FIRE Trainer 2006

A Field Study

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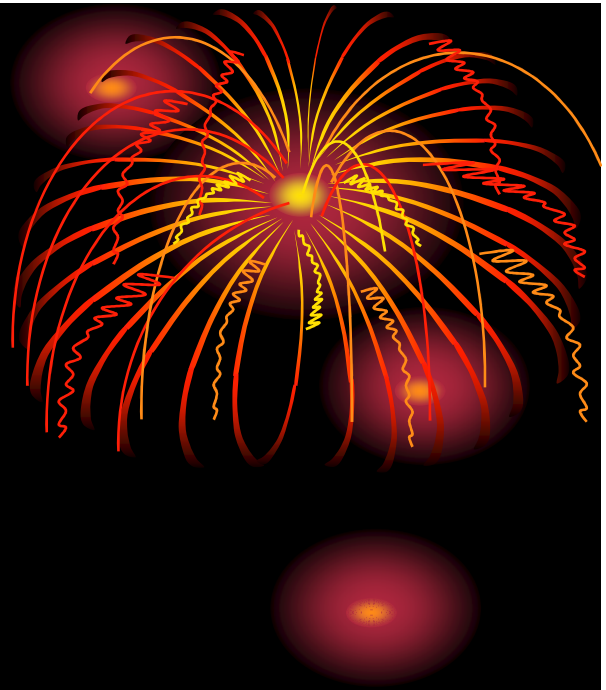
A Fieldstudy to Examine the Demands of the Firefighters

with no control group

Before and 10 mts after the exercise the following parameters were measured:

Study Design



- RR (Blood pressure)
- Blood sugar
- Stress hormones
- ECG
- FEV_1 (Lung function)
- SpO_2 (peripheral oxygen saturation)
- Body weight
- Core temperature

Study Design

During the exercise the following parameters were taken telemetrically:

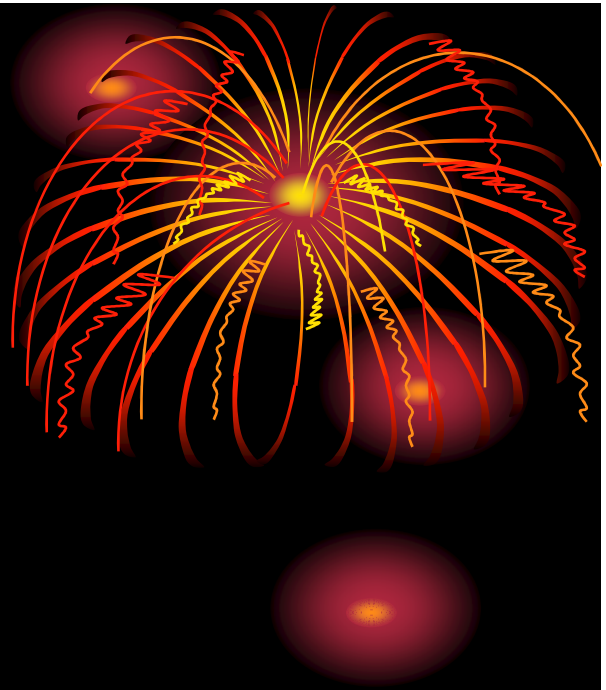
- **Blood pressure**
- **Oxygen saturation**
- **Heart rate**

Requirements to take part in the study

- Ergometry in last 12 months 100% performance
- Normal blood pressure

  (under therapy)
- Normal lung function
- BMI < 30 – 31
- No acute infection

ANAMNESIS



- Past infections
- Smoking habits
- Drinking habits

PREPARATION

- No nil by mouth (no fasting)
- Consumption of ½ liter of water
- Empty bladder
- Wear protective trousers and boots
- Naked from waist up
- Anamnesis

PARTICIPANTS

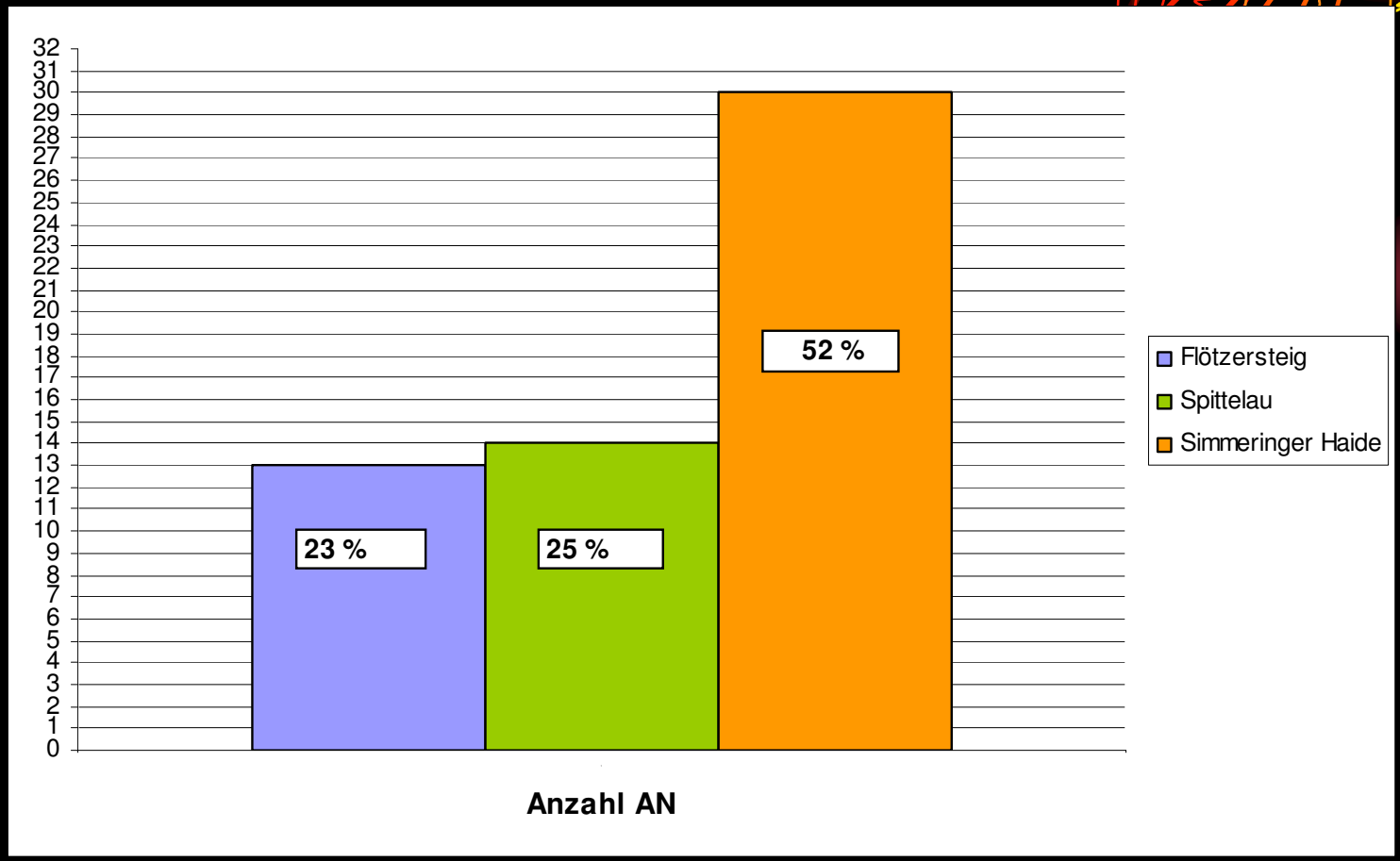
112 employees registered

However:
Only 57 took part
Which equals 51%

REASONS for DECLINING

9%	Vacation
11%	Illness
6%	Other medical reasons
13%	So called private reasons
11%	Not allowed
50%	No apparent reason given

PARTICIPANTS



Participants and Refusers

A quick look showed no difference.

BUT:

It is perfectly clear that refusers show abnormal findings.

HOWEVER:

The group with the risk of high blood pressure was relatively high.

INITIAL POSITION 1

AGE:

mean	=	38,5 yrs
Min.		22 yrs
Max.		60 yrs

HEIGHT:

mean	=	179 cm
Min.		153 cm
Max.		194 cm

INITIAL POSITION 2

WEIGHT:

mean	=	84,9 kg
Min.		55 kg
Max.		129 kg

BODY MASS INDEX:

mean	=	26,4
Min.		21
Max.		31

INITIAL POSITION 2a

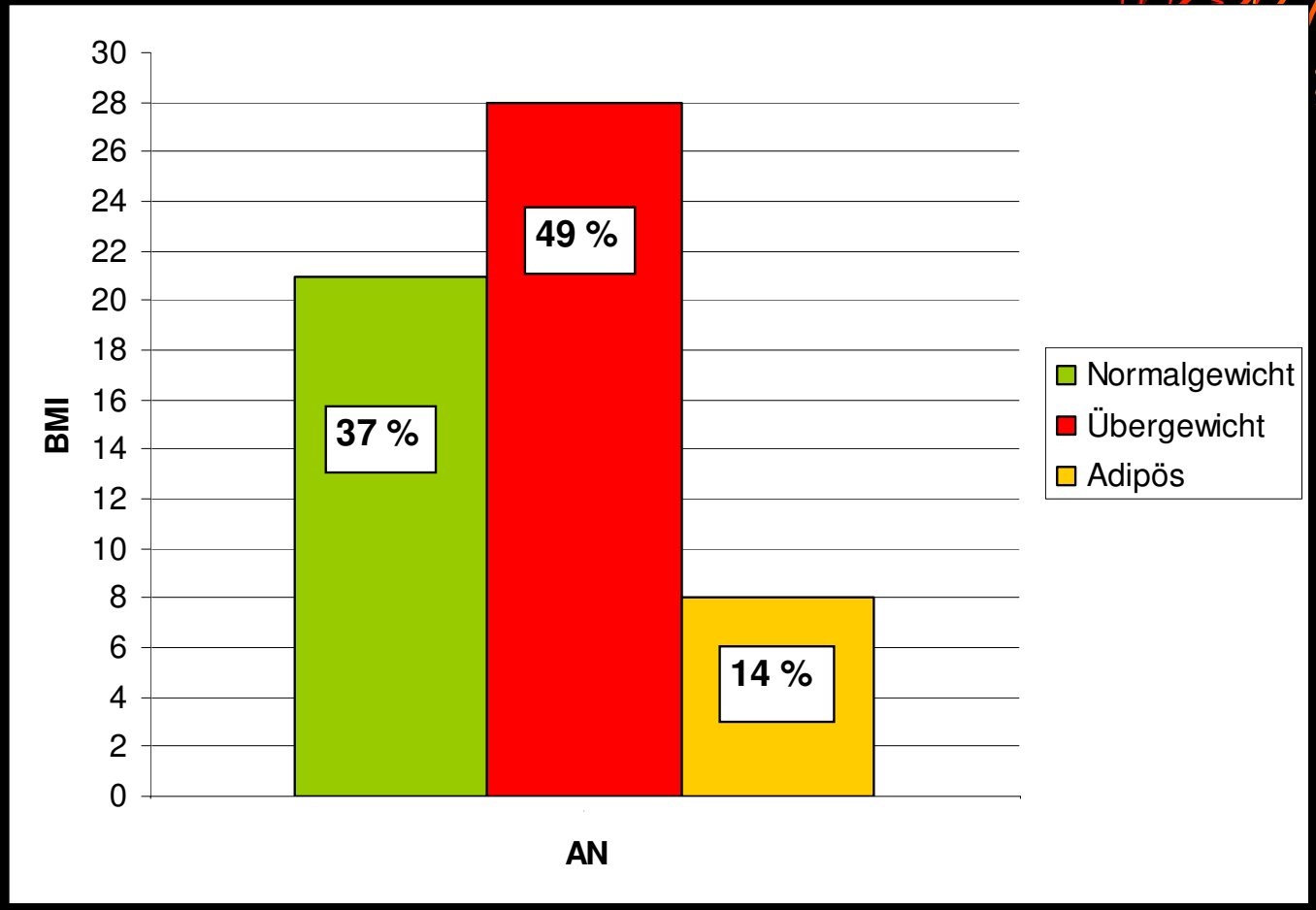
63% were overweight

14% of these were extremly overweight

BUT:

Only a measurement of fold fat can show how much of the weight derives from muscles.

BMI


30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
BMI
37 %
49 %
14 %
AN
Normalgewicht
Übergewicht
Adipös

INITIAL POSITION 3

ERGOMETRY:

Mean of the group during last ergometry*

	=	109,1%
Min.	=	83 %
Max.	=	135 %

42% of employees reached > 110 %

* According to the Austrian Society of Cardiology

INITIAL POSITION 4

SMOKING HABITS:

Smokers: 39% participants

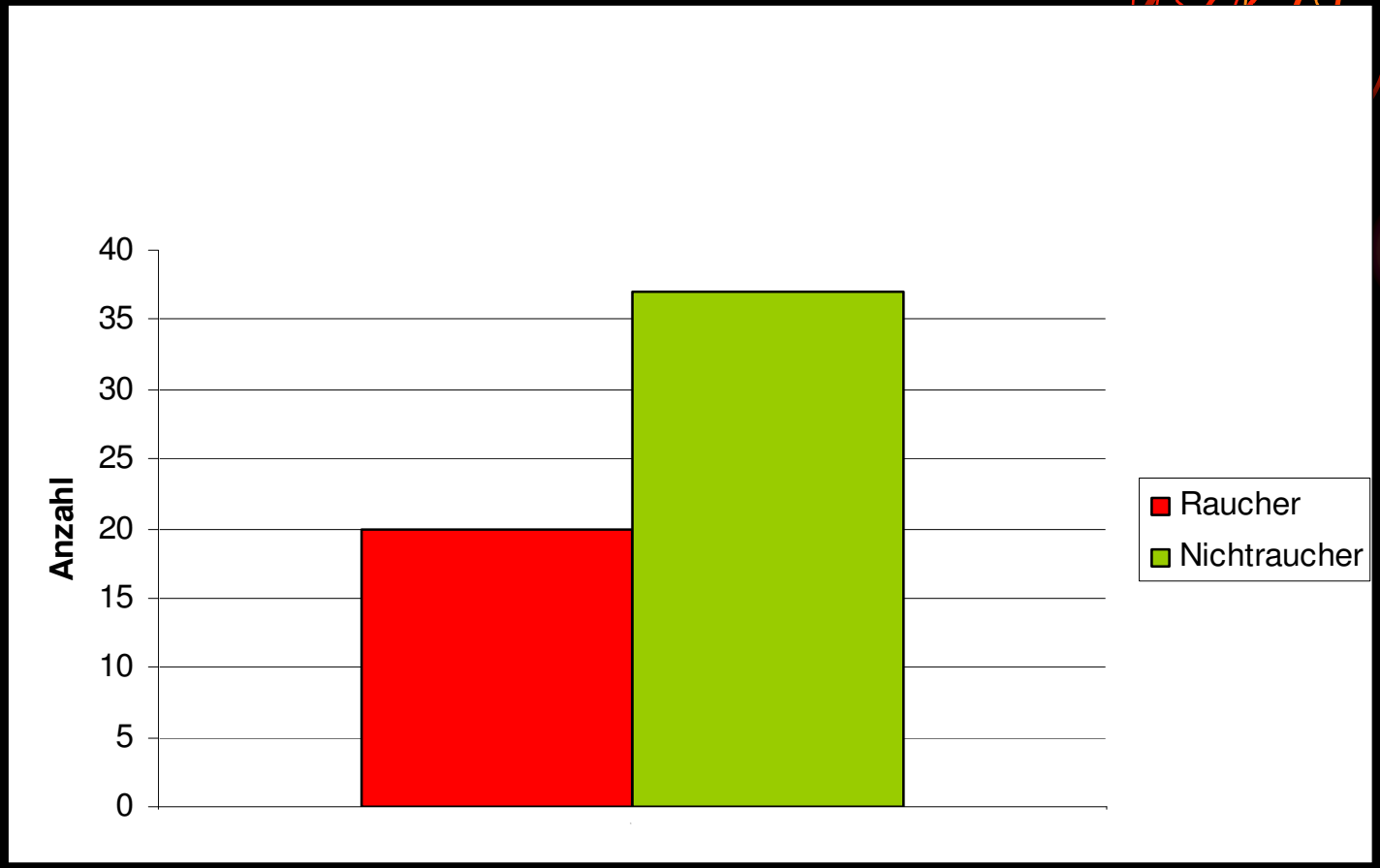
DRINKING HABITS:

***Regularly:** 11% participants

***Occasionally:** 89% participants

***from personal statements**

SMOKERS



INITIAL POSITION 5

FEV1 – LUNG FUNCTION:

Before the exercise:

slightly < 100%

After the exercise:

42% **> 100%**

21% of these **> 110%**

INITIAL POSITION 6

BLOOD PRESSURE:

There were more diastolic hypertensive measurements than one would expect among this age – group.

INITIAL POSITION 6a

BLOOD PRESSURE

Before exercise:

- **28%** (16 employees)

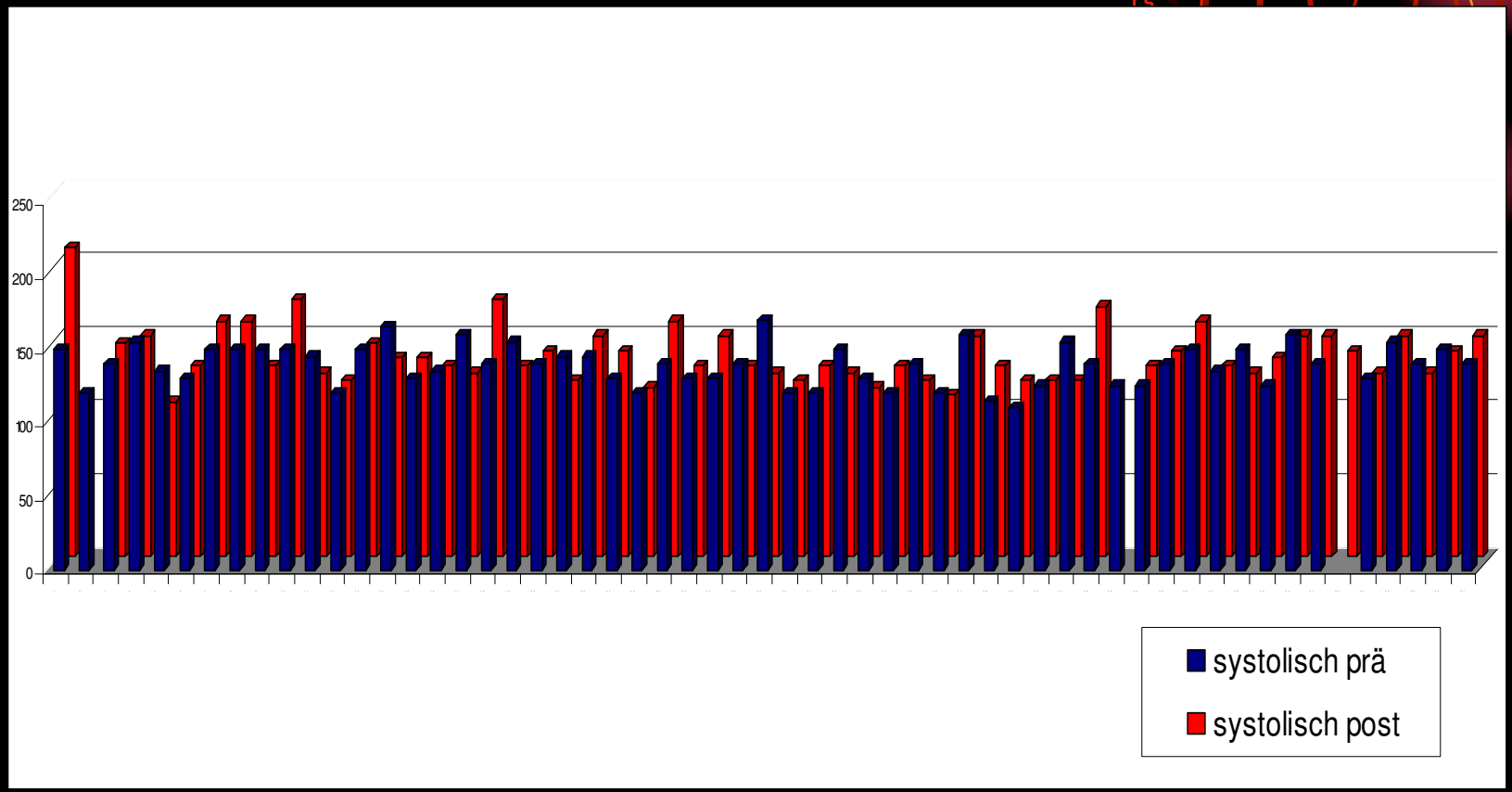
  needed controlling

  Mean : **= 149/97 mm Hg**

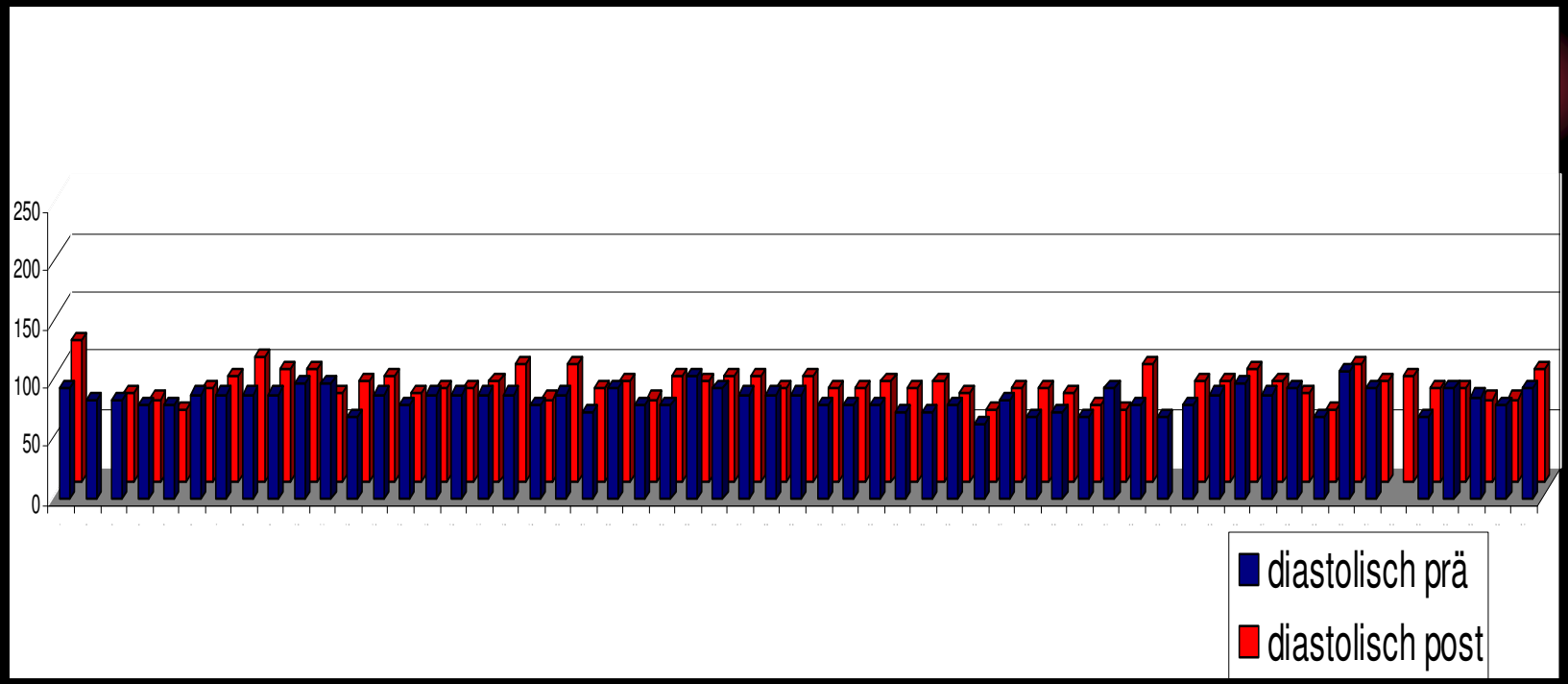
- **12%** (7 employees)

  hypertensive

DEVELOPMENT of Systolic Blood Pressure



DEVELOPMENT of Diastolic Blood Pressure



INITIAL POSITION 6b

BLOOD PRESSURE and HEART RATE:

Some participants showed typical characteristics of anticipation such as

- typical stress caused red hypertension or
- a slight stress caused tachycardia

COMPARISONS drawn 1

CORE TEMPERATURE:

Rise of mean temperature

from 36,7°C → to 38,3°C

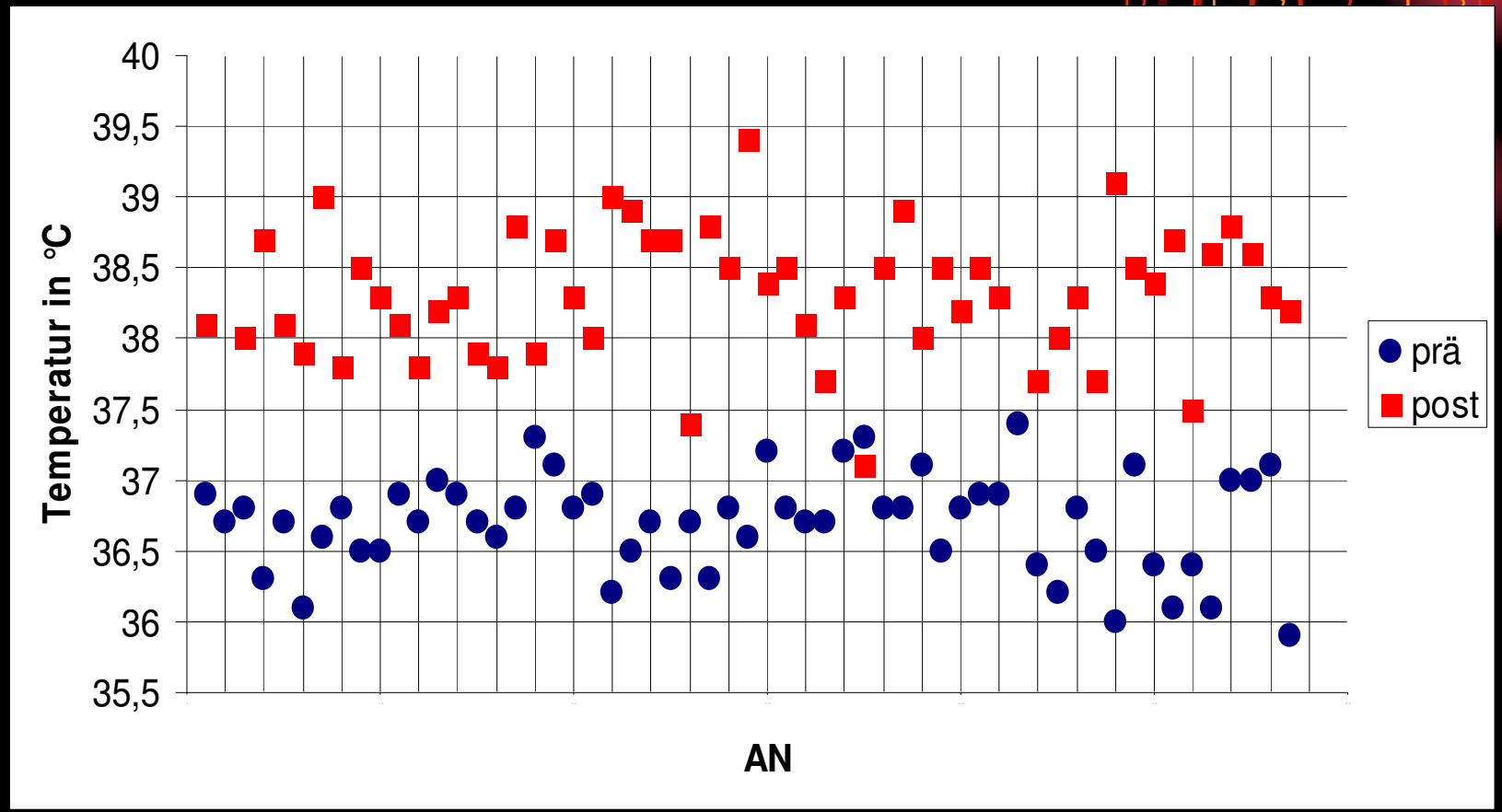
influenced by

- **strain**
- **heavy protective clothes**

ranging from

37,1°C to 39,4°C

Variation in TEMPERATURE



COMPARISONS drawn 2

LOSS of WATER:

Average loss of water during the exercise was 0,9 l

ranging from

0 to 2,5 kg loss of weight.

COMPARISONS drawn 3

BLOOD PRESSURE:

Mean RR

before **after** **the exercise**

134/83 **139/85**

Mean RR of participants suspected of Hypertonia

149/97 **162/99**

NB: **The mean of Adrenalin was lower to normal range → therefore it cannot be used as an explanation.**

COMPARISONS drawn 4

HEART RATE:

Mean frequency

before **after**

the exercise

73,9 bpm **101,4 bpm**

NB: **ECG was as expected.**

COMPARISONS drawn 5

FEV1 – LUNG FUNCTION:

Mean before	after the exercise
95,9%	99,9%

NB: Significant with $p < 0,05$

COMPARISONS drawn 6

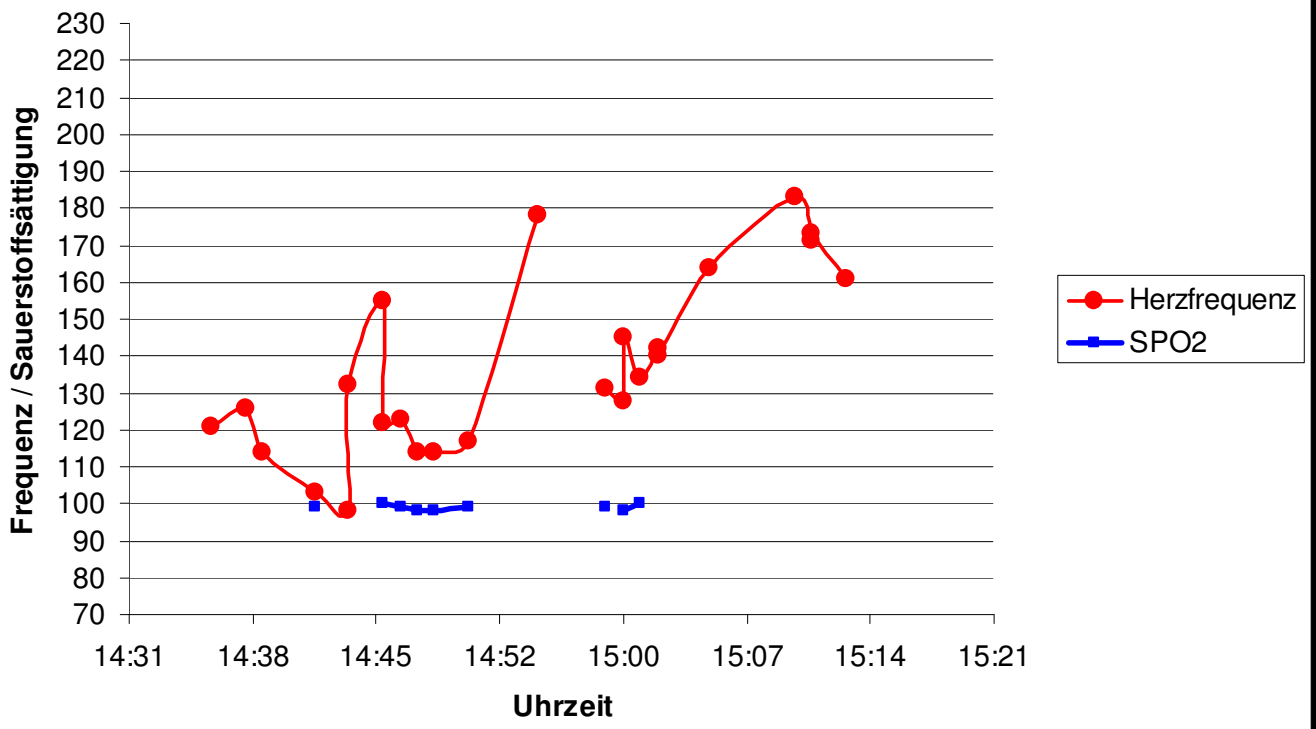
SpO2 - OXYGEN SATURATION:

The measurements were clearly below 100!

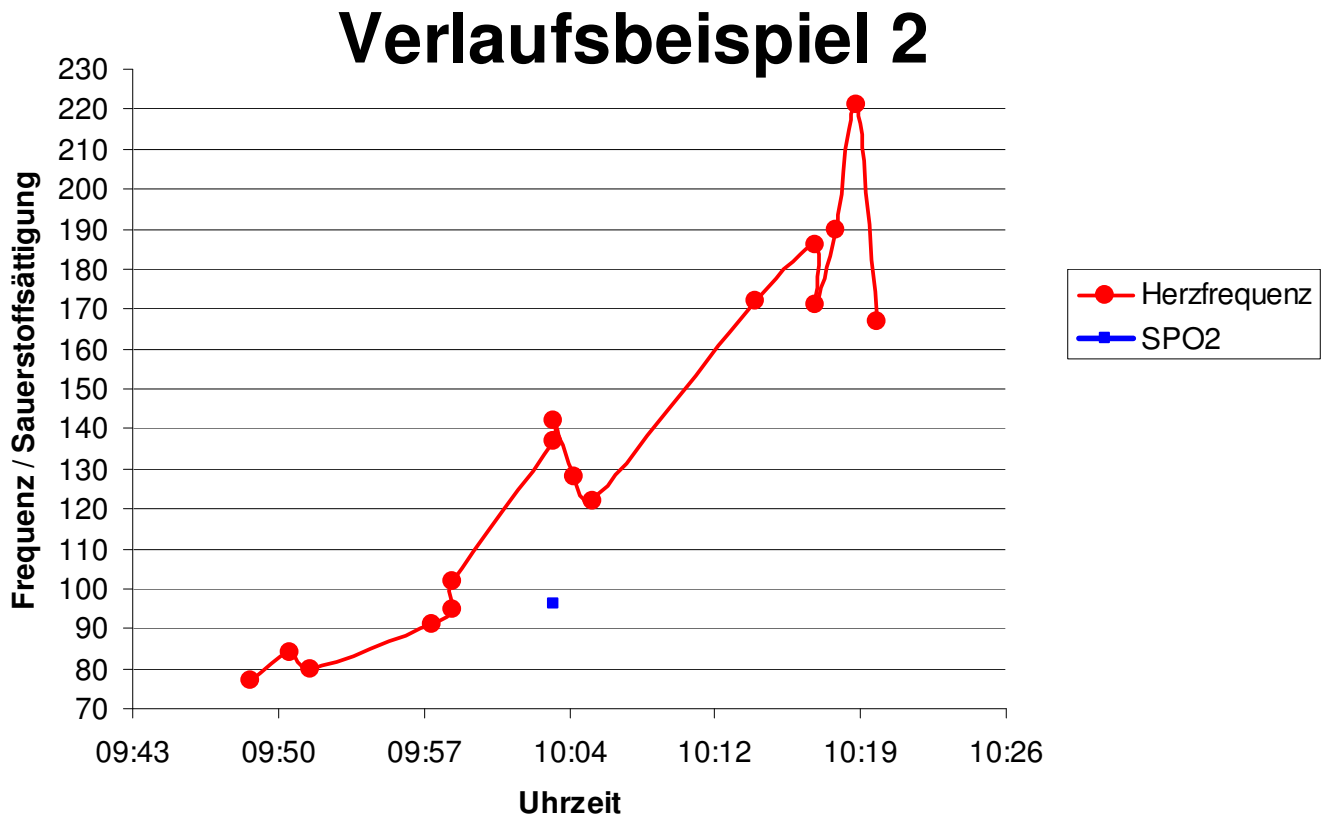
Mean oxygen saturation	
before the exercise	after
97,4*	93,5

*ranging from 87 to 99

EXAMPLE 1


Verlaufsbeispiel 1
Frequenz / Sauerstoffsättigung
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
14:31
14:38
14:45
14:52
15:00
15:07
15:14
15:21
Uhrzeit
Herzfrequenz
SPO2

EXAMPLE 2


Verlaufsbeispiel 2
Frequenz / Sauerstoffsättigung
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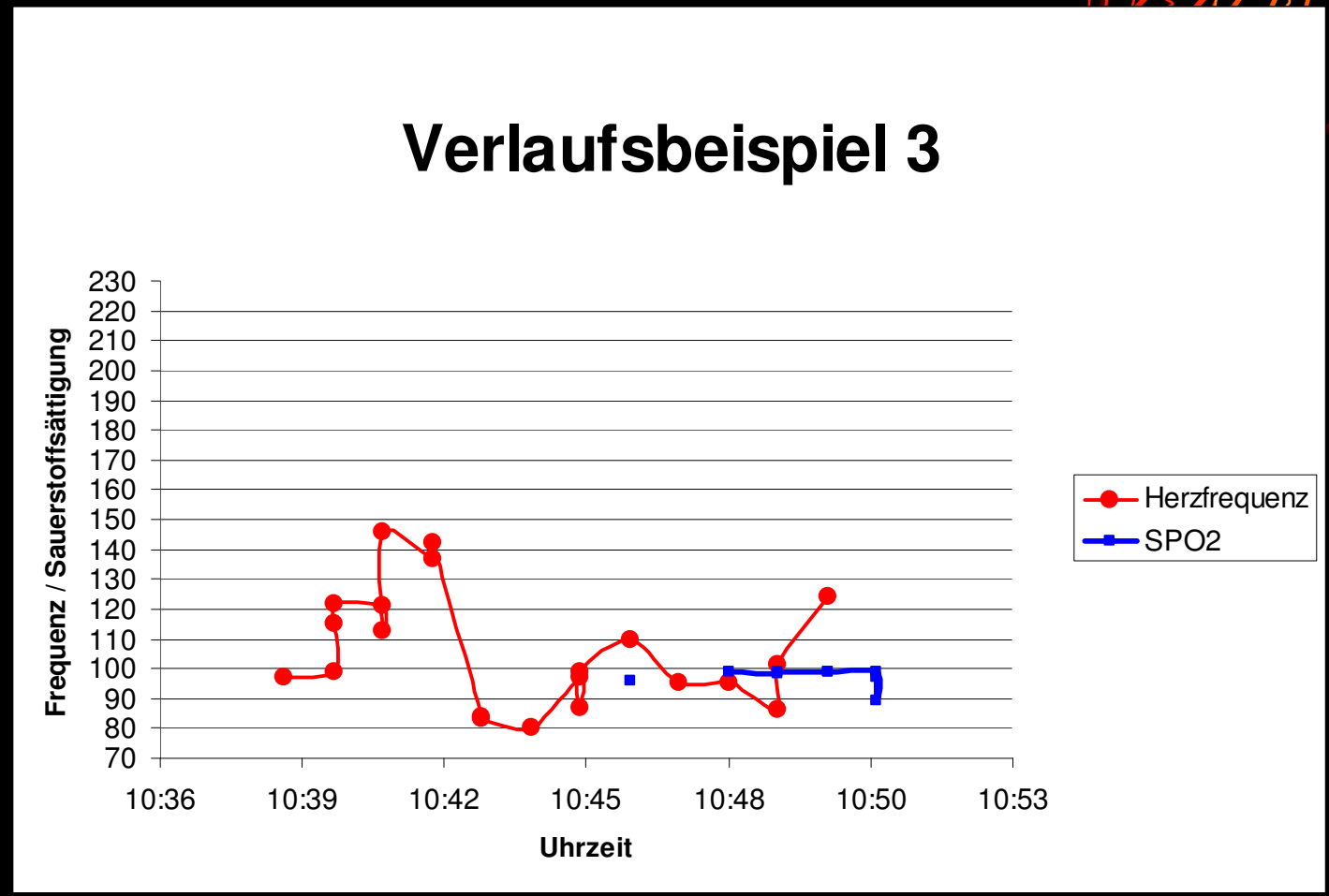
150
140
130
120
110
100
90
80
70
09:43
09:50
09:57
10:04
10:12
10:19
10:26
Uhrzeit
Herzfrequenz
SPO2

EXAMPLE 3


Verlaufsbeispiel 3
Frequenz / Sauerstoffsättigung
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200
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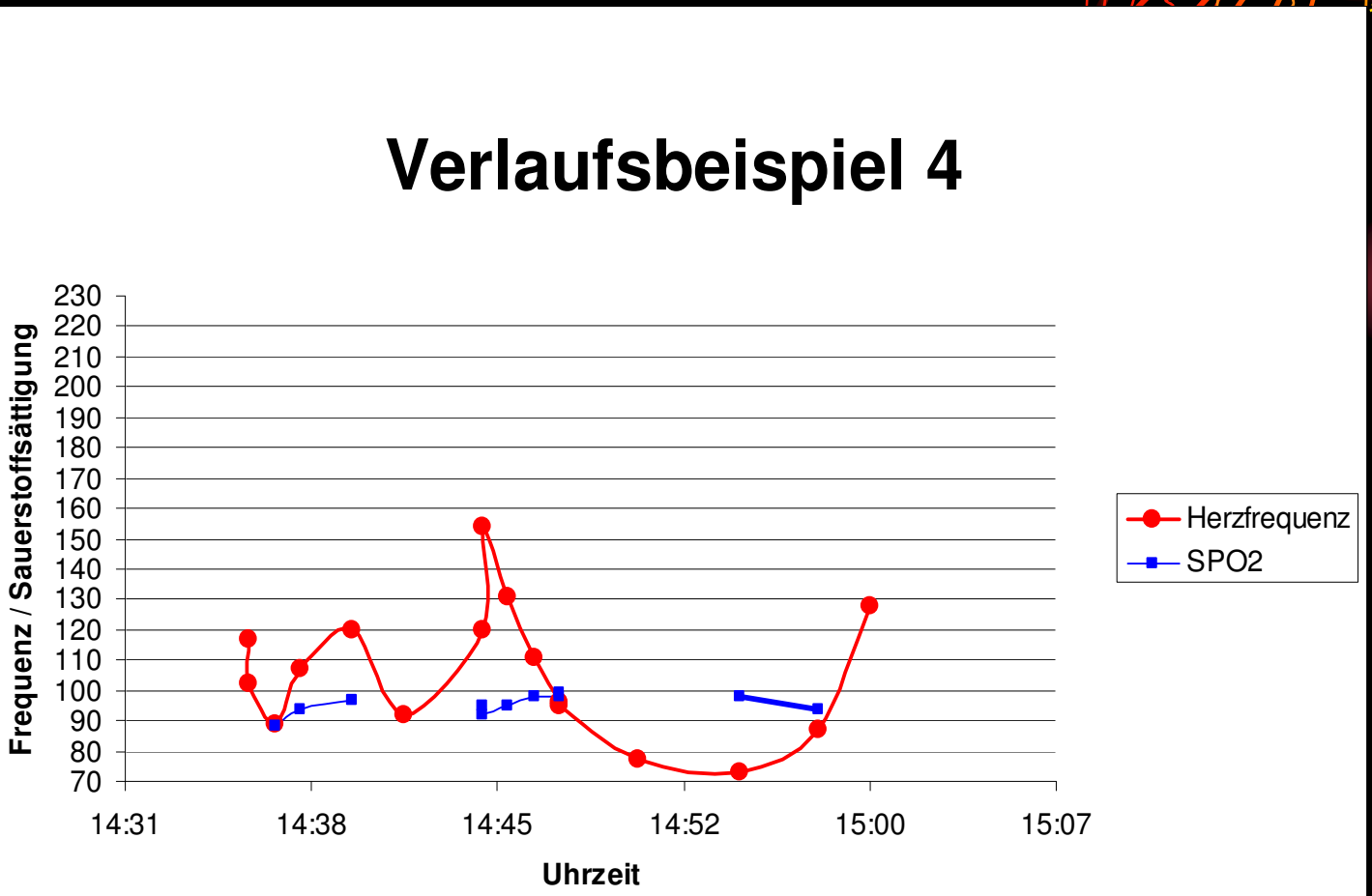
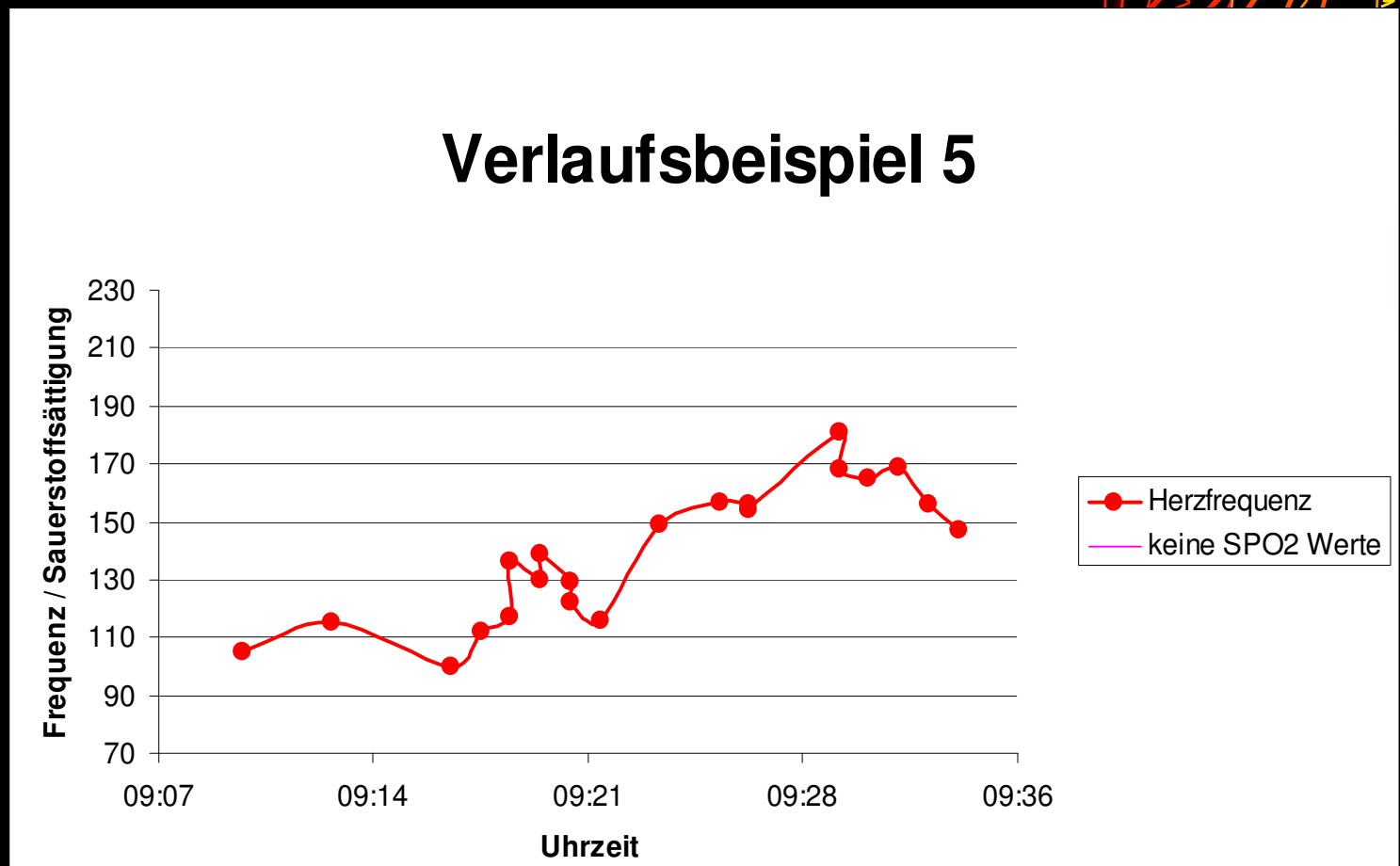
150
140
130
120
110
100
90
80
70
10:36
10:39
10:42
10:45
10:48
10:50
10:53
Uhrzeit
Herzfrequenz
SPO2

EXAMPLE 4


Verlaufsbeispiel 4
Frequenz / Sauerstoffsättigung
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
14:31
14:38
14:45
14:52
15:00
15:07
Uhrzeit
Herzfrequenz
SPO2

EXAMPLE 5


Verlaufsbeispiel 5
Frequenz / Sauerstoffsättigung
230
210
190
170
150
130
110
90
70
09:07
09:14
09:21
09:28
09:36
Uhrzeit
Herzfrequenz
keine SPO2 Werte

COMPARISONS drawn 7

BLOOD SUGAR:

Mean glucosis

before **after**

98,4 mg% **the exercise**

Ranging from 69 to 207

115,2 mg%

Ranging from 69 to 167

**

COMPARISONS drawn 8

BLOOD SUGAR:

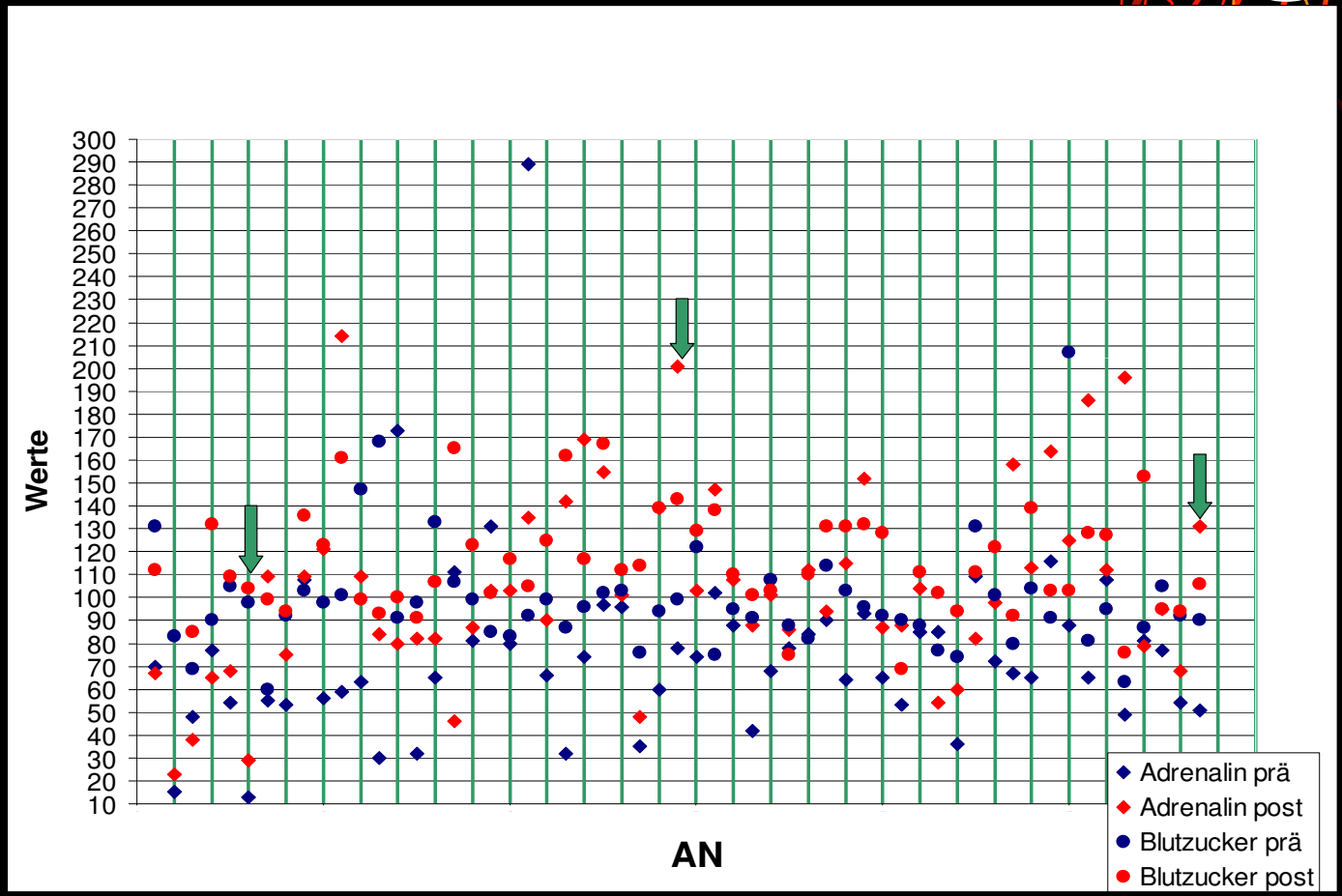
**There were a few Diabetes mellitus endangered employees with measurements above the standard.

COMPARISONS drawn 9

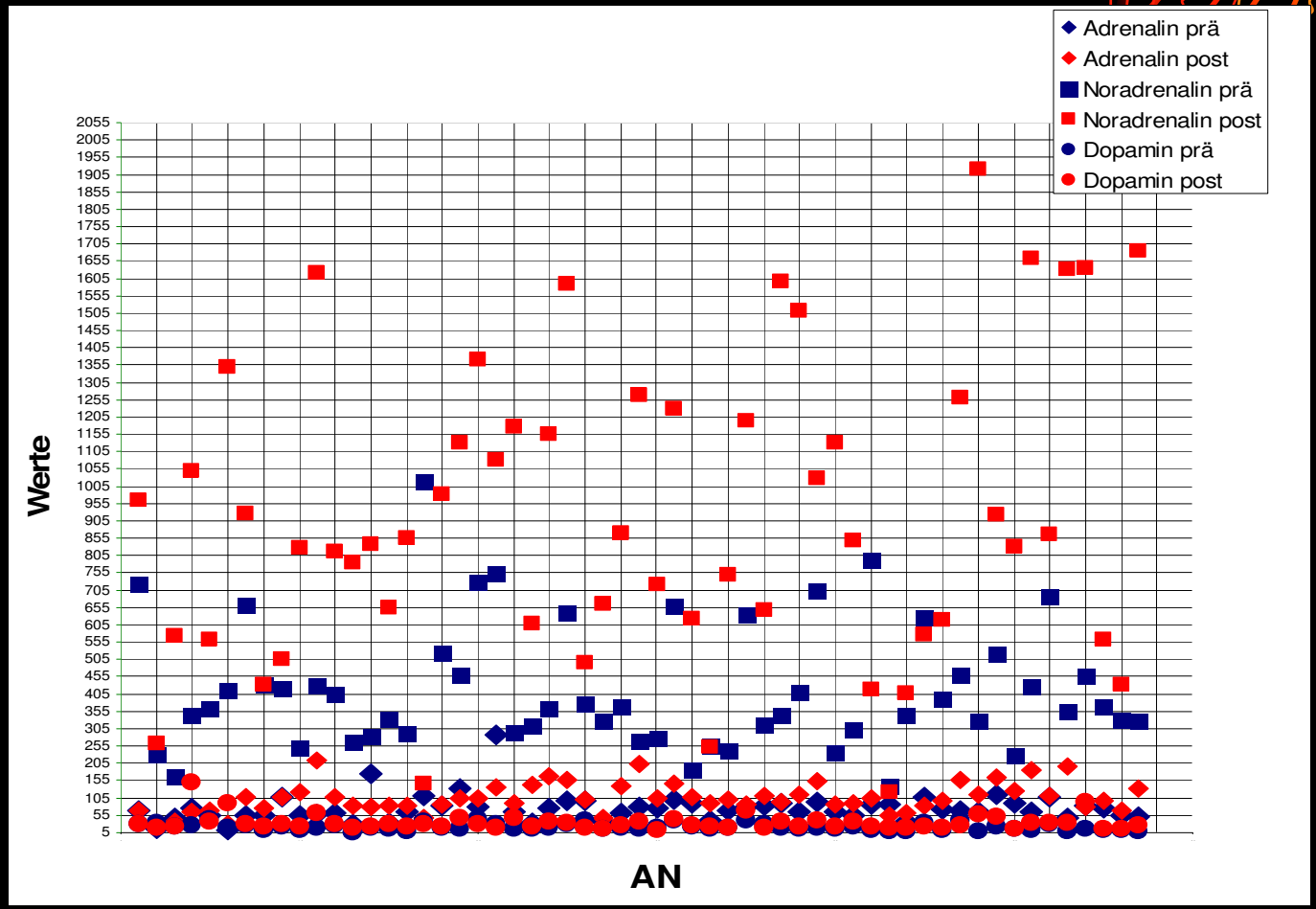
CATECHOLAMINES in Plasma

	before	after the exercise	normal
Adrenalin	75,6	104,9	30 - 100
N-Adrenalin	417,2	923,5	165 - 600
Dopamin	20,8	35,0	80 - 400

CORRELATION
Adrenalin – Blood Sugar



CATECHOLAMINES



RISE of HEART RATE

In correlation with:

- **Rise of Catecholamines**
- **Rise of core temperature**

INCREASE in HEART RATE

Per 1°C increase of core temperature

→

increase of 33 bpm of heart frequency.

RISE of HEART RATE

After arithmetical elimination of the catecholamines´ influence a tachycardia remained in anticipation of appr. 18 bpm,

→i. e. appr. the measurements of an experienced long distance runner.

LUNG FUNCTION

Smoking had the strongest influence on FEV_1.

Mean lung function before stress:

- **Smokers - 87,8%**
- **Non smokers - 98,5%**

of desired value

Peripheral OXYGEN SATURATION and BLOOD PRESSURE

A strong decrease of oxygen saturation

in 6 employees

during the exercise was

connected with

a clear increase in blood pressure.

Peripheral OXYGEN SATURATION and CATECHOLAMINES

The decrease of SpO_2 was connected with a clear increase of Catecholamines above the mean measurement.

Peripheral OXYGEN SATURATION and CATECHOLAMINES

Adrenalin

rise on average from - to

70,7 → 130,2

Mean rise

(104,9)

Nor - Adrenalin

531,2 → 1086,3

(923,5)

CORE TEMPERATURE and CATECHOLAMINES

The increase of core temperature correlates clearly with the increase of N-Adrenalin level.

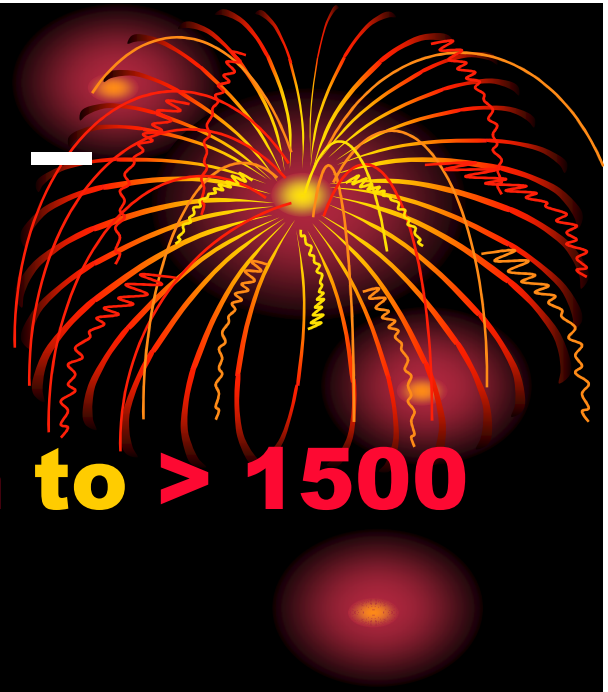
CATECHOLAMINES

The rise of CATECHOLAMINES is expected.

Question:

Are there predictions for a striking increase in other parameters?

CATECHOLAMINE – Increase



An increase of N-Adrenalin to > 1500 caused a stronger rise in :

- **Adrenalin to 142,6**

  (Mean 104,9) and

- **Dopamin to 43,8**

  (Mean 35,0)

CATECHOLAMINE – Rise

If N-Adrenalin level went up to
> 1500

- **Mean weight (94 kg) and**
- **BMI (27,7)**

were sigificantly higher than average
(mean weight 84,9 kg / 26,4 BMI).

(p < 0,05)

CATECHOLAMINE – Rise

As N-Adrenalin level increased to > 1500

smoking habits were important.

66% of these employees were smokers!

Among the others only 30,4% were smokers.

CATECHOLAMINE Increase and SMOKING

As N-Adrenalin level increased to > 1500 we found

- Reduced FEV_1
  Smokers (FEV_1 = 89,9%)
  Non - Smokers (FEV_1 = 95,6%)

- More frequent unstable Hypertension
  (especially diastolic hypertonia).

CATECHOLAMINE - Rise

If Adrenalin rose to > 130
it was striking that there was

- **slightly lowered SpO_2**
- **higher blood sugar increase**
  (from 92,4 mg% → 121,9 mg%)

$p < 0,05$

CORRELATION ERGOMETRY – Results CATECHOLAMINE - Reaction

There was a negative correlation between
Ergometry - results and
Catecholamine - increase after the stress

Adrenalin	p < 0,003		
N-Adrenalin	p < 0,05	Dopamin	p < 0,001

CORRELATION ERGOMETRY – Results CATECHOLAMINE - Reaction

is a significant proof of:

The more efficient the Ergometry → the less the increase of stress hormones under enormous stress.

CORRELATIONS and QUESTIONS

Can employees with blood pressure risk during the exercise be picked out before?

YES

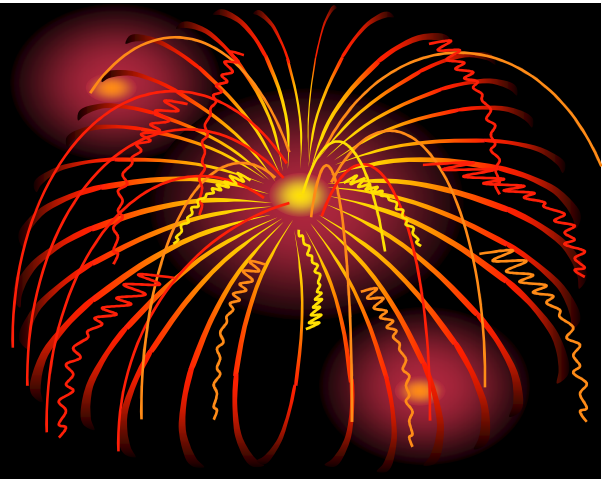
- **Through borderline**
  RR – measurements before stress
- **Through clearly higher plasma – N - Adrenalin**

STATEMENTS

- Fire trainers have realistic stress.
- We can find risks we would not find otherwise.
- The risks can be minimized through efficient medical check ups.

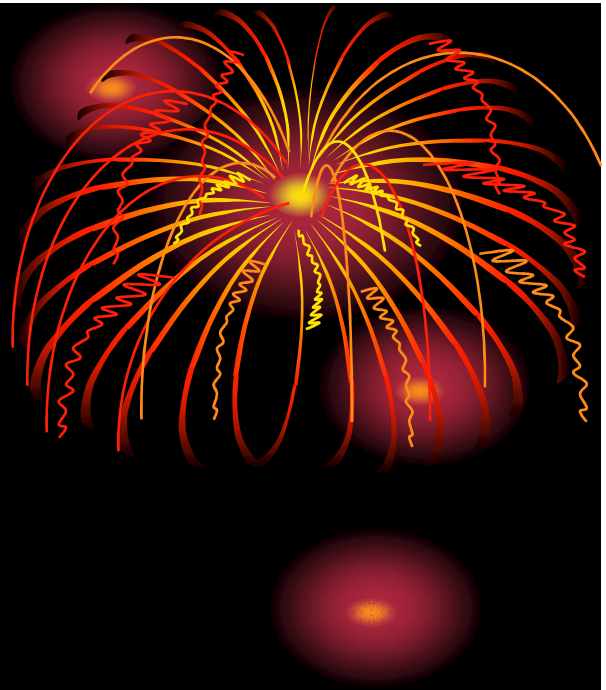
DEMANDS

- **Body fitness through correct training and acceptable nutritional condition**
- **Refrain from smoking**
- **Regular efficient medical check ups**



CONCLUSION

PRECAUTIONS 1

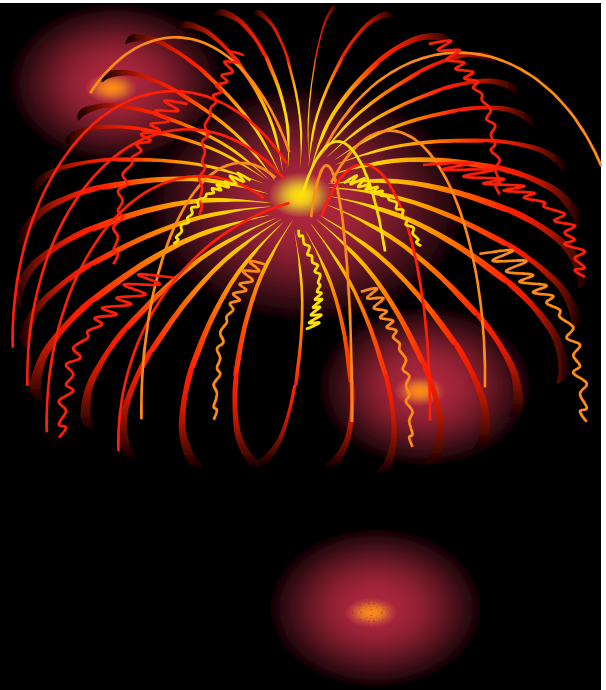


- **Early detection of**
  - **(labil) Hypertension**
    through anamnesis,
    RR - measurements, ergometry
  - **Diabetes mellitus**
    ev. through
    oral glucose load tests
- **Ergometry**

PRECAUTIONS 2

- Stamina - Training
- Orthostase test
  (before ergometry)
- Fold fat measurement + BMI
- Dietary advice
- Special programmes
  (e. g. anti smoking campaign)

Thanks to



Brady Comp.
Koch Ulrike
Meixner Manfred
Siegl Karin
Stallecker Otto