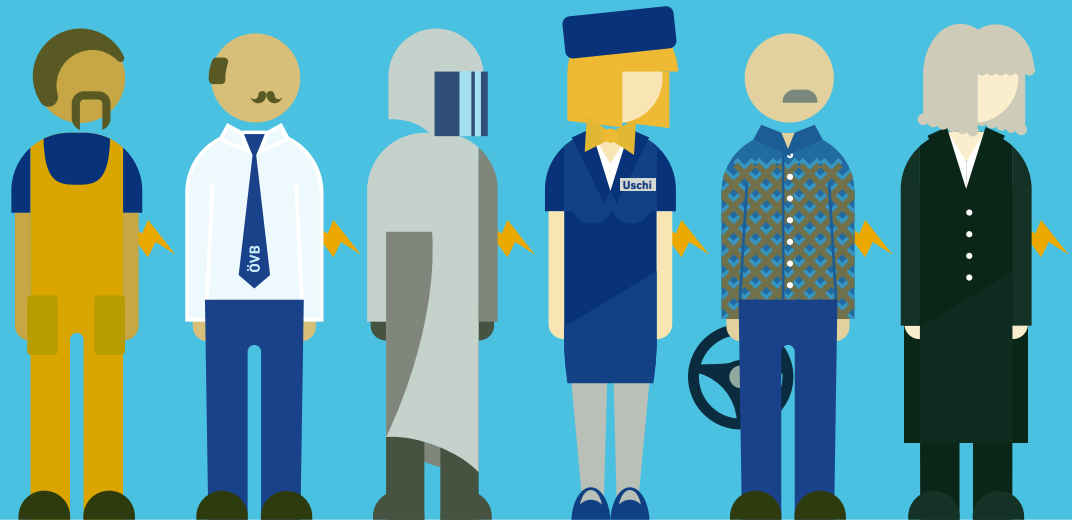
Preventive occupational health with orthopedic aids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Preventive occupational health with orthopedic aids
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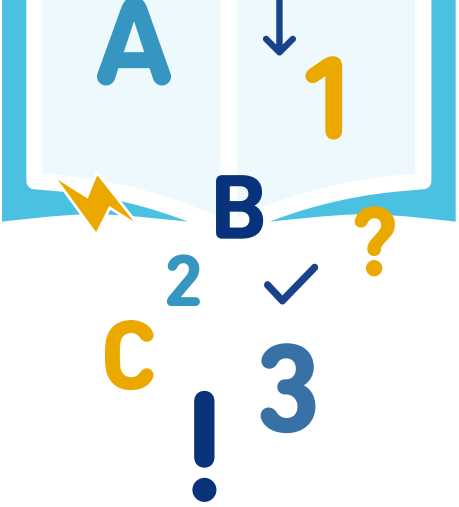
1 ABOUT THIS BROCHURE

How do preventive occupational health and orthopedic aids fit together? When Bauerfeind AG became more involved with this area in 2011, there was one doubt that came up repeatedly: the company had already established itself in sports medicine alongside classical patient care, but had little contact with the field of occupational health.

Company medical officers in Germany are not allowed to issue prescriptions, so they hardly receive any information about aids that are eligible for reimbursement. And occupational safety specialists placed little emphasis on orthotics for a long time:
active supports are still not included in the catalogs of specialist retailers. Knee pads and back support belts were the typical (erroneous) associations when Bauerfeind AG first presented its products at relevant trade fairs. A great deal of work was and is required in order to raise awareness.

Along with occasionally attending trade fairs, health days played an important role to bring these two worlds together:
Vein, foot and back checks carried out by orthotists nationwide, combined with consultations, demonstrated that preventive measures in companies were mostly limited to poorly attended fitness offerings, while no information was provided about options available under standard statutory care – despite an evident need particularly among employees in technical and industrial sectors.

Thanks to the vision of a few HR directors, managing directors and occupational physicians, orthopedic aids were then directly purchased and issued to affected employees as a follow-up to such screening initiatives. This was possible after a simple comparison of health data and ruling out potential contraindications without the typical "patient journey" involving long waiting times,



days of absence not used for treatment and hurdles for access to medical treatment.

The success achieved through these initiatives exceeded the expectations of all parties involved and prompted **closer investigation into the effectiveness of preventive occupational health in the form of observational studies**. In this context, "closer" also means industry-specific, since many procedures and safety requirements differ significantly between individual occupational groups.

The fundamental process remained largely the same: if the company identified particularly affected divisions and departments, their voluntary participation was requested and an informational meeting was held. As with the screening initiatives, the response was generally impressive and large numbers of participants were quickly recruited – between 25 and 100 test subjects depending on the size of company.

At the informational meeting, the background and medical context were explained based on the particular target group, potential risks and contraindications were reiterated, instructions were provided for the use and care of the test product and the proper size and design were determined.

Particular attention was paid to maintaining questionnaires for data collection in the form of "activity diaries" where the test subjects anonymously documented their health status, perceived pain level, product experience and other aspects on a regular basis.

The following chapters present a sample selection, which will be expanded in future editions to include additional study findings from the nursing care and construction sectors, among others.

2 "NEW WORK" AND LASTING CHALLENGES

Ever since industrialization began, efforts have been made to automate production steps that are physically demanding or monotonous. The "human factor" is universally perceived as a risk that needs to be minimized, as it is associated with high costs and is also prone to wear.

As a result, increasing efficiency and reducing the workforce through automated processes became a central focus for many companies until well into the 1980s and was driven further by the progressive development of digital technologies: established procedures were radically transformed or entirely eliminated, and new skills became necessary. From production to logistics and administration, the landscape has changed fundamentally, and the dynamics of change inspire visions of the future working world.

At the same time, buzzwords like "Industry 4.0" or "New Work" can obscure the fact that humans will still be needed for their mental and physical capacities in the decades to come: on the one hand, this includes a decreasing number of well-trained specialists who have to manage and bear responsibility for a broadening range of complex process. Then there are also processes that are largely automated already, and the human element is reduced to repetitive activities that produce one-sided stress. Such areas of work with rather little required qualifications are an increasingly relevant component in highly technological environments in particular.

Both groups have long resisted further attempts at streamlining, which is also evident from the number of accidents at work: while these figures fell by more than 30% from 1.2 million to 885,000 during the peak of automation and digitalization from 2002 to 2012, accident numbers have stagnated since then.

At the same time, the frequency, duration and nature of periods of incapacity for work demonstrate the serious impact on the mental and musculoskeletal health of employees as a result of this recent intensification and concentration of work.

Along with the rise in average age due to changing demographics, this presents new challenges for health-oriented workplace design and effective preventive services.

3 DEVELOPMENTS IN OCCUPATIONAL HEALTH AND SAFETY

Companies emphasize their commitment to occupational health and safety to increase their appeal as employers. But initiatives of this kind are primarily undertaken due to statutory obligations:
Bismarck's social welfare legislation, the German Accident Insurance Act of 1884 and the formation of institutions for statutory accident insurance and prevention were all reactions to social injustices and health abuses that had negative social and economic ramifications during the early period of industrialization in the 19th century.

The "Safety First" movement originating in the USA in the 1920s laid down important principles before the German Occupational Health and Safety Act of 1974 established legally binding standards in the form of various regulations concerning workplaces, load management or the handling of hazardous materials.

While the rapid technological transformation seen since the 1990s has led to continually shifting work methods and environments (for instance computer workstations), simplified operational principles were introduced in 2011 with the regulations of the German Social Accident Insurance (DGUV) to streamline the excessively complex array of existing regulations.

The DGUV regulations have significantly boosted collaboration between occupational safety specialists and company medical officers, and since 2008, company medical officers are even required to receive special additional training in occupational safety before they are appointed.

The health of employees must no longer be viewed merely as a personal issue, but as a potential safety risk for the entire operational process that must be addressed proactively with suitable prevention initiatives and the promotion of occupational health.

In line with this, risk assessments that previously focused more on technical aspects were expanded in 2011 to include the evaluation of health risks, and a mandatory specification was added in 2015 for mental illness due to a sharp increase in the number of cases among employees.

To support companies with the introduction and implementation of health promotion structures, in Germany, these services are tax deductible up to 500 euros per employee each year as of 2009, and up to 600 euros as of 2020.

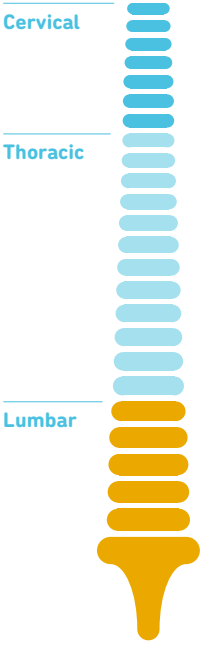
The basis for tax recognition is the prevention guideline drawn up by the German National Association of Statutory Health Insurance Funds in 2010, which was revised in 2016, that defines binding quality standards and particularly emphasizes sustainable planning and systematic organization of the initiatives carried out in companies.

This could include course offerings certified by the ZPP (Central Inspection Body for Prevention) such as back training, health checks carried out by medically trained specialists or workshops on "healthy leadership".

The growing interest shown by companies in preserving employee health and thus performance is also evident in purchasing behavior for personal protective equipment (PPE such as work clothes, hearing and sight protection, work safety shoes):
despite slightly declining sales figures, manufacturers continue to show growing revenues due to the increasing use of higher-quality products and new products offering enhanced protection and comfort.

4 BACK PAIN IN EVERYDAY WORK ROUTINES

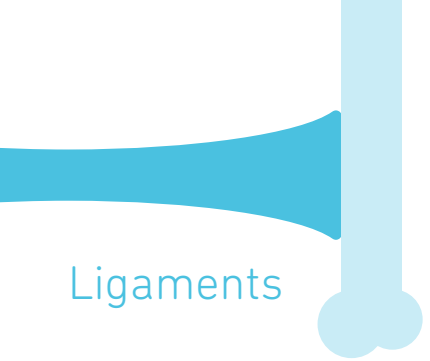
4.1 PHYSIOLOGY OF THE SPINE

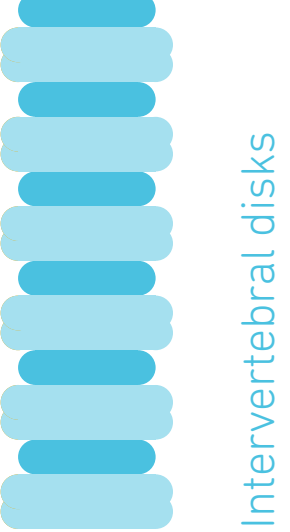


As the central weight-bearing element of our body, the spine ensures high mobility and flexibility with its around 100 intervertebral joints. Its double S-shaped curve also absorbs the stress and impact that naturally occurs when walking upright and protects the sensitive organs and structures that it carries.

The areas with differing curvature are subdivided into the cervical vertebrae with seven vertebral bodies (C1–C7), the thoracic vertebrae (Th1–Th12) and the large lumbar vertebrae (L1–L5), a region that is particularly subject to mechanical stress. The fused vertebral bodies of the sacral bone and coccyx make up the last region, the sacral spine.

Apart from the first cervical vertebra, all vertebrae have a comparable structure, consisting of the actual vertebral body along with an inferior and superior end plate.





Covered with an outer layer of highly compact bone material (cortical bone), the interior of the vertebral body has a sponge-like structure reminiscent of lightweight structural design (trabecular or cancellous bone). Bony projections serve as insertion points for ligaments and muscles, while each vertebra also has four articular processes for connection to the vertebra immediately above and below.

This linked chain is also made up of intervertebral or facet joints, **ligaments and intervertebral disks**. Intervertebral disks consist of an outer fibrous ring, the anulus fibrosus, and a gelatinous core that acts like a water cushion to buffer mechanical stresses and ensure distribution of pressure between the segments.

Strong ligaments ensure support for the spine, while the relevant muscles of the torso and the primary torso muscles (erector spinae muscles), in particular, are responsible for providing active stabilization. They tension the spinal column like the rope hoists used for a ship's mast.

The abdominal muscles act as counterparts to the back muscles, enabling forward bends while supporting lateral and rotational movement and stabilizing the spine.

A balanced interplay of adequately trained abdominal muscles and back muscles is essential for healthy posture, smooth sequences of movement and wear-reducing relief of the intervertebral disks, an important concern when lifting heavy loads.

Moreover, a significant portion of the forces acting on the spine are generated by our own body weight. Modern lifestyles and work routines, predominantly characterized by a great lack

of activity, contribute significantly to muscle degeneration, obesity and one-sided stresses that negatively impact the anatomical condition and functionality of the spine,

According to the German Federal Health Reporting for 2006, one in five women and one in six men suffer from chronic, often non-specific back pain …

… such as tension, impaired muscle control and pathological changes to the connective tissue in the back.

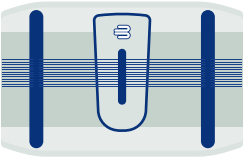
The most common spinal disorders also include intervertebral disk problems, which can be caused by high-pressure loads applied to just one side, short regeneration times or age-related degenerative processes.

If the pain is limited to the area of the spine, this is referred to as an intervertebral disk protrusion – as opposed to an intervertebral disk prolapse, or herniated disk, where tissue is pushed into the spinal canal and cause nerve damage. The pain generated often radiates to limbs, accompanied by symptoms of numbness or paralysis in the legs.

Another common symptom is sciatica, which is caused by problems in the sciatic nerve mainly around the fifth lumbar vertebra or the first sacral vertebra. It is characterized by dragging pain radiating from the buttocks down the rear side of the thigh and lower leg all the way to the big toe.

Deep-seated back pain that radiates to the buttocks and legs is also a symptom for problems of the sacroiliac joint (SI joint syndrome) that can occur as a result of pregnancy or long-term forced or incorrect posture.

Osteoporosis is another form of degenerative spinal disorder that commonly affects post-menopausal women. It involves the loss of bone mass caused by a decrease in the body's production of the hormone estrogen, which is important for bone formation. The resilience of the vertebrae declines accordingly, and there is an increased risk of fractures under stress.



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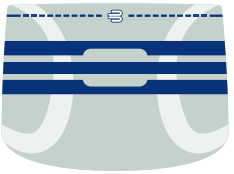
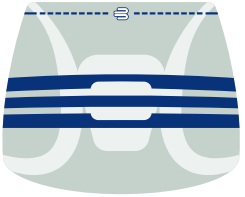


LumboTrain®



LumboTrain® Lady

4.2 BAUERFEIND LUMBOTRAIN®

If the primary cause of many symptoms lies in back muscles that have degenerated or are subject to high levels of stress on one side, the mobilization and strengthening of these muscles must be the first priority.

However, the support belts that were previously used for occupational health and safety are counterproductive in this regard: while they provide temporary relief as a stabilizing and relieving "corset", they do not offer the necessary muscle stimulation that leads to fundamental improvement of the physical constitution.

This is where flexible sports supports or active supports come in, providing neuromuscular stabilization for the lumbar spine by exerting gentle compression. Viscoelastic pads also increase local pressure in the lumbar region, reducing pain and offering stimulation: **Intermittent compression massage acts like a "hand on the back" to reduce tension, promote circulation and effectively enhance stimuli even during low-intensity activities.**

In contrast to simple discount store supports, orthopedic aids such as the LumboTrain have proven to be medically effective and are also optimized for long-term use. This can be seen in the particularly skin-friendly, hypoallergenic and breathable material, which is unobtrusive and prevents pressure points and constriction thanks to extra-flat seams.

A removable pad attached with Velcro fastening and modern functional fibers ensure easy cleaning in line with stringent hygienic requirements.

Other features that set these aids apart include different shapes for men and women as well as seven different standard sizes for a positive effect on the pressure conditions as well as the fit and secure position of the support, which is worn directly on the skin or over underwear.

Increased freedom of movement plays an important role: many occupations involve repeated rotation and bending of the torso, so supports intended for use during work must not restrict such movement or slip out of place.

While the LumboTrain has already proven effective in athletic competitions and as a support for physiotherapy and rehabilitation, occupational physicians also confirmed that it is highly suitable for assembly work.

The use of this product only involves risks in case of pronounced skin conditions, neuropathy (sensory disorders), cardiovascular disease as well as immediately after surgery. As a medical device, LumboTrain is eligible for reimbursement when medically prescribed like many other orthopedic aids, but the product is also available over the counter from technical medical retailers since a prescription is not mandatory.

4.3 USE ON THE JOB: PUBLIC UTILITY

In 2016 and 2017, screening tests were conducted at multiple locations for 400 technical and industrial employees of a public energy, water and public transport utility in North Rhine-Westphalia. Significant deviations from the standard values were identified particularly during the back checks, with 70% of participants complaining of frequent pain in the cervical and lumbar spine.

Apart from job-specific forced postures that were often unavoidable, notable limitations were identified in mobility tests and fingertip-to-floor distance.

Depending on the severity of the symptoms, many of the employees were given individually selected orthopedic aids after a confidential assessment. These aids were co-financed by the employer in line with data protection requirements based on a flat rate included in the service package.

While discount store supports had previously been used to relieve symptoms in specific cases, typically accompanied, however, by OTC pain medication, the employees who were issued higher-quality active supports remained persuaded of the positive results even months down the line.

The company management and OHM steering committee therefore approved a six-week observational study with voluntary test subjects, specifically focusing on back supports to precisely examine the therapeutic effects in everyday work routines.

The findings were documented on a weekly basis in a total of 48 activity diaries and then evaluated. The test subjects were almost exclusively men between the ages of 27 and 61, with an average age of 47, which corresponds to the average age of all employees in Germany.

More than half of the subjects performed varied tasks during work involving sitting, standing and walking. 18 participants worked predominantly while sitting, four while standing.

The majority of the participants categorized their level of physical stress as "moderate", with twelve employees assessing their strain as high and one as very high, while ten employees indicated low or very low levels of strain.

The employees' subjective assessment of their own health status before the start of the test was predominantly "good" and "acceptable" in equal shares, with one subject answering "very good" and three answering "poor".

One of the most important criteria for the study was the frequency and intensity of back pain during the observation period. In both cases, significant improvements were demonstrated: The average number of days of pain per week fell from 4.0 to 2.5, and the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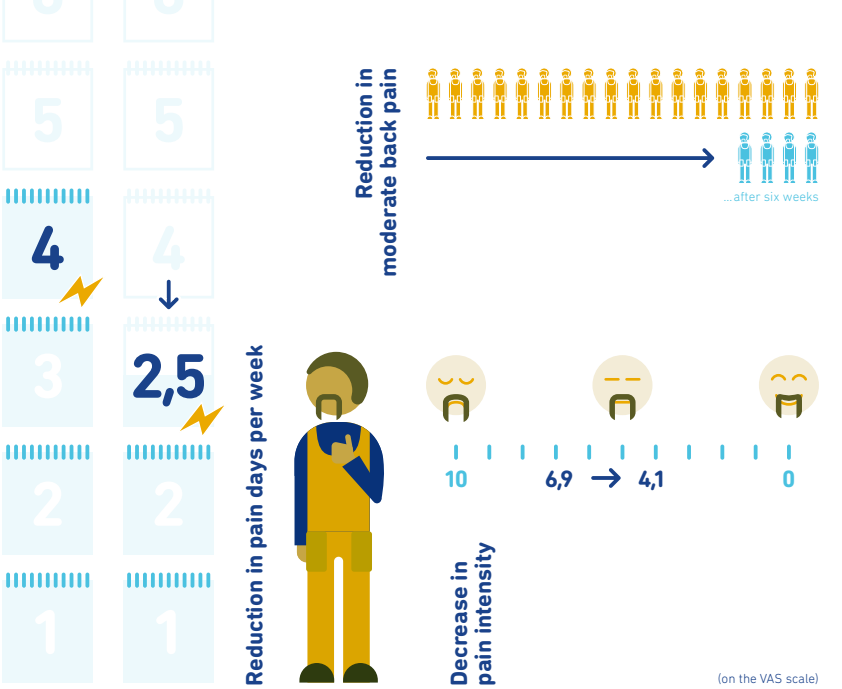
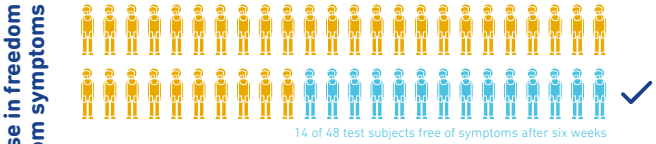


intensity reduced from 6.9 at baseline to 4.1 on the VAS scale. While 18 subjects reported "moderate" back pain in the first week, only four subjects reported moderate pain in the sixth week. The number of participants experiencing only "mild" back pain increased from 23 to 26, and 14 of the 48 test subjects were entirely symptom-free by the end, compared with just three at the start.

In line with these results, the average frequency of pain medication use fell from 0.9 to just 0.4 days per week. On the other hand, no changes were reported for four of the participants with severe or very severe pain; a transition to more extensive, specific treatment should be reviewed in these cases.

The average physical activity in their spare time (exercise, gardening etc.) remained largely unchanged overall, ranging from less than two hours per week for one participant, two to five hours for 32 participants and more than five hours per week for 13 participants.

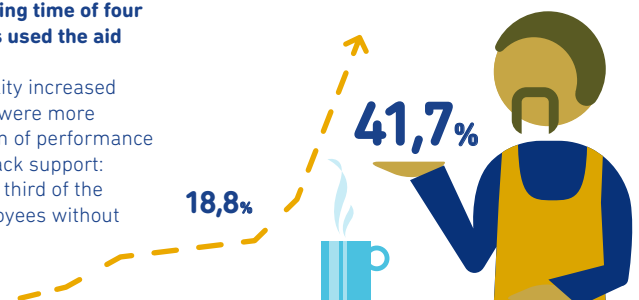
The findings were more mixed concerning the wearing comfort and fit of the support, with 56% assessing these criteria as "good/very good", 35% as "acceptable", yet 9% as "poor/very poor":



particularly for work performed while sitting, test subjects perceived the aid to be unsuitable and reported that it often slipped out of place. In contrast, the personal comments from some participants who worked while standing or moving in a variety of ways indicated "perfect" support and good effectiveness also in certain working situations.

While the duration of use was highly varied at the start, by the end of the study only ten participants wore the back support for fewer than four hours per day. **The majority of participants indicated an average daily wearing time of four to six hours, and 15 participants used the aid for longer than six hours.**

The general sensation of stability increased slightly from 6.1 to 6.9, yet there were more marked changes in the perception of performance capacity achieved by using the back support: at the start of the study, almost a third of the test subjects (including the employees without symptoms) said they experienced slight improvement or no noticeable effect, but only one in five subjects agreed with this statement by week 6. The assessment "(only) somewhat accurate" was 52.1% at first and later fell to 37.5%. Participants who described the increased performance capacity achieved with the back support as "accurate" or "completely accurate" first made up 18.8% of the test subjects and ultimately came to be the largest group with 41.7% of the test subjects.



4.4 USE ON THE JOB: STEELWORKS

According to studies carried out by the scientific institute of the health insurance provider AOK (WIdO) in 2016 and 2019, musculoskeletal disorders are not only a significant factor for days of absence from work in general, but are also particularly prominent in certain industries: Employees in the supply and waste management, road construction, metal processing and foundry sectors are affected at almost twice the average rates.

When testing the pain-relieving and health-promoting effect of back supports, foundry operations experience high environmental temperatures of 80 degrees Celsius, a condition that complicates use.

Such temperatures do not have a direct impact on the material thanks to the protective clothing worn by the employees, but they do increase the requirements for material breathability when it comes to tolerability and acceptance.

Since classical support belts and simple discount store supports had already proven unsuitable for testing the use in steelworks, a particularly lightweight back support by Bauerfeind optimized for athletic activities was chosen as an alternative to LumboTrain: the "Sports Back Support".

A total of 20 employees with an average age of 47 tested the product while working for a period of six weeks, including three office employees who primarily work while sitting. All other participants performed their work while standing and walking.

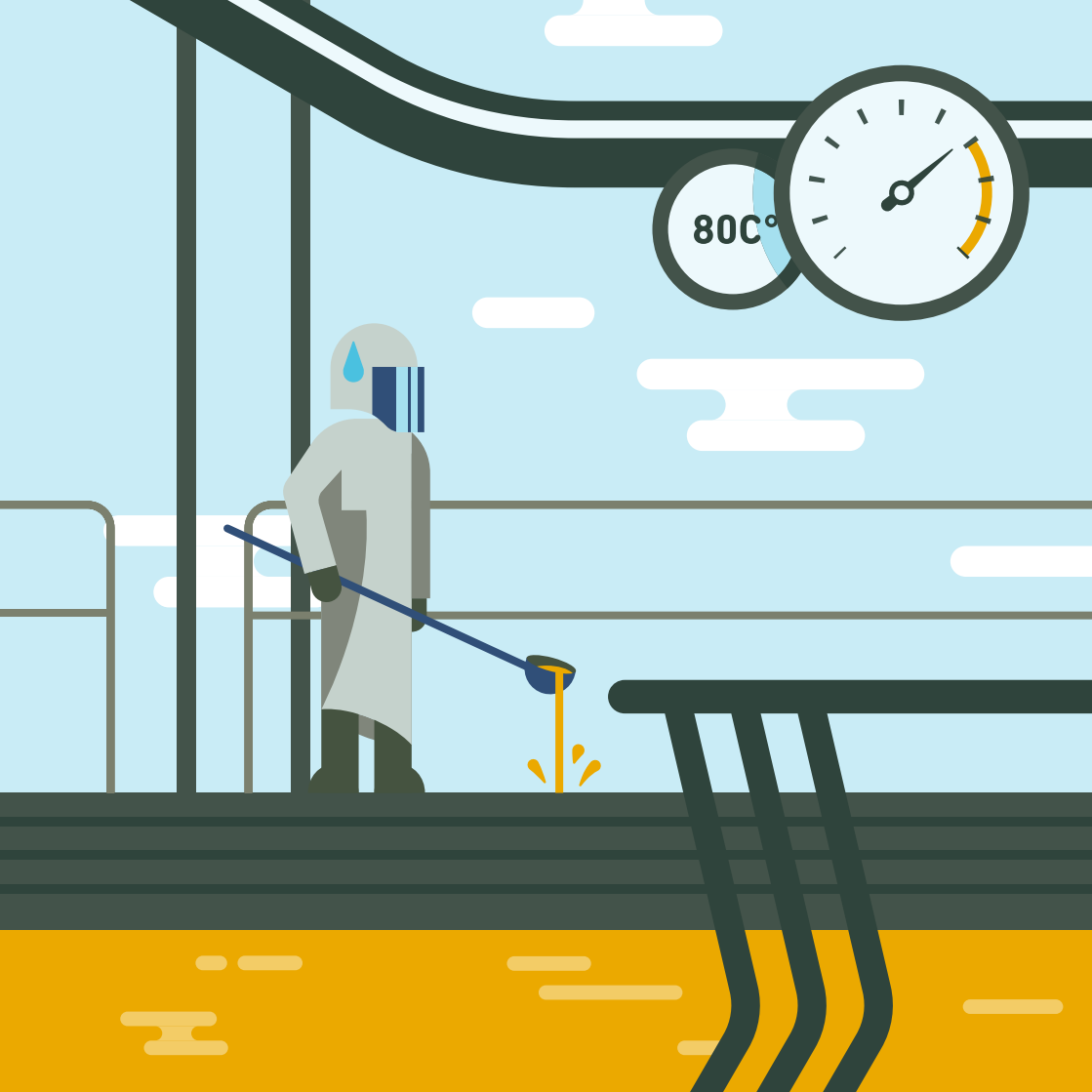
The average assessment of intensity of physical activity during work (3.3) and in their spare time (2.4) remained constant throughout the test period; accompanying treatments and the use of pain medication were not reported.

Only seven participants experienced a comprehensive improvement in their health status, while three participants still reported occasional back pain and nine participants mentioned frequent back pain (in at least four out of six weeks).

The frequency of pain during the week was markedly reduced from 2.1 days to 1.1 days on average, along with the perceived intensity, which decreased by more than half from 3.8 to 1.7.

While the physical stress experienced at the beginning was assessed as "high" with an average of 3.7, this value was just 3.1 ("moderate") by week 5.

In contrast, there was a slight increase in perceived performance capacity from 2.9 to 3.2, while the support and relief provided by the support were consistently perceived as "strong" and corresponding effects were felt more strongly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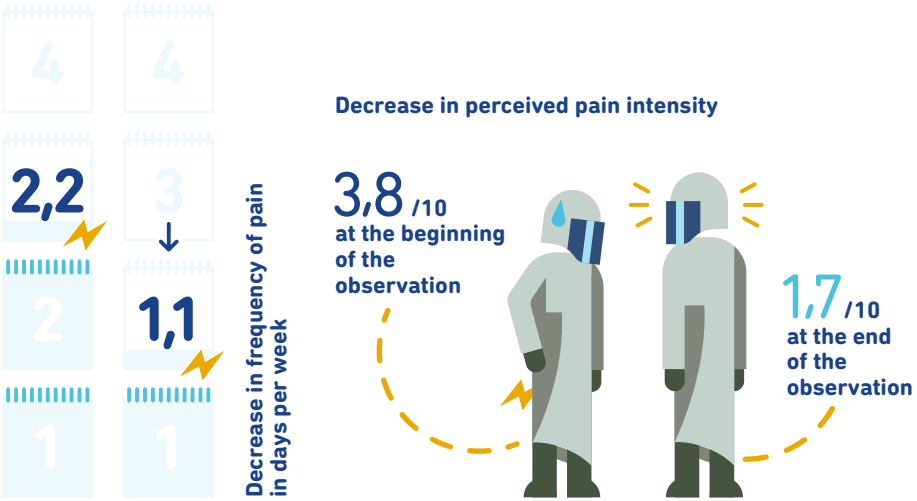


over time (increase from an average of 6.3 to 7.0). The same applies for the fit, secure position and wearing comfort of the back support, with a slightly improved score from 2.0 at the start to 1.7 at the end (rating system from 1 (excellent) to 6 (poor)).

Restrictions were only mentioned for test subjects who worked while sitting, while high temperatures only had an insignificant impact on the structural stability of the support, massage pad and resulting wearing properties.

This was also reflected in the average wearing period, which increased slightly overall but already amounted to more than six hours per day for eleven participants at the start of the test. **According to the operational managers, most participants have been using the supports regularly even after the end of the observation period, and the supports have contributed significantly to improving their work situation.**

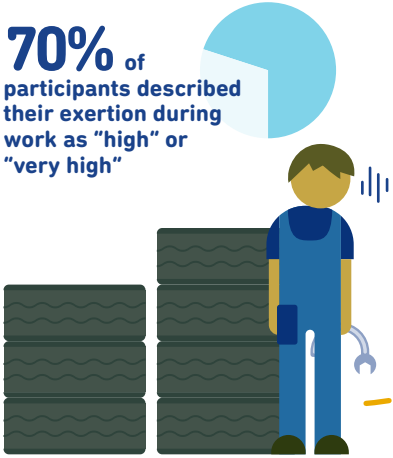
4.5 USE ON THE JOB: VEHICLE SERVICE PROVIDERS

Many work processes become more efficient if the tasks involved are carried out in a more focused manner. Reduction of complexity enables a high level of concentration on tasks and more rapid execution, but also leads to greater one-sided stress:
Employees working in tire assembly, for example, stand almost exclusively at the lifting platform and are highly restricted in their radius of activity or opportunities for balanced movement.

Increasing market shares for off-road vehicles and SUVs with tires larger than 20 inches and nearly twice the weight of standard tires also increase the physical strain when changing tires (repeated heavy lifting with torso rotation in quick succession).

To provide balanced stimulation for the back muscles of employees and achieve sufficient torso stability by strengthening the muscles, the company medical officer in charge reviewed more than a dozen different orthopedic back supports available on the market.

Apart from general factors such as sturdiness and washability, safety-related criteria also had to be considered and restrictions to mobility had to be prevented, for example during torso rotation.



Ultimately the LumboTrain by Bauerfeind was chosen and tested by voluntary test subjects, all of them men ranging in age from 23 to 61 (average age 39), in a six-week test at various locations of the company across the country. 23 test logs were evaluated.

One striking difference from comparable studies was that almost 70% of the participants described their exertion during work as "high" or "very high". This matched the employees' assessment of their own health status, which was described as "mostly good" in eight cases and as merely "acceptable" by all other participants.

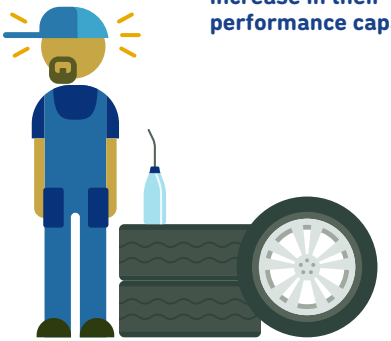
Around half of all participants stated that they pursued athletic activities in their spare time for two to five hours per week, thus indicating proactive efforts against the inactivity occasioned by their professions and a significant interest in personal health promotion.

The high acceptance of the back supports from the start was evident from the wearing period, which was up to four hours in only four cases and amounted to more than six hours per day in twelve cases.

Throughout the observation period, the secure position, fit and wearing comfort of the support were consistently assessed by the majority of participants as "good" or "acceptable".

Slight improvements were reported in the sense of stability, which increased from 6.4 to 7.2 on average. The overall reduction in back pain was more marked, falling from an initial average of 4.0 days per week to just 2.6 days per week by the end. This factor was also reflected in the reduced use of pain medication, which decreased from 1.2 to 0.4 days:

73%
confirmed a significant increase in their performance capacity



At the end of the study, 50% of the participants stated that they only experienced mild occasional back pain. Severe back pain was experienced by five employees at the start and none of the employees by the end, while the number of participants entirely without symptoms increased from one to six.

73% of test subjects confirmed the increase in their performance capacity with "(entirely) accurate", leading the company to directly purchase and provide LumboTrain back supports as (non-mandatory) personal protective equipment for employees subject to relevant strain.

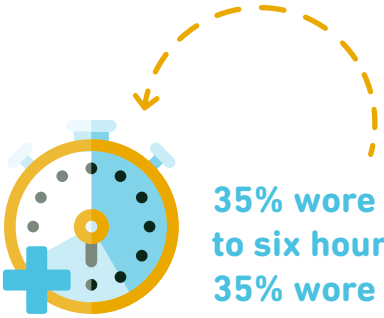
The request and issue process was handled by the location's occupational safety officers in the same way as for work safety shoes: these officers confirm the general need, determine the individual size and rule out potential contraindications and risks of using the product with the help of a predefined questionnaire.

In case of doubt or an unclear medical history or status, a check-up should be performed by a company medical officer or general physician before issuing the product to confirm that there are no medical concerns with respect to future use.

Two subsequent surveys carried out by the employer (six months after first issuing the product to 240 employees and using the same catalog of questions again after 18 months with 150 employees participating) reviewed the proper implementation of these requirements and the long-term practical benefits at the participating branches. Since the differences between the overwhelmingly positive findings of both surveys are very slight, the average values are given here:
42% of employees outfitted with a back support struggled previously with "frequent" or "very frequent" back pain that was "moderately severe" in most cases, and a similar percentage experienced the same symptoms "occasionally". Only 12% had no symptoms before the request and opted for purely preventive use, around 5% of participants provided no information in this regard.

The employees' subjective perception of average physical stress was comparable to the figures from the initial observational study, with 35% classifying their exertion as "moderate" and 62% stating that it was "high" or "very high".

The initial assumption that the supports would only be used temporarily in many cases was clearly refuted by the findings of the long-term surveys. Users continued to perceive a variety of positive effects on personal well-being after more than a year, and the supports were used regularly



35% wore the support for four to six hours per day, another 35% wore it longer than six hours per day

in everyday work routines on a long-term basis, although the intensity of use depended on the severity of the symptoms and strain:
Around 30% of users wore the support up to four hours per day, while 35% wore the support for four to six hours, and another 35% wore the support for longer than six hours. In comparable proportions, 70% continued to assess the secure position, fit and wearing comfort as "good" or "very good", and 28% stated that this was "acceptable".

The findings were similar for the increased performance capacity achieved by wearing the support and the subjective perception of support and relief, which 6% perceived "not at all", 22% perceived "slightly" and 72% perceived "noticeably" or "very noticeably".
This was reflected accordingly in the assessment of fulfilled expectations for the product and likelihood of recommendation (21% with reservations or comments, 73% with a clear "Yes").

No problems with use were reported, isolated discrepancies in size calculation were corrected by exchanging sizes. Apart from this, no detrimental effects were identified, for instance in the form of weakening muscles (atrophy) or skin irritation during long-term use.

Since the health-promoting benefits of the LumboTrain back support were confirmed for operational use by the majority of participants, the internal guidelines for determining need, risk-free use and provision to different locations as an optional form of PPE have also been maintained for more than two years, during which time the support has been issued to more than 30% of personnel.

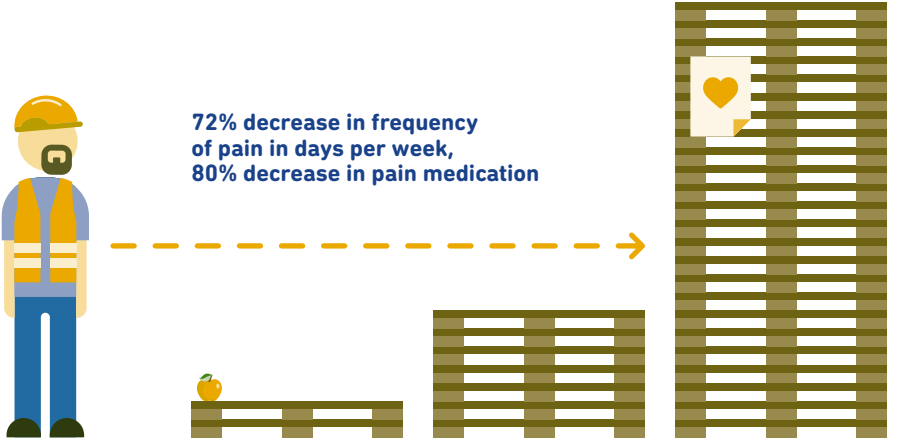
4.6 USE ON THE JOB: LOGISTICS CENTERS

Connected to around 40 regional centers of a discount supermarket chain, the logistics locations are used to distribute goods to the local branches.

The primary activities of employees include moving pallets, stocking and removing items from high-bay storage and the distribution and repackaging of containers. A variety of physical stresses are involved and provided the basis for an observational study of various orthopedic products for the hand, back and knee in three logistics centers around the country.

At two locations, the LumboTrain (or "LumboTrain Lady", given the large number of female employees) was used to relieve back pain for four to six weeks, while the "Sports Back Support" was tested for six weeks at a third location.

While the two back supports achieved comparably good results, the test period shortened to four weeks at one of the centers (with daily documentation of results instead of weekly documentation) proved unfavorable: Significant effects were primarily demonstrated from the fourth week on; although initial improvements were evident here as well, the results were not as clear as the results from the fifth and sixth weeks: the shortened test achieved improvements of 54% for light and moderate back



pain and 38% for moderate to severe back pain. In contrast, during the regular observation period of six weeks, **the average reduction of pain days was more than 70% from 2.9 to 0.8 days per week, the intensity of pain experienced fell from 10.5 to 3.1, and the consumption of pain medication was reduced by more than 80%.**

The wearing period for the majority of patients was four to six hours per day since the start of the test, with a slight increase in longer periods of use as well. At the end of the study, back supports in particular were viewed as highly effective for an improved sense of stability and increased resilience, achieving average values of 8.5 and 8.1 out of 10, respectively.

The level of physical activity outside of work was quite low, with a value of 2.0 on average, and was mainly limited to occasional exercise at home.

However, this figure might also be caused by the extensive offers for occupational health promotion available at the locations: many employees make use of these services, reinforcing the effect of the supports through a combined approach.

The combination of a health-promoting movement programs with orthotic support can constitute a suitable and feasible set of measures.

5 STRESSES OF THE KNEE
5.1 STRUCTURE OF THE KNEE JOINT

The knee is the largest joint in the body, consisting of the thigh and lower leg bone (femur and tibia) along with the kneecap (patella). Each of these three bones features opposing joint surfaces covered with a cartilage mass that is several millimeters thick. This layer enables the bones to move smoothly and performs additional metabolic functions with the synovial fluid.

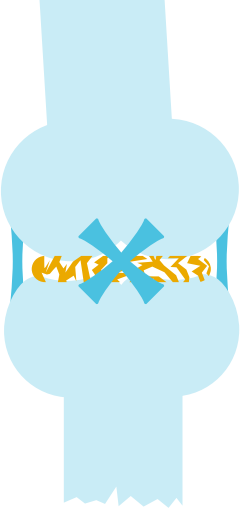
The kneecap is housed inside the patellar tendon of the large thigh muscle, reduces friction between the bone and tendon and also secures them from slipping laterally.

The knee is stabilized by two collateral ligaments and two cruciate ligaments: the latter support the joint during flexion, while the medial and lateral collateral ligaments provide support during extension.

The medial and lateral menisci are anchored with ligaments in the center of the knee on the joint surface of the tibia: these flexible, crescent-shaped fibrocartilaginous structures work together with small muscles, allowing the knee not only its hinge function but also slight medial and lateral rotation.

The movement sequences for flexion, extension and rotation are a complex interplay of various tendons and muscles. The two largest muscle groups are the front and back thigh muscles (quadriceps femoris or "quads" and biceps

Knee joint with ligaments



Wear and degeneration in cartilaginous tissue

femoris, part of the muscle group known as "hamstrings"). Unnatural movement patterns and accidents can cause ligament strains and tears as well as injury to the menisci. **Degenerative processes or wear caused by long-term excessive strain can damage the crucial function of cartilage tissue.**

If relevant factors occur frequently and in combination, the necessary protective functions, along with the knee's mechanical resilience, are severely restricted, bringing about risks such as permanent irritation and painful joint inflammation.

5.2 INDUSTRY-SPECIFIC STRESSES

Apart from leisure routines and consumption habits, lack of physical activity is often discussed as a cause of muscular degeneration processes that lead to conditions such as obesity and increased joint strain. But this is not relevant for many activities in logistics or field work: Instead, the movement sequences and work environment (e.g. hard, slippery or uneven floors, repeated transition between different heights) play a decisive role.

During the health checks in waste management companies around the country, a conspicuously high number of knee joint disorders were identified, often with advanced symptoms, meniscus and cruciate ligament conditions as well as osteoarthritis and instability.

The triggering factors for such conditions are mechanically demanding movements during walking and jumping, involving frequent irregular bends, shearing movements and turns: a comparable pattern has been demonstrated among football players for whom wear and injuries are typical cases for treatment in sports medicine.

Apart from these long-term strains, employees also have to transport heavy waste containers that are not designed ergonomically in terms of size, grip height etc., requiring various degrees of flexion and extension when loading the refuse collection vehicle.

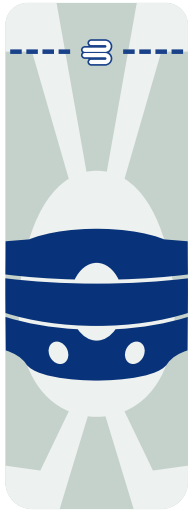
Early impairments and trauma to the knee joints cannot be ruled out during long-term professional activity and may also be recognized as occupational diseases depending on the circumstances: relevant proceedings brought before the social welfare courts along with investigations carried out by the German Federal Ministry for Health and Social Security (BMGS) were decisive for the inclusion of osteoarthritis of the knee in the Ordinance on Occupational Diseases (BKV, 2009; BK 2112).

The particular impact on this group of professionals has also been confirmed by reports of the scientific institute of the health insurance provider AOK (WIdO) in 2016 and 2019, indicating that the employee sick leave rate in the waste management sector is 50% higher than in other industries and shows a particularly high rate of musculoskeletal disorders of 40%.

Long-term stresses on the knee joints also occur in industrial sectors, for instance among machine operators, maintenance personnel and logistics workers: these are primarily activities involving repeated forced postures or standing on hard surfaces.

If heavy loads also need to be moved in tight spaces, additional joint strains are generated.

5.3 BAUERFEIND GENUTRAIN®



The primary active principle of the GenuTrain knee support is the combination of gentle compression, intermittent compression massage and stimulation of specific pressure points: This stimulates the metabolism, enables swelling to be reduced more quickly and strengthens the stabilizing leg muscles for added reinforcement of coordination through proprioceptive effects.

Knee supports are commonly equipped with a patella insert, a viscoelastic pad that encloses and stabilizes the kneecap. In addition to the integrated massage nubs and the special shape that promotes the reduction of swelling and pain ("Omega pad"), GenuTrain offers other distinctive design features:

Even during slight activity, two massage points work to relieve pain around the joint space and menisci, while two additional pads exert controlled pressure, stimulating the infrapatellar fat pads under the kneecap.

Ensuring a secure fit is a major challenge for knee supports to prevent them from slipping or fitting too tightly: anatomically contoured and available in eight different sizes (and five additional "Comfort" sizes), the GenuTrain can be adapted to individual requirements without restricting mobility. **The special texture of the breathable and flat, lightweight fabric holds the knee support securely in position even when under significant stress.**

Especially soft material behind the knee ensures wearing comfort and enables high flexibility during flexion and activities requiring longer periods of kneeling.

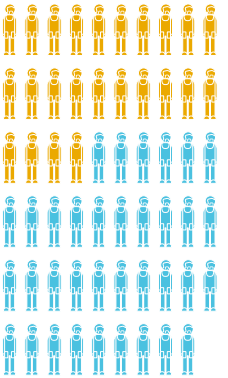
5.4 USE ON THE JOB: WASTE MANAGEMENT BUSINESSES

In 2014, the OHM team at Bauerfeind AG conducted its first orthopedic screenings, employee surveys and workshops at multiple Berlin depots of a disposal company operating nationwide.

Organized based on shift periods, these initiatives reached a large share of the workforce starting with 300 voluntary participants, and the subsequent preventive supply of orthopedic aids according to individual need was met with great acceptance.

The distribution of active supports, medical compression stockings and orthopedic foot orthoses was based on the measurement results documented by the orthotists without a bias towards particular products as well as the symptoms described the employees. With the employee's consent, a confidential consultation with the responsible occupational physicians was also offered.

According to the company management and works council, this initiative demonstrated significant improvements even after a short time with respect to the personal well-being of many employees and performance reduction or days of absence due to illness. Subsequently, this initiative was expanded to additional locations within the corporate group and conducted repeatedly by many other enterprises in the disposal sector operating locally and nationwide.



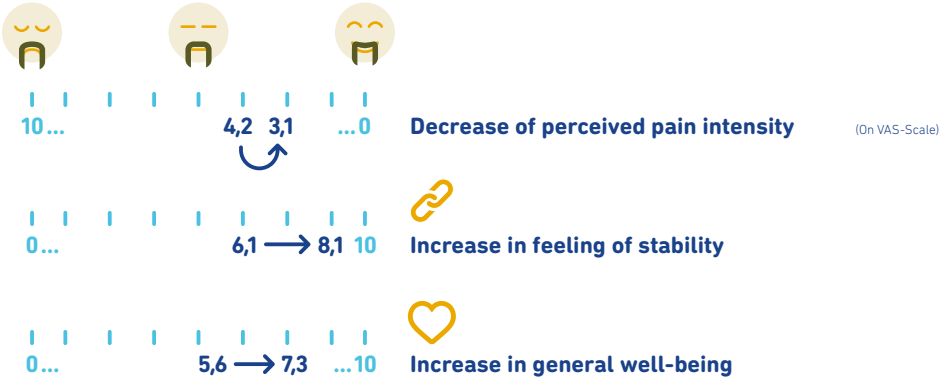
24 participants with knee pain, meniscus disorders, cruciate ligament disorders or osteoarthritis or instability

One noticeable difference compared with other sectors was the frequent mention of knee pain, which was only sometimes attributed to foot misalignments (skew foot, flat foot and splay foot) as a potential influencing factor after foot pressure measurements were taken. To investigate these symptoms in greater detail, observational studies were carried out on garbage workers in the city cleaning departments of Mannheim and Magdeburg in April 2016.

The call for voluntary participants brought in a total of 59 employees with an average age of 45 (the youngest participant was 26, while the oldest participant was 63). At that point, 24 participants already had indications such as knee pain (six participants), meniscus disorders (nine participants), cruciate ligament disorders or osteoarthritis (four participants for each) and instability (one participant).

Earlier treatment efforts were highly varied in terms of their methods and duration and did not achieve sustained success. Out of this group with prior indications, five participants reported an inability to work for one week and two participants reported an inability to work for two weeks during the observation period. None of the participants underwent accompanying physiotherapy treatment during this period that could have influenced the results.

Only four participants had used knee supports in the past, including one product obtained under a prescription from a manufacturer of medical aids who was not named and three models from the drugstore/discount retailer. These products were assessed negatively particularly in terms of material tolerability and durability, which led to initial skepticism about the GenuTrain support in the test. Nevertheless, its benefits regarding



quality and design quickly became clear: the initial percentage of test subjects who wore the support for a maximum of four hours per day was 27%, falling gradually to 19% as the study progressed. On the other hand, the percentage of test subjects who wore the support for between four and six hours per day increased from 37% to 47%, while approximately 35% of the participants consistently used the knee support for more than six hours per day. This is in line with the assessment of wearing comfort, which 78% of participants rated as "good to excellent" at the end of the observational study.

Another decisive criterion is the subjective perception of the frequency and intensity of knee pain, documented once per week on a scale from 1 to 10: the average value demonstrated a clinically relevant decrease over six weeks from 4.2 to 3.1 pain points (VAS), while the feeling of stability increased from 6.1 to 8.1 and the general sense of well-being improved from 5.6 to 7.3.

At the same time, there was a slight increase in the activity level of employees, consisting of their professional and leisure activities, and a greater general willingness to participate in accompanying health-promotional initiatives was reported. This is a potential result of the reduced pain levels achieved during the observation period as well as the improved effect of the knee support during movement.

5.5 USE ON THE JOB: COMPONENT MANUFACTURING

An international vehicle electronics manufacturer produces components for sensors and transmission control at its location in Thuringia. Although many manufacturing processes have already been automated, there are work steps in machine operation, maintenance and logistics involving specialist employees – largely activities carried out while standing and walking that cause an increased level of knee pain. These activities were examined in an observational study carried out in late 2019 (with a different assessment scale compared to the earlier studies):
The 20 test subjects who participated were predominantly men with an average age of 44. Before the start of the study, 19 of them complained of weekly knee pain, though this was only associated with the occasional use of pain medication in isolated cases.

The self-assessment of physical strain was 2.7 on average (moderate to mild) at the start of the study; work activities included lifting and moving heavy loads only to a limited extent.

The general health status was assessed similarly at 2.6, improving to 1.9 over the course of the study, with a higher rate of improvement than for perceived physical strain (2.2 in week 6 of the study).

The wearing period remained nearly unchanged at up to four hours per day for six participants, four to six hours per day for eleven participants and more than six hours per day for three participants, in line with the largely unchanged assessment of wearing comfort (2.2).

Health-promoting effects were identified especially during the last weeks of the test: the number of participants who experienced weekly pain dropped from 19 to eleven and then to eight. The frequency of pain experienced during the week also fell from 4.0 (that is, nearly every working day) to just 1.7. In fact, the combined frequency and intensity of pain decreased by more than 70% (from 6.2 to 1.8).

The extent to which this affects ability to work is demonstrated by the data concerning restrictions caused by knee pain: while the change in everyday work routines was moderate (decrease from 1.9 to 1.6), a more significant change was demonstrated in sports and leisure activities (from 2.6 to 2.1), and the **improvement during work activities (from 2.7 to 1.8) was particularly noticeable.**

In contrast, the participants observed an average increase in performance from 3.2 to 3.6 and said they were in favor of using knee supports at work as well as comparable support initiatives.


general
health status
2,6 > 1,9
experienced
weekly pain
19 > 11
frequency of
pain per week
4,0 > 1,7
frequency and
intensity of pain
6,2 > 1,8
work activities
improved
2,7 > 1,8

6 WRIST CONDITIONS
6.1 ANATOMY OF THE WRIST

Our hands are a particularly specialized evolutionary structure of the human anatomy: we need them to grip and move objects, to hold and support, for communication and to guide and operate tools.

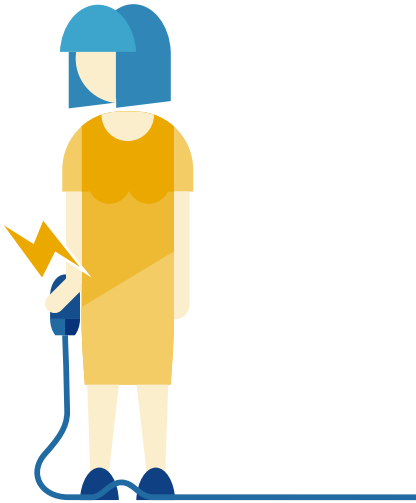
To guarantee the necessary degree of flexible flexion, extension and combined abduction movements, the wrist has a highly complex structure.

The three proximal carpal bones act as an interface with the radioulnar joint, also known as the scaphoid, lunate and triquetral bones because of their shapes.

A thin, loose joint capsule is attached to the edges of their cartilage edges and the articular disk and reinforced by numerous ligaments. The carpal bones make up a functional unit together with the midcarpal joint, which has an arched shape and operates solely as a hinge joint.

This locomotor apparatus is supported by multiple secondary joints, among which the carpometacarpal joint of the thumb has a special function: as a freely mobile and thus "true" joint, it enables the oppositional movement of the thumb against the remaining fingers.

The wrist bones are controlled by a dozen different ligaments, among which the transverse carpal ligament extending transversally across the carpal bones and the extensor tendons on



the back of the hand inside the tendon sheath, a protective envelope filled with fluid, are particularly significant.

These ligaments have become well-known because of the widespread symptoms among the general population:

Around one million people in Germany suffer from carpal tunnel syndrome (CTS), most of them women.

The condition, caused by anatomic constriction and excessive mechanical strain, is initially perceived as an abnormal sensation and is exacerbated by unnatural positioning and distortion of the wrist with painful pressure on the median nerve. Potential consequences include inflammatory reactions and damage to the nerve.

Long-term, repetitive uniform stress often associated with incorrect postures when using a keyboard and mouse at computer workstations, for instance, can cause tenosynovitis involving damage to collagen fibers that will not be sufficiently restored if there is inadequate regeneration.

This makes the tendons less resilient and particularly susceptible to irritation due to microtrauma that is felt as "tingling" as well as sharp stabbing and dragging pain. Induration and swelling in the wrist can also be observed.

In contrast, RSI (repetitive strain injury) syndrome tends to produce rather non-specific symptoms that worsen under more demanding activities and typically involves a combination of hand, arm, neck and shoulder pain.

Other wrist conditions include osteoarthritis of the carpometacarpal joint of the thumb, caused by excessive strain on the joint, that primarily occurs during certain assembly activities or exercise ("skier's thumb").

6.2 INDUSTRY-SPECIFIC STRESSES

While wrist conditions are recognized as occupational diseases for computer-based work in the USA and Australia, the first cases were only acknowledged in Germany over the last few years:
although the associated stresses can be effectively and economically reduced with ergonomic keyboards, mouses and wrist rests along with height-adjustable tables, the intensive use of smartphones and computers in private life are aggravating factors that can be attributed to leisure behavior.

There are also challenges in occupational medicine in many other professional groups that primarily perform manual work:
Apart from typical trade professions, this primarily includes wait staff in restaurants who bear one-sided loads of multiple pounds on their wrists when carrying food and drinks.

Repetitive, uniform activities are also an issue for cashiers in the retail sector, where goods of all sizes and weights have to be drawn past the scanner on the conveyor belt at high frequency – always in the same direction for the entire shift, and with constant one-sided bending of the wrists. In industrial sectors, comparable strain occurs primarily for employees on sorting lines and packaging lines.

Manual work steps are also common for specific assembly processes in the automotive industry, for instance when attaching smaller components and electronic components and when manufacturing interior trim: more than in other sectors, **excessive strain on the carpometacarpal and the other joints of the thumb** is a significant factor here.

Intense mechanical forces acting on the wrist, for instance when working with pneumatic hammers, often trigger vibration trauma that causes damage to vessels and results in insufficient blood supply to the joint complex.

The resulting degeneration or even complete necrosis of the lunate bone, known as lunatomalacia or "Kienbock's disease", can lead to a complete loss of carpal function if left untreated.

6.3 BAUERFEIND MANUTRAIN® AND RHIZOLOC®

The frequent and often intensive strain on the wrist places strict requirements on suitable aids. Mobility must not be restricted and appropriate relief must be guaranteed under varying levels of irritation: even brief overloading can often cause severe symptoms to recur after initial healing progress.

To balance stabilization and stimulation in all situations, the ManuTrain hand support includes the option of using an individually adjustable stay made of lightweight plastic if greater stabilization is needed.

This stay offers firm support around the wrist and carpus to protect against further overloading. The degree of stabilization can also be flexibly adjusted using a wide Velcro strap. Once the irritation has mostly subsided, the stay can easily be removed to shift the support's effect towards mobilization of the wrist:
Anatomically adjusted for the left or right hand and available in six sizes, the ManuTrain support provides compression to promote circulation, and its two viscoelastic pads accelerate the reduction of swelling and edema caused by irritation.

Due to the particular sensitivity of the hands, care was taken to use a breathable, easy-to-clean material with no bothersome seams between the thumb and index finger to allow gripping movements without irritation.

In case of damage to the capsular ligament complex in the thumb caused by trauma or strain, or osteoarthritis of the carpometacarpal joint, RhizoLoc is a special orthosis that splints and stabilizes the thumb at the carpometacarpal and metacarpophalangeal joint with an individually adaptable aluminum frame.
Once the pain relief and regeneration enabled by immobilization of the joint has progressed, a special Velcro fastening allows the support to be loosened gradually. This makes it possible to start mobility exercises at an early stage.

The design of the orthosis makes it easy and fast to put on or take off with one hand. As "ManuLoc Rhizo", it is also available with a stabilizing wrist orthosis in various designs to treat combined indications.

6.4 USE ON THE JOB: POINT OF SALE WORK

As part of OHM initiatives, hand supports are already regularly issued to affected employees in the hotel and catering sector, manufacturing and logistics. New demand has arisen for preventive applications for employees in the automotive and retail industries.

To identify reliable data concerning medical efficacy and compliance with work processes and occupational health and safety provisions, their use was tested and evaluated in two companies over a period of 6 weeks to serve as an example.

In fall 2018, 28 cashiers at various stores of a large discount supermarket chain in North Rhine-Westphalia, most of whom had been working for many years, participated in a practical test of the ManuTrain hand support that was assisted by the store managers and coordinated by the OHM officers in the region.

Initially, the employees judged their general health status with an average score of 2.6 on a 5-point scale (acceptable to good); this figure improved to 2.2 (mostly good) at the end of the observation period. Eight of the participants continued to assess their health status as "good", and six participants remained at only "acceptable". This means that the other half of the participants demonstrated an average improvement of nearly one point.

While 19 of the 28 participants reported specific wrist complaints at the start of the test, this number began to decrease in the third week: over the last two weeks, just twelve participants indicated relevant health restrictions. The significant factor here is primarily the reduction in the frequency and intensity of pain: **Initial average values of 3.6 "pain days" per week fell down to just two days per week over the six week period.** This development is even clearer in the figures derived from multiplying this number of days by the intensity assessed on a 4-point scale: the level of pain experienced per week fell from 6.3 to 2.6 on average. Two participants with frequent pain and two participants with constant pain experienced no change, along with the six employees who had no pain from the start of the test as anticipated.

A similar tendency was reflected in the declining use of pain medication: **the 28 participants took pain-relieving medication a total of 48 times during the first week (1.9 times on average), a figure which ultimately reduced to just twelve in total (0.5 times per week) and thus 25% of the original rate.**

Since ten participants took no pain medication throughout the study and one participant provided no information, the statistically adjusted results for the remaining group demonstrate a reduction to one third or complete cessation with respect to the initial consumption of pain medication.

The fundamental physical strain caused by work activities remained "moderate to high" for eleven participants with an average value of 3.6 on a 5-point scale; for employees with milder strain, the value decreased from 3.4 to 2.8.

Slight improvements were also demonstrated in the perceived increase in performance capacity (from 3.1 to 3.4 on a 5-point scale) and the support and relief provided by using the hand support during work (from 6.9 to 7.4 on a 10-point scale).

The average wearing period of four to six hours per day remained largely unchanged, as did the wearing comfort assessed as "mostly good" with 2.2 points. The assessment only worsened slightly in two cases: one employee described wearing the support as "unacceptable" and one employee rated this as "not very good".

A habituation effect is evidenced in the assessment of restrictions felt on a 5-point scale due to regular use: during work, this fell from 2.7 to 1.9, while in leisure activities, there was a comparable decrease from 2.3 to 1.9, and a similar decrease from 2.4 to 2.0 was demonstrated in everyday problems caused by wrist complaints.

No accompanying measures such as physiotherapy treatment were used for 22 of the participants during the observation period, two participants used such measures sporadically, and only four participants made use of them consistently:
Further studies are needed to show to what extent this is determined by experience from previous attempts at treatment, factors like time and money or the ready availability of pain medication.

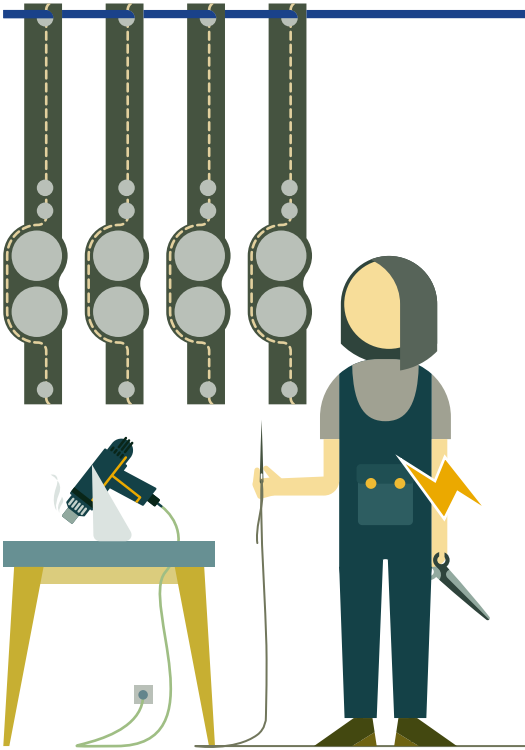
6.5 USE ON THE JOB: AUTOMOTIVE SUPPLIERS

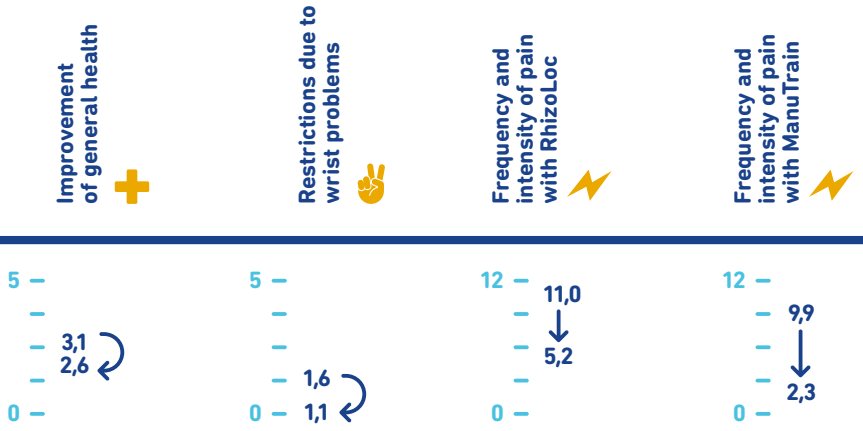
For cars in the premium segment, is particularly important to use high-quality materials in designing the vehicle interior. Mounting such materials to prefabricated support elements such as dashboards, glove compartments and center consoles generally requires manual precision work: adhesive points must be positioned carefully and protruding material such as kinks or folds must be removed with a cutter knife, and subsequent shaping is accomplished using hot air guns.

In early 2019, 20 employees at the Thuringia location of a supply company participated in an observational study, also involving parallel testing of products to relieve knee and back pain due to the variety of workstations.

For better correlation, the following data exclusively relates to the use of the ManuTrain wrist support by a total of seven employees and the use of the RhizoLoc orthosis for the carpometacarpal joint of the thumb by four employees.

In four additional cases, the test with RhizoLoc was stopped because the support occasionally left pressure marks in the processed material during work. Design adjustments along with additional protection of the interphalangeal joint of the thumb against excessive stretching could increase the range of possible applications.





The improvements were moderate in terms of the general health status of the participants (from 3.1 to 2.6 on a 5-point scale). Restrictions in everyday routines caused specifically by wrist problems decreased from 1.6 to 1.1, and the perceived strain during work fell slightly from 3.4 to 3.1 when using the support. Increased performance capacity remained constant with an average of 3.3 ("accurate/partly accurate").

In contrast, the frequency and intensity of pain (pain days per week multiplied by the pain level on a 4-point scale) decreased to a similar extent as in the previous study:
With RhizoLoc, this value fell from 11.0 to 5.2 over the six-week period, and ManuTrain demonstrated an even greater decrease from 9.9 to 2.3. In both cases, the pain level at the start of the test was clearly higher than for cashier work (with initial average values of 6.2).

The most significant pain reduction was detected during week three and four, although two employees with initial mild pain were consistently pain-free as of week two. Only one employee reported a constant high level of pain in the range of 10 to 12 and thus did not benefit from the initiative.

Comparable to other tests, the average wearing period of the hand support or orthosis was four to six hours per day, and the assessment of wearing comfort became more positive over time (from 2.9 "acceptable" to 2.1 "mostly good" on a 5-point scale, five participants experienced no change), and increasing relief or support was perceived (increase from 5.8 to 7.4 on a 10-point scale).

7 VENOUS INSUFFICIENCY

7.1 ROLE OF THE VASCULAR SYSTEM

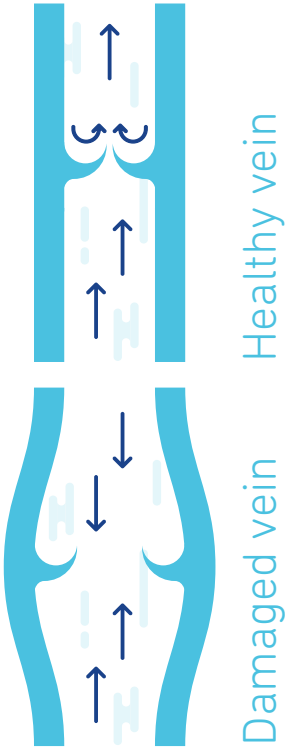
While the heart pumps nutrient-rich blood through the arterial system to the organs via an extensively branching network, from the aorta ultimately down to tiny capillaries, the venous system transports back the deoxygenated blood enriched with metabolic products.

As a low-pressure system (15 mmHg in supine position), the veins accommodate the majority of the circulating blood volume (80%). Venous return flow primarily occurs via the deeper venous system (the fibular veins, the great saphenous vein, the femoral vein as well as the external and common iliac veins).

The interaction between various mechanisms (including suction effects, breathing and the diaphragm, joint pumps and especially the calf muscles) exert pressure pulses on the elastic vascular walls of the veins.

The venous valves are located at regular intervals within the veins, acting like check valves: they open only upward towards the heart in response to pressure, but remain closed downward to prevent blood from pooling due to gravity.

This system can be impaired due to various factors: Women have a higher indication rate than men since their connective tissue is weaker because of hormones. In addition, pregnancy significantly increases the blood volume and



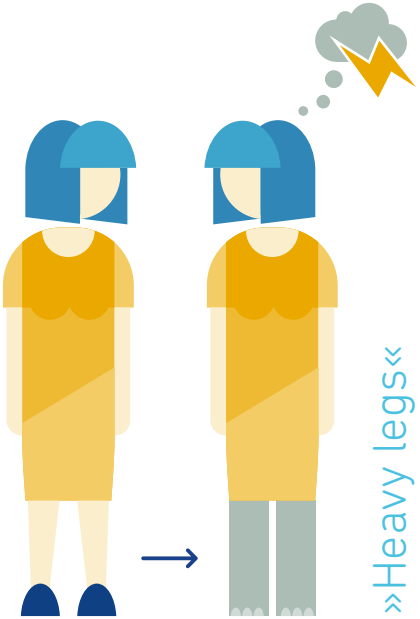
places greater strain on the venous system. Weakly developed muscles or reduced viscosity of the blood due to insufficient fluid can have negative impacts as well; genetic predisposition or obesity are also considered potential causes of venous insufficiency.

Another significant influencing factor, however, is the lack of activity common in the general population, which is aggravated by work carried out predominantly while sitting or standing.

Without the required frequency and intensity of pressure pulses exerted by the muscles, the venous return flow becomes slower: the result is "pooling", an increased amount of blood in the venous system. This causes the vascular walls to dilate, the venous valves are overloaded, and their function can be damaged permanently under long-term strain.

Such hemodynamic disruptions initially manifest as branches of the superficial venous system, also known as "spider veins". **Typical symptoms also include increasingly "heavy legs" over the course of the day and swollen feet, early fatigue and loss in concentration.** At an advanced stage, insufficient supply to the tissue becomes evident in dry, scaly and pale skin around the ankle and lower leg, which ultimately causes venous leg ulcers.

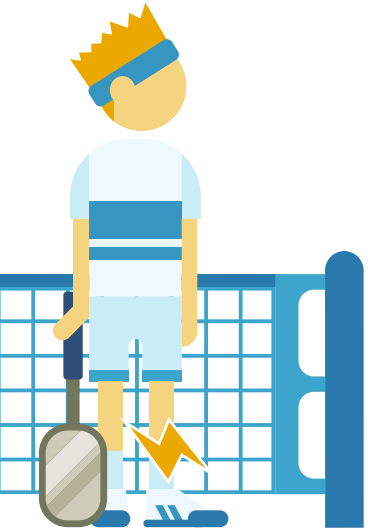
Damages to the deeper venous system are not perceptible from the outside but can be life-threatening: impaired vein function causes an increased risk for the formation of blood clots, which can become dislodged and clog vessels as they make their way through the cardiovascular system as a thrombus ("blood clot").



»Heavy legs«

This condition called thrombosis generally occurs spontaneously and requires immediate medical treatment to prevent insufficient blood supply to the tissues and organs involving extensive associated risks.

Positive effects of compression stockings in sports medicine as well



Although chronic venous insufficiency (CVI) is generally irreversible, the progression of the condition can be stopped through surgical removal ("stripping") of damaged veins: this procedure is covered by most health insurance funds, provided there is a medical need. New minimally invasive procedures using endovenous laser treatment (EVLT) or (foam) sclerotherapy of damaged vein sections can be carried out with comparably little effort, but are not yet generally recognized as a covered procedure by health insurance funds due to additional risks and high recurrence rates.

When diagnosed early and provided there is a low degree of risk, intermittent compression therapy and, in particular, medical compression stockings have proven successful as conservative methods of treatment.

Due to its demonstrated positive effects, the latter method is used in sports medicine and competitions and is becoming increasingly common for preventive occupational health: in fact, a large German automotive manufacturer already issued sports compression stockings to 400 employees standing at assembly lines and conveyor belts for prevention purposes in 2014.

7.2 INDUSTRY-SPECIFIC STRESSES

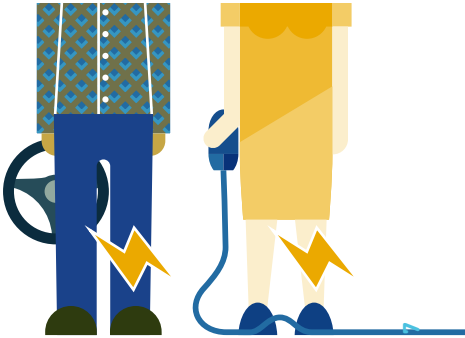
Venous problems tend to be a work-related ailment, with relevant symptoms particularly affecting professions that require extended periods of standing, for instance in retail, logistics or industrial operations – not to mention the percentage of people that mainly work while sitting:

Increasing digitalization has led to more than half of employees in Germany now working at computer-based workstations. Such employees are particularly considered in laws such as the German Ordinance on Work with Visual Display Units (BildscharbV) with respect to potential strain on the eyes, atrophy of back muscles, posture damage and RSI syndrome (see above) due to inadequate ergonomic conditions as well as a lack of balancing movements and reasonable break periods.

In contrast, chronic venous insufficiency is hardly given consideration despite high rates of indication: still, special cushions or footrests at the office can make a small contribution towards optimal sitting posture and improved circulation.

The health burden and case numbers are usually difficult for human resources and health officers to grasp since they are grouped together under the heading of cardiovascular diseases in the general analysis of sick leave rates. As a specialist discipline of medicine, phlebology only plays a minor role in medical training and thus in patient consultations, so there is little awareness about corresponding risks and the need for prevention.

Another significant group of employees are drivers, whose field of activity extends from forwarding agents and haulage companies, field sales representatives and vehicle drivers in local and long-distance public transportation. Compared with office workplaces, ergonomic adjustments and regular activity breaks are more difficult to provide here, and there are occasionally other detrimental factors such as unhealthy eating habits, obesity and insufficient fluid intake.



7.3 BAUERFEIND VENOTRAIN®

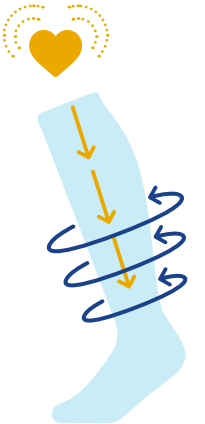
The goal of compression therapy is always to speed up the venous return flow to the heart to relieve the venous valves, improve the supply of nutrients and reduce the risks of thrombosis: **to this end, VenoTrain medical compression stockings exert defined compression that decreases from the ankle up to gently compress the dilated veins and reinforce the effect of the calf muscle pump even during slight impulses of movement.**

Although this basic principle also applies to anti-embolism stockings, support stockings or travel compression stockings, the compression provided by medical compression stockings and thus their degree of efficiency is significantly higher depending on the compression class (1 for mild, 2 for moderate and 3 to 4 for severe or very severe venous insufficiency).

The precise fit of the stockings plays a decisive role, which is why the first step after a prescription is to measure the leg circumferences and length at an orthopedic medical retailer: even simple knee-high stockings are not determined by shoe size, but rather according to the circumferences around the ankle and calf using a complex system of standard sizes, and in many cases they are custom-made for the individual patient.

With different colors, fashionable design, breathable microfibers or an athletic look, compression stockings have improved considerably in recent years both visually and in terms of comfort, gaining acceptance as medically proven functional clothing for everyday use.

Compression garments have become firmly established in the field of sports, but a great deal of education is still needed for general use and preventive occupational health.

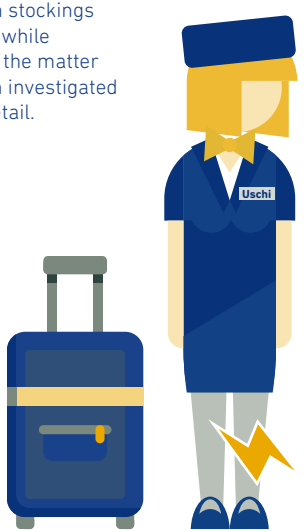


Calve muscle pump

7.4 USE ON THE JOB: AIRLINE

Venous disorders are among the known health risks on long flights as they are associated with limited mobility or sometimes dehydration and fluctuations in pressure.

Frequent fliers often use medical compression stockings or basic travel or support stockings as a prophylactic measure. Cabin staff are also recommended to use compression stockings preventively while working, but the matter has not been investigated in greater detail.



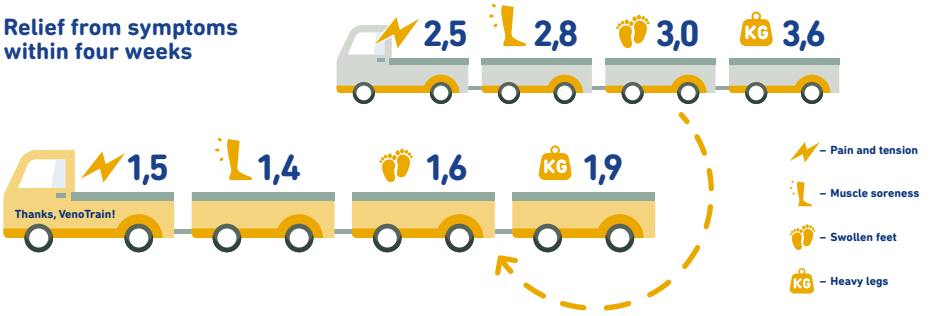
The response among the workforce was thus overwhelmingly positive when they were offered the opportunity of voluntary participation in a four-week observational study during a health week in 2017:
In just two days, 100 participant slots were filled, and an additional 20 participants were on the waiting list. With 97 log books, the response rate was also higher than average and a good data basis was established for analysis.

83% of the participants were women, and the majority was in the 40–49 age bracket, accounting for 34.4%. The distribution of the age groups 20–29 and 30–39 was approximately equal at around 25%, and 12.5% of the participants were in the 50–59 age group. 52% of all participants had been working as crew members for more than ten years, and 27% had been working for more than 20 years.

28% of participants already wore compression stockings regularly, and some were equipped with stockings in compression class 2 upon request, in contrast to the majority of first-time users.

Special consideration was given to the requirements for crew uniforms concerning the color, design and visual style of the stockings.

Relief from symptoms within four weeks



While 33.7% of the participants experienced no pain at the start of the test period, 46.5% reported suffering from heavy legs or swollen feet once or twice per week. Nearly 6% reported experiencing those symptoms on a daily basis.

Other symptoms indicated in declining order of severity included recurring muscle soreness, itching, feelings of tightness and non-specific leg pain.

With the perceived symptoms only slightly reduced from 2.4 to 2.1 on the VAS scale, the prevalence of itching was largely unchanged at the end of the test; this could be caused by stronger forces exerted on the skin under compression, pre-existing damage or dry air in the cabin.

More significant changes were recorded for pain and feelings of tightness, which each decreased from 2.5 to 1.5, and muscle soreness which fell from 2.8 to 1.4.

While heavy legs and swollen feet were the most common symptoms reported at the start of the test with 3.6 and 3.0 respectively, the frequency and intensity of symptoms reduced nearly by half to 1.9 and 1.6 by the end of the observation period.

In line with these figures, no participants reported daily symptoms by the end of the study, occasional symptoms reduced by a third to 31.3%, and the percentage of crew members without symptoms nearly doubled from the initial figures to 65.1%.

Apart from the level of suffering, material properties and visual characteristics, another important factor for the acceptance of compression stockings is the effort involved in putting them on: 2.4% of participants consistently rated this factor as "too difficult", while 36% initially reported that it was "strenuous", a rating that was only given by 24.3% at the end of the test. On the other hand, a significant majority of 61.6% (initially) and 73.3% (end of test) described the effort involved as "low".

Based on their positive overall impression, 89% said they would recommend the general use of compression stockings during work and would continue to regularly wear the stockings themselves at work after the end of the test.

7.5 USE ON THE JOB: PUBLIC TRANSPORTATION

Typically, compression stockings are designed to offer equally high levels of comfort and support when sitting, standing and walking.
Inspired by requests from a medical facility for paraplegic patients, Bauerfeind AG developed a special stocking that is also suitable for wheelchair users to reduce swelling and edema formation:
This product version features a special enlarged heel section and a modified knitted fabric in the instep area to prevent creases and potential pressure points that frequently form while sitting.

To also evaluate the relevant benefits for employees who predominantly work while sitting, a voluntary blind study performed in 2019 equipped bus and streetcar drivers from a local transport company in Thuringia with VenoTrain soft compression stockings. Half of the stockings were conventional models and the other half had been specially adjusted.

The final assessment demonstrated that very few of the participants had prior experience with compression stockings. That is why emphasis was placed on the general findings, and the two stocking versions are grouped together in the discussion below.

With 19 out of 22 participants, there vast majority of participants were men. The average age was 45. Only five participants had worn compression stockings from various manufacturers in the past; nine participants stated that they had no prior knowledge of vein health.

Given this background, the acceptance of the stockings was high from the start of the test; a total of 13 participants wore them five or more days per week. Three participants restricted their use to three or four days per week, and five participants only wore them for one or two days.

With respect to the average wearing period per day, this degree of use only changed slightly over the four weeks, and no significant trend was evident:
nine participants reported wearing the stockings for longer than eight hours. Ten participants reported average wearing periods of five to eight hours, and three participants indicated up to four hours. One participant initially and three participants at the end provided no specific details here.

No difficulties were perceived in wearing comfort for the most part: only the upper edging of the knee stockings received initial criticism from seven participants, with scores ranging from four to seven on the 10-point scale.

There were scarcely any restrictions to comfort when standing, walking or lying down; five of the participants outfitted with conventional compression stockings reported slight restrictions solely during sedentary activities, which decreased over the course of the study.

For unexperienced users, putting on the compression stockings posed difficulties initially, as evidenced by their assessments: at the start and end of the test, only four participants described the process as easy; six at first and ten by the end indicated that the process was mostly without difficulty.

Nine participants reported slight effort, and ten participants even reported considerable effort at the start, but most of these assessments reduced to "without difficulty" or "slight effort" over the four weeks.

This might be related to the effects achieved by treatment even after a short time: although five participants had already worn compression stockings in the past, 18 participants reported multiple substantial symptoms on a 10-point scale at the start of the observational study, such as heavy legs (3.8), swollen feet (3.4), feelings of tightness (3.3) and pain (2.8).

Occasional tingling of the lower leg, muscle soreness and itching were also reported but less pronounced with average scores of 2.5. All but four of the participants experienced all symptoms at least to a certain degree.

From week three onwards, a correspondingly marked reduction became evident:

In most cases, the severity of symptoms is reduced by half

The symptom of heavy legs reduced to 1.9 and swollen feet reduced to 1.7. The smallest change was indicated for itching, where there was still a significant reduction from 2.4 to 1.5, and the largest change was reported in occasional muscle soreness, which decreased from 2.6 to 1.1.

14 of 22 participants subjectively stated "slight to significant" changes starting with the first week and retained this assessment until the end of the test (2.7 on a 4-point scale). With 1.4, the average assessment was correspondingly positive: physical improvements were noticeable in the majority of cases, and most participants were happy to be wearing the stockings. In the final assessment, 20 of the 22 participants were in favor of occasional or regular use of compression stockings during everyday work.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ÖVB

7.6 USE ON THE JOB: LAW FIRM

As representatives for sedentary work at computer workstations, 19 employees from a Hamburg-based law firm operating nationwide were recruited for an observational study involving VenoTrain micro and VenoTrain business compression stockings.

No information was provided about gender or age. A comparatively large group of ten participants had previously worn compression stockings at some point or repeatedly.

With respect to heavy legs and swollen feet, only three patients reported no symptoms at the start. Four employees indicated occasional problems (once or twice per week) and six employees reported frequent problems (three or four times per week). Another six employees stated they had symptoms nearly every day.

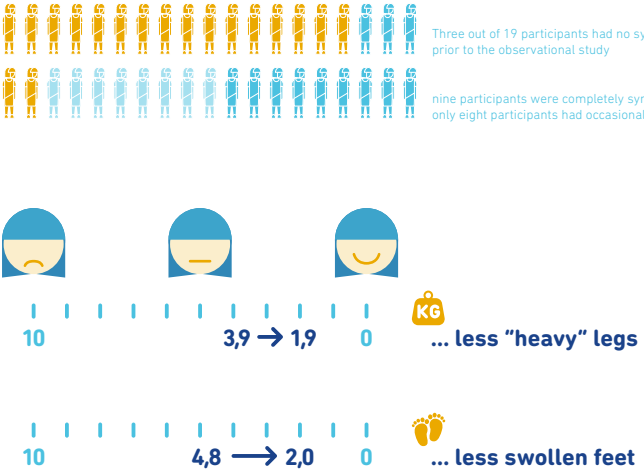
Positive changes were demonstrated even after the first week of the test, with only two participants experiencing frequent symptoms and eight participants experiencing occasional symptoms after four weeks. Nine participants reported no symptoms at all by the end of the observation period.

Significant improvements were ultimately identified in all cases, without stagnation or deterioration compared with the initial values.

In addition to the frequency of symptoms, their intensity as assessed on a 10-point scale also decreased significantly, from 3.9 to 1.9 for "heavy legs" (including one slight worsening and two cases without symptoms) and from 4.8 to 2.0 for "swollen feet".

Mild pain and muscle soreness were only mentioned by eight participants and fell by 1.2

Heavy legs and swollen feet



and 0.7 points, respectively; twelve employees reported tingling in their legs, which improved significantly compared with other studies from 3.1 to 1.3, and 14 participants indicated frequent feelings of tightness, which gradually reduced from 4.1 to 1.6.

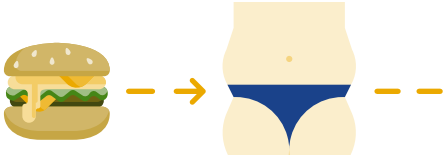
The experience in putting on the support remained largely unchanged during the test period (low effort for two participants at the end of the test, eight participants reported that putting on the support was easy, and another eight reported no difficulty, one employee provided no information here). There was also no change in the consistently long wearing period for the stockings (one to four hours per day for nine cases, up to eight hours for five cases and more than eight hours per day for four participants).

A considerable majority of 15 participants said they felt the observational study was worthwhile because of the generally positive effects achieved in a short time (with one negative response and three responses of only "somewhat worthwhile"). Accordingly, in the final assessment, two employees somewhat recommended the use of compression stockings, and 17 other participants strongly recommended the use of compression stockings for sedentary work in the office.

8 MUSCULAR ATROPHY AND MUSCLE PAIN

Loss of muscle strength can have many different causes: deficiencies caused by illness, age or diet can reduce muscle mass, and nerve damage can lead to reduced stimulation of the tissue.

The relevance of this phenomenon is evident from post-operative immobilization after bone fractures, for example: due to complete inactivity, muscle function is severely restricted after just a few weeks and requires mobilizing exercises during the subsequent rehabilitation phase with the guidance of a physiotherapist.



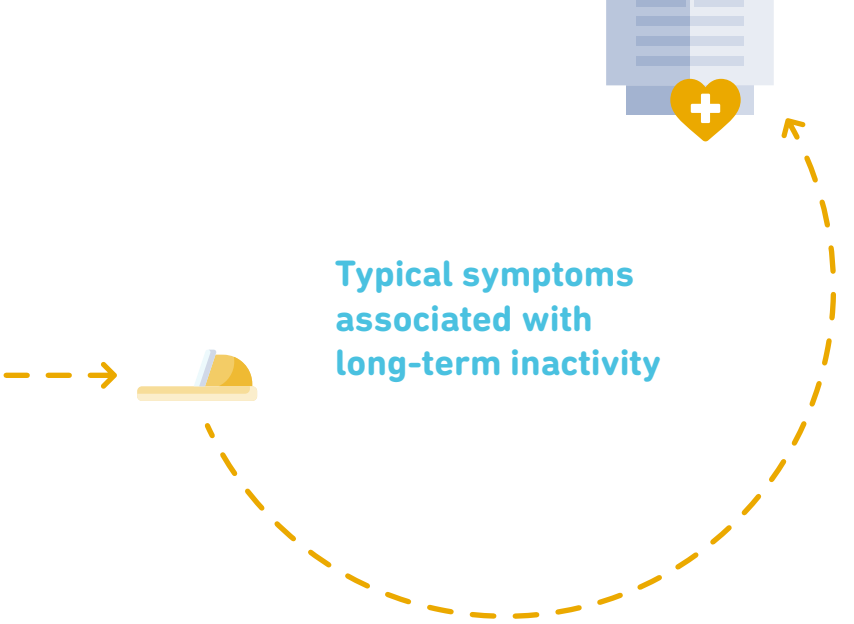
In contrast to pathological forms of muscle wasting, the cause of muscular atrophy in everyday life is primarily insufficient or one-sided movement:

Muscle stimuli in the back muscles are significantly reduced during predominantly seated or standing activities. Other typical symptoms associated with long-term inactivity include impaired blood flow and less efficient fat metabolism.

The resulting weight gain exerts additional physical strain and limits mobility. In the event of an advanced decrease in muscle tone, even slight strains can ultimately trigger pain, and the risk of falls or overstretching of ligaments is also increased due to this weakened function. Patients tend to move even less as a result, which further aggravates their health problems.

In recent years, gym balls (also referred to as "Pezzi balls" after one of the leading manufacturers) have frequently been used as a preventive measure in office workplaces: their lack of back and side support and the slightly unstable, constantly variable sitting position exert a constant, scarcely noticeable stimulation of the back, abdominal and buttock muscles, thereby at least partially compensating for the lack of "natural" movement sequences.

To ensure healthy sitting posture, it is important to ensure that the ball is the correct size determined by height and lower leg length and that it has sufficient bearing capacity and high pumping pressure.



It must also be considered that gym balls involve a certain risk of accidents and should therefore be fixed on the ground with a stabilizing ring. The daily period of use should also be restricted to one or two hours to maintain the degree of stimulation within an appropriate extent and prevent painful microtears of the muscles ("sore muscles").

Muscle pain can occur not only during particularly strenuous work or due to restrictions caused by degeneration: low-intensity activities that are repetitive, uniform and monotonous can also result in pain.

For instance, employees whose work entails typing on computers, who work in packaging and sorting facilities or assembly processes with small components or professional musicians frequently suffer permanent strain of specific muscle fibers:
The underlying overstimulation of these constantly hard-working fibers can ultimately trigger chronic muscle pain syndrome if the repetitive processes are not regularly interrupted and sufficient time is not allowed for regeneration.

A relevant relief effect can be achieved by rotating employees through different areas of work.

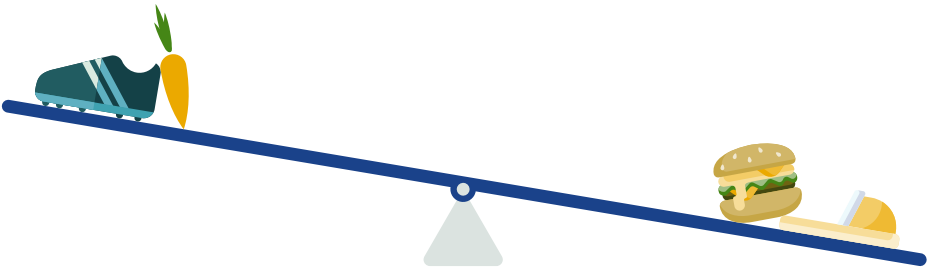
9 FOOT MISALIGNMENTS AND POSTURE

Similar to our hands, our evolutionary development into bipeds involved the formation of a highly complex anatomy in the human foot: to compensate for the double weight load compared with four-legged vertebrates and to ensure the necessary mobility when standing and walking, 26 different bones work together with a group of ligaments and muscles in each foot.

The foot features a curved arch that acts as a cushioning shock absorber to protect the joints and organs against severe mechanical stresses when walking. The transverse arch is held up by the fibularis longus and tibialis posterior muscles, while the longitudinal arch is supported by two additional muscles, the flexor hallucis longus muscles as well as the plantar aponeurosis and the long plantar ligament.

As our lifestyle and ways of working have changed significantly over the centuries, our feet are also subject to very different stresses nowadays: most people walk relatively little in their everyday routines, many professions are practiced while standing or sitting, a large part of leisure activities are defined by TV and the internet.

In addition to degenerative decline of the foot muscles, increased weight and severe stresses caused by walking on hard surfaces (asphalt, stone floors, concrete) are also common factors. Shoes with insufficient cushioning or high heels can also cause problems.



Negative impacts to health are also evident around the balls of the feet and heels, which bear most of the weight of the body along with the outer edge of the foot.

Foot misalignments such as splay foot, skew foot or arch-decreased foot are very common and frequently occur in combination with inward rotation (pronation), or more rarely with an external rotation of the foot (supination).

Flat foot (pes planus) is a pronounced form of arch-decreased foot in which the longitudinal arch is severely flattened. This causes excessive strain on the aponeurosis and an inflammatory reaction in the heel bone. The result is severe pain and the formation of a heel spur created by calcium deposits in the lower or rear area of the heel bone.

With shoes that are too short or tight, weak connective tissue and a corresponding genetic predisposition found primarily among women, splay foot (lowering of the anterior transverse arch) can also be associated with the formation of hallux valgus (bunion): in this condition, the metatarsophalangeal joint of the big toe protrudes significantly and the toe bends increasingly inwards.

Heel spurs and hallux valgus typically cause pain and receive medical treatment, but other foot misalignments often remain undetected or only have an indirect effect that nevertheless implies extensive consequences for the musculoskeletal system:
The decreased cushioning caused by arch-decreased foot increases the mechanical strain on the articular cartilage in the ankle and knee and can also accelerate wear on the hips and spine in extreme cases (for instance when jogging on asphalt).

What is more, foot misalignments are never entirely symmetrical: for instance, the arch of the foot might be flatter in one foot than the other, causing misalignment similar to a difference in leg lengths.

While slight congenital differences in leg lengths are often compensated during physical development, this is not possible for acquired foot misalignments. The increased joint strain is accompanied by disrupted posture with underlying muscle tension occurring on one side as the body attempts to correct the incorrect posture. This tension is primarily felt in the form of localized hip, back and shoulder pain for which the treatment of symptoms alone does not offer sustainable healing opportunities.

In contrast with purely cushioning insoles from shoe retailers or discount stores, orthopedic foot orthoses are individually adjusted after careful measurement by an orthotist. Targeted support and relief is provided by the appropriate shape and placement of pads, raised outer edges and stimulation points.

Modern foot orthoses have a considerably flatter design than insoles of the past and can also be used with fashionable footwear. **For work safety footwear it must be ensured that only design-tested foot orthoses certified according to national safety directives are used.** Otherwise, the company will be exposed to significant safety and liability risks regardless of the actual accident.

HEALTH TIPS & TOOLS

As an international manufacturer of orthopedic products, Bauerfeind AG offers a variety of informational resources that are easily accessible from medical retailers, in free print media and online:

BAUERFEIND-GROUP.COM/EN/KNOWLEDGE/HEALTH-GUIDE.HTML
Expert knowledge, clinical symptoms, exercises and tips for everyday life

HEALTH TIPS AND EXERCISES
Articles, guides and interviews about pain-free movement and staying healthy

PRODUCTS
Overview of the product ranges: supports, orthoses, orthopedic foot orthoses and compression stockings

BAUERFEIND LIFE – MAGAZINE
For physicians and partners in the healthcare sector, also online at: www.bauerfeind-life.com

BGM.BAUERFEIND.DE/EN
Overview of available services for health days, health management and occupational health and safety

SPECIAL THANKS

In this brochure, the participating companies were not named due to data protection. We are however happy to forward your data on demand to the respective persons responsible for further contact.

Many thanks to all company doctors, safety experts, organizational health and human resource managers and especially the many dedicated staff members for their trust, active participation in the on-the-job studies as well as all the organizational support!

With your help, precious insights in common strains at work and productive prevention measures could be gained and made accessible for other companies.

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