The Role of Biomechanics in Daily Physical Activity, Exercise and Sports

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Educational Opportunities for Young Researchers

As a specialized university, NSSS has a national responsibility for research and education within the field of sport.

Sport is a broad concept and includes various forms of human activity: organized sport, physical education, outdoor activities, games, dance, training and exercise, movement culture.
Exploratory Workshop
The Future of Research in Sport Participation in the Lifespan (EW10-170)

Standing Committees:
European Medical Research Councils (EMSC), Humanities: (SCH), Social Sciences (SCSS)
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Title doctoral program: Doctor scientiae

No of years: 3-4 years, (after MSc)
240 ECTS (100-75% dedicated to research work)

40 ECTS dedicated to compulsory courses:
Theory of Science & Ethics,
Quantitative & Qualitative Methods,
Methodology in specific research

Funded by NSSS
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Dept. Physical Performance (Head: J. Cabri)

Main research areas

factors affecting performance

performance in broad perspective:
   elite
   physical activity
   after injury
   youth - elderly
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Dept. Physical Performance (Head: J. Cabri)

5 labs

- Exercise Physiology
- Muscle Physiology & I.H.
- Biochemistry
- Field Lab
- Biomechanics
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Inter-University Cooperation

U. Brussels, Technical University Lisbon, U. Marseille
U. Jyväskylä, U. Turku, U. Copenhagen, U. Salzburg,
U. Frankfurt, U. Southern Denmark,
German Sports U., U. Örebro, ETH Zürich,
U. Bern, U. GötEBorg, U. Bratislava,
U. Rome “Foro Italico”, U. Birmingham

U. Auckland, U. Stanford,
U. Texas Austin
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Future plans / developments

• Consolidate international research exchange

• Center of excellence

• Increase outcome & external funding

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The role of biomechanics in daily physical activity, exercise & sports
Background

• Biomechanics defined:
  • applies laws of mechanics and physics
  • to human performance
  • to gain understanding of performance in movement
  • through modeling, simulation and measurement
Background

• Biomechanics research plays a role in:
  • Performance enhancement
    • (e.g. movement and technique analysis, development of new materials and equipment, etc.),
  • Pathogenesis and recovery of injuries
  • Loading during sports (exercise) movements
Background

- Biomechanical variables
  - Kinematics
    - Distance, velocity, acceleration, Euler angles, joint angles, ...
  - Kinetics
    - Force, torque, work, power, ...
  - Muscular activation
    - iEMG, mean/median frequency, wavelets, reaction time, ...

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Background
Background

PA & Sports participation ↑

Injury rate ↑

Load > loading capacity

"Overuse"

"Acute" injuries

"Chronic" injuries
Background

Biomechanics Research

Loading

Performance
- Examples
  - Gait analysis
  - Running shoe
  - Bicycle design
  - Swim suit
  - Golf swing

Prevention
- Examples
  - Fall prevention
  - ACL injury in sports
  - Backpack design
  - Obesity & PA

Intervention
- Examples
  - Osteoarthritis & TKA
  - LBP in golfers
Open questions

- How to improve performance in sports?
- How to reduce or prevent injury during work, home, exercise, or sport tasks?
- How to improve movement quality in individuals with pathologies in clinical situations?
- How to optimize equipment for the above?

- Performance/safety/health & disease issues
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Current research lines (biom. gr.)

- Musculo-tendinous adaptation to habitual stretching
- Barefoot running & shoe design
- Shock absorption during impacts
- Core stability
- Arthrokinematics in throwing

- In vivo function of the muscle-tendon unit
  - Force generation (muscle activation)
  - Intermuscular force transfer
  - Loading of force transmitting tissues
  - In sports and daily life
  - In health and injury
Actual Forms of Interplay

Impact of backpack design & weight
- Biomechanical aspect
- Physiological aspect
- Impact (loading)
- Walking economy
- Prevention
- Performance
- Economic aspect (industry)
- Social aspect (outdoor life – military)
Enhancing Synergies

Please, prospect future international actions aimed to enhance synergies with other research fields in Europe

That’s why we are here!
Thank you!