9th International Congress
Mountain, Sport & Health
updating study and research from laboratory to field
16-17 November 2023 Rovereto (TN) Italy

Individualized endurance training – the 24-h approach

Billy Sperlich

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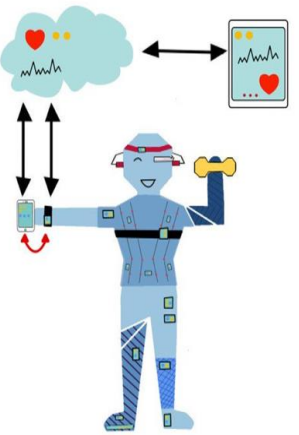
@BillySperlich



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Today

1. Factors associated with endurance performance
2. Reasons for inter-individual responses
3. Moving to 24h-analysis
4. Elements of a personalized training signature

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Factors associated with high-level endurance performance

PLOS ONE 2022 17(12)

RESEARCH ARTICLE

Factors associated with high-level endurance performance: An expert consensus derived via the Delphi technique

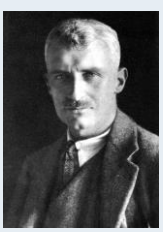
Magdalena J. Konopka[1,2☯*], Maurice P. Zeegers[1,2,3☯], Paul A. Solberg[4☯], Louis Delhaije[2☯], Romain Meeusen[5,6☯], Geert Ruigrok[2☯], Gerard Rietjens[3☯], Billy Sperlich[7☯]

26 factors

- maximal oxygen consumption
- running economy
- recovery speed
- carbohydrate metabolism
- glycolysis capacity
- lactate threshold
- fat metabolism
- number of erythrocytes
- iron deficiency
- muscle fibre type
- mitochondrial biogenesis
- hydrogen ion buffering
- testosterone
- erythropoietin
- cortisol
- hydration status
- vitamin D deficiency
- risk of non-functional overreaching and stress fracture
- healing function of skeletal tissue
- motivation
- stress resistance
- confidence
- sleep quality
- fatigue

3

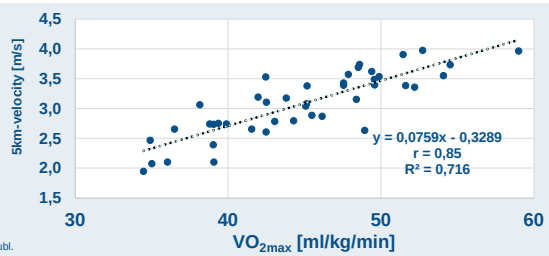
„Endurance“ & maximum oxygen uptake



"Maximum oxygen uptake (VO_{2max}) […] sets the upper limit for endurance performance."

Archibald Vivian Hill
Nobel Prize 1922

Basset JAP 2002



Own data unpubl.

JAMA Network Open

Original Investigation | Cardiology

Association of Cardiorespiratory Fitness With Long-term Mortality Among Adults Undergoing Exercise Treadmill Testing

Kyle Mandsager, MD; Serge Harb, MD; Paul Cremer, MD; Dermot Phelan, MD, PhD; Steven E. Nissen, MD; Wael Jaber, MD

Review

Mortality trends in the general population: the importance of cardiorespiratory fitness

Duck-chul Lee[1], Enrique G Artero[2], Xuemei Sui[1] and Steven N Blair[3]

Abstract

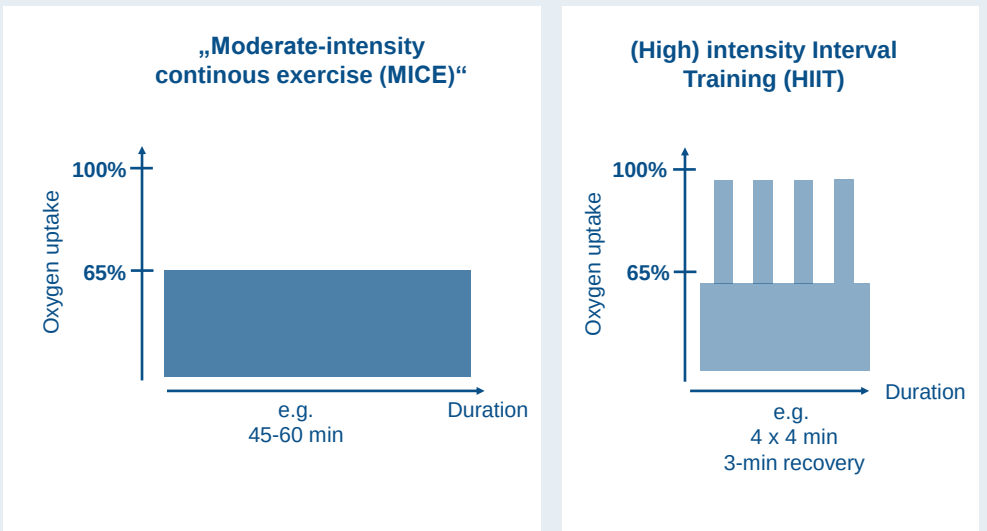
Journal of Psychopharmacology

Reduced risk of

Coronary heart disease, hypertension, diabetes, stroke, cancer, etc.

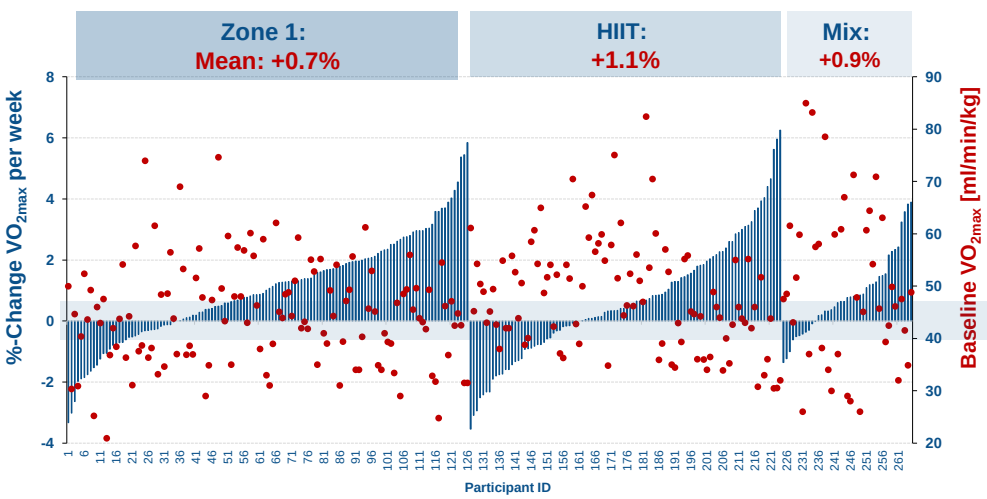
4

Maximum oxygen upatke: Training methods



Düking et al. EJAP 2020
Zinner et al. MSSE 2018
Born et al. Front Physiol 2017
Sperlich et al. Front Physiol 2017
Messler al. J Atten Disord 2016
Schmitt et al. Physiol Rep 2016
Stoggl/Sperlich Front Physiol 2014
Sperlich et al. J Strength Cond Res 2011
Sperlich et al. Eur J Appl Physiol 2010

My experience: Pre-post VO_{2max} (3-9 weeks; 2-5 seesions/week, n=265)



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Genes & Trainability

Genomic predictors of the maximal O_2 uptake response to standardized exercise training programs

Claude Bouchard,[1] Mark A. Sarzynski,[1] Treva K. Rice,[2] William E. Kraus,[3] Timothy S. Church,[4] Yun Ju Sung,[2] D. C. Rao,[2] and Tuomo Rankinen[1]

Stepwise multiple regression analysis of the 39 SNPs identified a panel of 21 SNPs that accounted for 49% of the variance in VO_{2max} trainability

Genome-wide association study identifies three novel genetic markers associated with elite endurance performance

Three significant SNPs (NFIA-AS2 rs1572312, TSHR rs7144481, RBFOX1 rs7191721) in combination explained 24.6 and 48.8% of the variation in VO_{2max} of male and female endurance athletes, respectively.

REVIEW

WILEY

Genetics of long-distance runners and road cyclists—A systematic review with meta-analysis

(Inter)national competing runners and cyclists have a higher probability to carry specific genetic variants compared with controls.

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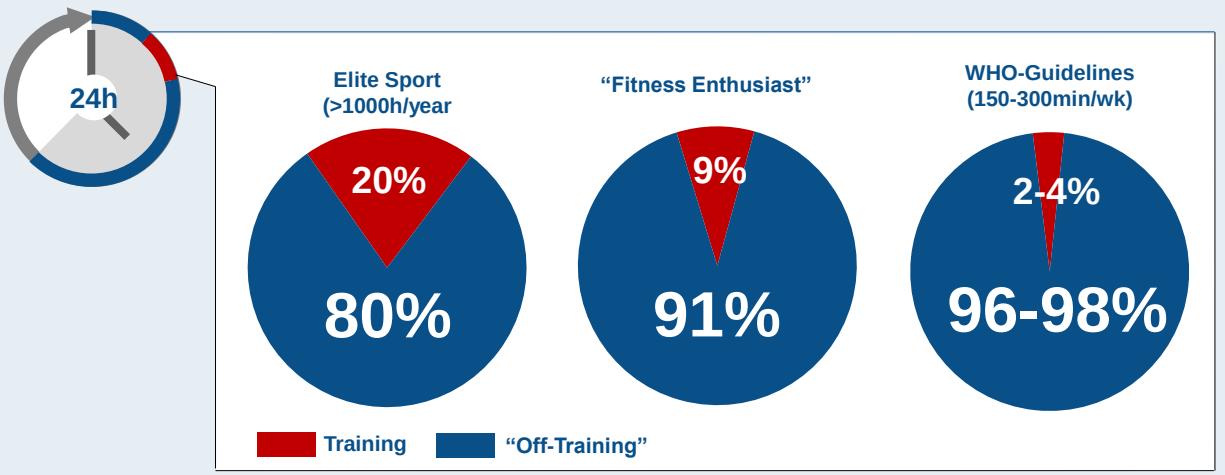
Training time relative to waking time in a 24h-continuum



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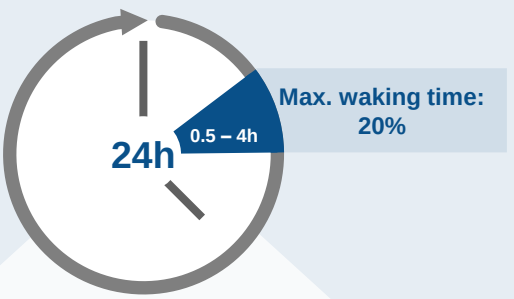
Adaptation to „free-living & exercising-biology“



a) **Activities of daily living**
b) **Sleep behavior** (hours, naps, travelling)
c) **Recovery procedures** e.g:
   - Massage & Stretching & Foam Rolling
   - Active/passive recovery
   - Compression clothing, etc.
d) **Nutrition** Pre-, intra-, post Training
e) **Environment** (UV, heat, altitude, cold, ozone, particulate matter, noise…)
f) **Mindset**
g) **Circadian Rhythm**
h) **Social aspects** (family, friends, sponsors, financial situation, media)
i) **Alcohol, drugs…**
j) **Doping**
k) **Factor x, y, z**

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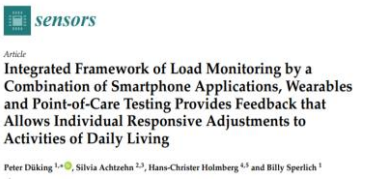
Informative (Bio)Markers




sensors

Article

Integrated Framework of Load Monitoring by a Combination of Smartphone Applications, Wearables and Point-of-Care Testing Provides Feedback that Allows Individual Responsive Adjustments to Activities of Daily Living

Peter Düking [1,*], Silvia Achtzehn [2,3], Hans-Christer Holmberg [4,5] and Billy Sperlich [1]

Biomarker	Wearable	Smartphone	Point-of-Care-Testing
Heart rate, HR variability, HR recovery	X	X	X
Energy expenditure	X	X	
Lactate-RPE Ratio	(X)		
Oxygenation	X	X	X
Hydration	(X)		X
Metabolites (Chol/Trig/Cr, Urea, etc)			X
Blood lactate & glucose	(X)		X
Blood gases (pH, pCO2, PO2)			X
Electrolytes (Na, K, Ca, Cl)			X
Haemotology (Hb, Hk, Ery, Leuc, Thromb)			X
Enzyme (AST, ALT, Y-GT, Amylase)			X
Cardiac markers (CK, CK-MB, cTnI, Myo, BNP/NT-pro BNP..)			X
Acute Phase Protein (CRP, hsCRP)			X
Temperature (skin, body, core)	X	X	X
Subjective ratings (RPE, Session RPE)	(X)	X	
Training Impulse (TRIMP)	(X)	X	
Diaries	(X)	X	
Questionnaires (sleep; POMS; fatigue; readiness, stress…)	(X)	X	

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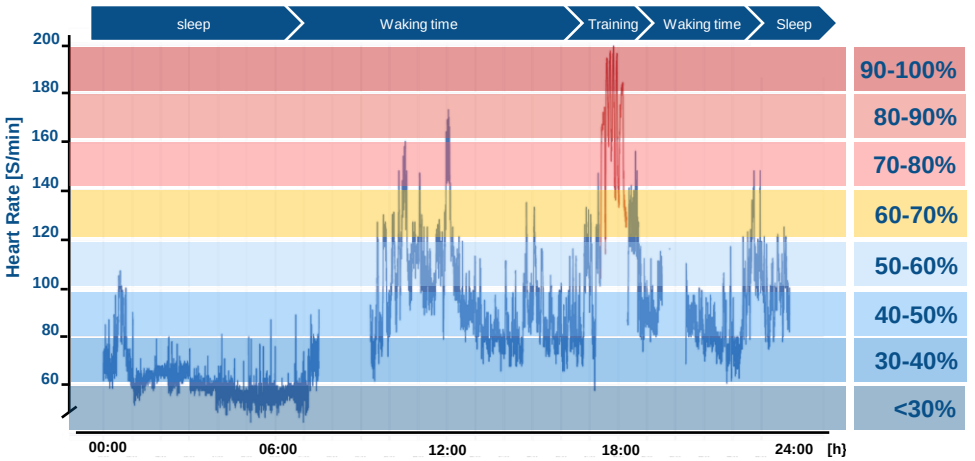
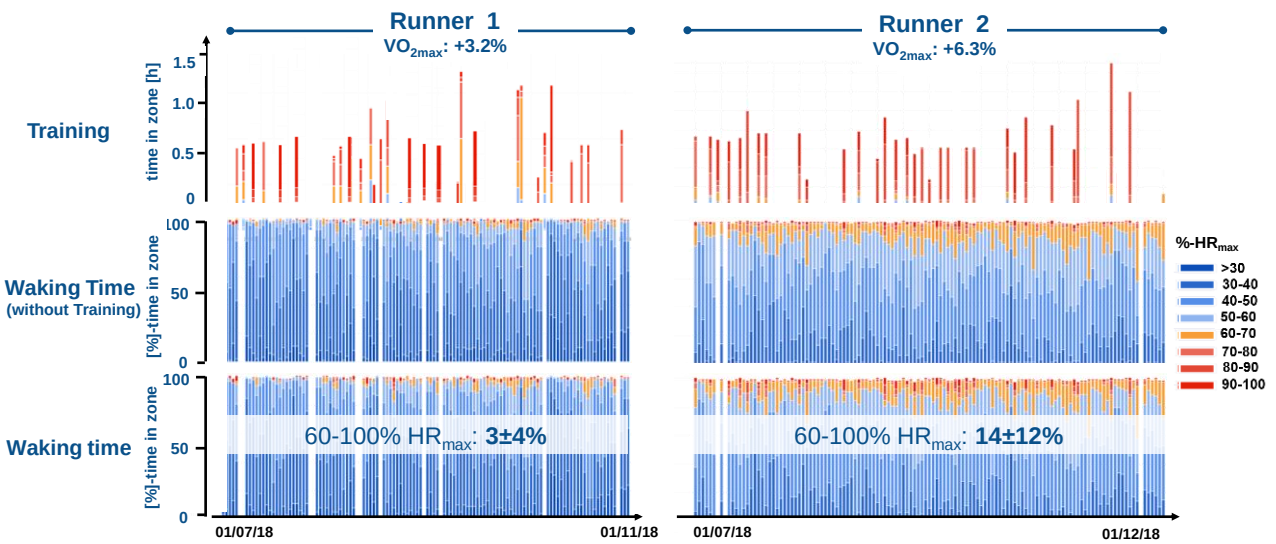
24h-continuum & intensity zones



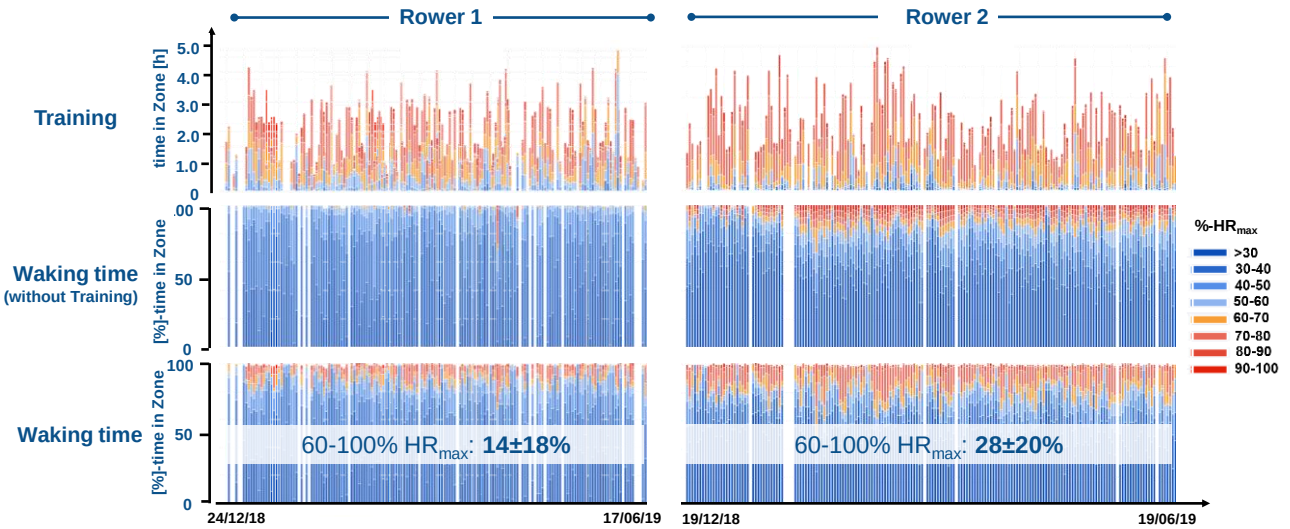
Polar M600; Kempele, FIN
Android based
1Hz HR-recording
ca. 36-48h batterie life

Long-term 24h-Monitoring - „Beginner“



Düking et al. EJAP 2020

Example 24h-monitoring – Elite rower



Treff et al. 2021 Sci Report

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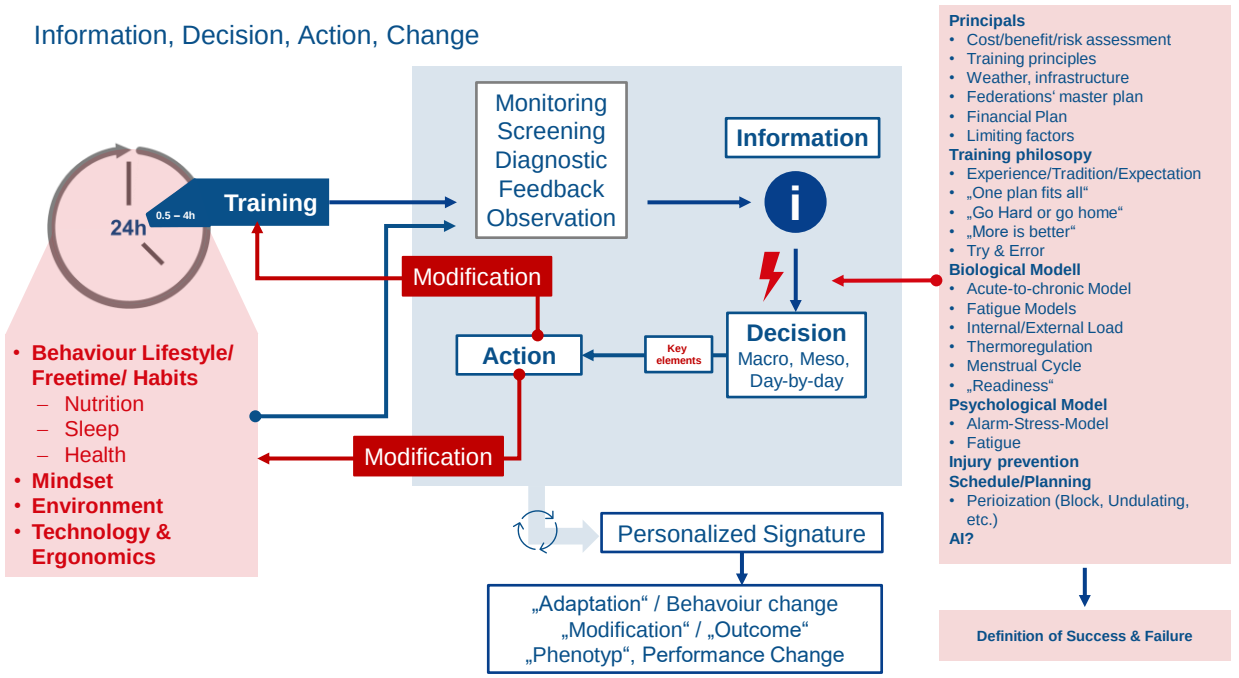
Information, Decision, Action, Change



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Thank you!

/billysperlich

- *2 years*
- *English spoken*
- *Tuition-free*

NEW Starting Oct. 2023

MASTER (M.Sc.)
EXERCISE SCIENCE & TRAINING

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