

## **ANTHROPOMETRICAL AND SPORT CONSTITUTIONAL COMPARISON BETWEEN YOUNG FIREFIGHTERS ( $\leq 30$ YEARS) AND SPORT STUDENTS ( $\leq 30$ YEARS)**

CHRISTOPH RASCHKA, DENIS BAMBUSEK, JONAS TÜRK

*Institute of Sports Sciences, Julius-Maximilians-University Würzburg, Germany*

### **ABSTRACT**

The goal of this study was to find the typical body composition of a professional firefighter from Frankfurt/Main in Germany. For this purpose, sport students and firefighter volunteers, who had not reached the age of 30 years at that time, were measured. 88 male test persons participated in the present study. From these 88 test persons, 30 were professional firefighters with the average age of 24.8 years ( $\pm 2.6$ ), and 27 firefighter volunteers with the average age of 22.8 years ( $\pm 3.2$ ). The control group contained 31 sport students from the J. W. Goethe-University Frankfurt/Main. The mean age of the students was 24.5 years ( $\pm 3.3$ ). The standard data body height, body weight, BMI, body fat and 55 body parameters after Raschka (2006) were assessed. The measurements were taken under standardized conditions by the authors of this work. The results were analyzed statistically.

The tallest body height and the highest body fat were found within the firefighter volunteers, the lowest value among the students. Interesting differences were found at the upper extremities, shoulder length and sagittal chest width. The professional firefighters had the biggest values followed by the firefighter volunteers. The AKS-Index showed no significant differences in all the groups.

High significant differences between the three groups were only found for the endomorphy. The somatochart of Heath and Carter showed no other significant findings.

Both firefighter groups showed the same characteristic in their plasticity. So they had a higher classification in the Plastic index than the students. They are in a more hyperplastic area than the students. Both groups also show a high bias

towards the decreasing pyknomorph body shape and an approach to the metromorph body shape like the students.

All three groups were in the leptomorph-makrosom area of the Knussmann constitution system. The professional firefighters are obviously more leptomorph and more makrosom than the students and the volunteers.

## **INTRODUCTION**

The target group of this anthropometrical study was the professional firefighter and firefighter volunteers from Frankfurt/Main Germany. The reason for the examination of this group was to find data in their daily work activities. These are protection against fire, technical salvage, operational readiness, accident ambulance, servicing the cars by tooling equipment and the technical installations like the extinguisher and several more. The main focus is the ongoing operational readiness for efficient fire- and rescue missions to save human life, animals, the environment and material assets.

An important task of a firefighter amongst others is to carry his heavy protective gear and equipment. Only the protective gear and the breathing apparatus weigh nearly 30 kilograms. This meant that a firefighter carries 40% percentage of his avoirdupois before he goes out to save human life by climbing stairs or robbing on the floor or to swing his axe. In addition a firefighter faces extreme heat and the exposure to fumes for his organism. Even more, the mental stress of shift work and traumatic deathtrap is often underestimated (Tempel 1998).

## **MATERIAL AND METHODS**

All the subjects for this study were chosen randomly and all the participants had done it voluntarily. The age of the subjects was between 18 and 30 years. The measuring took place happened between the summer of 2010 and the summer of 2011. Every measurement took nearly 25 minutes and was done in the fire stations of Frankfurt/M and for the students at the Sport University Frankfurt/M. All the measurements were made forenoon. The firefighter volunteers were measured in the evening because of their meeting times.

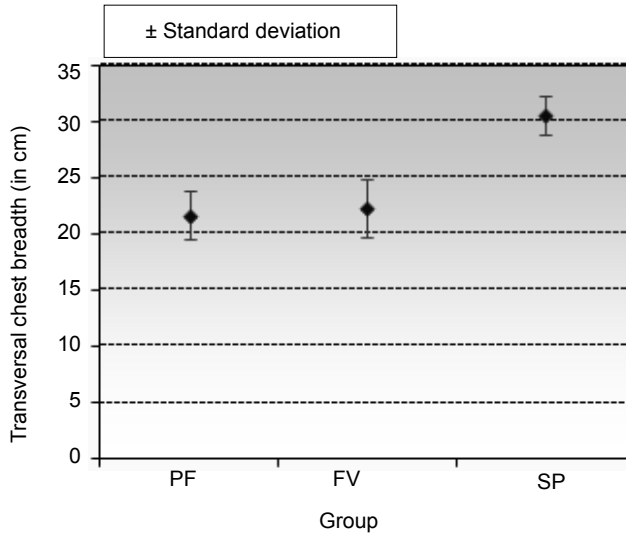
For the study, 55 body parameters after Raschka (2006) were measured and a couple of questions about private sport activities and the respondents own state of health were asked. The heights and the lengths were measured with a standard anthropometer, the breadths and width were measured with a pelvi-

meter, the circumferences were measured with a ribbon, the skin folds were measured with a caliper of the brand Ti Xing and the body weight was measured with scales.

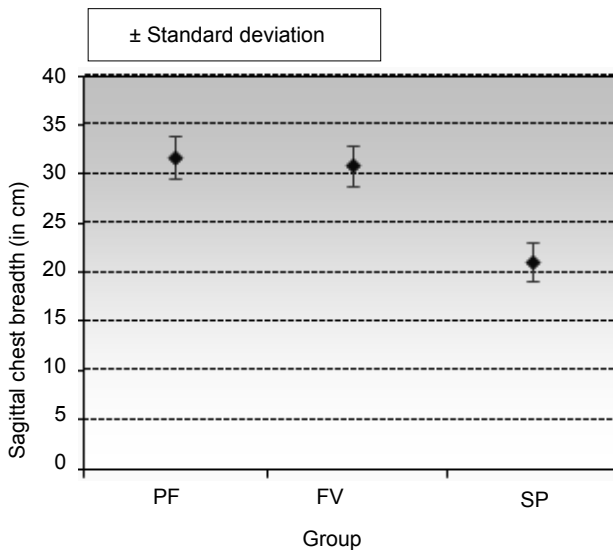
## RESULTS

Parameter	Professional firefighter (n=30)	Firefighter volunteers (n= 27)	Sport students (n= 31)	p
Age	24.8 (± 2.6)	22.8 (± 3.2)	24.5 (± 3.3)	p ≤ 0.001
Body height (in cm)	182.0 (± 5.8)	181.2 (± 7.7)	179.7 (± 6.8)	n. s.
Body weight (in kg)	83.9 (± 9.5)	87.2 (± 16.0)	77.4 (± 8.8)	p ≤ 0.01
Body fat (in %)	16.1 (± 3.7)	20.8 (± 8.9)	12.7 (± 3.5)	p ≤ 0.001
BMI (kg/m <sup>2</sup> )	25.3 (± 2.7)	26.5 (± 4.0)	24.0 (± 2.2)	p ≤ 0.001
Shoulder breadth (in cm)	43.0 (± 1.9)	41.7 (± 1.8)	41.1 (± 2.2)	p ≤ 0.01
Sagittal chest breadth (in cm)	31.7 (± 2.1)	30.9 (± 2.1)	21.0 (± 2.0)	p ≤ 0.001
Transversal chest breadth (in cm)	26.1 (± 2.2)	22.2 (± 2.6)	30.5 (± 1.7)	p ≤ 0.001
Radio-Ulnar- width (in cm)	6.1 (± 0.3)	5.8 (± 0.4)	5.8 (± 0.3)	p ≤ 0.01
Palm (in cm)	8.6 (± 0.4)	8.3 (± 0.6)	8.3 (± 0.4)	p ≤ 0.05
Forearm breadth minimal (in cm)	18.3 (± 1.2)	18.3 (± 1.6)	17.2(± 0.8)	p ≤ 0.001

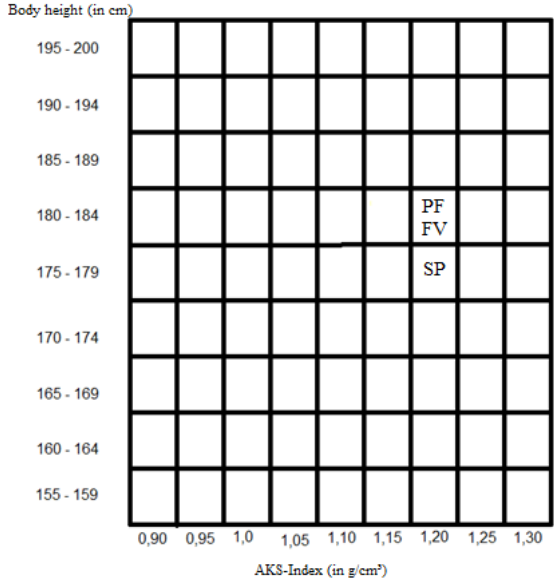
**Chart 1 Basic data**



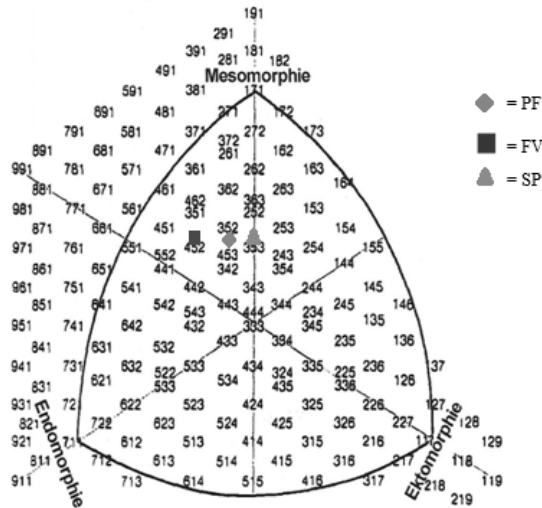
**Figure 1.** Mean values of the transversal chest breadth (in cm), divided into the groups (PF = professional firefighter, FV = firefighter volunteers, SP = Sport students)



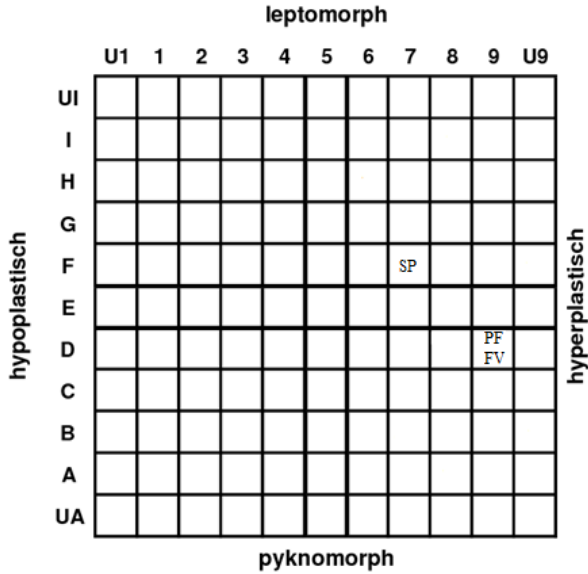
**Figure 2.** Mean values of the sagittal chest breadth (in cm), divided into the groups (PF = professional firefighter, FV = firefighter volunteers, SP = Sport students)



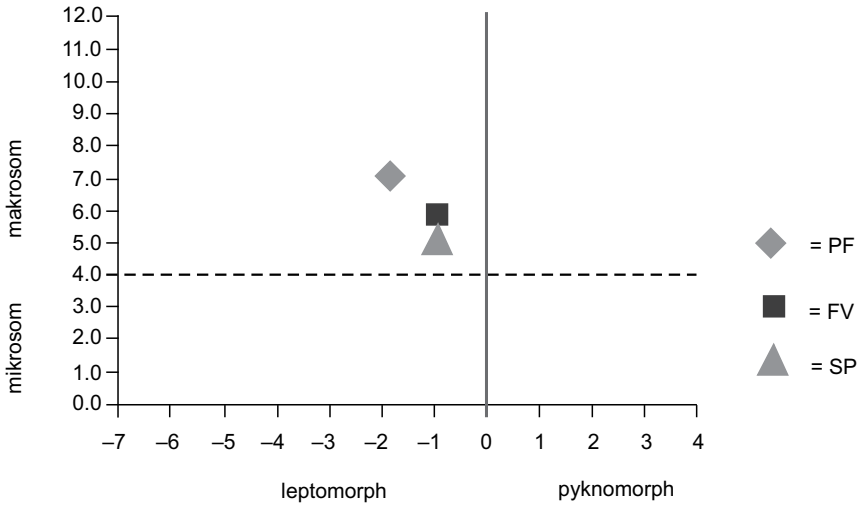
**Figure 3.** The average types of the professional firefighters (PF), the firefighter volunteers (FV) and the sport students (SP) in the AKS-Index/Body height – Diagram after Tittel andWutscherk



**Figure 4.** Somatochart after Heath and Carter for the average somatotypes of all three groups (PF = professional firefighter, FV = firefighter volunteers, SP = sport students)



**Figure 5.** The average constitutional types of all the 3 groups (PF = professional firefighter, FV = firefighter volunteers, SP = sport students) in the chessboard pattern graphic after Conrad



**Figure 6.** Average constitutional types after Knussmann (PF = professional firefighter, FV = firefighter volunteers, SP = sport students)

## DISCUSSION

The body height of the three groups showed no significant differences. The firefighter volunteers are significantly heavier than the sport students. The professional firefighter had a significant bigger shoulder width than the sport students: 43.0 cm ( $s = 1.9$  cm) vs. 41.9 cm ( $s = 2.2$  cm). The sport students had the lowest sagittal chest breadth compared with the firefighters. The mean values were 21.0 cm ( $s = 2.0$  cm) for the students and 30.9 cm ( $s = 2.0$  cm) for the firefighter volunteers and 31.7 cm ( $s = 2.1$  cm) for the professionals. This is highly significant and different. The authors interpret this difference with the regular use of the breathing mask in training and missions. Because of the respiration resistance, the respiration assistance muscle has to do more work. Research would help to approve the surmise.

In the area of the upper extremities the radio-ulnar- width and the palm show significant disparities between the groups. The professional firefighter had a higher significant radio-ulnar- width than the other groups. The examination of the palm revealed the same findings. This is probably the result of the daily work with the hands.

### The AKS-Index after Tittel and Wutscherk

The analysis of the active body mass and the AKS-Index showed no disparities between the three groups. The index diagram (Figure 2) shows only disparities of the body height.

### Somatotypes after Heath and Carter

High significant differences between the three groups were only found at the calculated components of the endomorphy. There were differences between the professional firefighter and the firefighter volunteers and also between the firefighter volunteers and the sport students. The endomorphy showed the level of the relative fat content. The professional firefighter had the level of 3.3. The firefighter volunteers had the level of 4.2 and the sport students had the lowest level of 2.6. The computed components of the mesomorphy showed no significant difference between three groups. The professional firefighter had with 5.4 the biggest muscle- and skeleton construction, the sport students the lowest with 5.2. Even the ectomorphy levels show no significant differences. The chart (Figure 3) showed both firefighter groups in the endo-mesomorphic area. The sport students can be found in the balanced mesomorphic area thus on the mesomorphy axis.

### **Discussion the body shape findings after Conrad**

Both groups of firefighters showed the same characteristic of plasticity in the chessboard diagram (Figure 4). Because of that, they had a higher classification (9) than the sport students (7) in the plastic-index of Conrad. Both groups also showed a trend to the pyknomorph body shape and an approach to the metromorph body shape of the sport students. The sport students were in the leptomorph area of the classification with a minimum trend to the hypoplastic area.

### **Discussion of the body shape findings after Knußmann**

All the groups (Figure 5) were in the leptomorph-makrosom area of the Knussmann diagram. The professional firefighters were more makrosom and leptomorph than the other two groups. The diagram classified the sport students and the the firefighter volunteers with the same leptomorph value but over all that the firefighter volunteers were more makrosom.

## **FINAL CONCLUSION**

The eye-catching disparities between the three groups were found at the sagittal chest breadth and the width of the upper extremity. We found that the typical firefighter has a height of 180 cm and a BMI of 25.3 kg/m<sup>2</sup> ( $\pm 2.7$  kg/m<sup>2</sup>). Further both firefighter groups were corpulent and massive; that means after Conrad more hyperplastic and after Knußmann more makrosom-leptomorph than the sport students. Both firefighter groups had broader shoulders, a higher body weight, a higher body height, a higher body range plus a specific shape of their upper extremities. The daily work with heavy tools makes the differences between the professional firefighter and the firefighter volunteers and sport students.

A national comparison of the professional firefighter could approve the results, because the amount and the type of work plus the requirement of the education of a professional firefighter are probably similar in all the regions of Germany.

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**Address for correspondence:**

Priv.-Doz. Dr.med. Dr.rer.nat. Dr.Sportwiss. Christoph Raschka

Institute of Sports Sciences

Julius-Maximilians-University Würzburg

Judenbühlweg 11, D-97082 Würzburg, Germany

E-mail: [christoph.raschka@uni-wuerzburg.de](mailto:christoph.raschka@uni-wuerzburg.de)