Anthropometrics and Maximal Physiological Responses of Male Olympic Rowers: 1964 - 2012

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Overview

• Testing concepts and monitoring of Olympic rowers from 1964 - 2012
  ▪ How and why we test, and testing and training equipment changes throughout the years
• Data collection and analysis
  ▪ Anthropometrics
  ▪ Physiological data
  ▪ Trends and predictors of performance
• Training, nutrition, and future directions
Introduction to Rowing

- One of the most physically intensive competitive sports
  - Some of the best athletes in the world
- Very high aerobic power
  - Cross country skiing
- The crew is only as strong as it’s weakest link
  - All must row well, in sync in order to be successful

Introduction to Rowing

- Maximal intensity racing over 2,000 meters – 2k
  - Time to completion depends on:
    - Category of boat – heavyweight or lightweight
    - Scull or sweep
    - Boat size – 1, 2, 4, or 8 (coxswain in some)
    - Environmental conditions
    - Water conditions

Olympic events

- Coxless Pair boat
  - London 2012 time - 6:53.30
- Coxless 4 man boat
  - London 2012 time - 6:07.20
  - Bronze medal
- Coxed 8 man boat
  - London 2012 time - 5:51.48
  - Missed medal by 0.3s
Energy Requirements

- Rowing 2,000 meters is 75-80% aerobic and 20-25% anaerobic
  - Mixture of aerobic vs. anaerobic depends on time to completion
  - Aerobic work measured by O₂ Consumption (VO₂)
    - During “erg” test
    - Want to rely on aerobic energy as much as possible
      - More efficient
      - More energy produced
      - Less painful

- Anaerobic work estimated by blood lactate, RER, and O₂ deficit
  - Anaerobic energy provides high amount of energy for a small amount of time
    - Anaerobic emphasis at the start and finish of 2,000 meters
      - Requires the athlete to “tolerate” high amounts of lactic acid and metabolism byproducts
    - Strategic moves during race
    - Ratio of anaerobic to aerobic influences training

How We Tested: Then and Now

- Olympic games 1964-2012
  - 13 Olympic games, including 1980 team that was forced to boycott
- Anthropometrics
  - Always measured height, weight, and % body fat
  - 6 site for rowers estimation of body fat
  - Subscapular
  - Triceps
  - Midbicep
  - Umbilicus
  - Suprailiac
  - Anterior Thigh
Differences in Anthropometrics

- 1988 Olympic 8 selection camp averages (bronze medal)
  - Age – 21
  - Weight – 191.2 lbs.
  - BMI – 23.5
  - 10.02 percent fat

- 2008 Olympic 8 selection camp averages (bronze medal)
  - Age – 27
  - Weight – 210.2 lbs.
  - BMI – 25.2
  - 8.83 percent fat

How We Tested: Then and Now

- Physiological Testing
  - Always measure peak VO2 during 2k and submaximal bouts, lactate response, wattage, and heart rate
  - Equipment used
    - Equipment has become more advanced
      - Biotelemetry in 1972
      - Lactates in 1972
      - Rowing ergometers
    - Gas exchange analyzers
      - Allow immediate analysis of RER, ventilation, peak VCO2, expired oxygen
    - Lactate analyzers
      - Provides accurate lactate measurements in less than 15 seconds

What Does it All Mean??

- VO₂ - Aerobic energy contribution
  - Higher VO₂ and low lactate indicative of very good at using aerobic energy metabolism
  - O₂ uptake, delivery, extraction, and usage

- 1984 invitees average VO₂ during VO₂ max test: 69.8

- 2004 invitees average VO₂ during 2k erg test: 68.2
What Does it All Mean??

• Blood Lactate – estimates anaerobic energy contribution and lactate tolerance
  • High lactate and lower VO2 indicative of inability to handle the workload
  • After training, will see increased VO2 and decreased post-exercise lactate during 2k erg test

• 1988 invitees average post-exercise lactate after 2k erg test: 12.4

• 2008 invitees average post-exercise lactate after 2k erg test: 17.0

What Does it All Mean??

• Use data to rank rowers for coaches
  – Also use anaerobic threshold from gas exchange
  – Ergometer times/wattages = erg scores
  – Racing ergometer can provide wattage and time
  • Want to see aerobic athletes that tolerate lactate well, generate high power, and are lighter in weight

Anthropometric Data

• Anthropometric trends 1964 – 2012
  • Athletes weigh more currently
    – ’60s-’80s average weight around 188 – 198
    – ’90s-2012 average weight around 198 – 212
  • Athletes are slightly taller
    – ’60s-’80s average height around 72” – 76”
    – ’90s-2012 average height around 75” – 77”
  • The recent athletes tend to weigh more but have similar body fat percentages
Muscle Biopsy

- Muscle Biopsies taken in the 80's

Nature and Nurture

- Parents and Sons
  - Miller’s
- Twins
  - Winkelvoss brothers
  - James brothers
- Complete opposite’s
  - Coffey & Staines

Physiological Data

- Physiological trends 1964 – 2012
  - Peak VO2 attained during 2k erg tests have improved
    - So has the technology
  - Average 2k erg test wattage and times have improved
    - Rowing ergs have been used for over 30 years
    - Rowing ergs continue to be developed to simulate on water rowing experience
  - Post-exercise lactates continue to rise with recent athletes
Training

• Aerobic and anaerobic training
  — Use testing to improve whichever area the athlete is deficient in
    • Critical power testing or gas exchange with post-exercise lactate
• Ergometer training
  — Allows accurate prescription and monitoring of training intensity
    — Concept 2
      • Models A – E
      • Dynamic
        • “The tank”
• On the water training
  — Skill, teamwork, and situational

Training Suggestions

• Establish current anthropometric and fitness status of athlete/s first
  — Keep athletes aware of current standards
• Continuously monitor variables to assess training effectiveness
  — VO2, LA, watts/kg, 2k times
• Prescribe intensity using power output/pace
• Utilize submaximal testing
  — Simple method to track changes in rowing and training efficiency
  — Not motivation dependent
  — See impact of buffering agents

Training Suggestions

• Must practice and simulate race starts and finishes
• DO NOT TRAIN ON THE DAY PRECEDING TESTING
  — Must know how to design appropriate test order
  — Need reliable results or entire program thrown off
  — 12-24hrs of no activity prior to testing
  — Hydration and appropriate nutritional intake, no ergogenic aids
• May be better of using a dynamic ergometer
  — Stroke rating closer to on water rowing
Training and Nutrition

- Weight training has made major contributions to the sport
  - Recent athletes weigh more, with similar body compositions to older athletes, and with better 2k erg times
  - Best athletes generate higher wattage/kg body weight over 2,000 meters
  - Can monitor watts/kg pre, during, & post-training
- Train for the specific components of the rowing stroke during weight training
  - Movement specific exercises
- Nutrition requirements, REST and RECOVERY

Future Considerations

- Improving and developing new weight training programs and techniques for rowers
  - Maximize watts/kg over 2,000 meters
  - Sport specific and focused on power generation
    - Upper body pull and lower body push workouts
    - Workouts designed to improve lactate tolerance
- More on water gas exchange telemetry
- Buffering agents???
  - Ethical and doping considerations
- Enticing basketball players to become rowers
  - Elite rowers usually are tall and have long limbs

Conclusion

- Balance and synchronization are just as important as physiological data in winning boats
  - Need good coaches
  - Only as strong as your weakest link
- Most data points have changed from 1964
  - Have become bigger, faster and stronger with better training and nutrition
  - Concept 2 rowing ergometers
  - Better coaches
  - Better boats and oars
  - A boat full of the best athletes, not just one or two great athletes
Questions