



UNIVERSITY OF PÉCS
MEDICAL SCHOOL



SPORTMED
PTE ÁOK SPORTMEDICINA TANSZÉK

Bests of athletic performance

Lecture 2



PTE557

<http://potecho.pte.hu>

Eva Tékus (PhD)

Requirements, recommended literature

- 25 % absence is allowed
- Examination: written test (simple choice, true false questions)

Lessons:

- 10/10/2024; 17/10/2024; 24/10/2024; 07/11/2024

Room: SIOT0037

Presentations: homepage of Sports Medicine Center (Educational materials)

- Recommended literature:

1. Cooper C.B, Storer T.W. Exercise testing and interpretation. A practical approach.

Cambridge University Press, Cambridge, 2004

2. Katch V.L., McArdle W.D., Katch F.I. Essentials of exercise physiology. Lippincott Williams & Wilkins, a Wolters Kluwer business, Philadelphia, USA, 2011

Result of the test (%)	Grade
100-85	5
84-75	4
74-65	3
64-50	2
0-49	1

The most resilient athletes



Physical performance - Classification of physical abilities

Conditional physical abilities:

1. Resilience / Endurance
2. Force
3. Speed

Flexibility

Coordinational physical abilities:

1. Ability to differentiate (coordination)
2. Coupling or synchronization capacity
3. Rhythm ability or rhythm
4. Balancing ability
5. Readaptation or change capacity
6. Guidance capacity
7. Reaction capacity

Special abilities

Resilience, endurance

Endurance: ability to maintain muscle movement for an extended amount of time

Cardiovascular endurance: ability to deliver oxygen to working muscles, where it can be used to produced energy. VO_{2max} is a good marker.

Muscular endurance: ability to maintain contracting a muscle, against resistance for an extended period of time.

Types:

- Aerobic endurance
- Anaerobic endurance
- Strength endurance
- Speed endurance etc.

Measuring of endurance

- Field tests E.g. Cooper test, 20-meter shuttle run test
<https://www.youtube.com/watch?v=Ko1qHVN7DXo>
- Laboratory test E.g. spiroergometric test – like Bruce protocol

<https://www.youtube.com/watch?v=g3msO9bLODg>

Sports where endurance is very important (endurance sports)

Ranking	Sport	Rating (%)
1.	Orienteering	85.5
2.	Triathlon	85.5
3.	Rowing	85.3
4.	Water Polo	84.1
5.	Ultimate frisbee	83.2
6.	Swimming (200m Free)	80.8
7.	Ultra Marathon	80.5
8.	Road Cycling	79.9
9.	Squash	79.0
10.	Boxing	78.8

The most resilient athletes I.– marathon (42.195km)

Current world record: Kelvin Kiptum (1999-2024)
2:00:35, Chicago Marathon 2023

He holds three of the seven fastest marathons in history.
Kiptum won all three marathons he ran.

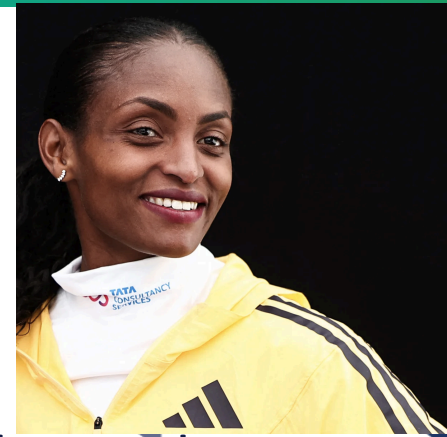
10 Fastest Marathoners on Record- Eligible Course: Men

Runner	Finish Time	Pace/Mile	Marathon
<u>Kelvin Kiptum</u> (Kenya)	2:00:35	4:36.0	Chicago, 2023
<u>Eliud Kipchoge</u> (Kenya)	2:01:09	4:37.2	Berlin, 2022
<u>Kenenisa Bekele</u> (Ethiopia)	2:01:41	4:38.5	Berlin, 2019

<https://www.youtube.com/watch?v=sloHbNL-o20>



The most resilient athletes II. – marathon



Current world record: Tigist Assefa (2:11:53), who she set a women's world record at the Berlin marathon in 2023. He was an 800m runner and ran his first marathon in 2022.

10 Fastest Marathoners on Record-Eligible Course: Women

Runner	Finish Time	Pace/Mile	Marathon
<u>Tigist Assefa</u> (<i>Ethiopia</i>)	2:11:53	5:01.8	Berlin, 2023
<u>Sifan Hassan</u> (<i>Netherlands</i>)	2:13:44	5:06.0	Chicago, 2023
<u>Brigid Kosgei</u> (<i>Kenya</i>)	2:14:04	5:06.8	Chicago, 2019

<https://https://www.youtube.com/watch?v=NWHgG7J4PW4>

The most resilient athletes III. – ultramarathon runners

Legendary peak holders: Yiannis Kouros

He holds many men's outdoor road world records from 100 to 1,000 miles and many road and track records from 12 hours to 6 days.

Event	Record	Athlete	Date	Place
50 km	2:42:07	 Ketema Bekele Negasa (ETH)	23 May 2021	 Port Elizabeth, South Africa
50 miles	4:50:08	 Jim Walmsley (USA)	4 May 2019	 Sacramento, USA
100 km	6:05:41	 Aleksandr Sorokin (LTU)	23 Apr 2022	 Bedford, UK
100 miles	10:51:39	 Aleksandr Sorokin (LTU)	7 Jan 2022	 Tel Aviv, Israel
1000 km	5d 16:17:00	 Yiannis Kouros (GRE)	26 Nov–2 Dec 1984	 Colac, Australia
1000 miles	10d 10:30:36	 Yiannis Kouros (GRE)	20–30 May 1988	 New York City, USA
6 hours	98.496 km	 Aleksandr Sorokin (LTU)	23 Apr 2022	 Bedford, UK
12 hours	177.410 km	 Aleksandr Sorokin (LTU)	7 Jan 2022	 Tel Aviv, Israel
24 hours	309.339 km ^[a]	 Aleksandr Sorokin (LTU)	28 Aug 2021	 Pabianice, Poland
48 hours	473.495 km	 Yiannis Kouros (GRE)	3–5 May 1996	 Surgères, France
6 days	1036.800 km	 Yiannis Kouros (AUS) ^[b]	20–26 Nov 2005	 Colac, Australia



The most resilient athletes IV. – ultramarathon runners

Legendary peak holders: Sandra Barwick

She is a New Zealand ultramarathon runner who set a new six-day track world record in Campbelltown, Australia, 18–24 November 1990.

Event	Record	Athlete	Date	Place
50 km	2:59:54	 Desiree Linden (USA)	13 April 2021	 Dorena, Oregon, United States
50 miles	5:40:18	 Ann Trason (USA)	23 Feb 1991	 Houston, USA
100 km	6:33:11	 Tomoe Abe (JPN)	25 Jun 2000	 Yubetsu-Saroma-Tokoro, Japan
100 miles	12:42:40	 Camille Herron (USA)	11 Nov 2017	 Vienna, IL, USA
1000 km	7d 16:08:37	 Paula Mairer (AUT) <small>United States</small>	29 Sep-6 Oct 2002	 New York City, USA
1000 miles	12d 14:38:40	 Sandra Barwick (NZL)	18–28 Oct 1991	 New York City, USA
6 hours	85.492km	 Nele Alder-Baerens (GER)	11 Mar 2017	 Münster, Germany
12 hours	149.130 km	 Camille Herron (USA)	9–10 Dec 2017	 Phoenix, Arizona, USA
24 hours	270.116 km	 Camille Herron (USA)	26–27 Oct 2019	 Albi, France
48 hours	397.103 km	 Sumie Inagaki (JPN)	21–23 May 2010	 Surgères, France
6 days	883.631 km	 Sandra Barwick (NZL)	18–24 Nov 1990	 Campbelltown, Australia



Group work

Group 1: At what age can the greatest endurance performance be expected? Why?

Group 2: Are there differences between genders in endurance performance? If yes, what causes it?

Group 3: What are the most important characteristics of successful endurance athletes?

What are the most important factors that are necessary for someone to be the most resilient?

Elite marathon runners: 70-85ml/kg/min and average pace at 75–85% of VO_{2max} . Inversely correlated with the marathon time and positively with maximal cardiac output.

Three most important physiological factors:

- Maximal oxygen uptake (VO_{2max})
- Running economy (RE), i.e. energy demand of running
- Anaerobic threshold (AT)

Improvement of the RE allows to run at a higher speed for the same oxygen uptake. Genetical and acquired factors: high fatty acid oxidation, slimmer lower legs, lower body heat. In early life exposed to high altitude and exercise. Other influencing indicators: strength training, nutrition.

Strong relationship with the level of performance in the marathon. Significant correlation between running speed and AT.

Thresholds

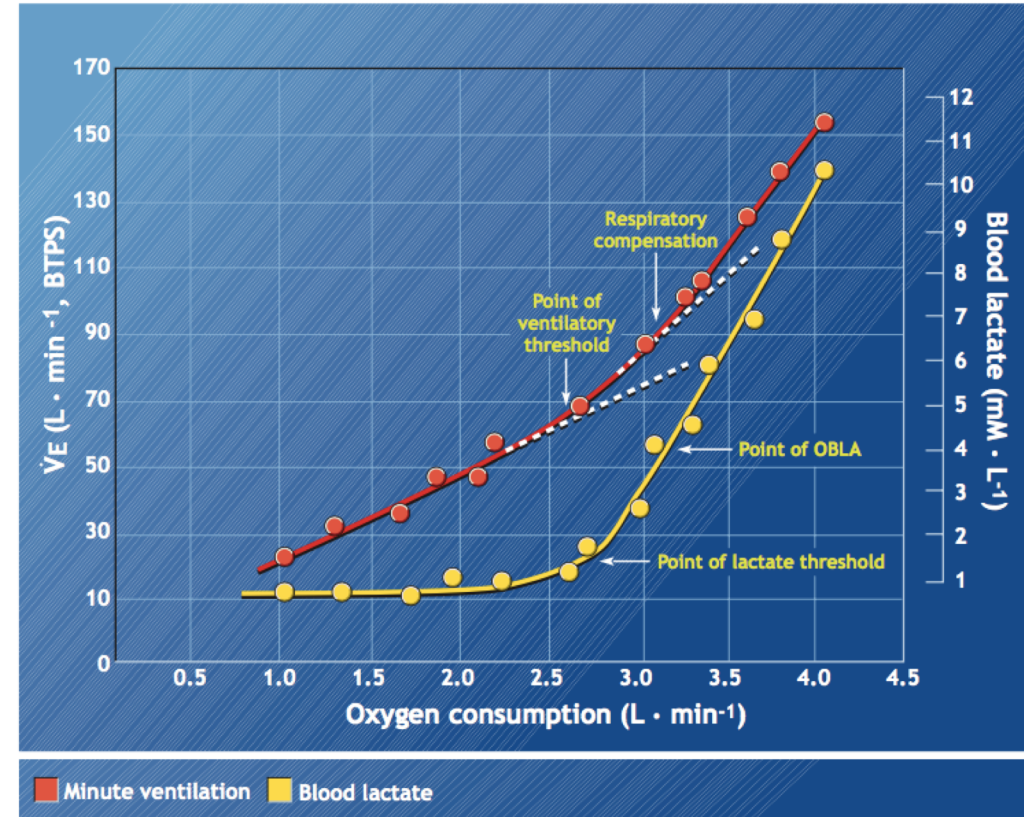
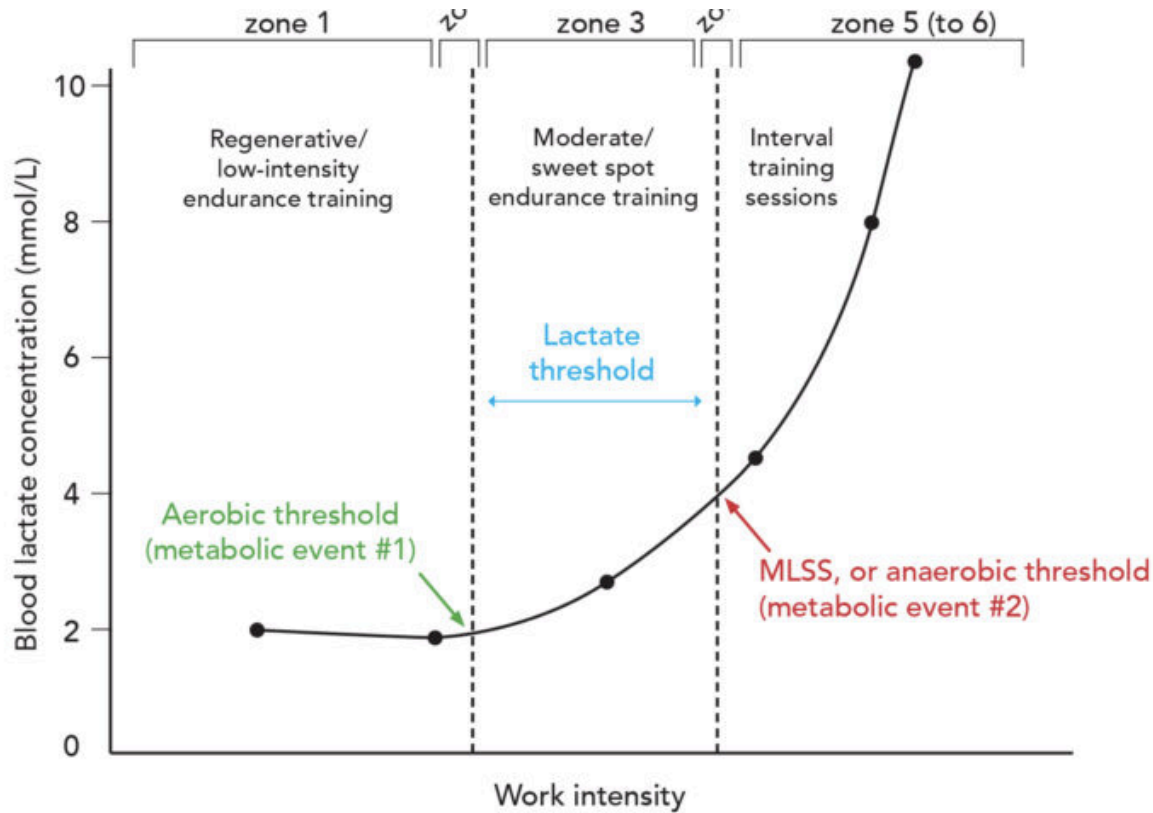


Figure 9.15 Pulmonary ventilation, blood lactate concentration, and oxygen consumption during graded exercise to maximum. The lower dashed white line extrapolates the linear relationship between \dot{V}_E and $\dot{V}O_2$ during submaximal exercise. The lactate threshold (not necessarily the threshold for anaerobic metabolism) represents the highest exercise intensity (oxygen consumption) not associated with elevated blood lactate concentration. It occurs at the point at which the relationship between \dot{V}_E and $\dot{V}O_2$ deviates from linearity, indicated as the point of ventilatory threshold. The onset of blood lactate accumulation (OBLA) represents the point of lactate increase just above a 4.0-mM baseline. Respiratory compensation represents a further disproportionate increase in ventilation (indicated by deviation from the upper dashed white line) to counter the decrease in plasma pH in intense exercise.

What are the most important factors that are necessary for someone to be the most resilient?

Age effect:

Best performance around age 35.

Reasons:

-Improvement of running technique.

-Development of mental abilities.

- VO_{2max} is lower.

Other influencing factors:

- Topographic factors (topography, Berlin)
- Climatic conditions (temperature, wind)
- Season, daytime
- Air pollution (PM10)
- Running in a protected position (drafting, IAAF violation)
- Steady running pace
- Advances in Shoe Technology (NAST)
- Origin (East African runners: anthropometry, muscle fiber composition, prize money)
- Gender differences (muscle mass, heart size, body fat, hemoglobin concentration, VO_{2max})

**The most skillful, the most
accurate athletes**



Skillfulness, accuracy

Skillful: Having the ability to perform well: able, capable, competent, good, skilled under high pressure and under competitive conditions.

Accuracy: the ability to control movement in a given direction or at a given intensity.

Skillfulness and technique of Ronaldo (28:30)

https://www.youtube.com/watch?v=0k2ey_okQ4E

<https://www.youtube.com/watch?v=tU16fvTaK3U>

Measuring skillfulness and accuracy

- Field tests E.g. Pin Point Accuracy (in Tennis)

<https://www.youtube.com/watch?v=o0PQoiBRXJQ>

- Laboratory measurement E.g. Accuracy of the throwing (American football)

<https://www.youtube.com/watch?v=tVoqA-LKGb4>
(1:45)

Sports, where is essential the skillfulness and the accuracy

1. Golf
2. Boxing
3. Ice hockey
4. Mixed martial arts
5. Tennis
6. Gymnastics
7. Hurling
8. Soccer
9. Water polo
10. Rugby

1. Billiards
2. Golf
3. Archery
4. Rifle, pistol, and shotgun shooting

Bests of athletic performance

The most skillful, the most accurate athletes

<https://www.youtube.com/watch?v=VltAgg2H-HE>



What skills are necessary for someone to be the most accurate and skillful athletes?



Accuracy:

- Hand-eye coordination
- Vision
- Balancing ability
- Strength, endurance
- Mental preparation

Skillfulness:

- Sport technical knowledge, practice
- Adequate level of motoric skills
- Creativity

The most flexible athletes



Flexibility, range of motion (ROM)

Flexibility: the ability that means the mobility of the muscles, the ligaments and the joints together.

ROM: degree, the subject can move the joint voluntarily.

The most flexible athletes:

<https://www.youtube.com/watch?v=h7ewRr2C7jo>

Types (ROM):

- Physiologic range of motion (ROM)
- Non-physiologic ROM

- Active
- Passive

Measuring flexibility



- Field test E.g. Sit and reach test

<https://www.youtube.com/watch?v=TgaGCX20UIQ>

<https://www.youtube.com/watch?v=ycMPXvq5Ejw>
(9:40)

Sports, where important the flexibility (sports requiring flexibility)

Ranking	Sport	Rating (/10)
1.	Gymnastics	10.00
2.	Diving	8.50
3.	Figure skating	8.25
4.	Wrestling	7.50
5.	Cheerleading	7.50
6.	Martial arts	7.00
7.	Track and Field: Pole Vault	7.00
8.	Skiing (freestyle)	6.88
9.	Track and Field: High Jump	6.63
10.	Racquetball/Squash	5.88

The most flexible athletes I. – Artistic gymnastics

Olympic Games 2024 individual winner: Simone Biles

Six-time Olympic champion, twenty-three times world champion.

<https://www.youtube.com/watch?v=axUOMKsTQsg>

References: https://hu.wikipedia.org/wiki/Simone_Biles
https://www.facebook.com/simonebiles/?locale=hu_HU



The most flexible athletes II. – Artistic gymnastics

Gymnast with the most medals: Kōhei Uchimura

He is a 7x Olympic medalist (all-around, team and floor exercise), 21x World medalist (all-around, team, floor exercise, horizontal bar, and parallel bars).

<https://www.youtube.com/watch?v=5m8WgS3LkG8>



Which factors can influence the flexibility, the range of motion?



- Genetic factors
- Anatomical structure of a joint
- Position and characteristics of tendons and ligaments
- Presence of other tissues (muscle, fat).
- Skin

- Muscle strength
- Muscle flexibility

- Gender
- Age

- Temperature / body temperature
- Daytime

- Previous injuries

Funny sport cases

<https://www.youtube.com/watch?v=T7GtFZWQFA0>



UNIVERSITY OF PÉCS
MEDICAL SCHOOL

Thank you for your attention!

PTE557

<http://potecho.pte.hu>



Kahoot!

<https://create.kahoot.it/details/12226673-0dc0-4f52-a995-b9229ccbeb57>