

Run Better

Current management of running injury and performance enhancement

Andrew Caldwell MCSP BSc (Hons) MSc

- Consultant Sports Physiotherapist & Clinical Director Active Therapy Ltd
- Specialist Running Clinic all levels
 of athlete/runner
- UK Tutor/Business Development
 Lead for The Running Clinic educate health & fitness professionals
- Provided services to UK Athletics, Loughborough University HPC, Runners World, Brookes UK, The FA, The LTA, The PGA
- Former Head of Physiotherapy & Sports Medicine Hearts FC







Before we commence !

- Lots of varied opinion online and within running communities everyone is an expert!
- Significant amounts of this opinion will be based upon CONFIRMATION BIAS from CHERRY PICKED DATA
- Be aware this exists and use reputable, evidence based sources for INFORMED DECISION MAKING
- Be aware that there is a HUGE body of evolving research in the area



Outline

- 1. Biomechanics of running -Practically applied
- 2. Injury epidemiology The Big 5
- 3. Strategies for injury risk reduction and performance enhancement
- 4. Strength & Conditioning for runners
- 5. Footwear selection What do I do?
- 6. Summary





Running Biomechanics

Practically applied

Current trends in running

- There is an exponential growth in number of recreational runners GREAT!
- Average marathon times are getting slower

1980 - 3.32 2002 - 4.20

- Approx 26% of runners training for marathons don't make event due to injury
- Many more runners commencing running with

Compromised physical competence

Inefficient biomechanics

Reduced 'training age'

Following inappropriate training plans



Health benefits of running

There is no **MEDICATION** in use or development which **REDUCES** ALL CAUSE MORTALITY as effectively as regular exercise!

Your Prescription for Health...



Exercise prevents or treats many diseases, including diabetes, hypertension, heart disease and obesity. Make physical activity part of your health.

Ask your healthcare professional how you can benefit from an exercise prescription.

www.exerciseismedicine.org



Health benefits of running

If you run regularly your ALL CAUSE MORTALITY reduces by





Which risk factor kills more people? Low fitness kills more people than smokadiabesity



Blair SN, BJSM 2009

Loads during running

Each footstrike 2-3x B.W in 0.2s

PFJ – 4.3-7.6x BW

Achilles - 6-12x BW

Approx 1500 contacts per mile Runner of 70kg at 9 min/mile

Mile = 262,500 kg

Half marathon = 3,412,300 kg

Marathon = 6,825,000 kg



Loads during runningEach footstrike 2-3x B-W in 0.2PFJ - 4.3-7PFJ - 4.3-7

,**₁**2,300 kg

arathon = 6,825,000 kg



Muscles & Tendons are Springs! Approx 80% kinetic energy returned 35% Achilles 17% Plantar Fascia



Muscles & Tendons are Springs! Approx 80% kinetic energy returned 35% Achilles 17% Plantar Fascia

How many people have been advised they 'OVER-PRONATE'



What is 'normal' pronation??





THERE IS NO 'PERFECT' RUNNING TECHNIQUE MOVEMENT VARIABILITY IS NORMAL AND HEALTHY THERE ARE CHARACTERISTICS OF RUNNING TECHNIQUE THAT ARE DESIRABLE

Efficient gait pattern

2013-Ogueta-Alday, 2011-Storen, 2011-Heise, 2011-Halvorsen, 2010-Fletcher, 2009-Pontzer, 2008-Tseh, 2007-Fletcher, 2007-Hasegawa, 2007-Romanov, 2007-Heise, 2006-Conoboy, 2005-Dallam, 2005-Divert, 2004(R)-Saunders, 2004-Arendse, 2004-Saunders, 2004-Hardin, 1996-Anderson, 1994-Morgan, 1992-Martin, 1990-Kaneko, 1989-Cavanagh, 1982-Cavanagh, 1982-Power

- Controlled posture looking ahead
- Compact arm swing cross body patterning
- Active knee drive
- Footstrike under C.O.M
- Light/Reactive/Stiff, reduced ground contact time, ?MFS
- Cadence circa 180 spm not the holy grail!



Inefficient gait pattern

2011-Arellano, 2011-Storen, 2008-Tseh, 2000-DeWit, 2005-Divert, 2004-Arendse, 2005-Dallam, 1997-Milani, 1996-Hennig, 1994-Morgan

- Often 'poking chin' posture
- Rounded shoulders
- Excessive arm swing ?substitution for low knee drive
- Overstriding foot contact ahead
 of COM 'braking' effect
- Increased vertical displacement, vertical loading rate
- Reduced cadence circa 156 spm



SHOD BIOMECHANICS

- 75-90% of runners in PECH shoes RFS
- Tendency toward lower cadence
- PECH shoes permit HEAVY RFS
 TRY IT!!
- Pronation control shoes DON'T actually 'control' pronation



Roy et al 2011

BAREFOOT BIOMECHANICS

- The human foot is a highly sensate region
- Improved impact moderating behaviour - reduced VLR
- Tendency toward higher cadence
- 'Barefoot' and Minimalist shoes don't reproduce BAREFOOT BIOMECHANICS



FOOTSTRIKE CONTINUUM BASED ON FOOT STRIKE INDEX



on hip & knee

Increase load on foot & calf



Running Injuries

INJURY 'PREVENTION' IS NOT ACHIEVABLE

INJURY RISK REDUCTION IS POSSIBLE BUT CAN BE **COMPLEX & MULTI-**FACTORIAL

Risk factors for Injury

30-80% Runners injured per annum

Injury rates haven't decreased significantly in 30 YEARS

Big 5

- 1. MTSS
- 2. Knee pain/PFPS
- 3. Tendinopathy Achilles/Patella

4. PHP



METHODS

military griding appartments, and to pri-

Risk factors for Injury

- Novice runners •
- **BMI>30** •
- **Prior Injury**
- Age 45-65 •
- MPW <18 & >40 miles
- Training Load Errors Frequency, Volume, Intensity
- Acute: Chronic Training Load

Second / Head for Second 2012 - -----A lock of the lock of the set of MEDICINE & SCIENC Prevalence, incidence and course of lower extremity injuries in runners during a 12-month follow-up period B. van Poppel', G. G. M. Survey Middelasen Verhauen Research Group Diagnosh Erennic MC Melical Unio Cervepositog autor: Dr 4800 E4 Brain, The Netla Predictors of Running-Related Injuries Accessed for publication 14 Among 930 Novice Runners To describe the incider course of lower extremi and after the Arragin design was based on a A 1-Year Prospective Follow-up Study population-based setting restaurs received a web which 713 participants Rasmus Cestergaard Nielsen,*12 MHSc, Ida Buist,⁵ PhD, Erik Thorlund Pamer,¹ PhD, mation about previous demographic data we Ellen Aagaard Nohr, 1 Ph mer TRED. Martin A Pab rade intensity of running inf riss wars obtained fro investigation performed The main estimate m Aarhus University, Denn REVIEW Backstreamt. To identify person factors associated with injury is Incidence and determinants of lower extremity running injuit Purpose: To identify demograph Long-distance running, Study Design: Classificial pr in long distance runners: a systematic review introng recreational spo Matheda: Expension reliding a efits of long-distance ? other sports activity, previous tur R N van Gent, D Siem, M van Middelkoop, A G van Os, S M A Bierma-Zeinstra, B W Kaes as improvement of g outcome of interest rise a number capacity, and weight rerunning that restricted the amou Brené et al., 2007). Fa running volume by global positio 513 Eastern man 2007, 61 448-480, doi: 10.1124/http: 200/ analyzed using a generalized life is associated with red The purpose of fills study was to present a systematic overview Results: A total of \$30 individu notable survival adva of published reports on the incidence and associated patential 155.318 km of running. By calo ring, the TASPI Type B behavior between 45 and 55 years (cPPD) Unfortunately, long-d risk factors of lower extremity running injuries in long distance ries and other physical runners. An electronic dotobose secret was conducted using of overraining (Melas) 22.4%) P a .08 ware consider the PubMed-Medline database. Two observers independently 20075 proups also revealed a borderin (Piz: 42), previous running-rela ossessed the quality of the studies and a best evidence synthesis Several studies evaluwas used to summarise the results. The incidence of lower of lower extremity injust Constantion: The findings of th extremity running injuries ranged from 19.4% to 79.3%. The Finnish retrospective st2 and previous injuries not related predominant she of these injuries was the knee. There was Finnish long-distance ? was protective, doil, the role of strong evidence that a long training distance per week in mple mainly to the foot, and Keywords: running-misted ins runners and a history of previous injuries were risk factors for ries in the foot and it, injuries, and that an increase in training distance per week was injuries was 75% of all a protective factor for knee injuries. and 59.4% were over Running-related injuries (III 2010). Among numers/ norice runners commanding a dam Marathon Study/ runners with a weekly running $S_{\rm physical}^{\rm perty} = transformed to the set of the set of$ expensity injury in Bagatian of the large mimber running as their preferred form (a training regimes and because The Mattal Erical Co. runners is high, it is important for incidence of obevioy, catchinescolar disease, and approved this study. many other others thanks problems. " Include of of injury in this population." For its usey adaptellility, long distance naming is risk fasters for injury sources 48.7.8 Province injuries," high weak movement," and training processed the interve papels and storag with the proving impress in disease prevention is portinua-to increase in populatory. Novement, numbing stay ated with injury constrance. 5, sito grue injuries, especially to the lower exceunset these relationships mitigs. Various exuitige have removed on the appointment are associated with prevelence and incidence of number injuries occurring in long distance numbers during values at max."" Risk factors contributing to these injuites have also hear reported.*** The Oringsaudig Jaures of Storie DOI: 10/1177/0005667115467516 To help preven such injuries is is necessary in summaries interviedge about potential risk factors. Thus the primery purpose of dife souly was to @ The Automa 20-2 present an overview of published reports describing the incluince of various numbing injurias of the lower entratilities in long distance numbers. Our ascound non-way to blancify risk factors associated

> See and of price for output of lipitors METHOOS

with these summing inducies.

were extended according to the criteria adown Relevant review publications and rans structulad utals in Fubruad ware searche the beginning of the detailers up to May 2 Study criteria

Abstracts The search in PubMed-Meillow produced

of atwarants which were screened using Informing other an · The sublect of the study was running 2004

the lower extremitian conuming in long di-turners. We included only studies where facts nan 25 ken nar tenining or men, or b · The summary were recreational or one

rutorars, but not balanged to the alter induce, prevanably can rulp on a balant m ALCONOMI . · The study described estatematory correincidence) or antiningy (determinence) of excreminy numbers injuries, or mich.

The easily included a easily population of a 10 includitatis (prove septiend) encilias, prospe onivers studies, retrospective others studies, control studies, case series and clinical trials The study was written in Snglish, De German, Presch, Spenish, Italian, Dat

Norrougilan, Swadials, Statanulle or Ind

Pull text orticles Resed on this first screening a selection of an

ers made, which eas hindur nationed using the following others after realing the saxs of the articles: inclutes other a presenting others studies sectional studies, representive minori, studies a follow up period of manimum one month.

internisat clinical state. Entheties orthonic studies in which the periods were predominantly expressi to types of spo activity other diam running laugh as oth military griding appartments, and to pri-



000 hours

eational

Injuries per 1000 h of running' is an important and injuries per 1000 n or running is an impo-useful measure of association that enables Key Puints useful measure of association that enables comparison of the risk of injury across studies. Novice runners are at significantly higher risk of Novice runners are at significantly nigher risk of injury 17.8 (95 % CI 16.7–19.1) than recreational runners, who sustained 7.7 (95 % CI 6.9-8.7) runners, who sustained 7.7 (95 % CI 6.9-8.7) running-related injuries per 1000 h of running. More studies on ultra-marathon runners and track More studies on ultra-marathon runners and track and field athletes are needed in order to calculate weighted estimates.

CrossMark

Running is one of the most popular and accessible spon kunning is one or the most popular and accessible spont activities worldwide [1, 2]. It can be performed with minimal eminment, and by a broad variety of permits activities worldwide [1, 2]. It can be performed with minimal equipment, and by a broad variety of people in 1 Introduction Springer

Running Injury risk per 1000 hours

Novice 17.8

Recreational 7.7



Specific types of running injury

 Table 1. The frequency (percentage) of specific diagnoses based on 2002 injury cases according to

 Taunton et al. The diagnoses are divided into volume or pace injury groups.

Diagnosis	Frequency (%)	Volume injury	Pacing injury
Patellofemoral pain	16.5%	Yes	
syndrome (PFPS)			
Iliotibial band friction	8.4%	Yes	
syndrome (ITBFS)			
Plantar fasciitis (PF)	7.9%		Yes
Patellar tendinopathy (PT)	4.8%	Yes	
Achilles tendinopathy (AT)	4.8%		Yes
Gastrocnemius injuries (GI)	1.4%		Yes
TOTAL	43.8%	29.7%	14.1%

Overstride with RFS

- Increases retropatella loading forces - Higher risk of PFPS/Anterior Compartment Syndrome
- High braking forces inefficient
- Associated increase vertical displacement



SOLUTION - INCREASE CADENCE +/- LIGHTER SHOE

Effects of cadence manipulation - Heiderscheit et al (2011)



3. Reduced foot strike angle

Excessive Adduction/IR

- Associated with higher risk of PFPS/ITBS/G.T
- Gmax/GMed strengthening
 alone will not address
- Need to re-educate running biomechanics in conjunction

TEST in 2's - SKB (Small knee bend to 45 degrees)

SOLUTION - Run either side of line/Push markers out to the walls



Training Load Error

75% of running injuries are CUMULATIVE





Soft Tissue Adaptation

MISADAPTATION

Intrinsic Factors Mechanical Stress

Extrinsic Factors

Biomechanical factors Tissue overload Prior injury Training errors Insufficient recovery

Running shoe Surface

Prevention of Overuse Injuries

ADAPTATION

Intrinsic Factors Mechanical Stress

Extrinsic Factors

Biomechanical factors Tissue overload Prior injury Training errors Insufficient recovery

Running shoe Surface

Prevention of Overuse Injuries

ADAPTATION

Calculated mechanical stress

Fix faulty biomechanics ... and muscle dysfunctions Solidify all structures Be progressive

Appropriate running shoe Adequate surface

Training Load Error

Volume 10-20% per week rule – no robust evidence.

Sensible progression

Intensity Manipulate after solid aerobic and strength base

Frequency Consider more frequent runs (x5 week) with lower volume or run/walk intervals

Training load progression

Training load progression

Training load progression

Annual Periodisation

OFF season

Shoe evolution!

Current practices of shoe selection

- Use of the 'wet foot test/arch type' isn't valid
- Shoe selection on this basis is suggested to simplistic and may INCREASE injury risk
- More expensive shoes don't reduce injury risk

that are outside their foot category will experi-

ence greater pain than those weating shoes that

they would be conventionally sesigned fie, nec-

tral feat to neutral shoa, pronated feat to stability

shoe and highly proneted feet to motion control shoe). Testing of this hypothesis against the pull

although this was limited by an inadeousts service are

Conclusion The findings of this study success that our

current approach of preactifying in-shoa promation control.

systems on the basis of foot type is overly simplistic and

patentially injurious.

Reasons to change shoe?

- Recurrent or chronic injury take advice from specialist practitioner <u>NOT</u> running store
- Need to improve tissue loading profile we can't abolish load just re-distribute
- Want to reduce O2 consumption 1% reduction per 100g shoe weight
- Not **comfortable** in current shoe

How do I select the right shoe?

- Wide Toe Box
- ?Anatomical lacing
- Correct syping point for metatarsal mobility
- The lightest, most flexible shoe you can tolerate
- · COMFORT
- 'Earn the right' to be in the shoe
- Consider shoe rotation

How to transition into new footwear safely

- Go slower than you would
 think incremetal changes
- 1 minute more per run for certain shoes/certain conditions
- Footwear selection is just part of the bigger picture

Injury Risk Reduction & Performance Enhancement

Stretching

'You can't STRETCH your way out of a problem you MOVED into'

- Injury risk and stretching
- Types of stretching what to do when
- Where does foam rollering fit in with this?

Strengthening

- Regular strength training reduces injury risk
- Improves athletic performance
- Builds robust tissue tolerance - M.S.Q
- Aim for x2-3 S+C sessions per week
- Run specific

S+C for Injury Risk Reduction

- Sport Injuries reduced by 66%
- Insidious onset injuries by 50%

X2-3 SESSIONS OF S+C

PER WEEK

rtuek.

Ownershill

7 October 2013

To obe: Lawrence 38.

The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials

Jeppe Bo Lauersen,¹ Ditte Marie Bertelsen,² Lars Bo Andersen^{3,4}

 Additional material is published online only. To view please visit the journal online ABSTRACT **Background Physical activity is int** prevention and treatment of many cit beta Adv. doi. avg/10.1136/ giorts injuries can pose serious probi 0079-3013-01253M Objective To determine whether p ¹Institute of Sports Medicine Capenhagen, Wapetjerg evencises can teduce sports injuries an analyses of strength training, stretching Hespital, Capenhagen IV. combinations of these, and provide se **Tacuty of Health and Medical** mence intro eximates. Coperinger N Material and methods Publied Department of Exercise Science and SPORTDiazus usee search Epidemiology, institute of Sport Sciences and Clinical results. Two independent authors sele candomised, controlled trials and qual with the Noneclarics Driversity of Journey, Otlense, conducted by all authors of this paper collaboration domain-based quality / Twelve studies that neglected to acci-Department of Source Medicine, Narwegian School Sport Sciences, Calls, Narway effects were adjusted. Quantitative (performed in STATA V.12 and sensition Column of ntention-to-treat. Heterogeneity (2¹) Correspondence to Harbord's small-study effects() were (Inspe Bo Leursen, Institute of Sports Medicine Results 25 triak, including 26 610 3464 injuries, were analysed. The pa Capenhagen, Bigetijerg Hospital, Building B, 1. Fibe injury prevention was heterogeneous Repetjerg Rokke 20, 3400 analysis second no beneficial effect Capenhagen NV, Sealand 2400, Dennaric 0.963 (0.846-1.0958), whereas stur eleveriend build in all mposumes (RR 0.655 (0.520-0.836) training INR 0.550 (0.547-0.8600.) Accepted \$1 August 2013 (RR 0.315 (0.307-0.4809) showed **Nokuhed Onlive First** creasing effect. Both acute injurie 0.8363 and overuse injuries (RR 0.57 could be reduced by physical activity Intention to treat sensitivity analysis even more sobust effect estimates. Conclusions Depite a few outly lavourable estimates were obtained neasons except for stretching. Stret sports injuries to less than 1/1 and of

be almost halved.

INTRODUCTION increasing evidence exists, for physical activity is important in F treatment of some of the most s/ our time,1-1 including cardiour heres, cancer, hypertension, e and depression. Although over physical activity is a general cor of leisure time physical activity tion have been reported in sort injuries are virtually the sole Bereisen Diet, Andersen UB. der / Spenis Biler 2010;48:871-877. but may be a common consequ-ity and have been shown to blems.³⁻⁷ Management of spot

runners: a randomised controlled trial Steef W Bredeweg, Sjouke Zijkstra, Bram Bessern, Ida Buist **Center for Sports Medicine** ARSTRACT University Medical Conten Objectives Them is no consensus on the articlogy and Generger, Deservity of Generger, Grossger, The Nationalis prevention of running-related insuries in surners. recorditioning studies among different attients Carraspandance to pspulations show positive effects on the incidence of porta injuries Shell VI Receivery, Cetce for Sports Ministrie, Gelversky Ministral Center Gewinger, Repetitenia A 4-week proconditioning programme in navice survers will reduce the incidence of survivo-University of Generation, Nanosphere 1, 1750-185 Generation, The Nathant idated interies. Study design Handoniand controlled clinical triat, level of evidence, 1. similarity and Methods Novice surveys (N=432) prepared for a four rile recreational running event. Participants were Repired 31 May 2012 Accepted 4 July 2010 Published Delive Feet 38 July 2010 allocated to the 4-week preconditioning (PRECON) group (N=211) or the control group (N=221). The PRECON group started a 4-week training programme, prior to the

Whent these strands and the

The effectiveness of a preconditioning programme

on preventing running-related injuries in novice

we, buch due the

surving programme, with walking and hopping exercises. After the 4-week period both groups started a 3-week

running programme. In both proups information was

registered on lumming exposure and running-related

inguites (FFIb) using an internet-based running log.

imary outcome measure was RPIs per 100 run

lover extremity at lover back causing restriction of

Results The incidence of APIs was 15.2% in the

VECON group and 16.8% in the centrol group. The

difference in Rills between the groups was not

significant (g²=0.161, d)=1, p=0.68.

turving for al least a week.

IDACE NUMBER.

INTRODUCTION

Wi was defined as any musculosielenal complaint of the

Conclusion The prospective study domonstrated that a

5-week PREDDN programme with welking and hopping

eventieses had no influence on the incidence of RHs in

Recentional and competitive mining is very popular wouldends and the number of runners in

men-increasing. Remaining is an easy sports activity to

aintain an active bushby blentyle, and has benefi-

cial efforts on candiarespiratory fitness, origin control and mental health.¹ Sooner or lates, however,

many newlot, secretational or competitive runners

naining distance, history of previous injuries, lack of

This is the first study among numers that evaluates the effect of preconditioning in proventing naming related injuries (RRs). The 4-week preconditioning programme did

not prevent RRbs in novice names

running experience and running to compete are th ing injuries.¹² 18 factors for incompationsity of Helps: states that many; if not all, running injuries are caused by training ermen.¹⁶ Van Mechelen's opinion that the

RRIs is primarily based on trial and error in still valid.¹⁸ So far, little high-quality seasach has been dane on the prevention of RBJs in navice or sense ational runners.⁴ Studies on the effects of interver-tions to prevent RRIs have methodologic. ngs, hence the continued need for con where the trailed totals to shed light on mails interventions Buist at af" showed that previous sports particpation without axial loading (ie, swime ing and cycling) was an important pedictor for EEh in ravies ranners in contrast with sports with anial loading die, soccer, hockey; huslerhall and volleythis observation it can be hype that a lack of previous participation in sporting activities without said loads is a risk factor for sustaining an RRI. Milgeon¹⁴ found that the type of physical activity of secruits prior to militar induction was a major determinant for stress lital ture risk in basic training. In a healthy attuation the resocialsideral system

can adapt to mechanical loading and physical activity.^{19–20} These mechanotranaduction mechanisms converts mechanical forces into biochemical events in machinelected times in a leading-magnitude-dependent manner.¹⁹ ²⁰ When an optimal level of load is applied to the missculodaletal eveters, its strength will increase given adequate monvery time. When loading is too high or the accovery time is nazan injuries. The incidence of nancing-actual. When loading is too high or the recovery time is injuries (URIs) is high. Incidence cares vary from too short however, the musculoakaletal system will 20.9% to Bit 9% and from 3 to 59 RR is per 1000 h of the westerned and the likelihood of eutramorg as ratening ⁸⁻⁴ Mast RRIs are overcast multicalizational overcast inputy to increased ¹⁴ 19¹⁰ Injuries of the lasest eccentrics,^{24,3}-01 Ployter memory are frequently

Device networks an interface the second seco disarse. Wennes purported intrinsic and extrinsic risk culcularletal systems are not used to the repetitive factors for RRIs have been studied, but most studies and high-impact forom of rateoing." renning programmes the himmechanical load is on these factors show inconsistent or conflicting remning programmes the hiererchaesical lead is multi-¹⁴ ¹⁴ There is evidence that a genere weekly high from the start. When the munculoslasteral soutiers all the number runner cannot cope with the

Performance benefits of S+C

- 26 Studies evaluated
- All levels of runner
- Male and female

- 1-3 sessions per week (Ave 2-3 per week)
- 6-12 weeks average
- Heavy (4 x 6RM) and Strength Endurance (3-5 x 10-15RM)

Running Economy - Improved Ave 4%

3k Performance - Improved ave 3-6%

Sports Mod DOI 10.1007/sat279-014-0246-1

REVIEW ARTICLE

Strategies to Improve Running Economy

Kyle R. Barnes - Andrew E. Kilding

© Springer International Publishing Switzerland 2014

Abstract Ranning economy (RE) represents a complex interplay of physiological and biomechanical factors that is typically defined as the energy demand for a given velocity of submaximal running and expressed as the submaximal oxygen uptake (VO2) at a given running velocity. This review considered a wide range of acute and chronic interventions that have been investigated with respect to improving economy by augmenting one or more components of the metabolic, cardiorespiratory, biomechanical or neuromuscular systems, Improvements in RE have traditionally been achieved through endurance training. Endurance training in runners leads to a wide range of physiological responses, and it is very likely that these characteristics of running training will influence RE. Training history and training volume have been suggested to be important factors in improving RE, while uphill and level-ground high-intensity interval training represent frequently prescribed forms of training that may elicit further enhancements in economy. More recently, research has demonstrated short-term resistance and plyometric training has resulted in enhanced RE. This improvement in RE has been hypothesized to be a result of enhanced neuromuscular characteristics. Altitude acclimatization results in both central and peripheral adaptations that improve oxygen delivery and utilization, mechanisms that potentially could improve RE. Other strategies, such as stretching

K. R. Barnes (52) - A. E. Kilding Sports Performance Research Institute New Zealand, Auckland University of Technology, Level 2, AUT-Millensian Campus, 17 Amates Place, Mairangi Bay, Auckland, New Zealand o-mail: bylchames@yahon.com; humesk@prou.edu

K. R. Barnes Department of Movement Science, Grand Valley State University, Allendale, MI, USA

Published online: 28 August 2014

should not be discounted as a training modality in order to prevent injuries; however, it appears that there is an optimal degree of flexibility and stiffness required to maximize RE. Several nutritional interventions have also received attention for their effects on reducing oxygen demand during exercise, most notably dietary nitrates and caffeine. It is clear that a range of training and passive interventions may improve RE, and researchers should concentrate their investigative efforts on more fully understanding the types and mechanisms that affect RE and the practicality and extent to which RE can be improved outside the laboratory.

Key Points

A range of training and passive interventions such as endurance training, high-intensity interval training, resistance training, training at altitude, stretching and nutritional interventions may improve running economy.

Improvements in running economy may be made by modifying one or more factors that influence metabolic, biomechanical and/or neuromuscular efficiency.

1 Introduction

The goal in competitive distance running is to run a given distance in the least time, or at least faster than the next best competitor. A number of physiological attributes contribute to successful distance running performance [1, 2], including (i) both a high cardiac output and a high rate

2 Springer

Gluteus Medius - EMG

<u>5 in 5</u>

- 1. Side bridge to neutral
- 2. SLSq
- 3. SLDL
- 4. Hip hitch on step
- 5. Sidelying hip abduction

GLUTE MED (REIMAN ET AL. 2012)

Gluteus Maximus - EMG

<u>5 in 5</u>

- 1. Forward step up
- 2. SLDL
- 3. SLSq
- 4. Wall Squat

5. Bird-Dog

GLUTE MAX (REIMAN ET AL. 2012)

Calf & Ankle

- Develop <u>strength</u> calf raises with eccentric component +/weight
- Improve single leg <u>balance</u> running specific +/- drills
- Develop <u>SSC</u> improve 'reactive stiffness' of calf/achilles with hopping/skipping/ankling

Trunk-Pelvis Control

- Exercise SPECIFICITY and TRANSFER i.e planks
- Standing v non-standing patterns
- Upper and lower body focus? Cross body patterns
- Low and High threshold

Bodyweight Strength Examples

Heavy Strength Training

Evidence Based Information for Runners

- The Running Clinic Blaise Dubois
- Kinetic Revolution James Dunne
- The Running Physio Tom Goom
- Run Research Junkie Craig Payne

Health benefits of running

There is no MEDICATION in use or development which REDUCES ALL CAUSE MORTALITY as much as regular exercise!

If you run regularly you're ALL CAUSE MORTALITY reduces by <u>63%</u>

Summary

- Aim for EFFICIENT RUNNING TECHNIQUE for YOU
- GET STRONG and MAINTAIN
- Train SMART & CONSISTENTLY Develop a TRAINING PLAN
- Develop a RECOVERY ROUTINE

Thank you

www.active-therapy.com

admin@active-therapy.com

Facebook - activetherapy1

Twitter - @activetherapy1

Physiotherapy & Sports Injury Clinic

ENJOY YOUR RUNNING !!