Integration of Sport Science in Table Tennis Practice

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Outline of lecture

Warm-ups, cool downs and stretching.

• Why are they important?
• What should they look like?
• How we can use sport science in creating an effective warm-up/cool down strategy.

The structure of a Table Tennis session.

• What do we know?
• Using Sport Science to help structure.
Learning Outcomes

• Understand why structured warm-ups and cool downs are effective and important before and after exercise.

• Differentiate between a warm-up, a cool-down and stretching.

• Be able to integrate some sport science into creating a practice session.

• Appreciate the needs of different athletes according to age and ability.
What do we know?

- Warm-up **BEFORE** exercise and cool down **AFTER** exercise but use stretching during **BOTH**.
- Warm-up, stretching and cooling down all have **DIFFERENT** functions.
- Only doing stretching **DOES NOT** consist of a complete warm-up or cool down, it is only one aspect of the session.
What are the differences?

- **Warm-up**: prepares the athlete for competition.
- **Cool down**: allows your heart rate and breathing to return to normal and promotes relaxation.
- **Stretching**: increases range of motion, reduces injury risk and aids recovery.
Part 1 - Warm-up

• What is a warm-up?
  “To prepare yourself for a physical activity by doing some gentle exercises and stretches”

• What happens in a warm-up?
Warm-up

Why do we warm up?

Because others do it!!!!

“Instead of viewing a warm-up as an obstacle we should embrace the benefits and utilise it as the integral component prior to any training or match.”
Warm-up

Why do we warm up?

• It helps prepare our body for subsequent exercise/training.
• Prevents potential injury during exercise.
• Helps us prepare mentally.
Warm-up

Some benefits established within the literature:

- Reduced muscle stiffness
- More $O_2$ for the working muscle
- Improved mental focus
- Increased muscle fibre performance
- Greater speed of contraction
- Greater speed of relaxation

Increased overall performance
Warm-up

How long should we warm-up?
• A warm-up $\geq$ 15-minutes in duration has shown to elicit beneficial effects prior to exercise (McGowan et al. 2015).

What is the focus of a warm-up?
• To work all major muscle groups.
• Start slowly and then increase the intensity.
Warm-up

The main principles of the warm-up?

1. **Totality**
   Full body needs to be warmed up.

2. **Specific**
   Specific to the needs of the athlete/activity.

3. **Progressive**
   Increase the intensity and difficulty.

4. **Time**
   \(\geq 15\)-min in duration (or longer).
The Structure of the warm-up?

1. **Aerobic component**
   Jogging, jumping, running or an activity that will increase cardiovascular output.

2. **Adaptation component**
   The movement of joints through “dynamic” stretching.

3. **Culmination component**
   Increase of intensity to reach higher heart rate and body temperature to reach an “optimal” point.
Warm-up

Some scientific information:

• Sport-specific warm-ups show to be the most appropriate due to rehearsal of activity/event movements.

• Dynamic warm-ups show to increase performance as long as fatigue is not induced.

• Warm-ups have shown to reduce the likelihood of sport injuries in athletes.
Warm-up

The practical application:

“Warm-ups incorporating stretching prior to training or competition is a common procedure that enhances performance and prevents injuries.”

**BUT**

“Knowing which type of warm-up and stretches that should be performed is the key to success.”
Questions ITTF
High Performance & Development
Part 2 - Warm-up

1. Aerobic component
2. Adaptation component
3. Culmination component
Warm-up

1. **Aerobic component**
   Increase cardiovascular output
Warm-up

2. **Adaptation component**
   The movement of joints through “dynamic” stretching

- High Knees (Form not speed, get knees up as high as possible)
- Butt kicks (Staying on the toes and quick feet)
- Shuffle (Forwards and backwards)
- Carioca (As much hip rotation as possible, knee drive on back leg)
- Lunges (Lunge forward and backwards)
- Squats (Squat forward and backwards)
- Glute walk (Knee up to chest while stretching the glute, take a step after each)
- Pointers (Walking forward touching pointed toe)
- Gate exercise (Opening and closing the gate)
- Bear Hugs
- Arms (Forwards and backwards)
Warm-up

3. **Culmination component**

Increase of intensity to reach higher heart rate and body temperature to reach an “optimal” point.
Warm-up

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**YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR MALES**

- **GROWTH RATE**
- **MATURATIONAL STATUS**
- **TRAINING ADAPTATION**
- **PHYSICAL QUALITIES**
- **TRAINING STRUCTURE**

The model illustrates the progression of physical development from early childhood to adulthood.
## Warm-up

### Youth Physical Development (YPD) Model for Males

| Chronological Age (Years) | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21+ |
|---------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Age Periods               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Early Childhood           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Middle Childhood          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Adolescence               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Adulthood                 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Growth Rate               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Rapid Growth              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Steady Growth             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Adolescent Spurt          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Decline in Growth Rate    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Maturational Status       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Training Adaptation       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Physical Qualities        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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| Agility                   | Agility | Agility | Agility |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Speed                     | Speed | Speed | Speed |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Power                     | Power | Power | Power |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Strength                  | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength | Strength |
| Endurance & MC            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Training Structure        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Unstructured              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Low Structure             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Moderate Structure        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| High Structure            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Very High Structure       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

### Notes
- FMS: Functional Movement Screen
- SSS: Static Stability Screen
- Hypertrophy refers to the training phase focusing on increasing muscle size and strength.
- Endurance & MC: Endurance and Multisport Conditioning
# Warm-up

## Youth Physical Development (YPD) Model for Males

| CHRONOLOGICAL AGE (YEARS) | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21+ |
|---------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| AGE PERIODS               | EARLY CHILDHOOD | MIDDLE CHILDHOOD | ADOLESCENCE | ADULTHOOD |
| GROWTH RATE               | RAPID GROWTH | STEADY GROWTH | ADOLESCENT SPURT | DECLINE IN GROWTH RATE |
| MATURATIONAL STATUS       | YEARS PRE-PHV | PHV | YEARS POST-PHV |
| TRAINING ADAPTATION       | PREDOMINANTLY NEURAL (AGE-RELATED) | COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED) |

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## Youth Physical Development (YPD) Model for Females

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|---------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| AGE PERIODS               | EARLY CHILDHOOD | MIDDLE CHILDHOOD | ADOLESCENCE | ADULTHOOD |
| GROWTH RATE               | RAPID GROWTH | STEADY GROWTH | ADOLESCENT SPURT | DECLINE IN GROWTH RATE |
| MATURATIONAL STATUS       | YEARS PRE-PHV | PHV | YEARS POST-PHV |
| TRAINING ADAPTATION       | PREDOMINANTLY NEURAL (AGE-RELATED) | COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED) |

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## Training Structure

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<th>MODERATE STRUCTURE</th>
<th>HIGH STRUCTURE</th>
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**Legend:**
- **FMS:** Fundamental Movement Skills
- **SSS:** Stagnant Skill State
Warm-up

**Aim:** to deliver additional technical development, by reinforcing some of the body movements we use in Table Tennis.

**Fundamental movement skills**

- Walk
- Run
- Skip
- Jump
- Throw
- Balance
- Catch
- Kick
- Strike
- Stork Stand
Warm-up

Table tennis movements:

- **Acceleration**
- **Deceleration**
- Ready Position
- Directional Step
- Hip Turn
- Lateral Shuffle
- Crossover Step
- Speed and Power Cut
- Curve Run
- S-Line Run
- Circle Run
Warm-up

The ability to change direction quickly is an essential component of physical performance in racquet sports.

Rapid changes in direction occur over minimal amount of distance/time in response to external stimuli.

Characteristics of rapid deceleration have been associated with success.
LOW
Curve Run
S-Line Run
Circle Run
Speed Cut
Power Cut
Acceleration
Deceleration
Ready Position
Directional Step
Hip Turn
Lateral Shuffle
Crossover Step
HIGH
Curve Run
S-Line Run
Circle Run
Speed Cut
Power Cut
Acceleration
Deceleration
Ready Position
Directional Step
Hip Turn
Lateral Shuffle
Crossover Step
Warm-up

Aim and objectives:

• Develop technique in a broad range of sports generic movement skills to master technique.

• Improve acceleration through teaching “correct” running mechanics.

• Enhance the athlete's ability to decelerate in numerous different positions.
Warm-up
Lay a foundation

“…athletes who are able to effectively and efficiently perform these movements will be the individuals who maximise performance later.”

Jeffreys, 2009

FOUNDATION

Movement Drill Characteristics
Closed
Simple
Distributed (time to rest)
Varied (Directions & Distances)
Emphasis on correct technique

PLUS
Games for engagement & contextualizing drills
Warm-up

Looking at the science

The average number of acceleration/deceleration movement patterns and the average amount of distance covered during training sessions were higher for the Senior athletes.
Questions ITTF
High Performance & Development
Part 3 Warm-up to training

### Youth Physical Development (YPD) Model for Males

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### Training Structure

- Unstructured
- Low Structure
- Moderate Structure
- High Structure
- Very High Structure
Warm-up to training
1. Aerobic component
2. Adaptation component
3. Culmination component
3. Culmination component
Warm-up to training

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3. Culmination component
Warm-up to training
Training
Part 4 - Training

Focus of training:

- Physical component is generally focused on developing motor abilities.
- Mastering a new movement/skill requires practice.
- Intensive and repetitive training is essential for success.
Warm-up to training

Components of training:

• Physical component is generally focused on developing motor abilities.
• Tactical component focuses on acquiring and further developing different ways to be successful during matches.
• Psychological component focuses on improving the athlete’s personality.
• Technical component focuses on acquiring sports skills through motor learning.

Practice makes perfect . . . Or does it?!
Warm-up to training

Fine motor skills:

Fine technical skills involve precise movements using small muscle groups. These movements are performed with great detail and generally involve high levels of hand-eye coordination.
Warm-up to training

When should we practice service?

“Tasks, which demand fine motor control are performed better in the morning”

“The accuracy and consistency of serves in racquet sports show higher accuracy around mid-afternoon”

“Fatigue induces long-lasting detrimental changes in motor-skill learning at all times”
Warm-up to training

If the **main focus** of the exercise is the service, at the end of the session when players are mentally and physically fatigued

=  

Negatively impair the execution of the exercise
Warm-up to training

For the coaches and players:

“Coaches/players are required to possess the ability to make dynamic decisions, requiring strategic intervention plans, supported by an intensive activity of reflection, decision and implementation.”

Class-room based approaches are beneficial but we have to be ready to adapt to the needs of the individuals.
Cool down

• What is a cool down?

“the act or an instance of allowing physiological activity to return to normal gradually after strenuous exercise by engaging in less strenuous exercise”

• What happens in a cool down?
Cool down

Why do we cool down?

Because others do it!!!!

“It is widely assumed that promoting physiological and psychological recovery after exercise allows individuals to perform better during subsequent training sessions or competition and lowers the risk of injuries.”
Cool down

Why do we cool down?

• It helps reduce our heart rate and body temperature.

• Prevents potential injury after exercise.

• Helps us relax mentally.
Cool down

Some benefits established within the literature:

- Reduced potential of DOMS
- Reduces the chance of dizziness/fainting
- Removal of metabolic by-products
- Increased blood flow to muscles and skin
- Decrease in lactic acid

Beneficial effect on performance
Cool down

How long should we cool down?
• A cool down $\geq$ 10-minutes in duration has shown to elicit some beneficial effects on recovery (Tavares et al. 2017).

What is the focus of a cool down?
• To work all major muscle groups.
• Start with a jog and then some form of stretching.
Cool down

What to consider with the cool down?

1. **Load**
The physiological and psychological demands of the session.

2. **Adaptation**
The long-term adjustment of the session and the recovery required to obtain the stimulus.

3. **Recovery**
The process of recovering from the intensity of the session.
Cool down

Some scientific information:

• A cool-down can improve sports performance later during the same day when the time between successive training sessions or competitions is $\leq 4$ h.

• A cool-down can theoretically reduce the risk of injuries during a subsequent training session, because a better recovery may result in less neuromuscular fatigue.

• Foam rolling and stretching may facilitate recovery from exercise.
Cool down

Some of the different modalities:

Static stretching

Foam Rolling

Cold baths

Massages
Cool down

Static stretching:
Involves placement of the body and limbs in an extreme ROM position and holding this position for a period by gravity, partner assistance, or agonist muscle tension.

Enhances flexibility.
Prevents muscle fatigue.
Prevents muscle soreness

Stretching for 15 to 45-s will show benefits, but any longer can be detrimental to recovery.
Cool down

Foam Rolling:
Recovery method, based on self-myofascial release, with several proposed physiological effects similar to those of massages.

- Increased flexibility.
- Improves arterial function.
- Reduces muscle pain sensation.

The effects of foam rolling on performance and recovery are rather minor and partly negligible with evidence suggesting foam rolling as a warm-up activity rather than a recovery tool.
Cool down

Cold baths:
Involves immersing in water at temperatures of less than 15°C, is sometimes used to manage muscle soreness after exercise and to speed up recovery time.

- Reduces swelling and tissue breakdown.
- Reduces onset of muscle soreness.
- Improves motor and cognitive performance.

There is some evidence to suggest that cold-water immersion reduces muscle soreness at 24, 48, 72 and even at 96 hours after exercise, but not more effective than an active recovery.
Cool down

Massages:
The rubbing and kneading of muscles and joints of the body with the hands, especially to relieve tension or pain.

Improved performance.
Improved recovery.
Injury prevention.

Research shows little evidence to suggest massage benefits fatigue but did find flexibility to be increased and DOMS to be decreased.
Cool down

The reality:
There is no compelling scientific evidence that suggest temperature water immersion therapy, hyperbaric oxygen therapy, nonsteroidal anti-inflammatory drugs, compression garments, stretching, electromyostimulation or a combination of these modalities aids subsequent performance, but athlete perception of reduced muscle soreness is present when pre- and post-activity stretches are used.

Light training followed by pain-free stretching is proposed as an effective means of achieving an active recovery that was superior to taking a day off from training.
Cool down

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Light training followed by pain-free stretching is proposed as an effective means of achieving an active recovery that was superior to taking a day off from training.
Take home message

Optimal recovery requires a favorite activity among many young humans, sleep.

Recovery from exercise is integral to the athlete’s training regimen and without adequate recovery of carbohydrate, protein, fluids, and electrolytes, beneficial adaptations and performance may be hampered.