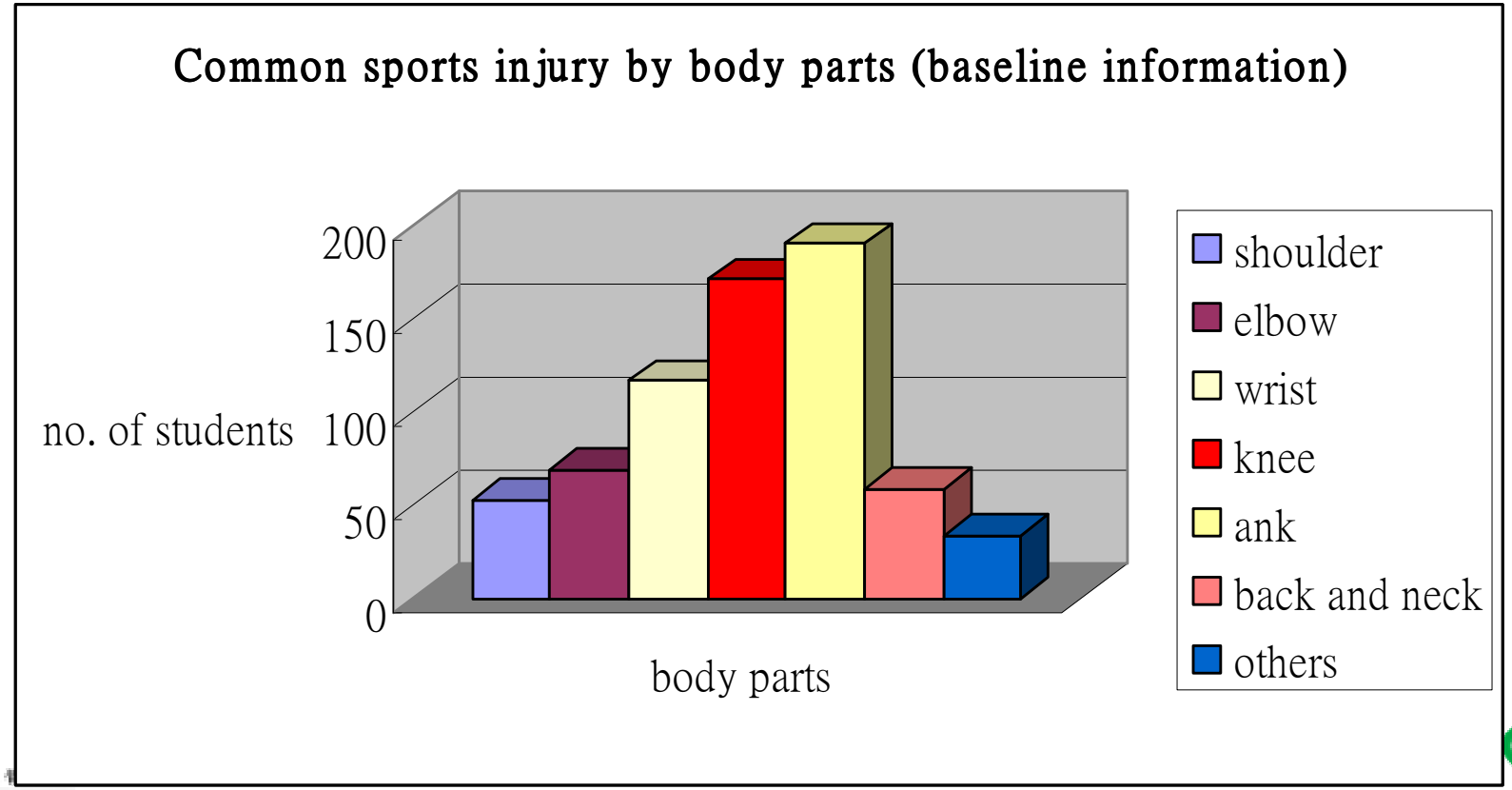
反應及成果

- 透過十二次大型健康講座，向超過二千五百位同學講解預防運動創傷及有關熱身運動的知識，反應熱烈。

- 我們向區內共二十六間中學校派發海報和書籤，估計資料可覆蓋達二萬六千名中學生。

反應及成果

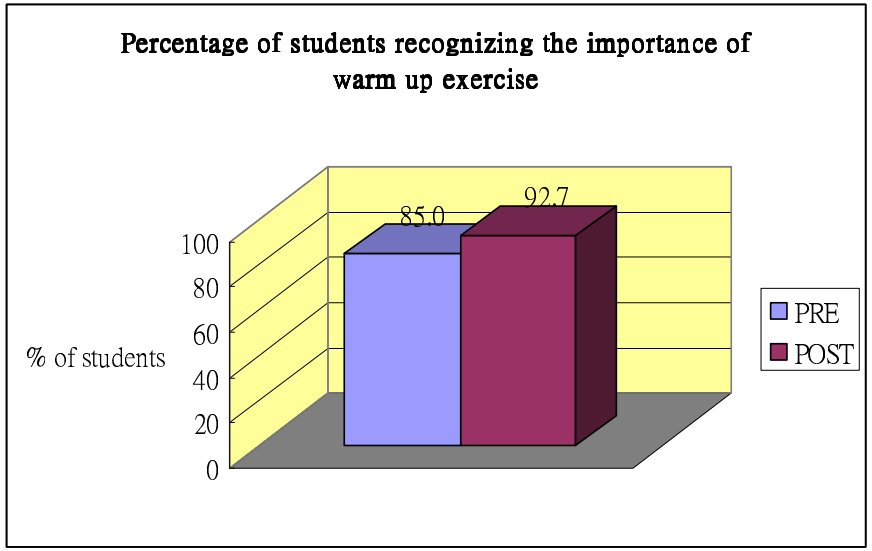
- 身體部位曾受傷



反應及成果

在是次活動，我們成功而且正面地改變了部份學生在熱身運動的態度和行爲:

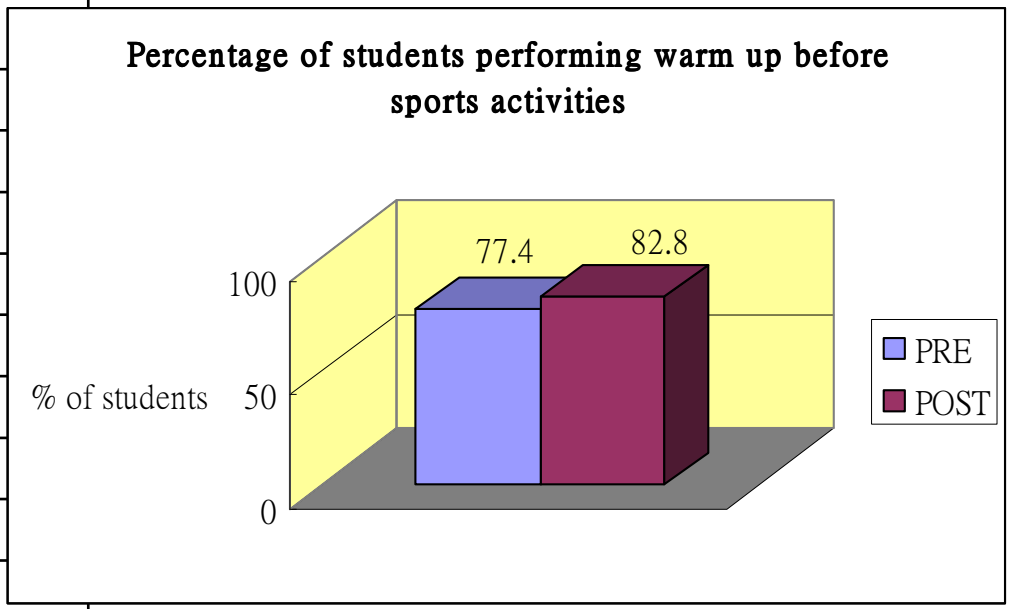
- 同學們認同熱身運動的重要性比率由原先的85%提升至92.7%。



反應及成果

- 表示在參與劇烈運動前有進行熱身的同學亦由原先的77.4%提升至82.8%。

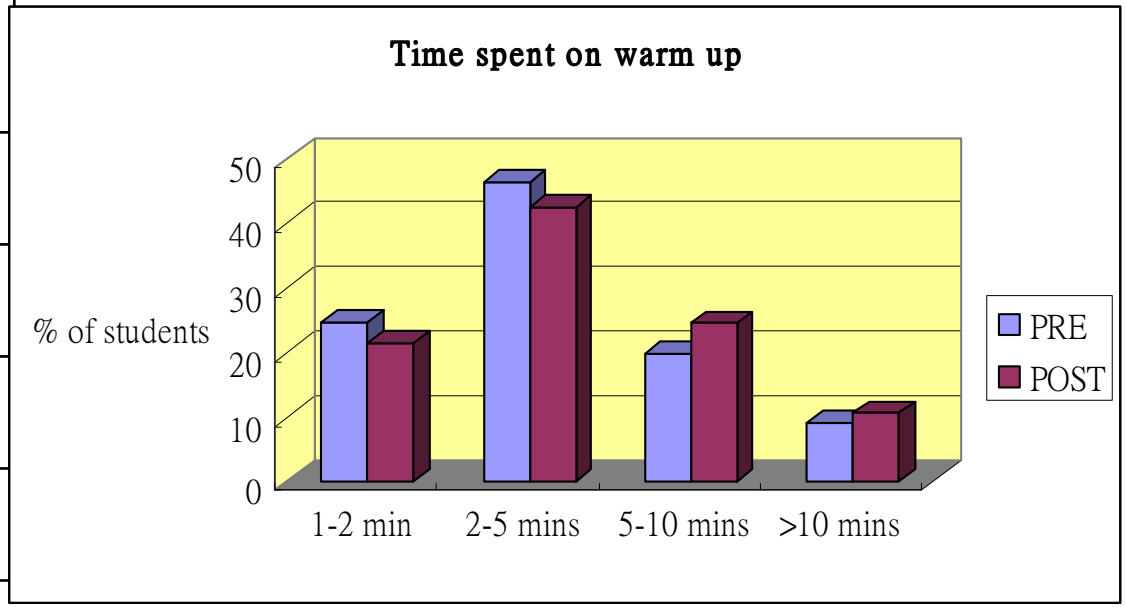
The percentage of subjects doing warm up before exercise		
	pre	post
A	82	97
B	74	76
C	91	80
D	70	82
E	64	75
F	94	98
G	78	95
H	64	77
I	98	87
J	85	92
Overall	77	83



反應及成果

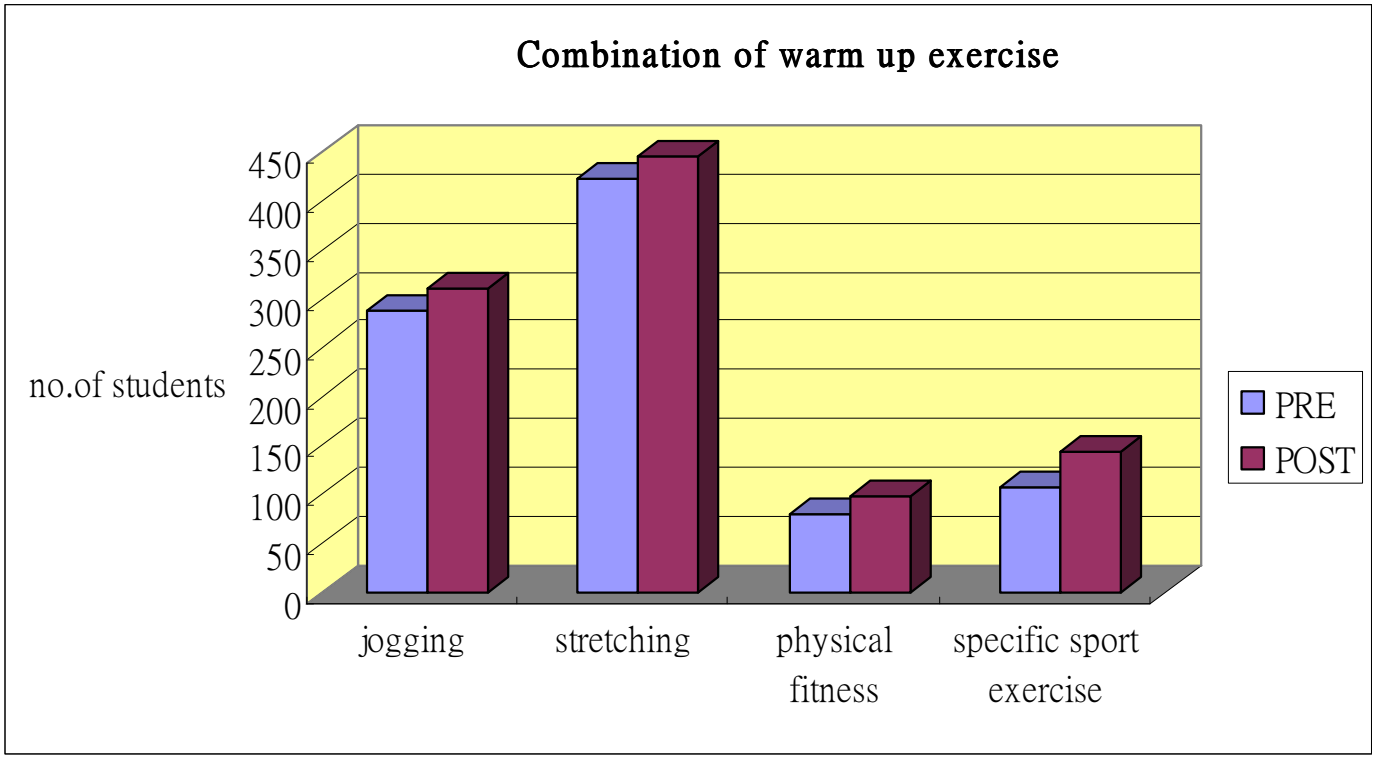
- 平均熱身時間由原先三數分鐘的做法，亦顯示有提升至十數分鐘的趨勢。

Time spent on warm up	PRE %	POST %
1-2 min	24.7	21.6
2-5 mins	46.3	42.5
5-10 mins	19.8	24.6
>10 mins	9.2	10.6



反應及成果

- 而熱身運動的種類，由原先比較著重伸展(拉筋)，亦變得多原化及全面。



反應及成果

- 在以往三至六個月內表示曾經發生過運動創傷的比率由計劃前的60.4%降至計劃後的34.5%。

- 而與膝部有關的運動創傷亦由計劃前的171人次降至計劃後的84人次。

討論

透過是項活動:

- 我們已經成功地向社區踏出了重要的一步，增強本區居民的健康意識。
- 各中學和本院已增加了相互認識和溝通，更可望能成爲健康推廣的長期合作伙伴。

討論

雖然我們在是次計劃已取得正面的反應，我們卻深深知道，長遠的健康推廣，除了依靠我們的不斷宣傳外，更有賴各學校及老師們的合作，才可延續是次計劃所得到的成果。

回家信息

- Prevention is vital.
- Education can bring understanding and understanding can maintain health.
- Proper altitude towards healthy sporting activities – '*No pain, no gain'; 'No gain, no game'; 'No game, no pain'.*

回家信息

- Sports injury has multiple factors.
- $P_{(sport\ injury)} = P_{(random)}$ X [extrinsic & intrinsic risk factors] X load
- Most of extrinsic risk factors can be modified.
- Pattern of loading affects the personality of injury.

回家信息

- Correct idea of warm-up – *at least 3 components: aerobic ex., sport-specific stretching & specific functional activities.*
- Stretching alone is not useful.
- 20 min. warm-up with training elements can *significantly reduce* injury risk during sport at all levels.

THANK YOU