

Fighting fit – how exercise affects your immunity and susceptibility to infection



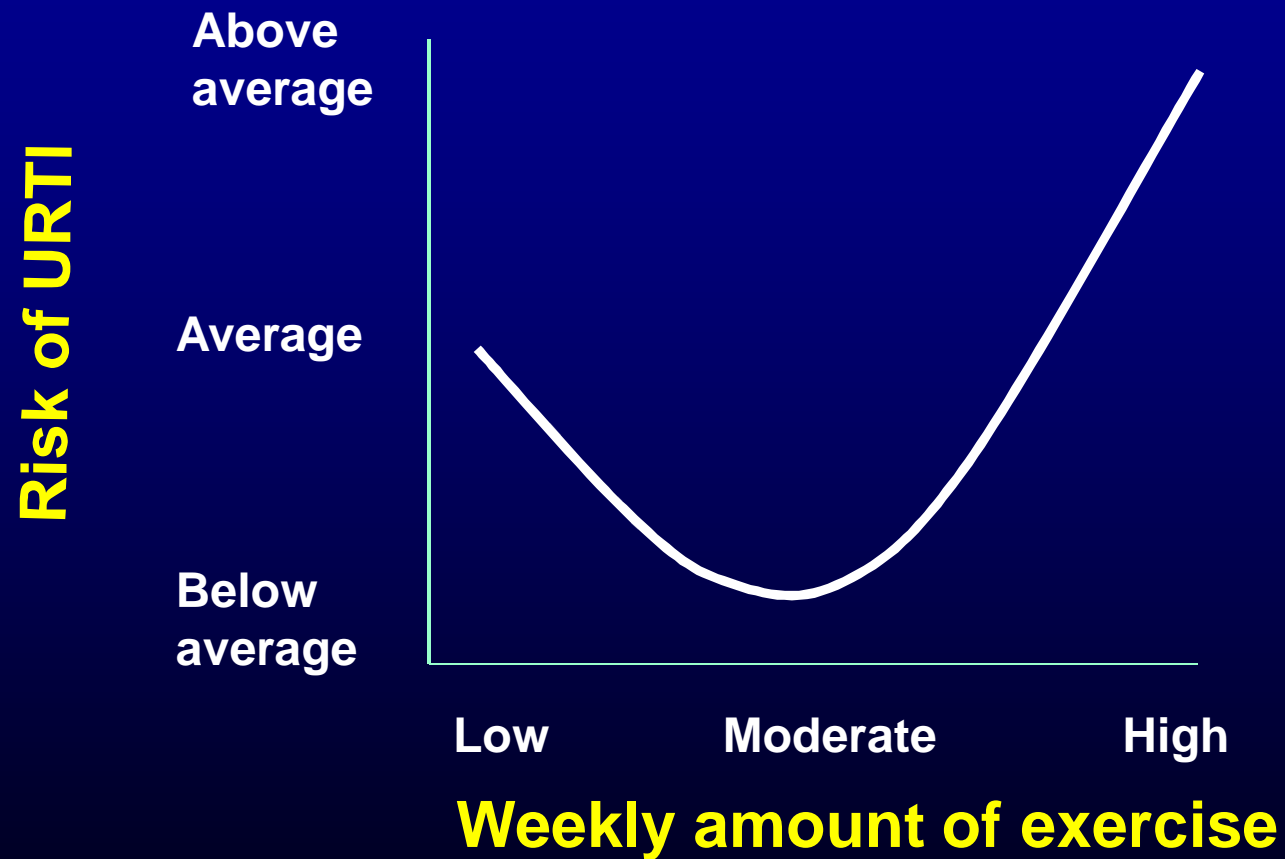
Prof Mike Gleeson
School of Sport, Exercise & Health Sciences, Loughborough University
ASE Liverpool, January 6th 2012

Structure of Lecture:

- **Exercise and risk of upper respiratory tract infection (URTI)**
 - **The J-shaped Curve**
 - **The General Population: regular moderate exercise**
 - **Sportsmen and women: prolonged strenuous exercise and training**
- **The effect of heavy exercise on immune function**
- **Can nutritional supplements influence the immune response to exercise?**

The 'J-shaped' model

Nieman, Med Sci Sports Exerc 26: 128-139, 1994



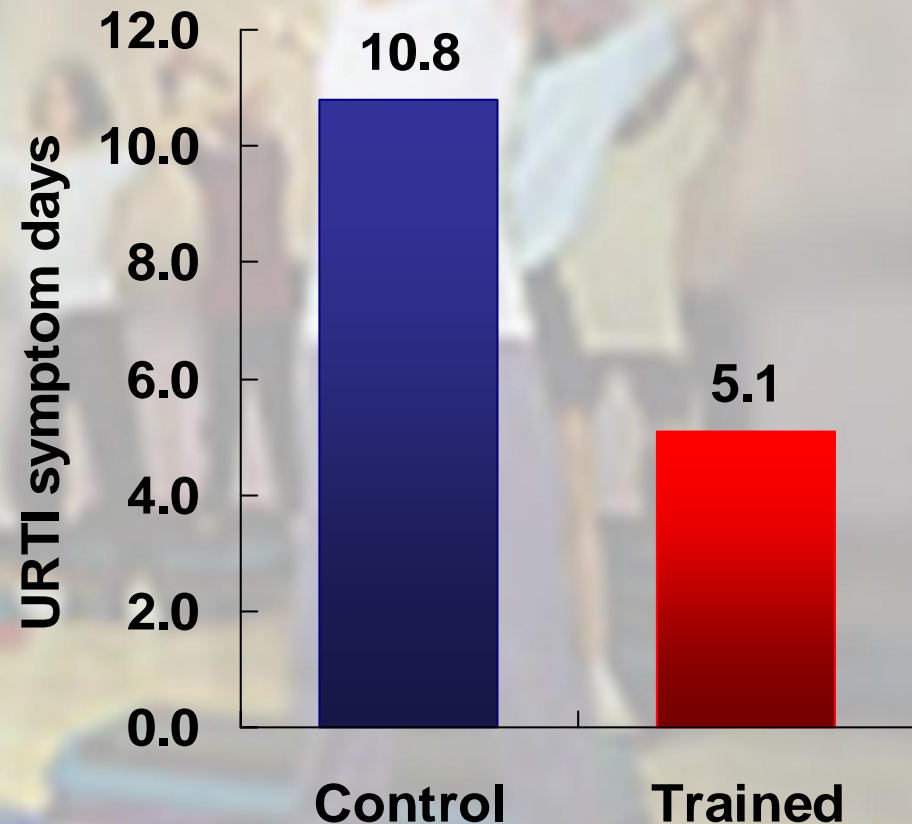
Moderate exercise and infection risk - anecdotal reports

- **Common belief among fitness enthusiasts that regular exercise confers resistance against infection:**
- **Example 1:** 170 non-elite marathon runners: **90%** agreed that they '*rarely get sick*'
(Nieman, 2000)
- **Example 2:** 750 'Masters Athletes': **76%** perceived themselves as '*less vulnerable to viral illnesses*'
(Shephard et al., 1995)

Moderate exercise and incidence of Upper Respiratory Tract Infection (URTI)

Nieman et al., Int J Sports Med 11(6): 467-473, 1990

- 36, mildly obese, sedentary women
- Assigned to either:
- 15 wk training, 45 min/day, 5 x per week at 60% heart rate reserve
- Non-exercising control group



A larger scale study

Matthews et al., Med Sci Sports Exerc 34(8): 1242-1248, 2002

- 547 men and women aged 20-70 years (mean 48 yr)
- 12 month study with periodic visits to a clinic
 - 3 month recall of colds, flu or allergic episodes
 - 3 x 24 h recall of physical activity (24PAR)



Household



Occupational



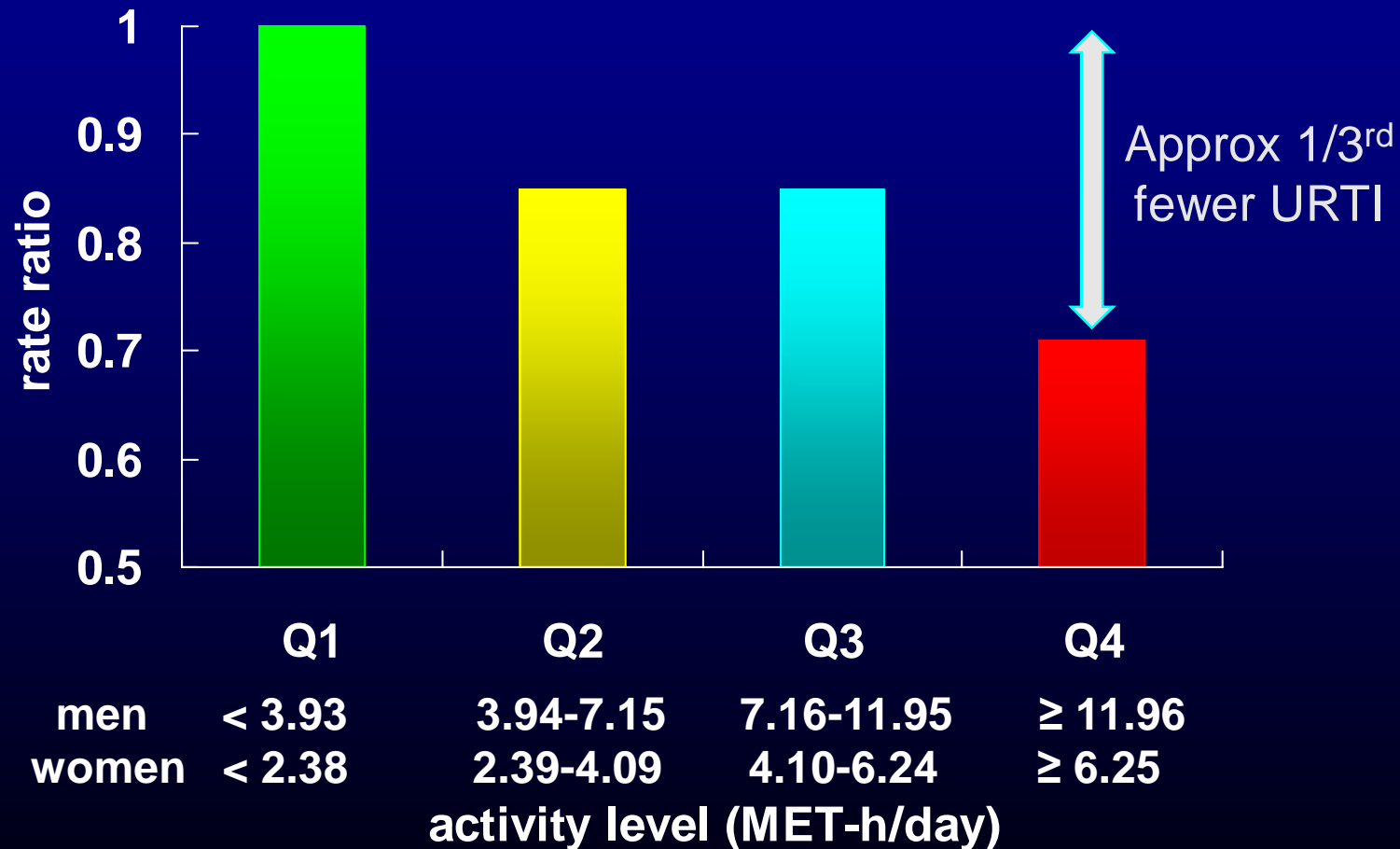
Leisure

- Adjusted data for confounders

Physical activity levels and incidence of URTI

Matthews et al., 2002

Data adjusted for age and gender.
29% lower URTI risk in Q4 compared with Q1
($P < 0.01$)



Activity levels and URTI over the winter months in 1002 men and women aged 18-85

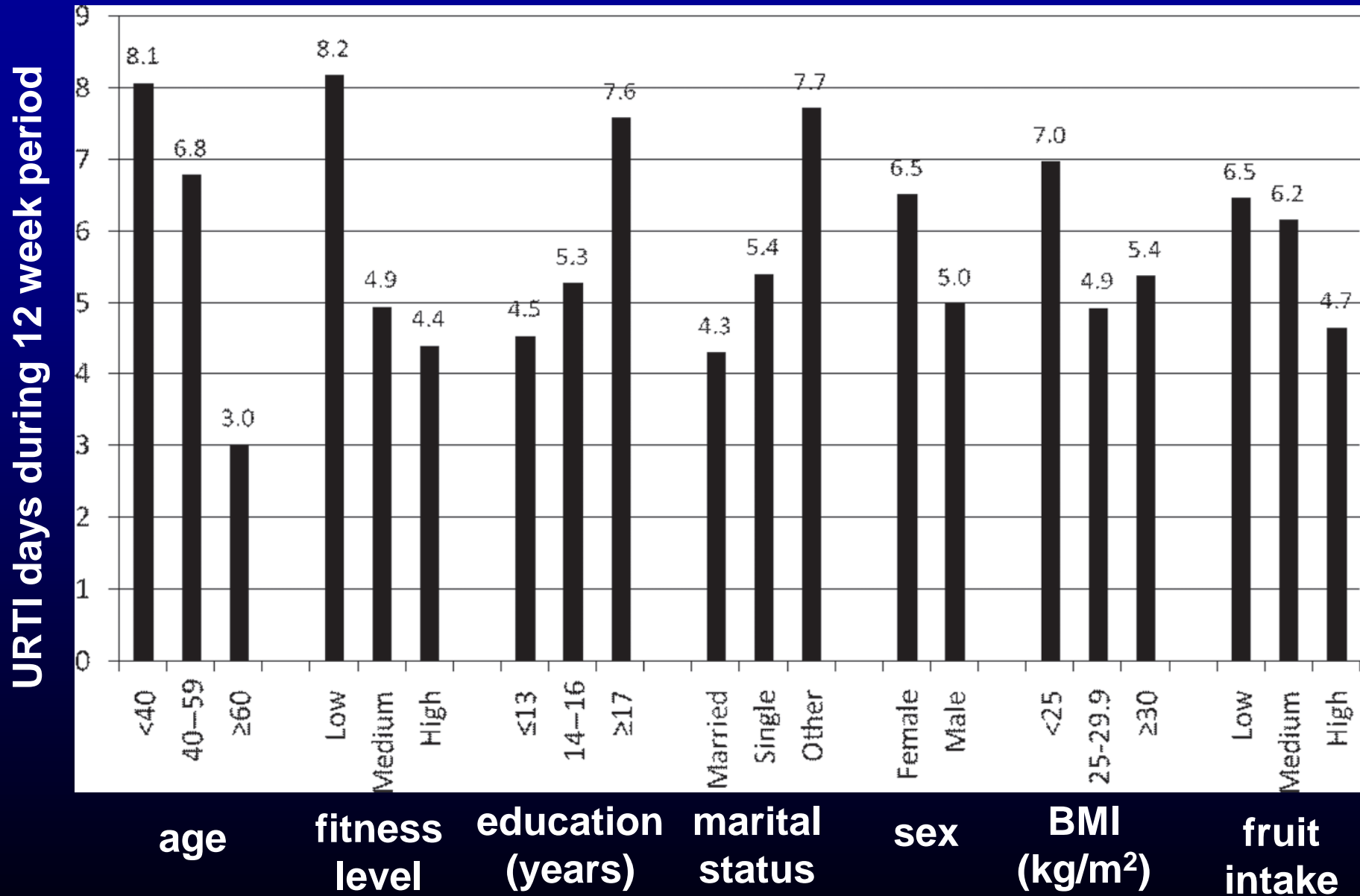
Nieman et al., Br J Sport Med 45(12):987-992, 2011

	Low activity (< 1 day/week) N=214	Medium activity (1-4 days/week) N=573	High activity (> 5 days/week) N=215
URTI total days	8.6	5.5*	4.9*
URTI severity score	18.2	11.5*	10.7*
URTI symptom score	93.9	63.7*	55.0*

* $P < 0.05$, compared with Low activity. Data adjusted for age, education, marital status, gender, stress level, BMI and fruit intake

Influence of other lifestyle factors

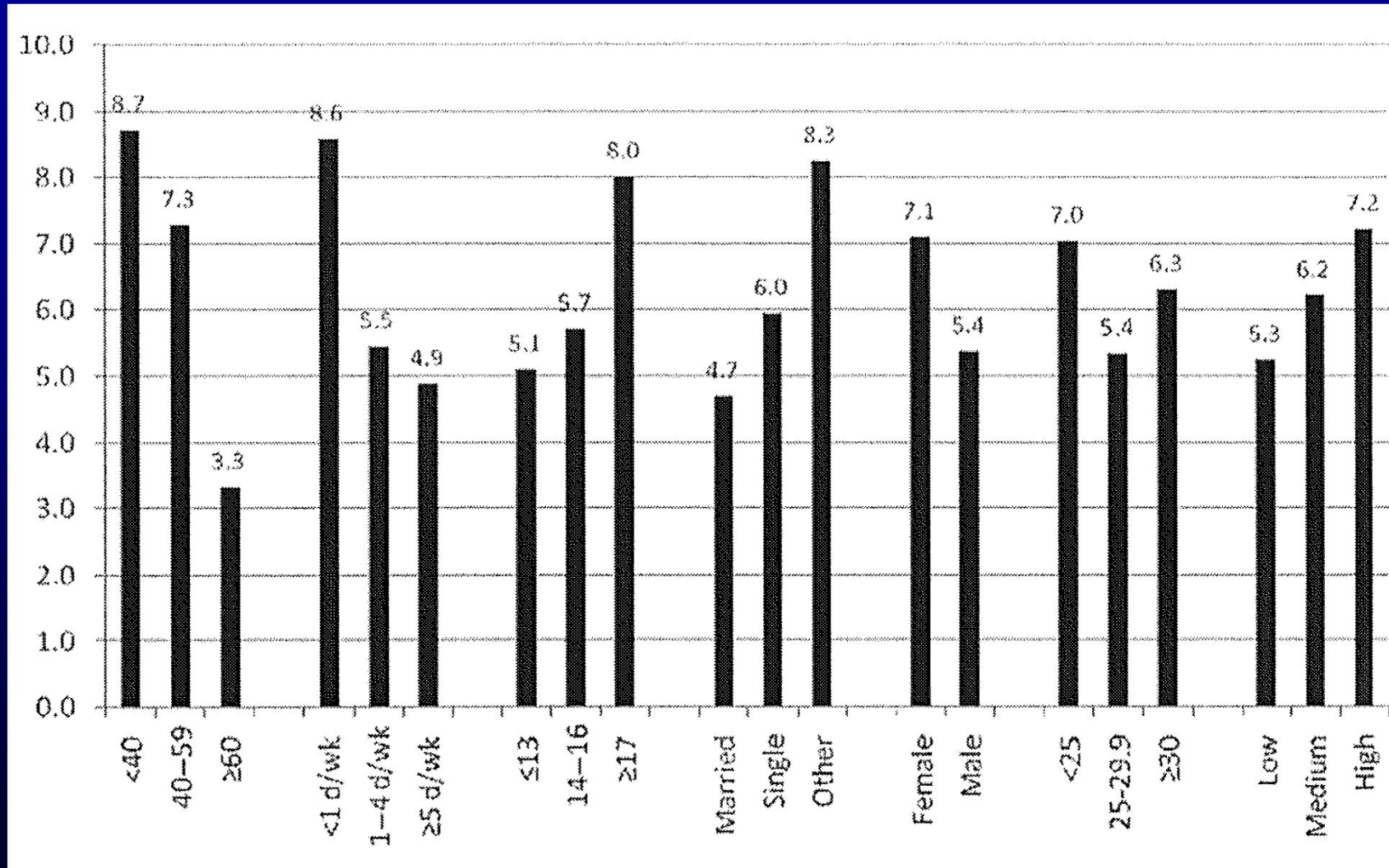
Nieman et al., *Br J Sport Med* 45(12):987-992, 2011



Influence of other lifestyle factors

Nieman et al., *Br J Sport Med* 45(12):987-992, 2011

URTI days during 12 week period



age

exercise
frequency

education
(years)

marital
status

sex

BMI
(kg/m²)

mental
stress

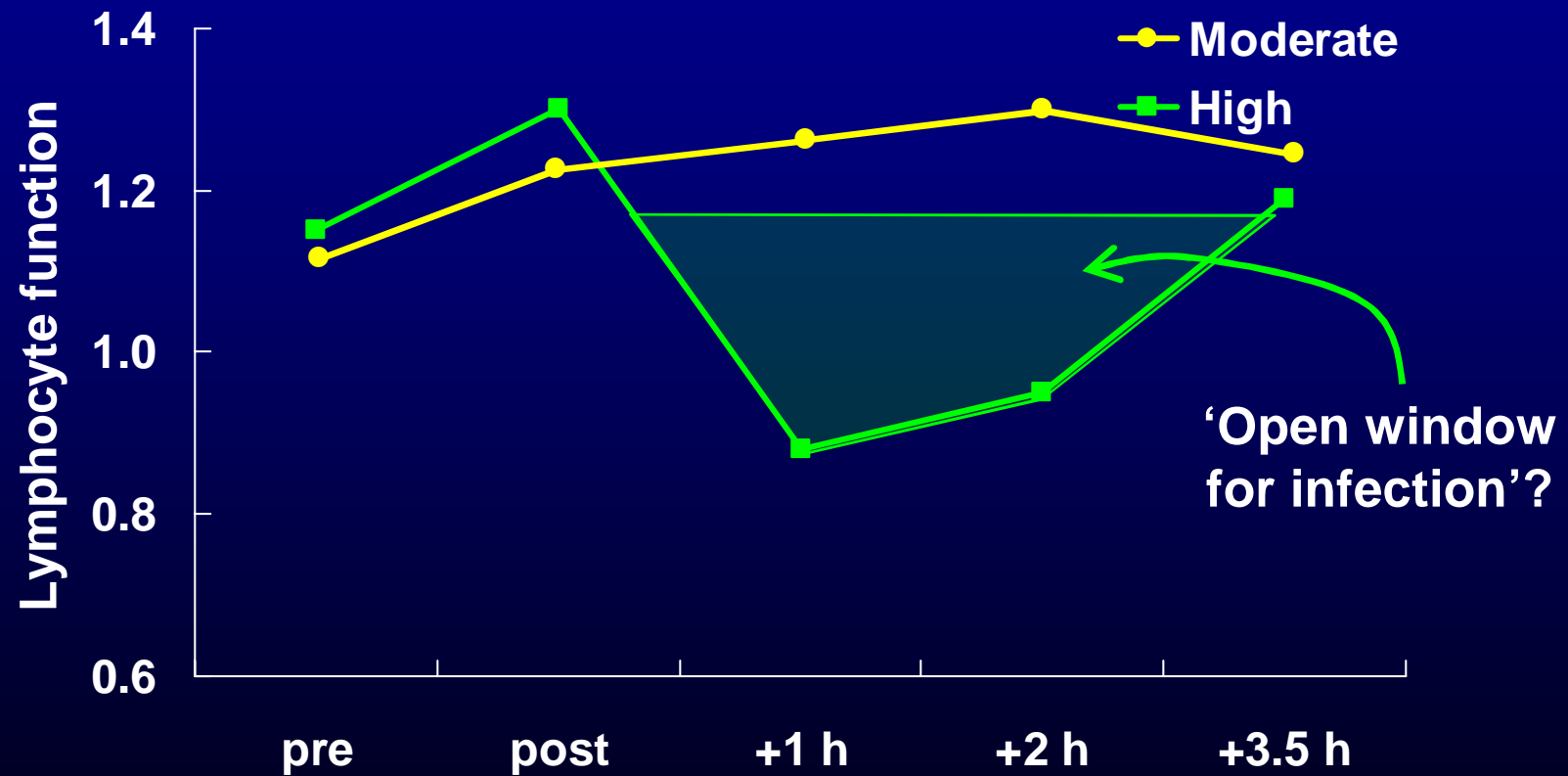
Why might moderate exercise be associated with a decreased risk of URTI?



Exercise and immune cell function

Nieman et al., 1994

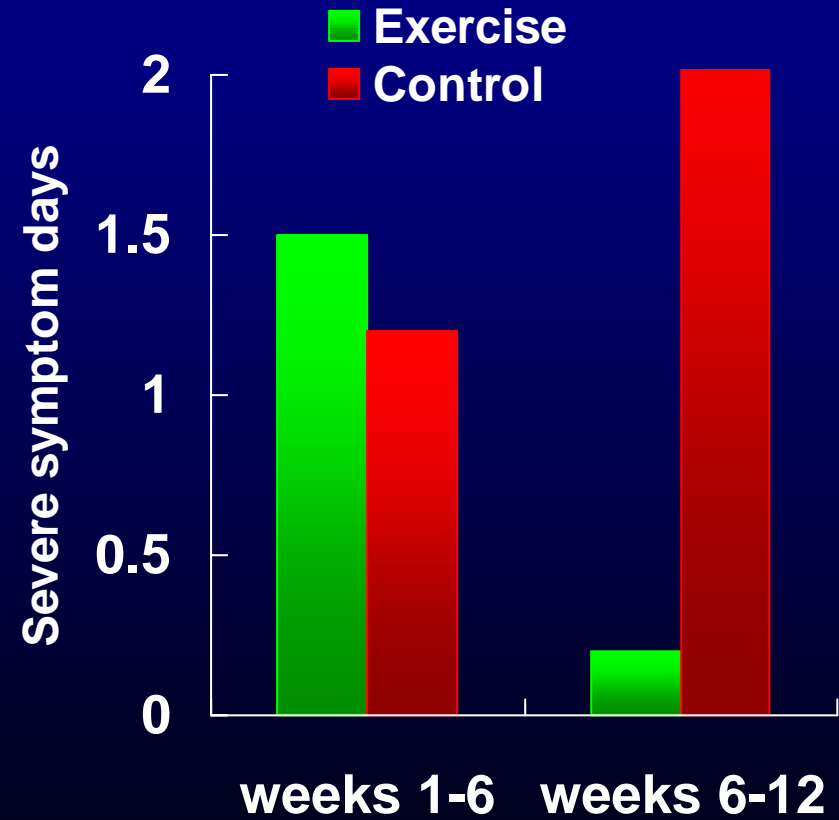
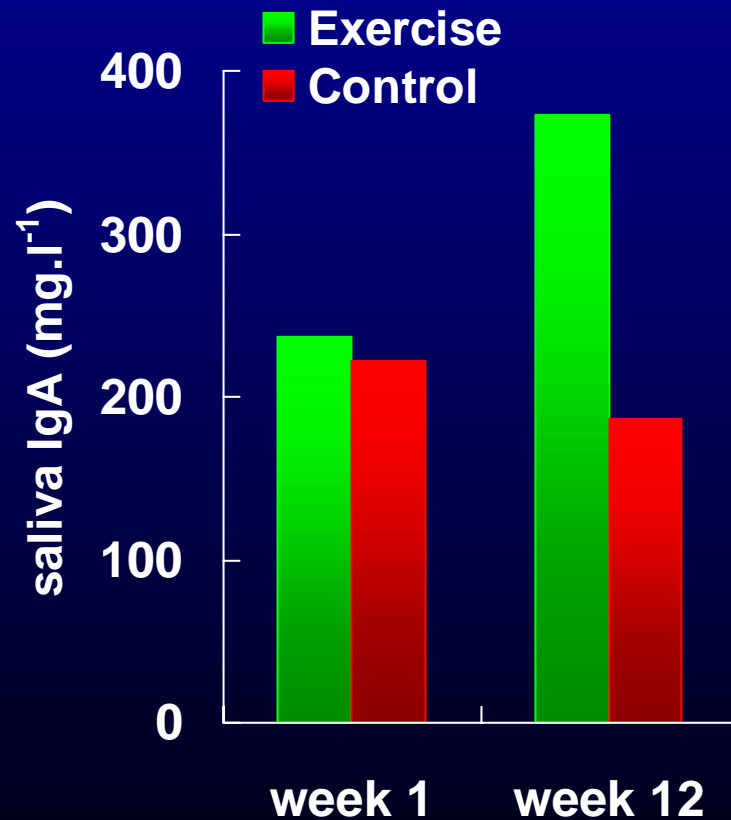
45 min at either 80% (high) or 50% (moderate) VO_2max



Regular moderate exercise, saliva IgA & URTI

Klentrou et al., Eur J Appl Physiol 87: 153-158, 2002

12 week training study (3 x 30 min sessions at 70% HR reserve)



Summary - Moderate exercise and infection risk

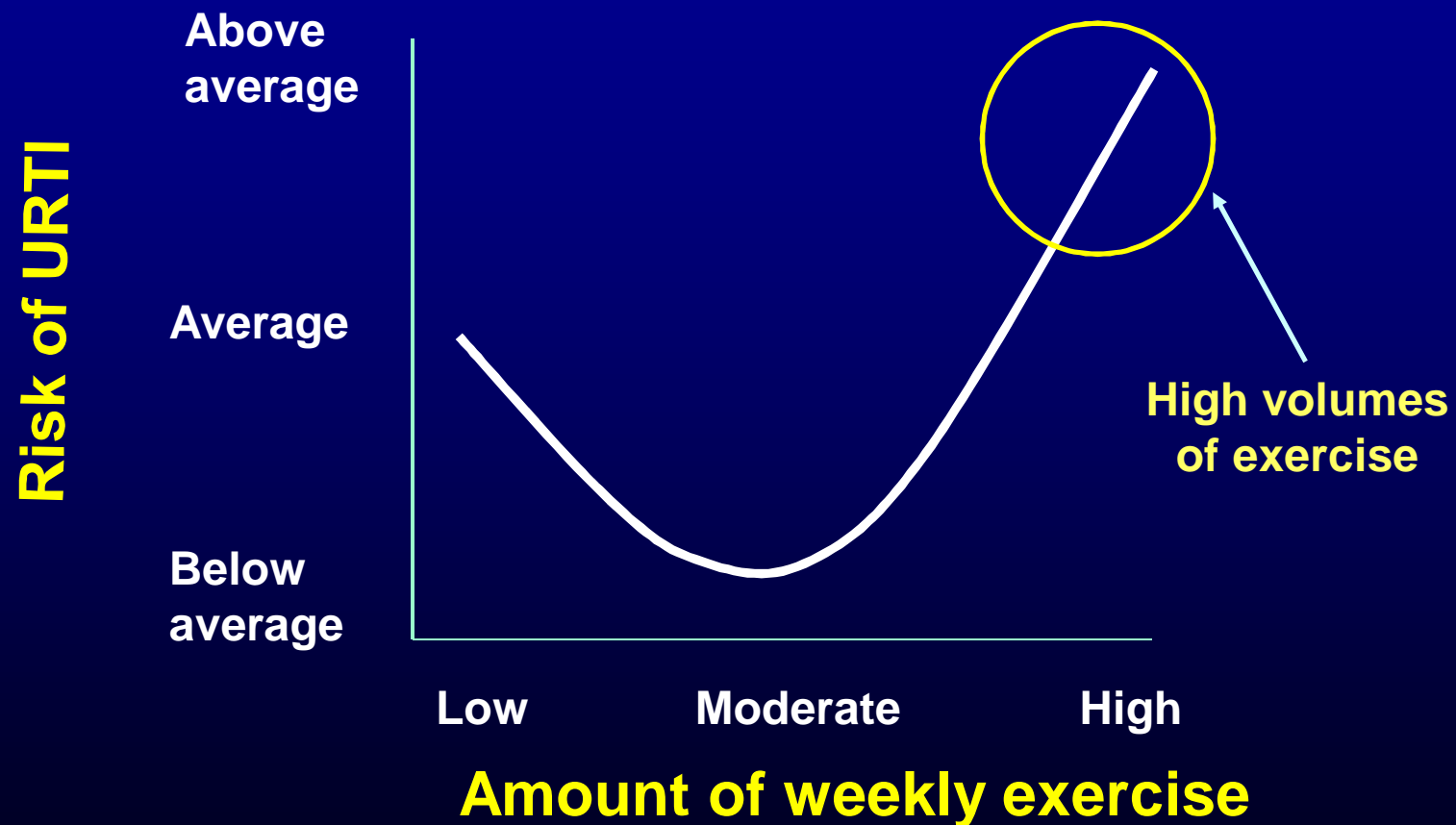
- J-shaped curve: Suggests that moderate exercise training is associated with a **lower than average** risk of URTI
- **Generally** supported by a number of epidemiological studies published to date
- To date, few studies report 'enhanced' immune function following acute moderate exercise, but **circulating leukocyte numbers increase** without functional suppression. Also, a programme of regular moderate exercise may be associated with **increased salivary IgA concentration and improved natural killer cell activity**
- **Other influences** need to be taken into account (e.g. improved nutrition, reduced psychological stress)

Heavy exercise and infection risk - anecdotal reports

- ***“...upper respiratory infections abound”***
 - *(Officials with the 1976 US Olympic Team)*
- ***“...those familiar coughs and colds”***
 - *(David Moorcroft, after setting the 5km WR in 1982)*
- ***“ I caught everything. I felt like I should have been living in a bubble”***
 - *(Alberto Salazar talking about how he caught 12 colds in 12 months when training for the 1984 Olympic Marathon)*

The 'J-shaped' model - revisited

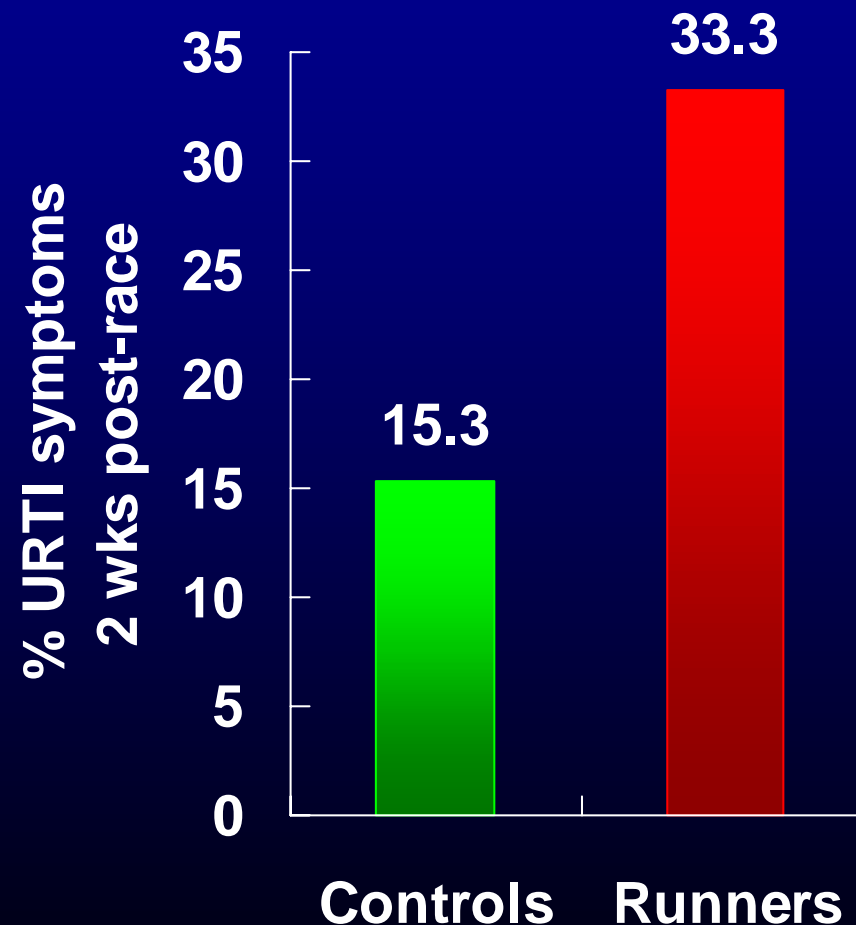
Nieman, Med Sci Sports Exerc 26: 128-139, 1994



Marathon running and self-reported URTI

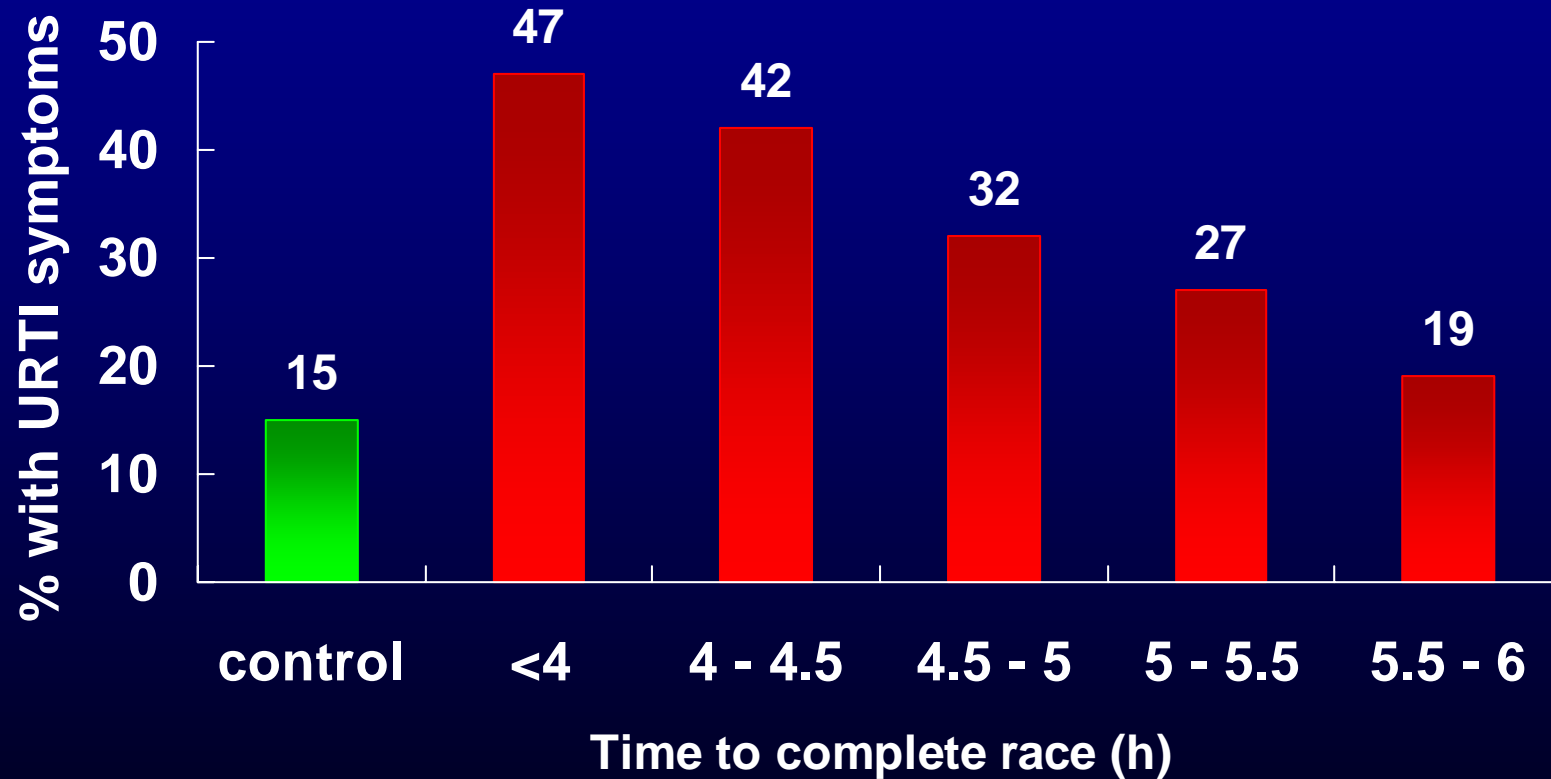
Peters and Bateman, S Afr Med J 64:582-584, 1983

- 140 runners **surveyed** before and 2 weeks after a 56 km ultramarathon
- Controls: age-matched non-runners living in the same household



Marathon running and self-reported URTI

Peters and Bateman, S Afr Med J 64:582-584, 1983

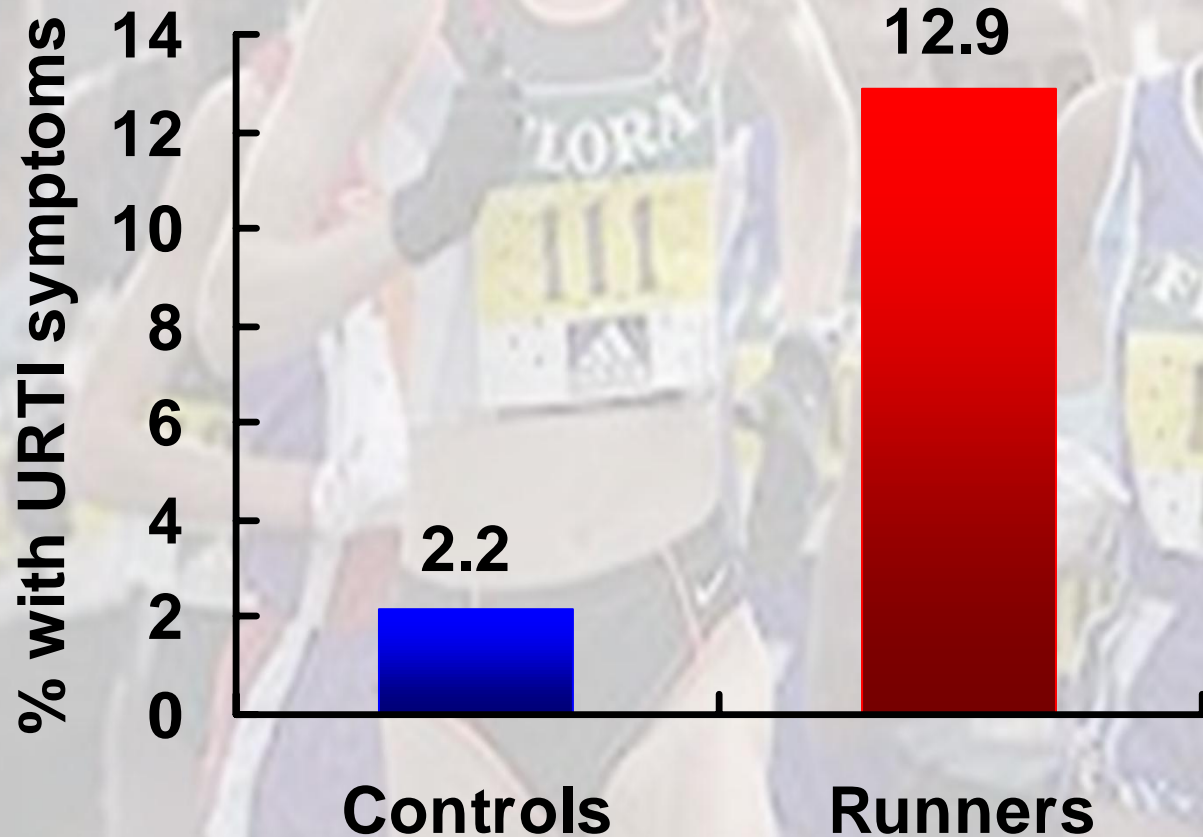


Higher URTI incidence in fastest runners (= highest training loads?)

Marathon running and self-reported URTI

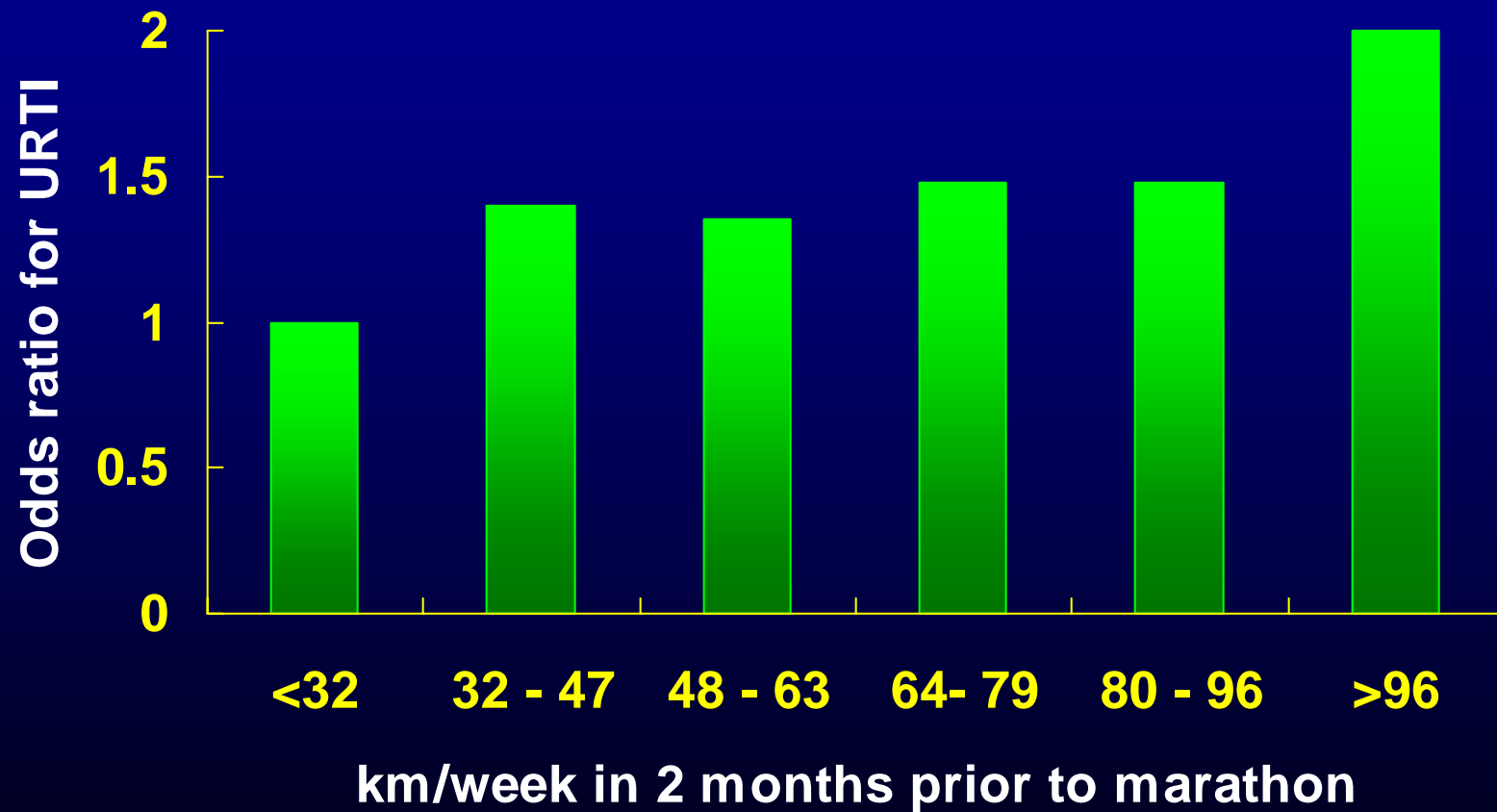
Nieman et al., *J Sports Med Phys Fitness* 30: 316-328, 1990

2,311 runners surveyed 1 week after the 1987 LA marathon



Training volume and URTI

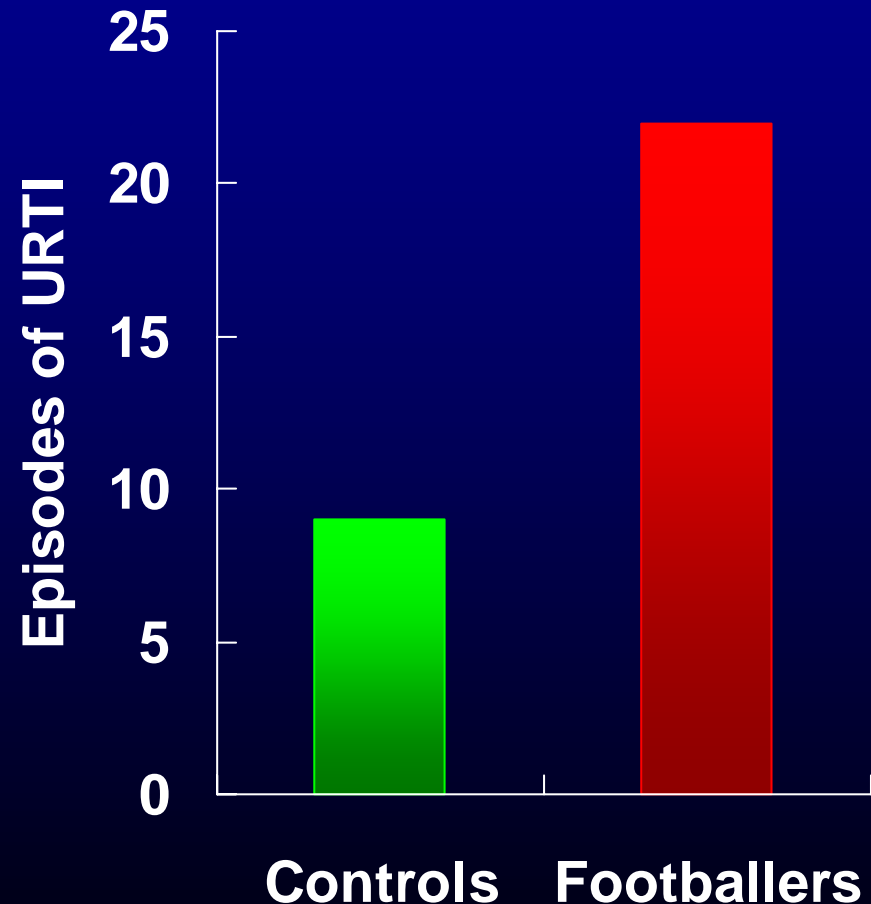
Nieman et al., J Sports Med Phys Fitness 30: 316-328, 1990



Football players and URTI

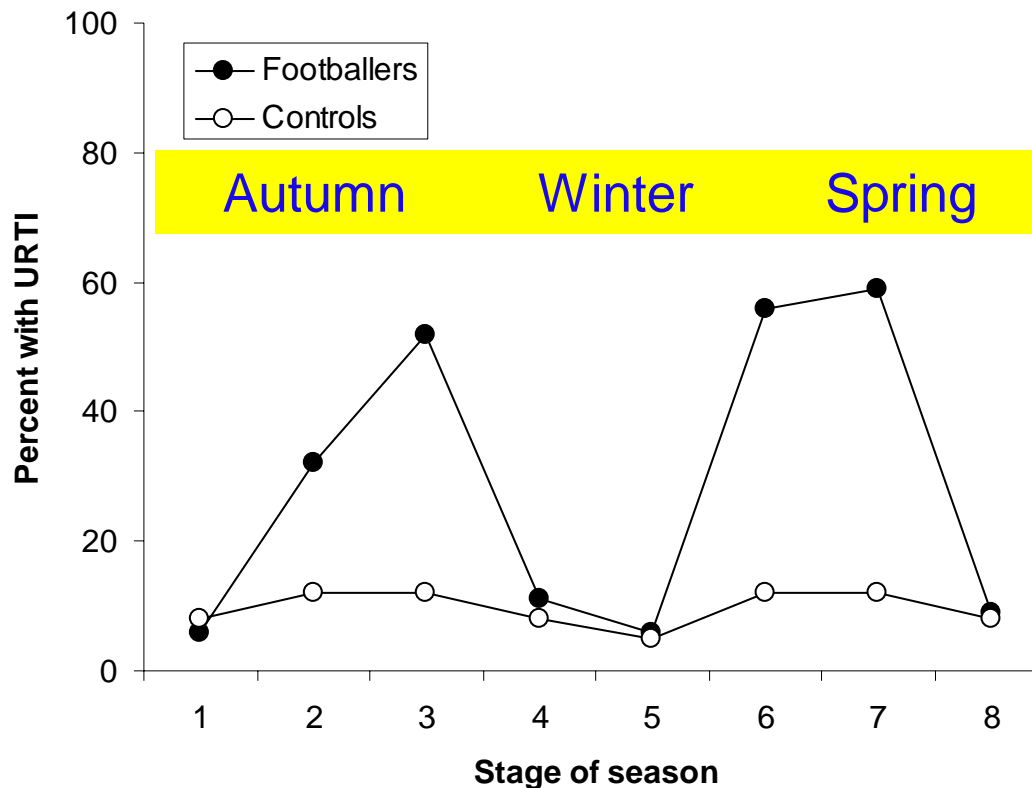
Bury et al. Int J Sports Med 19: 364-368, 1998

- Episodes of URTI over a season in a group of Belgian 1st division football players
- URTI was confirmed by medical diagnosis and serology
- 77% of episodes in footballers were diagnosed in winter
- Episodes of URTI also tended to last longer in the footballers



Mucosal IgA and URTI in American College Football Players: A Year Longitudinal Study

Fahlman & Engels. *Med Sci Sports Exerc* 37(3): 374-380, 2005



Why might heavy exercise be associated with increased risk of URTI?



Strenuous Exercise & Immune Function

Acute exercise

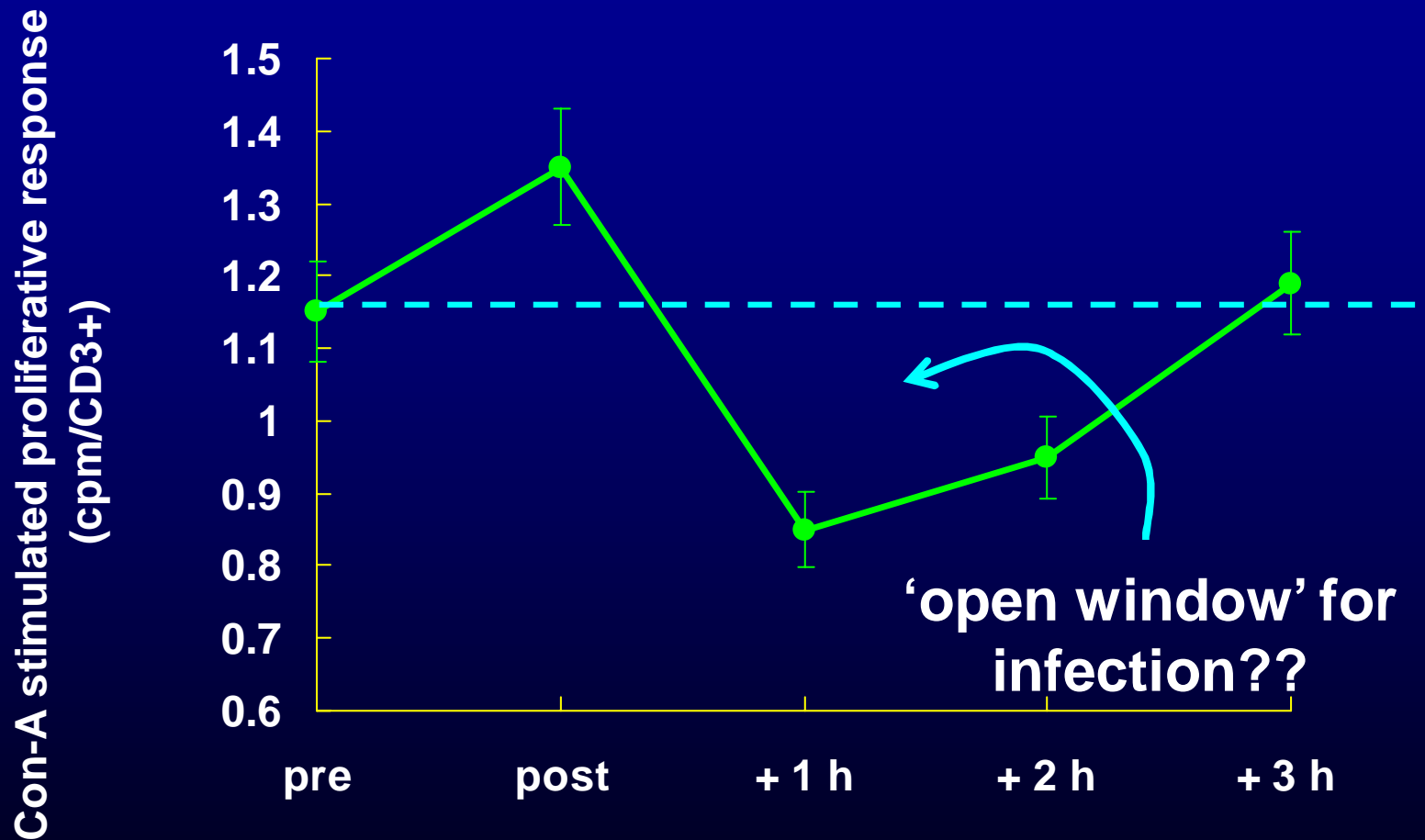
- Elevated white blood cell (leukocyte) counts
- But...Suppressed leukocyte function

Exercise training

- Lower resting leukocyte counts
- Decreased resting leukocyte function
- Suppressed antibody production

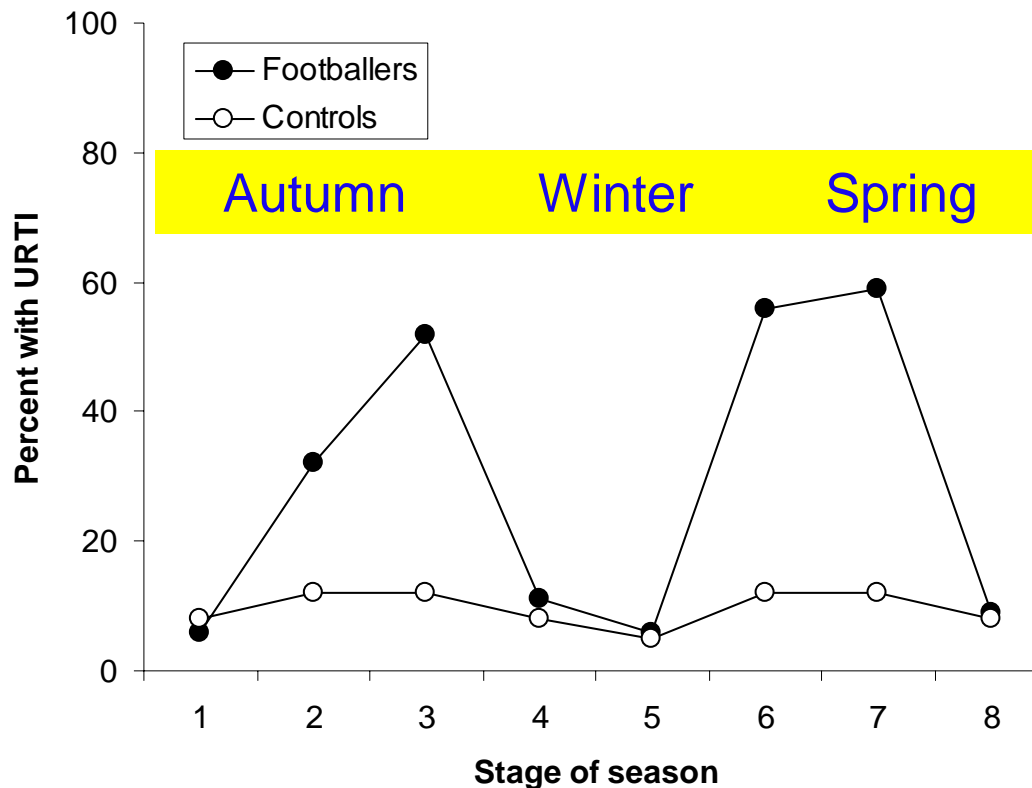
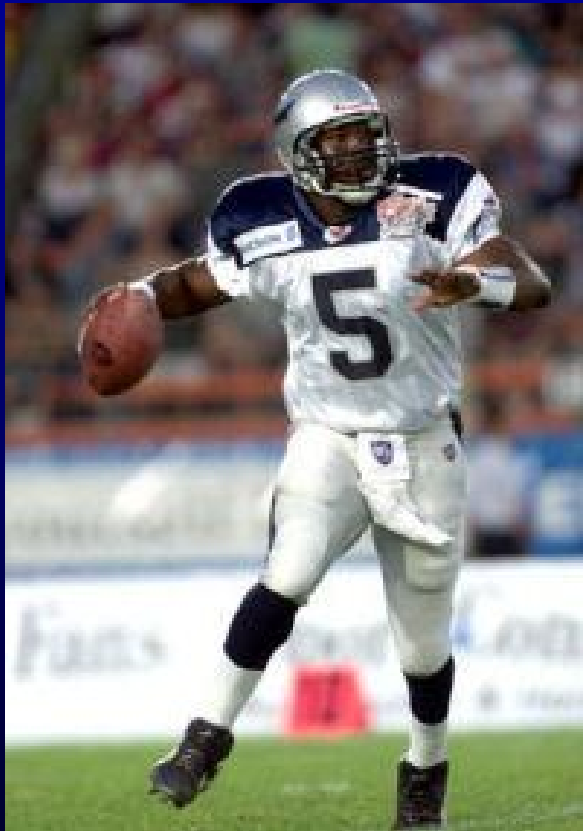
Acute intense exercise and stimulated T cell lymphocyte proliferative responses

Nieman et al., *Int. J. Sports med* 15: 199-206, 1994



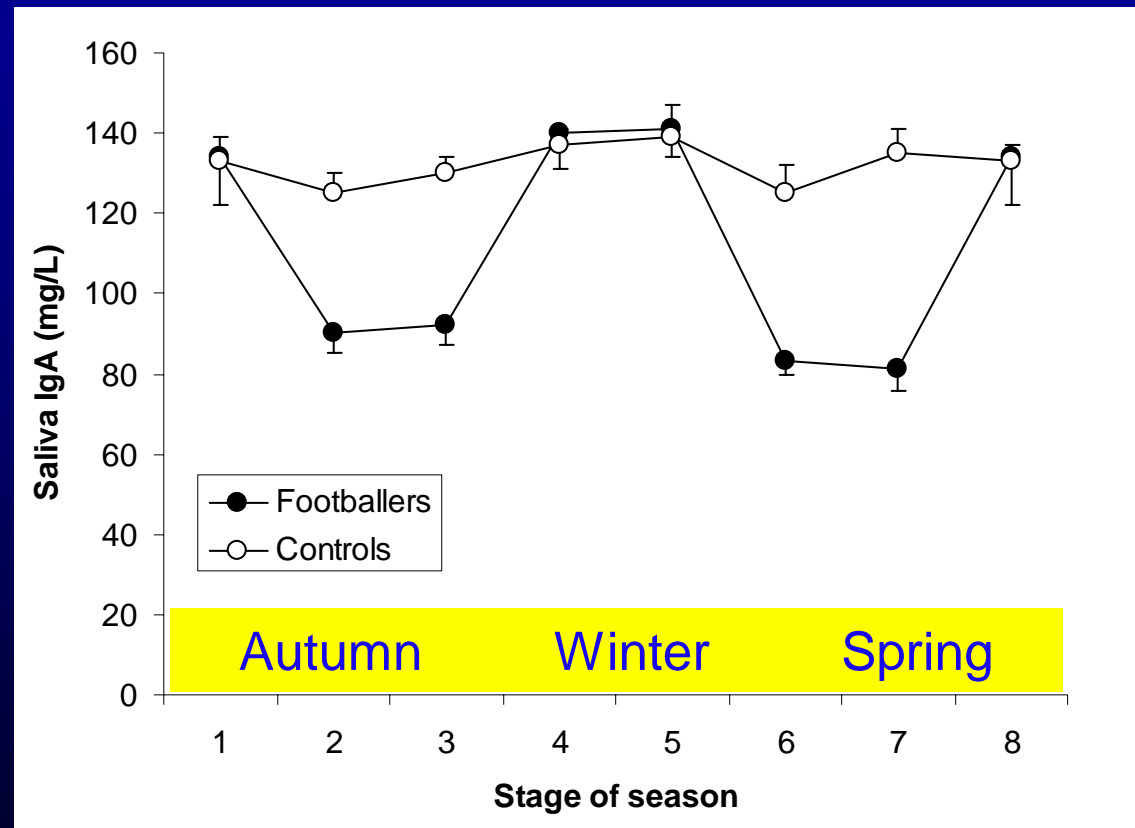
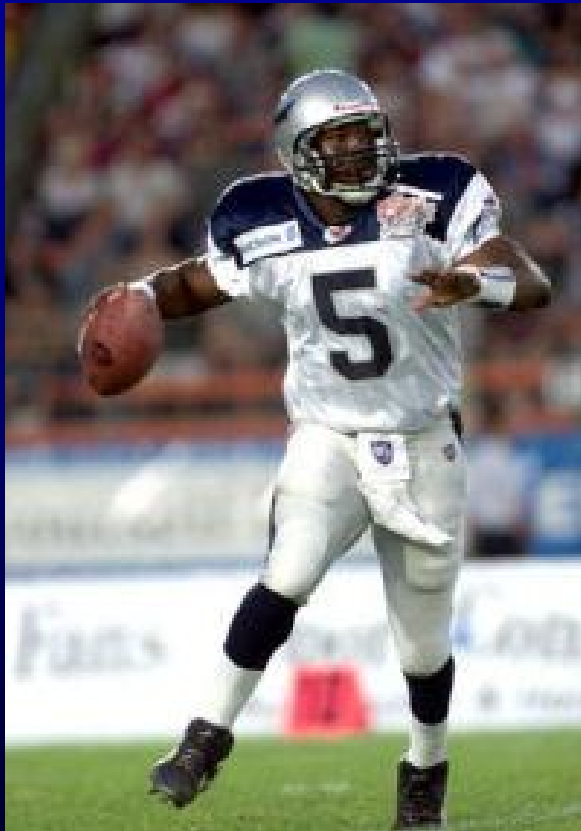
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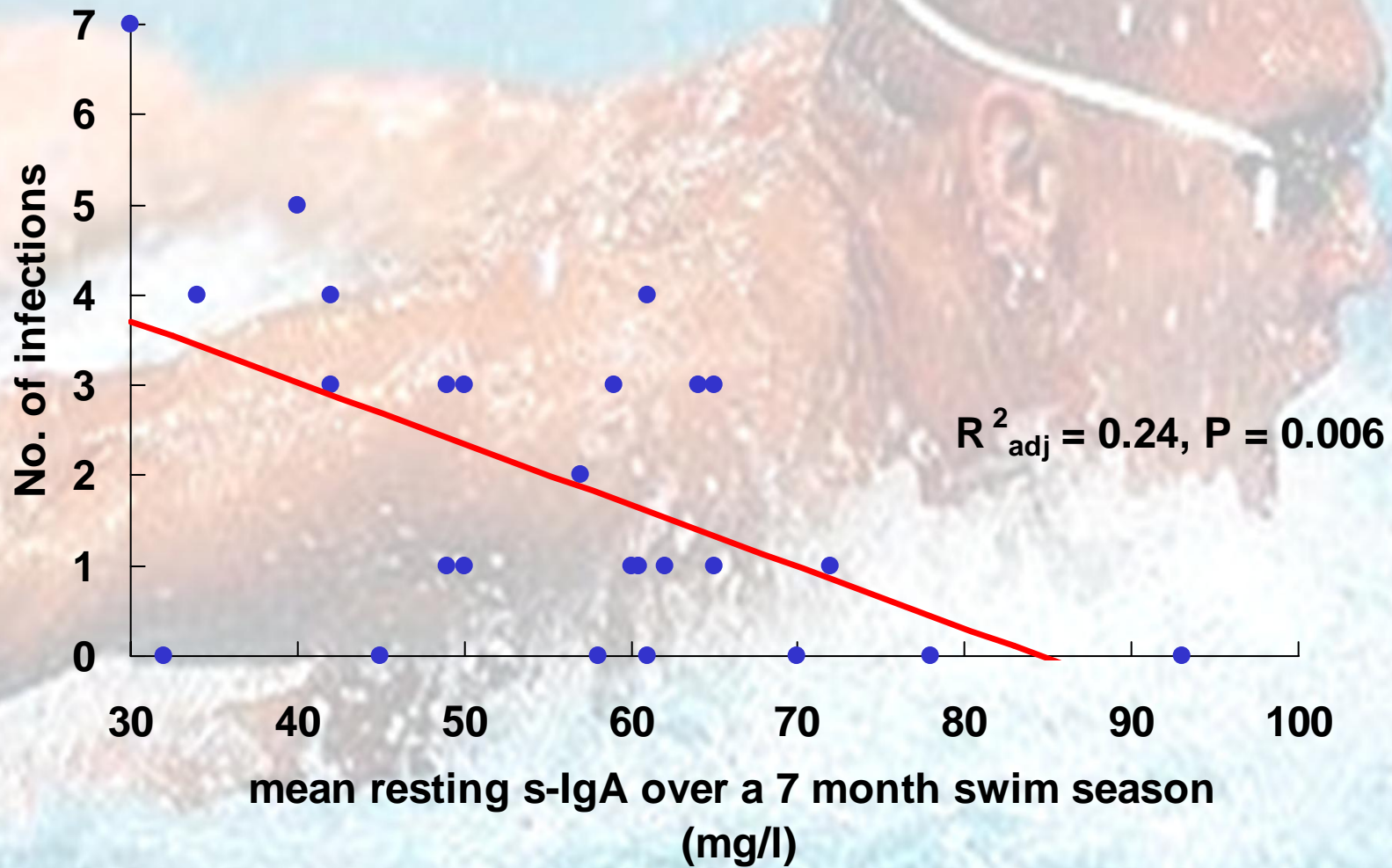
Mucosal IgA and URTI in American College Football Players: A Year Longitudinal Study

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Salivary-IgA and risk of URTI

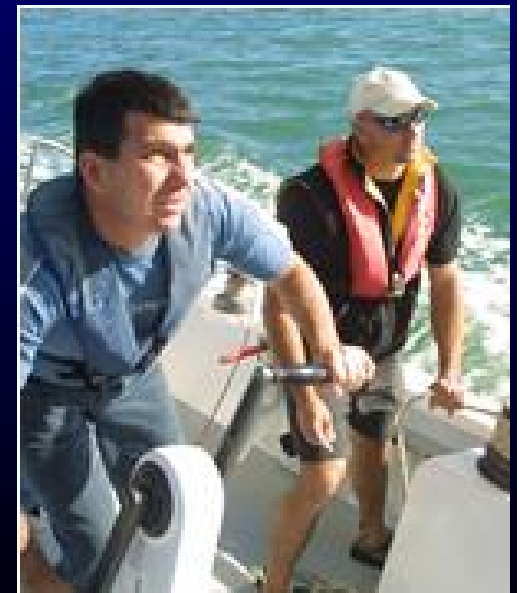
Gleeson et al., Med Sci Sports Exerc 31(1):67-73, 1999



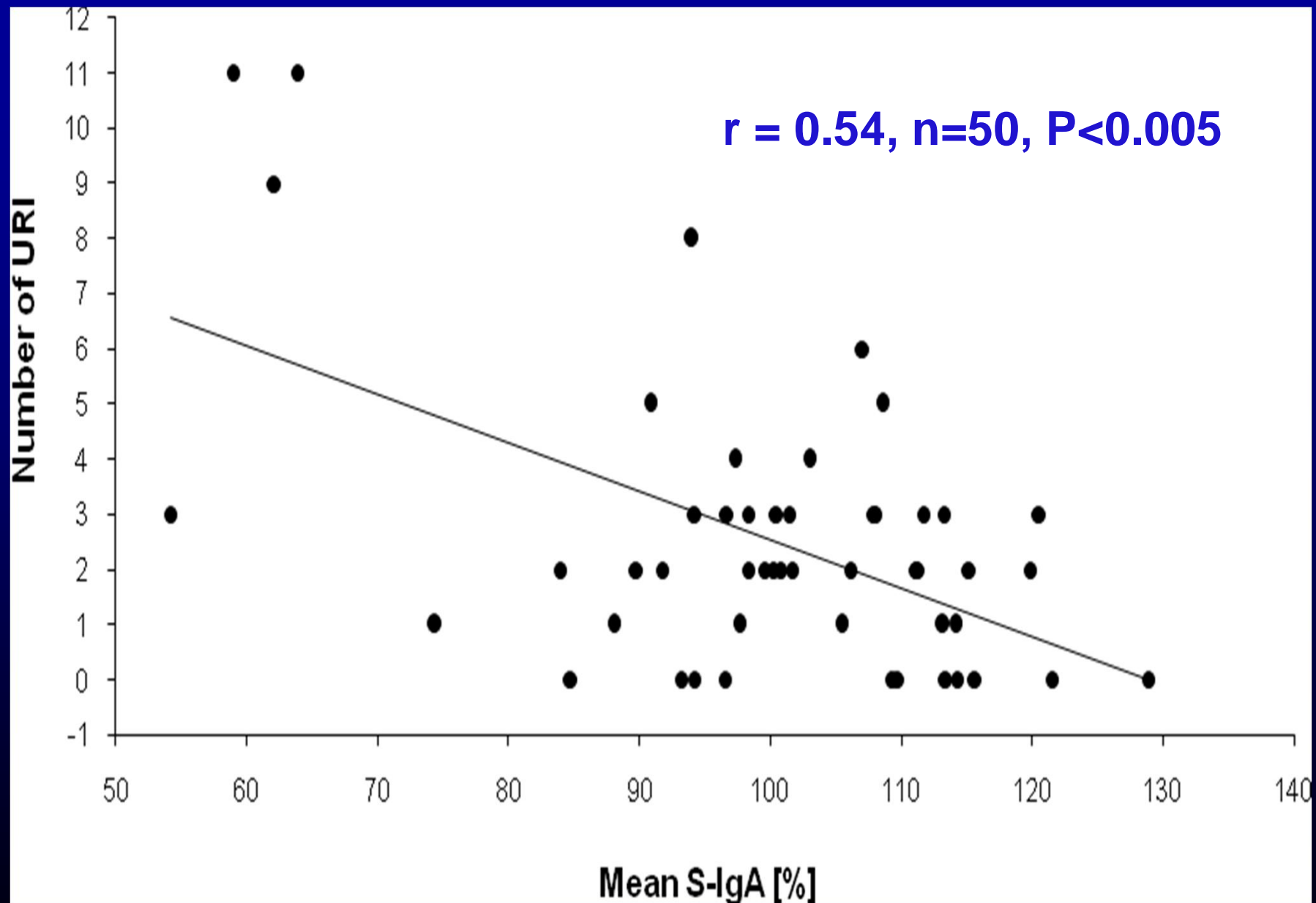
A longitudinal study of changes in s-IgA and respiratory illness in athletes

- 38 members of America's Cup yacht crew
- Studied over 50 weeks of training and sailing
- Morning saliva samples collected weekly
- Clinically confirmed illness

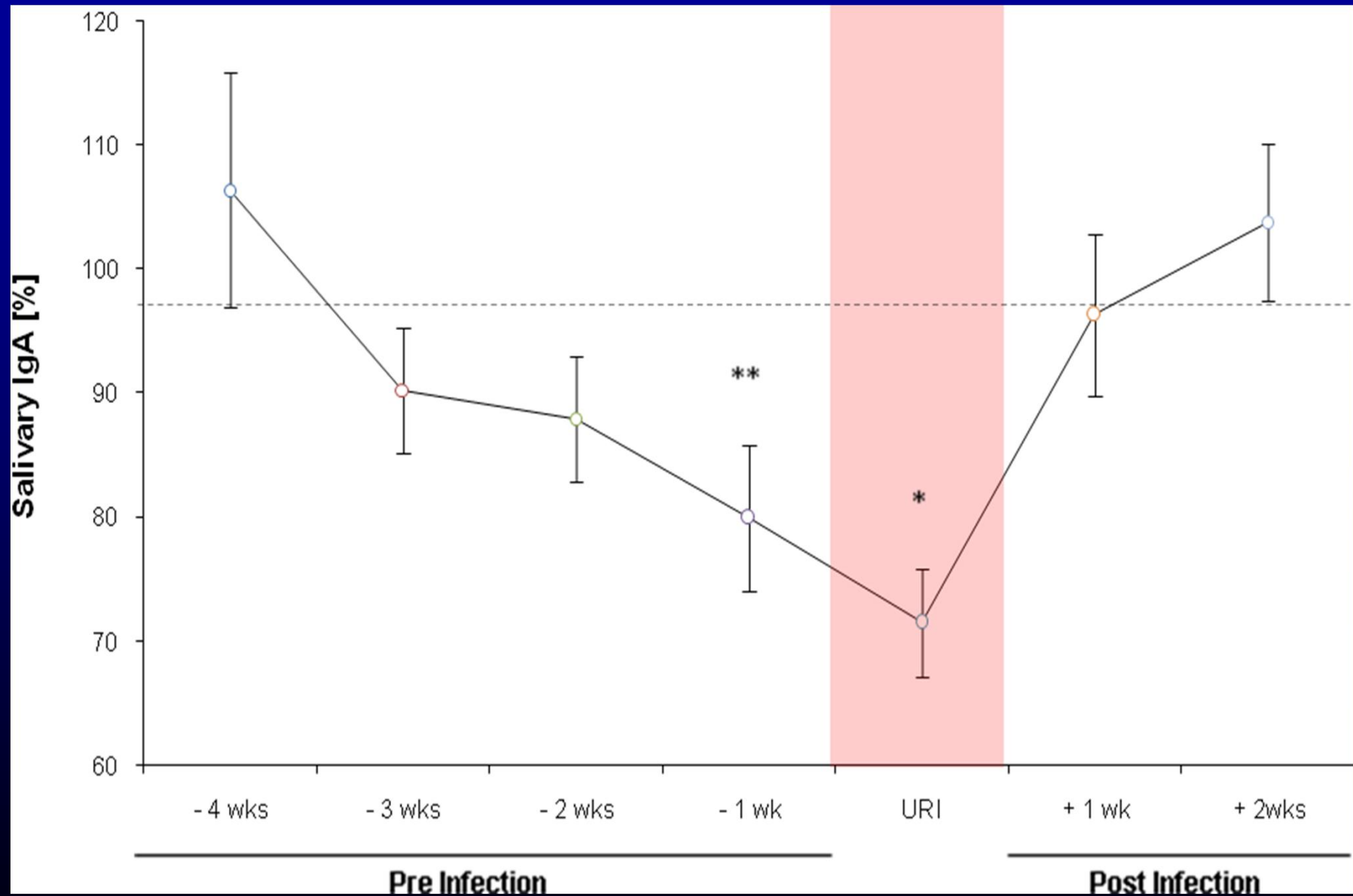
*Neville, Gleeson & Folland (2008)
Med Sci Sports Exerc 40(7):1228-1236*



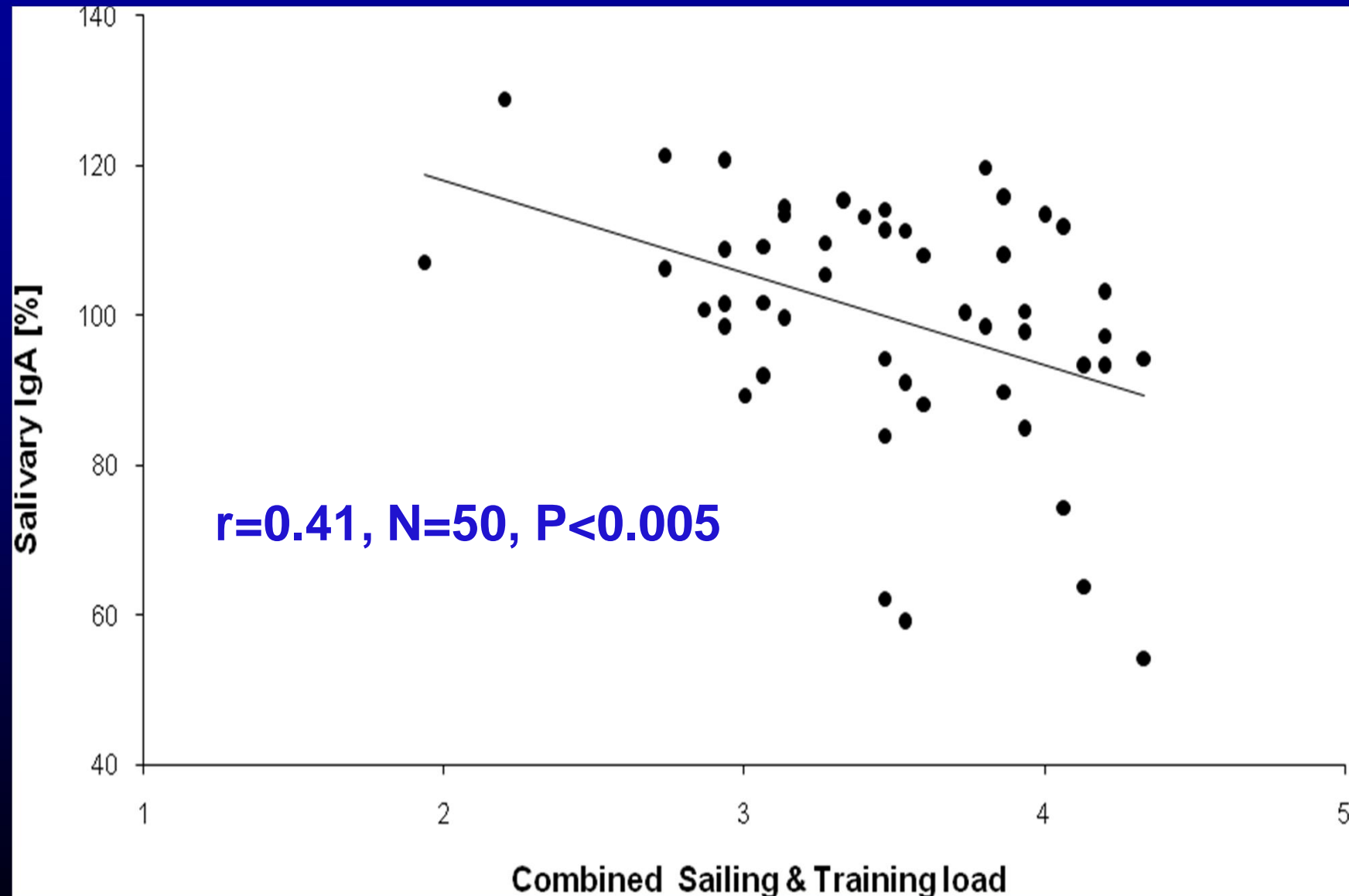
Relation between the weekly number of infections within the athlete cohort and their mean relative s-IgA



Relative s-IgA before and after an infection episode



Relationship between relative s-IgA and weekly combined sailing and training load



Other influencing factors?

- **A number of other factors which could influence infection risk in athletes have been suggested, including:**
 - Increased oral breathing
 - Psychological stress
 - Exposure to crowds
 - Pollution
 - Poor diet
 - Poor sleep
 - Frequent foreign travel
 - Insufficient recovery between training sessions



Summary - Heavy exercise and infection risk (1)

- J-shaped curve: Suggests that heavy exercise is associated with ***an above average risk of URTI***
- ***Supported*** by a number of epidemiological studies
- Susceptibility for URTI is related to both the ***intensity and duration*** of acute exercise and also ***training volume***

Summary - Heavy exercise and infection risk (2)

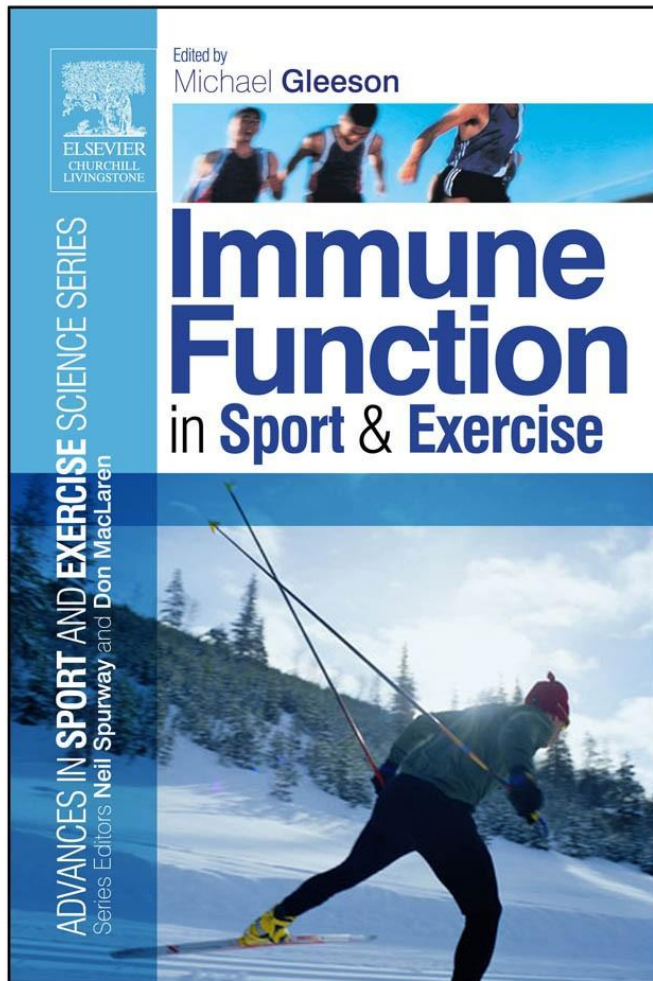
- Heavy schedules of training and competition are associated with ***depressed immune function***
- ***Direct evidence*** linking falls in immune function with increased infection risk is hard to obtain and other factors may also influence infection risk (N.B. exposure to pathogens)
- Keep in perspective! Hard training may mean a few more colds but is good for reducing risk of chronic metabolic and cardiovascular diseases!

Nutritional strategies to maintain immunity

- Ensure energy balance and adequate carbohydrate and protein intake
- Avoid micronutrient deficiencies (daily multivitamin tablet)
- Avoid dehydration and a dry mouth (drink plenty)
- Ingest carbohydrate during exercise (30-60 g/hour)
- High antioxidant intake (lots of fruit & veg)
- Dietary immunostimulants that *might* work for athletes:
 - Flavonoids/Polyphenols (about 1 g/day)
 - Vitamin C (500 – 1000 mg/day)
 - Probiotics (daily according to manufacturer's recommendation)

And...Nutrition is only one factor in illness prevention

Thank you for your attention



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