

# DEVELOPMENT AND APPLICATION OF A FITNESS TEST FOR FIRE FIGHTERS IN BELGIUM

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## INTRODUCTION

### Current Situation in Belgium

Legislation of 1971:  
necessity of good physical condition, and prescription of medical follow up and 8 physical tests  
code of good practice, not binding, no uniformity

2010:  
study ordered by Belgian Ministry of Internal Affairs:  
development of specific physical tests for fire fighters and providing of criteria

### Aim of the Study

Current physical fitness/ strength:  
test standards (recruitment and periodic evaluation)  
Relation physical fitness/ strength with:  
age, career, volunteer/professional/student,  
signal questions physical fitness/ strength.  
Relevance: are the tests considered functional/ relevant by experienced fire fighters?

### Study

Preparation:  
literature  
Belgian and European survey  
meeting of experts  
Organisation of field study:  
voluntary participants  
PAR-Q questionnaire  
physical tests  
relevance questionnaire

physical tests  
informed consent  
heart rate at rest  
recovery with heart rate monitoring

## POPULATION AND METHODS

### Test Population (149 persons were tested)

Fire Fighters	Students
Volunteers/Professionals	Secondary school, specialisation safety professions
No selection for years in the job or rank	14-22 year
8 Different brigades	3 schools
Voluntary participation	
80 participants - 3 women	69 participants - 12 women

### Description of the Test Population

	Mean	St Dev		Mean	St Dev		Mean	St Dev
Total Test Population (N=149)			Fire Fighters (N=80)			Students (N=69)		
Age	28	11,1	Age	35,6	9,9	Age	18,7	1,8
Height	179,3	7,6	Height	179,9	7,7	Height	178,5	7,4
Weight	76,1	11,6	Weight	79,7	11,3	Weight	71,6	10,5
BMI	23,6	2,9	BMI	24,1	2,9	BMI	21,9	2,6

### Physical Tests

Physical demand	Test
Strenght/Work above shoulder level	Pull up
Clamber/Climb	Clamber over a beam
Balance	Balance test on a beam
Bend/squat/kneel/creep	Squat run
Power endurance upper limbs	Push up
Drag/power endurance lower limbs	Dragging a 80kg rag
Push/pull/drag	Dragging a filled hose
Coordination/work above shoulder level	Collecting a hose
Energetic peak load	Stair run

### PAR-Q (Medical Questionnaire)

- Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
- Do you feel pain in your chest when you do physical activity?
- In the past month, have you had chest pain when you were not doing physical activity?
- Do you lose your balance because of dizziness or do you ever lose consciousness?
- Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?
- Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
- Do you know of any other reason why you should not do physical activity?

### Physical Tests - Fears

- Ladder test**
- 30m ladder on truck, extended, free under an angle of 70°
  - secured
  - climb up at steady pace
  - at the top wait for non verbal sign and call your name
  - descend at steady pace
- Tunnel test (not retained)**
- crawl through 10m, flexible PVC tube, Ø +/- 70cm on 35cm
  - at the middle, stop and wait for a sign to go on

### Physical Tests - Circuit

- "Resting heart rate"**
- Weight vest of 5 kg
  - Heart rate before and after every exercise
  - Each time: exercise for 1' and recover for 1'
  - Briefing during each recovery minute
  - After the tests: heart rate after 5' of recuperation

- Pull ups:**
  - 1'; as much as possible
  - pronation
- Clamber over a beam:**
  - as fast as possible; max. 1'
  - beam on 1.80m, go and return
- Balance on a beam**
  - as fast as possible; max. 1'
  - 3m to go, and return
- Squat run**
  - 8m to go and return; as fast as possible; max. 1'
  - knees in an angle of <90°
- Push up**
  - during 1'; as many times as possible
  - arms: from straightened to 90°
- Dragging a rag**
  - a rag with a load of 80 kg
  - 15m to go and return; as fast as possible; max. 1'
- Dragging a hose**
  - filled hose Ø 70mm/length 20m
  - 15m distance; as fast as possible; max. 1'
- Collecting a hose**
  - pull in a empty hose; Ø 45mm/length 30m
  - as fast as possible, max. 1'
- Stair run**
  - as fast as possible, max. 1'; step by step
  - 6 floors, 126 steps of 18cm high
  - (in practice: steps of 17cm (15-19) till 22,6m height)

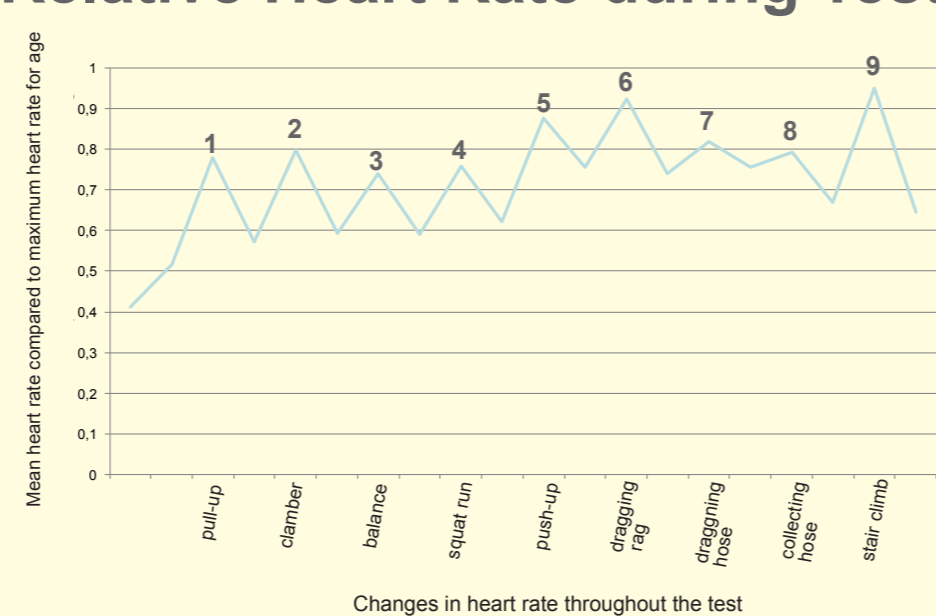


## RESULTS AND DISCUSSION

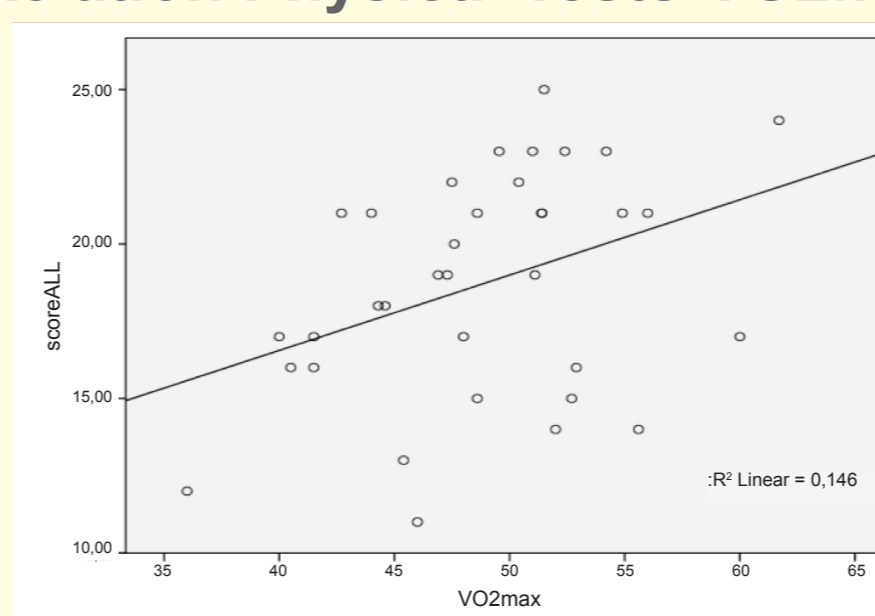
### Results Physical Tests Total Test Population

	Success(%)	Times	Time(sec)	SD
Pull up	88,6	7,1		5,2
Clamber	57		18,9	9,8
Balance	80,5		33,1	12,7
Squat run			17,3	5,3
Push up		33,7		12,8
Dragging a rag			28,5	10,2
Dragging a hose			8,8	3,8
Collecting a hose			16,1	3,9
Stair run			48,6	8,5

### Relative Heart Rate during Tests



### Relation Physical Tests-VO2max



### Score Relevance Physical Tests

	Mean	SD	Mode
Pull up	4,7	0,9	5
Clamber	4,7	1	5
Balance	4,8	0,8	5
Squat run	4,3	1,3	5
Push up	4,7	0,8	5
Dragging a rag	5,3	0,7	6
Dragging a hose	5,4	0,8	6
Collecting a hose	4,8	1,1	5
Stair run	5,5	0,6	6

from 1 (not all relevant) to 6 (completely relevant)

## CONCLUSION

### Conclusion

- The examined physical tests are found relevant
- After stair run heart rate was 94% of the max. HR
- Height/ weight are positively related to better results:
  - Height - clamber
  - Weight - dragging a rag/ a hose
- Age is negatively related to clamber/ stair run; strength (dragging) seems no problem
- Major difference between men and women in physical tests with strength component

### Minimal required psychological fitness at selection

- Ladder test is a valid "physical" test to evaluate fear of heights
- We found no good "physical" test for claustrophobia
- PAR-Q (physical activity readiness questionnaire)
  - is a valid questionnaire to evaluate risks to participate in strenuous physical tests
  - is not related to the actual results on the physical tests

### Minimal Required Physical Fitness

A. Physical tests: total score ≥ 8 based on success ratio of 75% of test population (>P25)

Score	-1	0	1	2	3	4
Pull up (times)	<2	≥2 -<4	>4 -<7	≥7 -<9	≥9 -<15	≥15
Clamber (sec)	/	failed	60->28	≤28 ->15	≤15 ->12	≤12
Balance (sec)	failed	60->52	<52->34	≤34 ->27	≤27 ->21	≤21
Squat run (sec)	60->21	≤21 ->19	<19 ->16	≤16 ->14	≤14 ->12	≤12
Push up (times)	<23	≥23 -<26	≥26 -<33	≥33 -<40	≥40 -<50	≥50
Dragging rag (sec)	60->33	≤33->31	≤31->27	≤27 ->23	≤23 ->20	≤20
Dragging hose (sec)	60->11	≤11->9	≤9 ->8	≤8 ->7	≤7 ->6	≤6
Collecting hose (sec)	60->19	≤19->18	≤18 ->16	≤16 ->14	≤14 ->12	≤12
Stair run (sec)	60->53	≤53->51	≤51 ->47	≤47 ->43	≤43 ->40	≤40

B. Coopertest: 12' running

Age	min.distance in m (men)	min.distance in m (women)
20-29	2400	2200
30-39	2300	2000
40-49	2100	1900
50-59	2000	1700

C. Swimming: certificate of (at least) 100m swimming

Physical tests OK + Coopertest OK + Swim certificate OK = physically fit for operational fire fighting

### Medical/Physical Follow Up in a Fire Fighter Career

#### Information

- Information to the candidate fire fighter
- PAR-Q questionnaire\*  
+ medical attestation by family physician (if needed, based on the PAR-Q)

#### Selection

- Physical fitness test\*

#### Entering the job

- Medical examination

- Psychological questionnaire\*

#### Formation

- Formation of recruits fire fighters

#### During operational fire fighter career

- Periodic medical check (1x/year)
- Periodic physical tests\* (1x/year)
- Periodic cardio respiratory exercise test (1x/5 years)
- Physical follow up\*

\* project IBZ