

Focus on IFA's work

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Stresses for police officers arising from the wearing of body armour

Problem

During certain deployments, officers in Germany's federal police force must wear body armour to protect them against flying stones, bottles and fireworks. The body armour comprises an armoured jacket, a helmet, and various protectors for the arms and legs. Together with the remainder of their equipment (firearm, handcuffs, multi-purpose baton), this equipment accounts for a total weight of approximately 20 kg. This impacts significantly upon the physiological performance of the police officers.

Before now, it was unclear what level of stress this equipment placed upon the musculoskeletal system. Conventional ergonomic methods for assessing load handling, such as the lifting-holding-carrying key indicator method, are unsuitable for use in this case owing to the particular distribution of the load over the body. In order for the musculoskeletal stress caused by the wearing of the body armour during a realistic deployment to be estimated, measurements were therefore to be performed focusing upon the stress upon the back. It was to be determined whether the use of body armour can lead to excessive stress upon the back or the joints, and whether this constitutes grounds for reducing the duration of use of the body armour.



Police officers wearing the CUELA measurement system during deployment

Activities

The CUELA measurement system developed at the IFA was modified to enable it to be fitted underneath the body armour and worn during deployment of the personnel.¹ During a real-case deployment (escorting of football fans and safeguarding of routes), the data for the body posture and movement of the police officers were measured, and musculoskeletal stress values determined from these data. The measured data were interpreted in accordance with ergonomic and biomechanical criteria in consideration of a deployment lasting ten hours.

¹ CUELA: computer-assisted measurement and long-term analysis of musculoskeletal workloads

In the deployment situation studied, the durations of deployment and recovery were balanced. The basic body postures of standing/walking/sitting were distributed in a ratio of 44:18:38. Based upon these data, model calculations of the stress upon the lower back were performed for the durations of deployment in which body armour was worn, in order for the additional stress imposed by the body armour to be determined.

Results and Application

The result can be summarized as follows: from a biomechanical perspective, the body armour does not appear to impose excessive stress upon the musculoskeletal system. The essential stress parameters for the lower back (compressive forces upon the intervertebral discs, lumbar moments) exhibited no notably elevated values. The police officers carry a range of loads during deployments; these are however well distributed and are carried close to the body, and do not therefore generate high biomechanical stresses. It was shown for example that the stress upon the lowest intervertebral disc increased by no more than 30% as a result of wearing of the body armour. In real-case deployments, maximum lumbar compressive forces of 1.8 kN were attained. Forces of this magnitude are not generally considered a significant biomechanical stress upon the intervertebral discs.

However, thermal or cardiovascular stresses cannot be ruled out when the body armour is worn. This is particularly the case for deployments substantially over two hours in duration. In the interests of prevention, the use of lighter body armour should be examined in this respect.

Area of Application

Police officers in the German federal and regional police forces

Expert Assistance

IFA, Division 4: Ergonomics – Physical environmental factors

German Social Accident Insurance Institution of the Federal Government and for the railway services (UVB)