

How old can a firefighter be?

Effects of ageing on physical performance and consequences for (early) retirement

Annual Conference FireFit Steering Group, Loughborough, UK, 29th september 2011



**INNOVATION EXPERTS
FOR EMERGENCY RESPONDERS**

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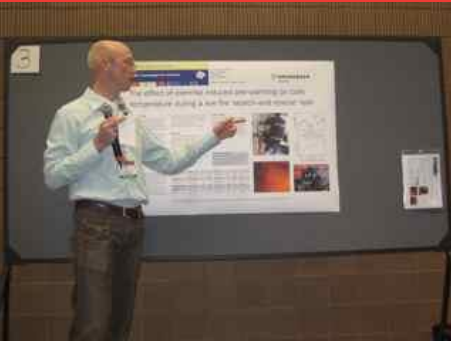


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What I would like to talk about:

1. Introduction;
2. Limiting factors to the physical performance of firefighters;
3. The role of ageing in relation to physical performance;
4. Is there health based support for (early) retirement based on firefighters' age?





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(Physical) performance of ‘First Responders’

- 1996 - 2006: research scientist / lecturer ‘Occupational Physiology’ and ‘Ergonomics’
 - Faculty of Human Movement Sciences, Vrije Universiteit, Amsterdam, The Netherlands
- 2006 - 2010: research scientist / project manager
 - TNO Defence, Security and Safety, Business Unit Human Factors, Soesterberg, The Netherlands
- 2010 - now: research consultant / owner
 - innovation eXperts for emergency Responders (iXeR.nl)
- Co-chair ‘Occupational Physiology Interest Group’
 - American College of Sports Medicine (ACSM)
- Visiting lecturer
 - Netherlands Institute for Physical Safety (NIFV) / Dutch Fire Academy





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Firefighting; general task characteristics

- Highly physically demanding tasks; equipment carry, stair climbing, dragging charged hoses, working in protective clothing, etc., etc. (a.o. Gledhill & Jamnik, 1992; Lusa *et al.*, 1993)
- Prolonged periods of low-intensity and occasional bouts of moderate to high-intensity efforts (a.o. Bos *et al.*, 2004)
- Strenuous work for periods of an unpredictable duration under conditions of high environmental heat strain (a.o. Smith *et al.*, 1997, Mol *et al.*, 2007)





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Firefighters; physical requirements to successfully complete these tasks

- High levels of contribution from both aerobic and anaerobic energy systems (a.o. Bilzon *et al.*, 2001)
- High levels of muscular strength and endurance
- High levels of cardiovascular and thermoregulatory strain due to a combination of strenuous work, protective clothing and high ambient temperatures (a.o. Cheung *et al.*, 2011)





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- **Cardiovascular**
 - Increased HR and BP, Decreased Stroke Volume
- **Hematological**
 - Decreased Plasma Volume, Hemoconcentration
- **Thermoregulatory**
 - Elevated Core Temperature, Dehydration
- **Respiratory**
 - Increased Breathing Rate and Oxygen Consumption
- **Metabolic**
 - High Oxygen Cost, Increased Lactate, Fatigue
- **Immune/Endocrine**
 - Increased Leukocytes and Hormones
- **Nervous**
 - Sympathetic Surge and Increased Adrenaline
- **Muscular**
 - Increased Oxygen Use and Heat Production



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Source: Smith, D.L., J.P. Liebig, N.M. Steward and P.C. Fehling; Sudden Cardiac Events in the Fire Service - Understanding the Cause and Mitigating the Risk, Skidmore College, Saratoga Springs NY, USA (2010)



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Limiting factors to physical performance in firefighting (i)

- Physical fitness
- (Underlying) illness
 - Cardiovascular disease (talk dr. James Bilzon)
- Ageing





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Firefighting

Physiological responses

Muscular/ ↔ Dehydration ↔ Heat Stress ↔ Cardiovascular Strain

- Metabolic fatigue
- HR, BP
- Blood clotting

Benefits of Physical Fitness

- ↑ Strength/Endurance
- ↓ Fatigue
- ↑ Plasma Volume
- Improved Thermo-regulation
- Tolerance for Higher Temperature
- ↑ Cardiovascular Capacity
- ↓ Risk of Clot Formation



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Limiting factors to physical performance in firefighting (ii)

- Physical fitness
- (Underlying) illness
 - Cardiovascular disease (talk dr. James Bilzon)
- Ageing





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Standard CVD risk factors for firefighters

- Current smoking
- Hypertension
- Obesity (BMI ≥ 30)
- Dyslipidemia (Cholesterol ≥ 200 ml/dL)
- Diabetes Mellitus
- Prior diagnosis of CHD (Coronary Heart Disease)
- Age (≥ 45 y/o)





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Limiting factors to physical performance in firefighting (iii)

- Physical fitness
- (Underlying) illness
 - Cardiovascular disease (talk dr. James Bilzon)
- Ageing



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Worth reading: Soteriades, E.S., D.L. Smith, A.J. Tsimenakis, D.M. Baur and S.N. Kales. Cardiovascular Disease in US Firefighters - A Systematic Review. *Cardiology in Review*, 19, 202-215 (2011)



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The role of ageing in relation to physical performance (i)

- Hundreds of peer-reviewed international scientific publications on firefighters
- Only 10% report on age-relevant issues
 - subjective ratings on workload
 - national figures about turn-outs or accidents
 - laboratory test findings from stress testing
 - functional test findings during simulations
 - physiological parameters during actual firefighting



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Source: Sluiter, J.K. and M.H.W. Frings-Dresen. What do we know about ageing at work? Evidence-based fitness for duty and health in fire fighters. *Ergonomics*, 50(11); 1897-1913 (2007)



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The role of ageing in relation to physical performance (ii)

- General tendencies
 - Objective workload of (Dutch) firefighters has increased in terms of number and nature of turn-outs (Bos *et al.*, 2004)
 - Task performance and capacities of ageing firefighters decrease with age
 - Increased duration of completion of simulated firefighting tasks (Sothman *et al.*, 1994)
 - Reduced aerobic capacity, bodily flexibility, muscular strength (Horowitz & Montgomery, 1993)
 - Reduced thermal tolerance and sweat production, increased susceptibility to heat injuries (Sykes, 2008)
 - Decreased postural balance (Punakallio *et al.*, 2004)





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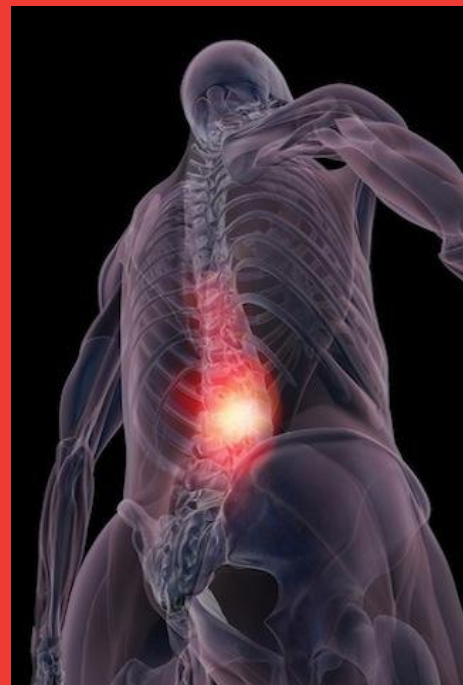
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Is there health based support for (early) retirement based on firefighters' age? (i)

- Based on Bos *et al.* (2004); workability of Dutch firefighters divided in 7 age cohorts (n=906)
 - <25 (n=29), 25-29 (n=123), 30-34 (n=207), 35-39 (n=140), 40-44 (n=97), 45-49 (n=121), >49 (n=191)
- Six-months prevalence of MSDs
 - neck, shoulders, arms, low back, knees and ankles
- Psychological complaints (% cases)
 - General fatigue, work-related fatigue, anxiety and depression

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Bos, J., E. Mol, B. Visser and M.H.W. Frings-Dresen. Risk of health complaints and disabilities among Dutch firefighters. *International Archives of Occupational and Environmental Health*, 77, 373-382 (2004)

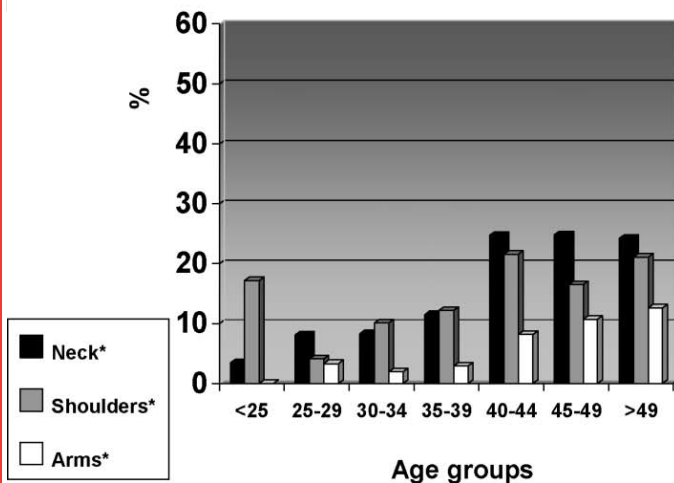




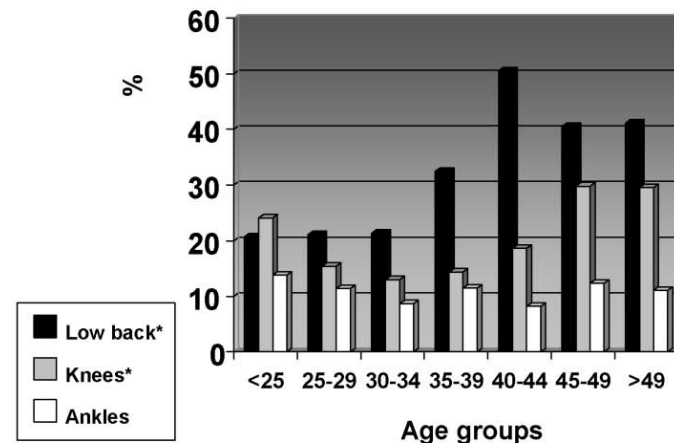
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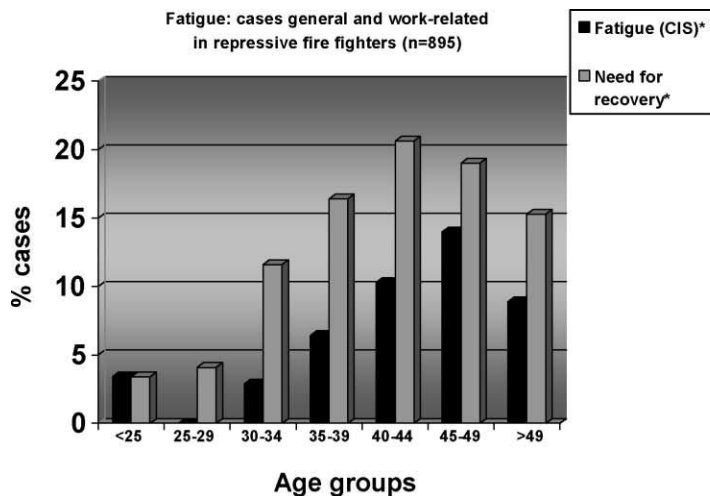
Prevalence MSDs repressive fire fighters (n=906)



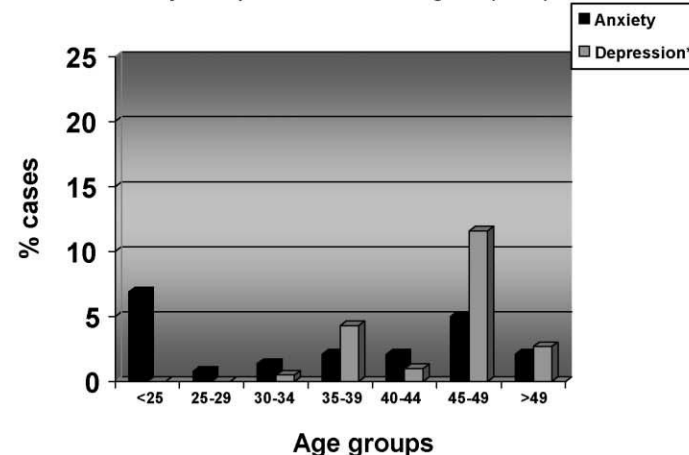
Prevalence MSDs repressive fire fighters (n=906)



Fatigue: cases general and work-related in repressive fire fighters (n=895)



Anxiety and depression: % cases fire fighters (n=908)





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Is there health based support for (early) retirement based on firefighters' age? (ii)

- MSDs show significant differences ($p < 0,01$) between age groups in all bodily regions, except for the ankle region
- Significant differences in the percentage of 'fatigued' and 'depressed' fire fighters were found between age groups
 - <35 y/o: 3-fold chance of suffering from 'work-related fatigue'



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Is there health based support for (early) retirement based on firefighters' age? (iii)

- Increase in work demands on all firefighters;
- Older firefighters experience higher emotional and mental demands (Sluiter & Frings-Dresen, 2004)
- Most indicators of 'fitness-for-duty' are related to age (Sluiter & Frings-Dresen, 2004)
 - Huge inter-individual variation between and within age groups in task performance and task related workload
- No age differences in lifting capacity (Rustenburg *et al.*, 2004)
- Higher risks of health complaints in older firefighters (Bos *et al.*, 2004)
- >49 y/o: 3-fold higher chance of sickness absence



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Age-related early retirement in Dutch firefighters; an historic perspective

- 1967: opinion-based ‘age limit’ for active firefighters
 - Task force ‘Funtioneel Leefstijdsontslag’ (‘functional early retirement’)
- Points of origin:
 1. Perceived exertion of job demands
 2. Decrease of functional capacity due to age



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So, since 1967 the early-retirement ages in The Netherlands were:

- Fire chiefs: 60 y/o
- ‘Higher’ fire officers: 55 y/o
- ‘Lower’ fire service personnel: 55 y/o

Is there an evidence-based age limit for (early) retirement of Dutch firefighters?

How old can a firefighter be?



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Conclusion (evidence-based)

- There is no absolute (health based) limit under the age of 60
- Older firefighters (>50 y/o) have a bigger chance on job related health complaints
- Health complaints are determined individually and may already occur from the age of 40
- There is a huge inter-individual variation between and within age groups in task performance, task related workload and concomitant occurrence of health complaints



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Early retirement of firefighters became a political issue

*‘Als u op of na 1/1/2006 een bezwarende functie vervult of gaat vervullen, bent u verplicht om **na 20 jaar** bezwarend werk een andere functie te vervullen’*

or, in English:

*‘If you started an aggravating function on or after January 1st, 2006, **after 20 years** of working in this aggravating function you will have to fullfill a different function’*



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So, what is next...? *-practical implications-*

- Job-specific workers health surveillance (WHS) for firefighters (Plat, 2011)
 - Worldwide use and effectiveness of job-specific WHS;
 - Good clinimetric quality of physical tests;
 - Signalling adverse health effects and high-risk groups;
 - Positive results for feasibility and acceptance.

Since January 2011, WHS has been implemented as a mandatory medical examination for Dutch firefighters

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Plat, M.-C..J. Occupational Health Care in High-Demand Jobs. PhD-dissertation, Academic Medical Center, University of Amsterdam, Dept. Coronel Institute of Occupational Health (2011)





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Thank you for your attention!



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