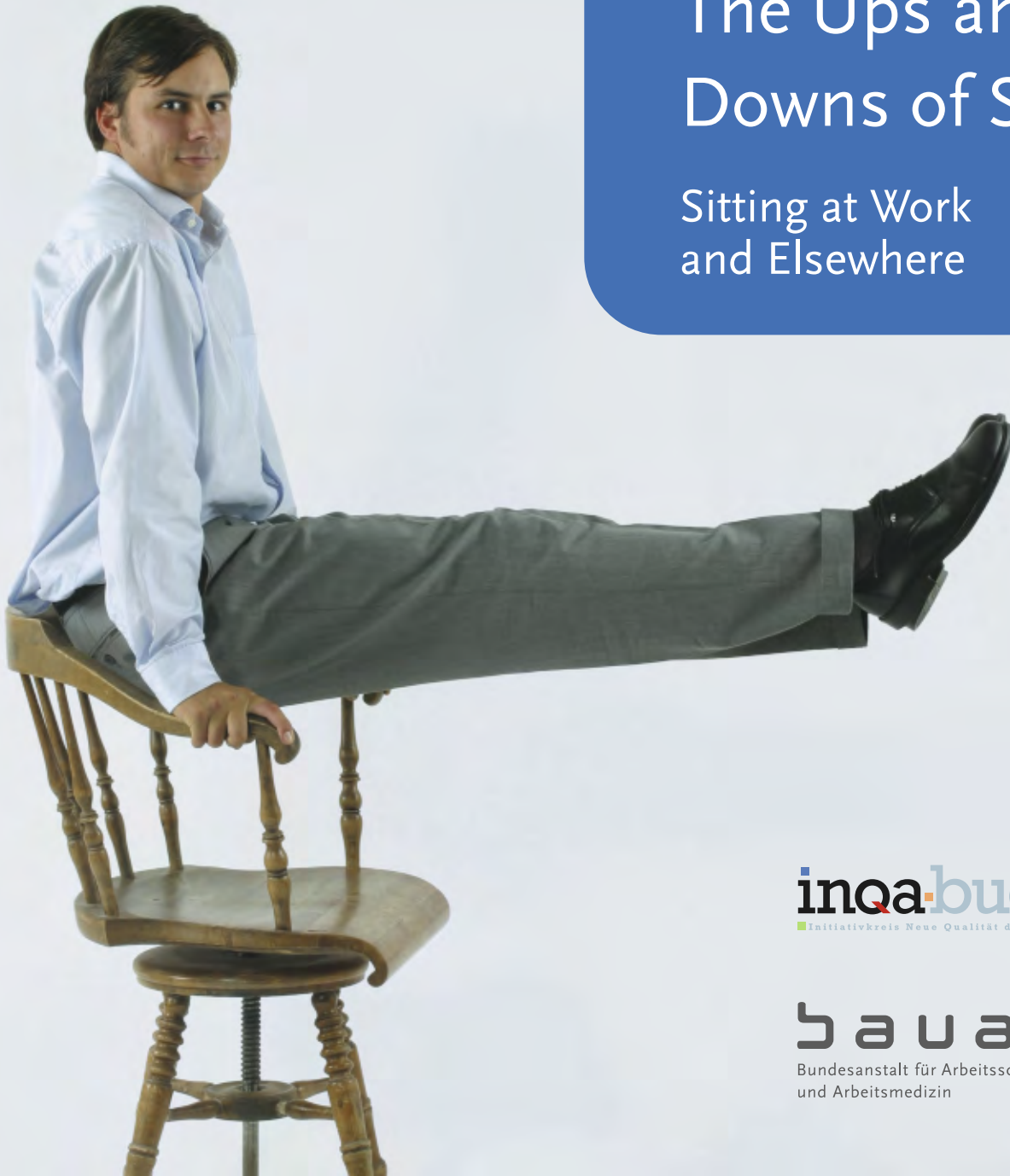


The Ups and Downs of Sitting

Sitting at Work
and Elsewhere



inoa.buero
Initiativkreis Neue Qualität der Büroarbeit

baua:
Bundesanstalt für Arbeitsschutz
und Arbeitsmedizin



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Introduction

Actually sitting is not really a problem. You sit down, and after a little time you stand up again. But the time span between sitting down and getting up has steadily grown longer in our modern society. And continuous sitting over several hours, as more and more people are forced to even at their workplace, is a problem. After all, man is actually made to move, and without movement not only does the cardiovascular system suffer, but also and in particular the support and motor apparatus degenerates. Disorders of the musculoskeletal system have long been at the top of the statistical tables when it comes to days lost through illness.

If we continue sitting like this, it's not only our health we're putting at risk. Economically healthy companies need healthy and motivated workers if they want to stay competitive in future. And the pressure of competition is not getting any less, given the move towards globalisation. As early as the year 2000, the Council of Europe formulated the objective in Lisbon of making Europe the most competitive and dynamic knowledge-based region in the world by 2010, with more and better workplaces for its citizens. There's really no option but to agree with this and to make one's own – albeit small – contribution! This brochure will not only explain how you should sit 'correctly'. Rather its aim is to turn your office into a 'dynamic economic area with an improved workplace'!

The possibilities for injecting more movement and dynamism into the daily office routine are many and varied, and they range from variable office furniture and mobile office designs through to a work organisation that renders the office chair increasingly superfluous. Some of this is presented in this brochure with the recommendation that you imitate it. If it catches your imagination and you would like to know more, you would be well advised to refer to the website of the Action Group New Quality of Office Work (www.inqa-buero.de (only available in German)). Here companies, social partners, Berufsgenossenschaften (institutions for statutory accident insurance and prevention), health insurance funds and the Federal Ministry of Economics and Labour have joined forces to promote and further improve the quality of office work.



The sedentary society

From homo erectus to homo sedens

On four wheels rather than on two feet

The Germans used to be known as the nation of poets and thinkers, but now it would be more appropriate to call them a nation of 'sitters'. 17 million Germans take their seat in an office day after day, and a further two to three million in industrial production. And for around 2.5 million their work involves a lot of movement, but not that they have to move themselves – day after day they take the driving seat in a heavy truck, in buses and in trains. It is essential to thoroughly prepare a person, who is actually geared to being on the move, for this life-long sitting marathon – an office worker alone spends 80,000 hours of his working life on his backside. That is why the more than 13 million school pupils and students normally have to follow the teacher's explanations while sitting down. Then the journey from the workplace to the home is made with our society's 'moving chair' – the motor car –, and then the leisure time is 'sat out' in front of the television or the computer. All this sedentary activity then soon accumulates for adults in industrialised countries to between 10 and 14 hours a day. And even children at nursery school manage to stay seated for 5 to 6 hours, school pupils even 8 to 9 hours. The message is that if you want to take your place in a sitting society, you just have to start practising early on!

The mobile person

Man has not always spent his time on chairs. Before he was able to sit on chairs, he first had to learn to stand upright of course. He did this for the first time about 5 million years ago – the emergence of homo erectus! From an orthopaedic point of view that's when man started to suffer from back problems. Although man had adapted physically to the strains involved in standing, walking and running and had thus modified in evolutionary terms, these adaptations were only possible in the context of his having originally been a quadruped. If he had not gone upright, however, man's success story would hardly have come about – only with the free use of his hands, the ability to grasp objects and to use tools enabled man to take further developmental steps. In this regard our back problems are the price we apparently have to pay for being human ...

Up to this point we have not mentioned sitting or even chairs. This is not surprising, since both played no part in our ancient ancestors' lives. Many would hardly have been able to operate as a hunter and gatherer from a sitting position! Rather prehistoric man wandered across the plains as he hunted, and then in the evening he cowered, squatted or lay down on the ground to rest, and then continued on his wanderings the next morning. A chair would

hardly have fitted into this peripatetic existence and even today chairs are not common among nomadic peoples. After all, a chair means stopping, taking a break, resting – a chair is thus an attribute of a sedentary existence. Sedentariness means primarily that territory is no longer crossed, but taken and occupied. Man's operating range therefore became smaller, the long hiking trails gave way to short walks to the field, to the nearby forest or to the garden. Man became calmer, sedentariness disciplined him, just as the act of sitting still serves as a disciplining measure: if you're running around, you can't (supposedly!) concentrate on the task in hand.

All postures between walking, standing and lying are a combination of being still and being active, where man can rest, eat, think, perform special jobs or talk with others. Only a chair creates a situation in which man can occupy himself and develop mentally. Or, as the cultural scientist Hajo Eickhoff formulates it: *"The development of sitting on a chair is a process in which the chair lifts earth-bound man to an elevated spatial and high cultural level."*

The first chair

It is not known where and when a human sat on the first chair. It is just as probable that it involved a throne as the assumption that the seated person was a priest-king of antiquity. The latter was seen, like the later worldly emperors and kings, as a link with the transcendental, as a mediator between the divine and the earthly; consequently he was not allowed to squat with the common people on the ground, but he had to sit in an elevated position. He did not need to move and often he wasn't even

allowed to. It was therefore logical that kings in some cultures were artificially crippled – they were no longer to move in the spatial domain, but exclusively in the spiritual. (This prompts the question of whether many a modern computer workstation is poorly designed so as to cripple the users and thus give them access to new, spiritual spheres.) Even in the 19th century it was said that the king had no feet.

The clergy take their place

Leonardo Da Vinci (1452–1519) already had a 'chair-centred' view of things. Otherwise he would have had Jesus and the disciples sitting on the floors in the famous painting of the Last Supper, and this would have been usual in early Christian communities according to Roman tradition. Instead he sat them on chairs, probably because the idea of putting Jesus on the ground displeased him since his clerical apologists, i.e. bishops and priests, had already taken up their position on chairs. In contrast, the congregation continued to stand or kneel, and even today in Italy's churches there are no facilities to enable the common people to sit down. It's different in the monasteries. As early as the 10th century choir stalls were introduced here. Seen through modern eyes the so-called misericord, the central element of the choir stall seat, anticipates for the first time today's sitting-standing furniture: The seat had a broadened front edge and, thanks to a folding mechanism, it was possible to switch between standing, sitting and kneeling. It is possible that the readings in the monasteries were just as interesting as many an office routine and that those

present had to stimulate their circulation with a little movement...

Apart from the fact that the monasteries considerably expanded the number of those who had to sit and thus prepared sitting for normal everyday life, another aspect is interesting: the monasteries developed in the Middle Ages into the intellectual centres of Germany and Europe. Where there was a lot of sitting, there was also a lot of thinking! If this is still true today, then we don't need to worry much about the future!

Standing up for sitting

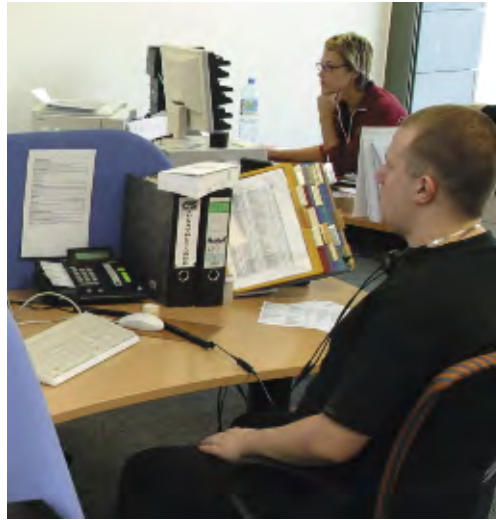
The first dedicated seat – the profane chair – was also to be found in church. In the 14th century the guilds and worshipful companies were permitted to set it up so that their masters could sit on it. Masters, now elevated to the position of chairman, served as an example and incentive for the prosperous citizens and as an incentive to want to sit on chairs as well. It is, however, certain that sitting gradually became a privilege and a desirable posture – whoever sat was someone: just think of the thrones used by bishops, the Pope and monarchs!

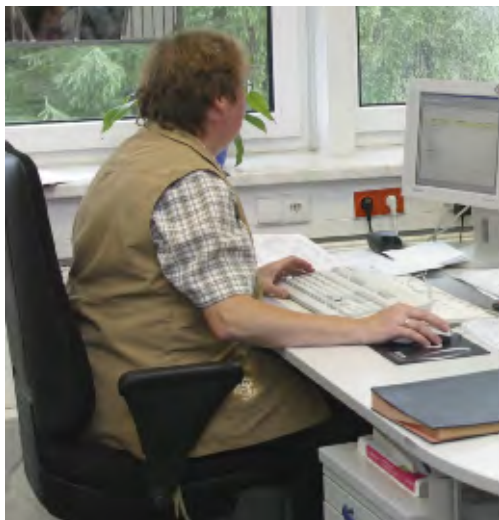
The Reformation then brought a fundamental change in the position of many burghers – literally. They became emancipated and their ambition focussed on a chair. The first victims of this new self-confidence were the 'elitist' choir stools – either they were smashed to bits or burnt, or they were 'misused' as seats for anyone in the church. The churches, initially Protestant ones, but then also Catholic ones, were given seats and benches. The burghers took their seats and hence adopted a

posture which they were to take for granted over the coming centuries. And what one came to appreciate in church – chairs – one also wanted to have at home! Alongside the political attitude – with the chair one reduced the distance to the seated classes of the clerics and the nobility and raised oneself above the non-seated, propertyless classes – the chairing of the bourgeois world also met a practical need. The economic success of the bourgeois traders and merchants led to a rapid expansion of administrative activities. And these could best be done with the feet at rest – the triumphal advance of the sitting professions had begun. The precursor of the modern office emerged and established itself as the new source of prosperity. With the French Revolution of 1789 sitting was then finally democratised, and the chair gradually became an object of use, even for the lower classes.

Industrial sitting

In political terms classless sitting was pushed through after 1789, but it only became possible for all classes with the arrival of the Industrial Revolution, which provided the population not only with cheap textiles, but also with inexpensive chairs. Thonet designed the first mass sitting furniture, which could be dismantled into its individual parts and was therefore easy to transport. Thonet brought more than 4 million chairs to the people between 1850 and 1870 alone – at least the west finally managed to sit down in the 19th century. But industrialisation not only mass-produced the necessary 'seating accessories', with the division of labour and mechanisation it also ensured that work





As long as people demand not to be able to move but to be able to sit, it will be difficult to save them from the adverse effects of sitting.



became increasingly motion-deficient and hence sitting-compatible. Heavy physical labour became and is becoming ever less essential, and the proportion of mental and thus sitting work has since grown steadily. In 1800, for example, 80% of people still worked on the land, and today this figure is only 8–10%. The value added in modern economies is generated nowadays in the industrial and service sectors, where between 80% and 90% earn their daily bread mainly while seated. This means that after thousands of years the open fields had outlived their usefulness as a workplace for humans; modern man's 'field' today normally measures only 160cm x 80cm, is located in offices or production shops and is called a desk. Here a seated person will sew and harvest, here he or she will gather the crops, and from here he or she will move the world without actually moving very much from the spot.

The seated human

Sitting has now become second nature to us. The mind of man has become so accustomed to sitting that the constrained physical posture is hardly perceived as such. On the contrary: despite all the adverse side-effects of sitting for health, the hunched physical posture on a chair is still regarded as a desirable and socially respectable state. Anyone who isn't currently 'sitting out' a term in jail, wants to sit down. The seated activity is still rated more highly than the standing one, and consequently the seated person is accorded greater respect than the standing one. Promotions at work nearly always involve 'relieving' the subject of physical movement and giving him the chance to sit more. The person who has become sedentary has really arrived – and that is true both spatially and, in particular, socially. That is why you will saw away at your competitor's safe seat while he, of course, defends it with all means at his disposal. That is why the boss will



have his subordinate “stand up straight” while he remains seated. And that’s why it is the prerogative of the more highly placed to offer the lowlier one a seat – or not, as the case may be.

As long as this remains the state of affairs, as long as people demand not to be able to move but to be able to sit, as long as offering someone a seat is a courtesy and can be taken for granted, it will be difficult to save them from the adverse effects of sitting. Standing up starts in the mind. But it is there that modern man often only has memories of movement as a burdensome nuisance, something that can at best serve to offset the adverse effects of sitting a bit. But if you don’t use your leisure time to move about and gain pleasure from it, but only do it to enable you to sit down for longer, you will always move too little to make up for the continuous sitting. It makes more sense to design workplaces and working sequences in such a way that they allow for greater movement. Since this will

remain a vain wish in many occupations, the aim should at least be to modify sitting habits and to organise them more humanely in the true sense of the term.



When discs slip ...

Medical and biomechanical aspects of sitting

Taking it easy – a dead-end pursuit

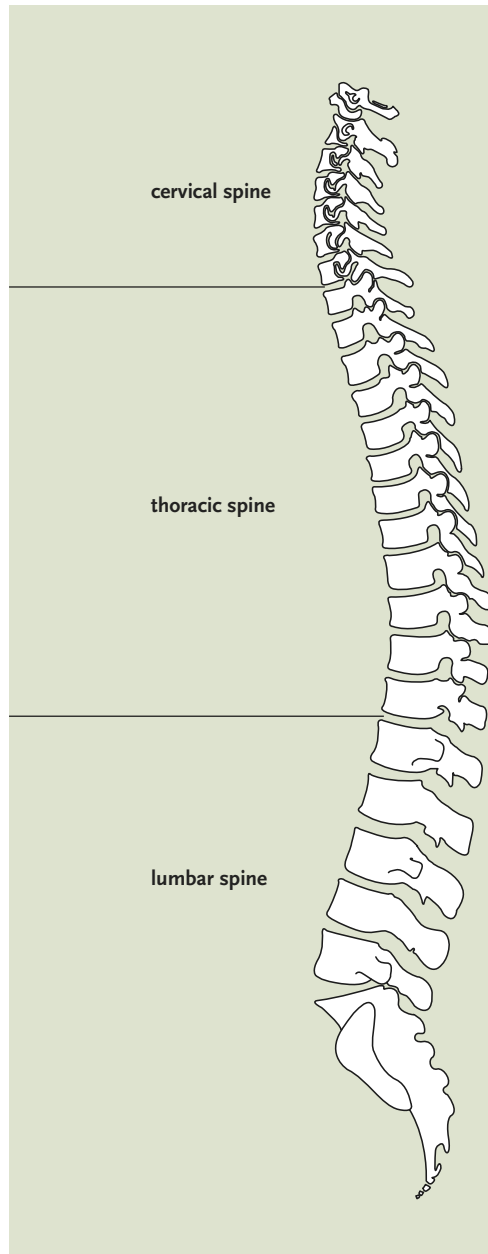
Compared to the story of human standing and walking, that of sitting is more of a short story: in the northern hemisphere people have only been sitting en masse and for long periods on chairs for the past 150 years. And in the southern hemisphere the chair has not really become fully established even now. This means that there has been little or no time for the human body to adapt to the strains of sitting. And because we ignore the fact that man is made for many things, but not for continuous sitting, our bodies protest against the constant inappropriate load. At more than 27%, the disorders of the musculoskeletal system were once again at the top of the tables in the statistics for days work lost through incapacity. In response to the question concerning health complaints at and after work, nearly 37% of workers mention back pains, closely followed by pains in the neck/shoulder area at nearly 29%. And that doesn't yet include all the feedback: today around 80% of all west Europeans have serious backache at least once in their life, and for many the pains even become chronic. There is no reason to fear a lack of intervertebral disc problems among the younger generation either: At the present time every third primary school pupil occasionally complains about pains in the small of the back, and

the number of cases of posture-related damage among nursery school children has doubled since 1945 from 20% to 40%.

But our sedentary lifestyle is not solely responsible for every slipped disc, and some back problems are also due to other 'back tormentors':

- inappropriate physical load due to continuous standing
- unfavourable body postures, e.g. working with bent torso and/or twisted spine
- frequent lifting and carrying of heavy loads under unfavourable spatial and climatic conditions
- types of sporting activities that adversely affect the back, mainly involving rotation of the lumbar spine
- individual features, such as obesity, incorrect nutrition etc.

Alongside these, and closely connected with our sitting culture, lack of movement in particular is responsible for our collapsing spines. If you think a life without physical effort protects the body and cuts down the wear and tear on it, you're making a big mistake, and one you will pay for painfully in the long run; after all, man need movement – and movement is his destiny. If you ignore this simple truth and condemn yourself and your spine to immobility, the following will happen:



The spine – structure and function

The spine has three main functions for a human being:

- static function: As the central axis of the body, the spine stabilises the human's upright posture.
- dynamic function: Thanks to its design, it enables a human to perform all the necessary movements, such as turning, bending, stretching etc.
- protective function: As a kind of 'cable duct', it protects the spinal cord from injury.

The human spine consists of 24 individual vertebrae with 23 intervertebral discs between them and eight to ten vertebrae intergrown vertebrae, of which five sacral vertebrae and three to five coccygeal vertebrae which cannot be moved, or only to a small extent. The 24 individual vertebrae of the spine can be divided into three sections:

- The cervical spine. It consists of seven cervical vertebrae and bears the load of the head, even though its vertebrae are relatively small.
- The thoracic spine. It consists of twelve strong thoracic vertebrae to which the ribs are flexibly fastened by means of joints.
- The lumbar spine. It consists of five lumbar vertebrae which are strongly built because they are the vertebrae in the spine which are subjected to the greatest load.

The intervertebral disks between the vertebrae are firmly connected with the vertebral bodies, they en-

able the spine to be highly mobile and at the same time they act as shock absorbers. Intervertebral discs consist of connective tissue with a relatively strong, externally elastic fibrous ring and a soft, gelatine-like inner core. To enable them to perform their functions – shock absorption and mobility – they have to be supplied with nutrients (oxygen and glucose). The discs' 'food intake' does not proceed like that of other organs via blood vessels, but exclusively by means of diffusion with the surrounding tissue. The prerequisite for this is the regular loading and relieving of the intervertebral discs, since only then will they be able to soak up fluid like a sponge and discharge it again when the load is removed: The intervertebral disc thus lives from motion! And we have to make sure it gets this by moving as much as possible ourselves, in other words changing our posture as often as possible from walking to standing to sitting and to lying. If we don't do this, the intervertebral discs will 'starve'. The result of this 'fasting diet': they will become brittle and crack. If, on the other hand, they are under constant pressure due to overload, they are also not able to absorb any liquid. Lack of movement therefore causes the intervertebral discs to wear even faster than they would anyway. From the fourth decade of life, time begins to gnaw at the intervertebral discs – they slowly lose their 'sponginess' and hence their elasticity.

So that the individual vertebral bodies form a spine, they must be connected with one another in both a movable and in a stable form. The inter-

vertebral discs, spinal joints and longitudinal ligaments are the essential prerequisite. Active movement is not yet possible, however, and the spine alone is not able to maintain or change its position. Only the muscles of the spine and its surroundings ensure its 'upright posture' and active mobility. To help you better understand this complex system of vertebral bodies, ligaments, intervertebral discs and muscles, imagine the spine as a ship's mast which is connected vertically with the deck (pelvis) via the bracing system (muscles). If the bracing system is in a state of equilibrium, the mast will stand upright. This means that the pelvis, as the base of the spine and the connection between the legs and the trunk of the body, plays an important role.

A crooked pelvis will mean a crooked spine and subsequently the cause of back problems. The correct, balanced position of the pelvis and a muscle system that stabilises the pelvis are an important basis for an upright body posture that protects the intervertebral discs.

The situation with the back muscles is similar: They give the spine posture and stability like a corset and are therefore indispensable for a healthy spine. If this system is too weak, which is the case for most of us because of a lack of strain at work and in our leisure time, the supporting effect of the muscles is lost, the spine loses stability and the intervertebral discs are subject to even greater pressure.

- Without an appropriate load the vertebral bodies, as load-bearing elements of the spine, become porous in the long term and the stabilising ligaments go limp.
- Without movement the muscles which make it possible for the spine to move waste away.
- The same applies to the intervertebral discs – which only remain supple and act as buffers if they are subjected to and relieved of load alternately. Otherwise they lose their ‘sap’: they become brittle and fragile.
- And finally: if you rest, you rust! If the spinal joints are to live up to their name, they need movement. Otherwise the joint capsules shrink, which makes them stiff and painful.

In other words: life in ‘low gear’ at best encourages our inertia, but it in no way protects our spine.

The consequences of bending

The occupational health care profession is unanimous today: continuous sitting is one of the main problems relating to health in the industrialised nations. What Herbert Junghanns, founder member of the Gesellschaft für Wirbelsäulenforschung e.V. (German Society for Spine Research), said as early as 1980 still holds true: “Sitting is and will remain the worst posture of the human body.” An insight that unfortunately is not yet shared very widely. Sitting is still seen by us in general as a largely relaxed posture, it is still common for a sedentary as opposed to physical activity to be classified as light work – after all, people sitting down aren’t doing anything! The impression is deceptive since sitting involves hard

work for the human body, and especially for the spine!

The spine adopts its natural form when a person is standing upright or walking. From the side, you can recognise a double-S curvature, whose purpose is to absorb loads and jolts. The arching or curvature of the spine is called, according to the relevant direction, lordosis (curvature to the front, arising as a natural posture in the area of the cervical spine) or kyphosis (curvature backward in the thoracic spine). If our spine were simply curved or even straight, it would wear more quickly with constant load or the impact on the head and pelvis would be considerably greater.

When we abandon the normal posture of standing, the form and loading of the spine change. Sitting imposes a much greater strain on the spine than standing or walking. Taking the pressure to which the intervertebral discs are subjected during standing as 100%, the relative figure for sitting up straight is already 140% and for relaxed sitting while bent forward is even 190%! What is responsible for this is the changed form of the ‘sitting’ spine, which puts considerable pressure on the intervertebral discs. Why is this so? Just imagine a hamburger. The two halves of the bread roll play the part of the spinal bodies, the lump of meat, tomato, cheese and ketchup are the intervertebral disc in between them. Take the hamburger on the side in both hands, take it up to your mouth and bite into it. What normally happens? The lump of meat will give way to the pressure which your upper and lower jaws exert on the two halves of the bread roll, and at the very

least the ketchup will squirt backwards. A quite similar thing happens to the intervertebral disc during sitting. When we sit, the following happens: the pelvis tilts backwards and the normal lumbar lordosis becomes a straight, stretched posture, often even a kyphosis. This changes the pressure in and on the intervertebral discs and boosts it in the front sections of these. The centrally located, soft gelatine core of the intervertebral disc tries to evade this pressure and slips backwards. If this happens repeatedly as part of a dynamic posture, it's not so bad. The problems arise when it's the normal state – as is the case with static, continuous sitting!

If you've got the choice...

Whether we're sitting, standing or walking – we always have to struggle to keep our balance. Normally we don't notice it, although the motor apparatus is constantly working and making necessary corrections to stop us falling down even if we feel relaxed. The aim of these corrections is to keep the body in a state of equilibrium with gravity, i.e. to maintain the body's centre of gravity line above the support areas – the floor or chair. If this is not possible, external forces (torques) act which internal forces, or muscular work, have to counteract to stop you ending up lying down...

To manage this balancing act while sitting down, man has the choice between two basic sitting postures:

- an upright, straight sitting posture
- a bent, 'crooked' sitting posture

Which is the better, in other words the healthier for the spine and intervertebral discs? If you have faith in your childhood memories, then the decision is clear. Who can forget grandma's stern command at the dinner table: "Sit up straight!" We never really took any notice of it – and most of us still don't take it seriously. After all, the 'crooked' posture without a back support is subjectively the relaxed and comfortable one. Unfortunately it's also the one that is worst for the health of your back. In this posture the spine takes the form of total kyphosis (curved back), pressing the front parts of the intervertebral disc and relieving the rear parts. An intervertebral disc which has no prior damage can take this 'hamburger effect', or the uneven distribution of pressure, quite well within limits, while an older disc that has already undergone degenerative modification is sure to create problems – at some stage it will be displaced backwards and will impact there initially on a presumably brittle fibrous ring and then, in the worst case scenario, on a nerve.

Apart from the intervertebral discs, both the back muscles and the ligaments of the spine are overstrained by the curved back posture. Man is 'sus-



"Sit up straight!" – that was considered the ideal sitting posture in the classroom in the 19th century. A mechanical system was used to guarantee upright sitting...



Advantages and disadvantages of sitting

If sitting were only a bad thing, we would probably not do it for such long periods. The fact that we insist on doing it is related to the advantages we have from sitting.

The most important of these are:

- Improvement of the trunk's stability because, as compared to standing, the body's centre of gravity is closer to the support surface (seat surface).
- Relief of load on the hip joints and legs, precautions to prevent the kind of hip joint damage and varicose veins we are familiar with from the standing occupations.
- Low energy consumption (not from persistent, continuous sitting!), relief of the load on the circulation system.
- Stable body posture with excellent visual overview for many working situations, and so the working posture for most activities today.
- Short periods of sitting can have a beneficial load-relief effect after a lengthy phase of standing.

Sitting also has numerous adverse consequences for our well-being and health, however. This is especially true if we (have to) stay seated for very long periods. The main disadvantages are:

- The abdominal, chest and hip extensor muscles go slack and may possibly become shorter. This can lead to the sitting paunch, often wrongly understood to be a prosperity paunch...
- Curved back as the result of long periods of 'comfortable' sitting.
- Constriction of the internal organs, affecting in particular the respiratory and digestive organs, which can also lead to shortage of breath and digestive problems.
- Inappropriate loading of the spine with negative consequences for intervertebral discs, the ligaments and back muscles.
- Painful shoulder and neck tension in the case of a continuous bent-forward posture when reading and writing, possibly leading to non-specific pain in the neck and head.

pended', so to speak, in his ligaments, these wear out from the constant overstretching and this can lead to painful tension. So was granny right with her command to sit up straight?

From the point of view of the spine and intervertebral discs, the answer is clearly yes. In contrast to the curved back posture, when you sit upright your spine remains in its natural double-S position, as though you were standing. And that ensures an almost even and hence appropriate pressure on and in the intervertebral discs. Unfortunately the story has a big snag: Sitting upright only works here by means of static muscle work (holding work), which makes this disc-friendly posture a subjectively strenuous experience. That is why most of us slouch down again into the comfortable curved-back posture simply because it involves less effort! And if you force yourself to adopt the upright sitting posture without any support, you still wouldn't have a chance in the long run. Studies in work physiology have shown that static, as opposed to dynamic, muscle work consumes considerably more energy and therefore involves a faster pulse and longer recuperation times. Accordingly, the muscles tire more quickly and you may experience fatigue pains. If you subject your muscular system constantly to inappropriate load from static holding work, for example you often work in constrained postures or simply while seated, you are even running the risk of developing chronic pain in your muscles, joints and tendons. The causes of this are inflamed, degenerative changes in the inappropriately loaded tissues.

There thus remains the relaxed, laid-back posture

with back support. We like to adopt this, but it is only suitable for working at a desk to a limited extent. You can use this position to play around with your ideas and of course to solve complex mental problems, but then you have a problem with your arms. They are now not long enough to reach the keyboard...

So modern man is in a classic dilemma. On the one hand, the sitting posture is the one which enables the majority of people in the industrialised societies to perform the work by which they earn their daily bread. On the other hand, the usual continuous sitting with its adverse consequences for health ensures that this posture cannot be maintained for the whole of one's working life. So what should we do?



In for a penny, in for a pound ...

Physiological aspects of correct sitting

The impossibility of sitting 'correctly'

Sitting is a compromise. Invariably. Man is not made for sitting and will not be in the near future, either. To paraphrase Theodor W. Adorno, we can therefore say: Wrong sitting cannot be done rightly! But sitting is the only conceivable (continuous) working posture in an office. And it isn't really possible to avoid it. Ulrich Burandt, Professor of Industrial Design, was already aware of this when, more than 20 years ago, he stated: "Sitting is unfortunately the only method suitable for supporting the body for stationary work." So how can what is in fact incompatible be made compatible then? How can one sit 'correctly' or more correctly or in such a way that health is not put at greater risk than is absolutely inevitable?

To anticipate: There is no such thing as the optimum sitting posture any more than there is the unique ergonomically right office chair. Basically the truth is that the best chair is precisely the one you are not sitting on at the moment and the best sitting posture is always the next one! In other words: If you stay at rest on a chair or in a sitting posture, you'll start to rust. And so movement is needed!

So when we're talking about 'correct' sitting, we mean 'correct' sitting in the physiological sense. This sitting posture is achieved when the spine

adopts its natural physiological form, i.e. the double-S, as far as possible when seated as well. This posture is possible when we tilt our pelvis slightly forward while seated, which will cause the rib cage to become upright slightly and the cervical spine to stretch. In this posture a person can breathe freely, his or her organs are not squeezed and the position of the spine is almost as good as that when standing. Hans-Dieter Kempf, the author of numerous papers on back health, compares the adoption of this posture graphically with a gear-wheel model: "If the bottom gearwheel (the pelvis) rotates to the front, the next will move reciprocally to the back (and hence lift the rib cage), and in turn this will cause the third to rotate to the front (and hence stretch the cervical spine)."

This sitting posture can be practised by attempting to stop the pelvis tilting away when sitting down. But it is not possible to hold this posture permanently on account of the static load on the muscles. Apart from the legs, which do not place a load on the back muscles when you are seated, the remaining body mass is supported by the muscles when you are sitting upright – and this means nearly 65% of our body (see table)!

If you want to help your spine adopt an upright posture when seated without overstraining your

Percentages in relation to total body mass

Head with neck	approx. 8.8% of body mass
Trunk	approx. 45.2% of body mass
Arms (both)	approx. 10.9% of body mass
Legs (both)	approx. 35.1% of body mass

muscles, you have to give your body appropriate support. And that's where the 'crutches' of our sedentary society – chairs – come in. More later about what these should

be like, what they should be capable of and how a good office chair can be recognised. At this point let us look at the basic features of the chair's supporting function:

Backrest: It should be high enough, i.e. it should reach at least the shoulder blades, and its prime function is to further the physiological lordosis of the lumbar spine and support the back over as large an area as possible, so as to take up a portion of the weight of the torso.

Sitting surface: It should be such that it stops the pelvis from tilting away and that it supports physiologically 'right' sitting.

Armrests: They are a useful extra, and not only when standing up or sitting down, but also as a rest to take a weight of approx. 8–10 kg, i.e. the arms, which would otherwise hang on the shoulder girdle and place a considerable load on it!

Seat height: The seat height must be adjusted so that both feet can rest completely on the floor.

If all this is right, it will be possible for you to sit on your chair quite comfortably for a certain time. Note that – for a certain time! No sitting posture is suitable for continuous sitting over a long period; any constant sitting is a constrained posture in the long term and it restricts well-being and health. That's why we have to get things moving ...

Sitting in motion!

When we talk of 'sitting in motion', we mean not so much a change of location in space. Accordingly sitting in motion does not involve racing across the office floor on five rollers. The sitter in motion is also naturally located at a fixed spot and can be found where the boss thinks he should be – at his workplace. Motion here means rather a change in the body's posture and position. And that also works when you're sitting down! The aim is to avoid a damaging constant posture with its adverse consequences of muscular fatigue and tension and poor supply to the intervertebral discs. The way to achieving the goal is pointed out by a negative childhood example – in workplace health care Fidgety Philip has long since been reinstated! If you have to undergo extended sitting sessions, you shouldn't stick rigidly to your chair, but you should take the following hints to heart:

- Rock your pelvis back and forward!
- Shift your weight sometimes more to the right and sometimes more to the left half of your behind!
- Push your rib cage forward and backward or to the side!
- Every now and again stretch your neck by pushing your head back!
- When sitting forward, support yourself on the desk!
- Lean back in a relaxed fashion against the back rest in the rear sitting position!
- While seated, try to gyrate your hips!
- Utilise the positive effects of breathing on the spine and muscles: Breathe in as deeply as possible quite consciously, then breathe out

slowly and press the residual breath out of your lungs. Try the exercise once more while stretching your arms and shoulders backwards as you breathe in and make yourself small like a parcel as you breathe out!

In order to sit actively and dynamically, it is also helpful to be aware that you can also do your work in a forward-leaning, upright or backward-leaning position and that you can switch between these. The whole thing can be compared with one of those little toys that spring back as soon as you knock them down, since your extended trunk will move around the body's vertical axis. The condition for dynamic sitting is an office chair with a movable backrest which goes along with and supports these movements. The best ones are those which have a mechanical system for changing the angle of the backrest and the angle of the sitting surface simultaneously. Such chairs with the appropriate mechanism (e.g. rocking mechanism, synchronous mechanism, permanent contact or combinations of these) have been commercially available for more than 30 years and are ideal for bringing out the Fidgety Philip in you, without forcing you to share his fate. Unlike with a conventional chair, when you rock on one of these chairs, neither the chair itself nor you will lose their floor grip ...

With modern office chairs it is possible to take up changing sitting positions, they give permanent support to the spine, especially in the lumbar area, and they thus prevent one-sided loading of the spine and muscular fatigue. If your office chair does not have this sensible extra, that doesn't say much about your boss's economic far-sightedness! After all:

The main feature of the office chair



The five rules of ergonomic sitting

1

Adjust both the height of your seat and that of your desk so that your arms and legs are approximately at a right angle! Although a right angle is not allowed for in nature, it is the 'most natural' sitting posture for the sitter. If the angle between the upper and lower arm and the thigh and calf is less than 90 degrees, this will interfere with the blood circulation. Your feet should be placed completely on the floor, and your arms should be able to rest loosely on the desk or in front of the keyboard.

2

Make complete use of your office chair! Your employer has probably paid for your chair in full, so you can sit on it to your heart's content! This means that you should utilise the whole sitting surface as far as possible so that at least 60% of each of your thighs is supported by it. To achieve this make use of the possibilities there may be of adjusting your chair. The situation is similar with regard to the backrest. It can only fulfil its function if you entrust your back to it. Make sure that the curvature of the backrest is set correctly to your individual body mass so that your spine is adequately supported in the lumbar area.

3

Sit up straight! When you sit down you should already make sure that your back is upright! If your pelvis bends backwards – which is inevitable occasionally – it should be supported by the backrest. This will help you avoid a humpback, which places such wear on intervertebral discs in the long term, and place an even load on your muscles. In addition the chest and abdominal areas will remain free and without pressure, which benefits digestion and breathing.

4

Sit actively and dynamically! Avoid a rigid sitting posture. Instead switch between a forward, upright and laid-back sitting posture, utilising the mechanism which is hopefully available. Never forget: the intervertebral discs live from movement and lack of movement starves them! You should therefore shift your weight to the right buttock and then back to the left one again. Slide around a bit on the sitting surface. Let your hips rotate as you sit! Any movement, no matter how small, is good by way of a little snack for your discs!

5

Use the whole 'seat crutches'! Rest your arms in a relaxed fashion on the armrests. This will relieve the load on the shoulder region and help prevent muscular tension. Resting the heel of your hand in front of the keyboard provides a similar relief for the shoulder and neck region. You have to create the space needed for this – it should be 10 to 15 cm. The basic principle is that every part of your body you cannot rest on something, place on something or lean on something will be drawn by the force of gravity and will have to be held by your muscles.

And another thing: if you can't apply the rules described here with your office chair, it can probably be classified as 'scrap' or it is quite simply not right for you!

- lack of movement reduces the muscular activity and leads sooner or later to tension;
- lack of movement places a load on the intervertebral discs;
- lack of movement impairs circulation of the blood and the supply of oxygen to all the organs.

‘Dynamic Sitting’ helps ward off the hazards of sitting workplaces.

The result is neither in your interest nor in that of the company: more rapid fatigue, decline in concentration, lower work performance levels and a high error rate. A moving office chair is therefore not ‘only’ in the interest of health, but it also promotes your efficiency and willingness to work!

This argument – increased efficiency – could also help make a previously despised sitting habit socially acceptable: putting up your feet occasionally. If you put your feet on the desk every now and again, the advantages are clear:

- It prevents shortening of the thigh muscles – a problem for habitual sitters.
- It eases the return of blood to the heart and stimulates the circulation.
- Vein weaknesses and varicose veins can be reduced in this way.

Admittedly, this little bit of relaxation is not possible at every workplace; wherever you have to deal with members of the public, such as in banks or public authorities, you will have to do without it. But in ‘normal’ offices you can certainly consider it and ignore the finer rules of etiquette at least every now and again.

Stand up for the sake of your back!

Normally an office worker spends about 80 to 85 % of the working day slumped on his chair. From the point of view of occupational health care, intervertebral discs and muscles, this is clearly too much. Only one thing will help: stand up! To ensure that this is possible as often as possible, however, a number of changes are needed in the working sequences, in the design of workplaces and not least in the heads of all sedentary workers! The aim of this concerted triple approach is that the worker will spend about 40 % of the working day sitting and about 25 % standing and moving about, respectively.

This is certainly an ambitious objective, but it is precisely the modern office worker’s tool – the computer – that has helped ensure that there is hardly any movement in the office except for the ‘mouse hand’. In former times, for example, the short walk to a colleague to fetch a file meant that at least there was a little movement, but today one click and the file is there. Many workplaces are also still designed according to the ergonomic creed from the last millennium whereby all items of work equipment have to be arranged on the desk in such

Sitting at school



If you sit continuously, you will certainly get too little movement. On top of that there is the incorrect and in particular high-calorie diet. And where's the best place to polish off a back of crisps or bar of chocolate? Sitting in front of the television or computer of course ...

Schools can counter this development by placing greater emphasis on circumstantial and behavioural prevention.

Circumstantial prevention

There are malicious people who claim that school serves less to impart knowledge than to prepare you for a life of sitting. One could indeed sometimes get the impression that teaching is also there to tame children's natural urge to move. And it seems to manage this if we take a look at the simple figures: The roughly 30 hours per week spent sitting at the desk in the classroom, which is already the case among primary school pupils, combined with endless sessions sitting at the computer and in front of the television, make even the youngest of us look old in some ways. Around 33% of children and young people suffer from posture-related damage, one fifth of children and one third of young people are overweight, approximately 8% are even obese, i.e. pathologically fat – and the trend is upward! And it will soon be necessary to find a new word in everyday language for diabetes mellitus type II: More and more children suffer from adult-onset diabetes. It is not only a lot of sitting that is responsible for this regrettable development, but it is certainly a contributory factor.

What applies to the adult marathon sitter is absolutely essential for children and young people: Tables and chairs must be adapted to the physical height of the individual pupil! To make sure this works, every school must have an adequate assortment of differently dimensioned tables and chairs since it is well known that little people grow into big people in the course of their time at school! When allocating the right furniture, DIN standards can be helpful among other things. They can ensure that like goes with like! Using colour markings, it is possible to see straight away whether a chair goes together with the table it's standing next to.

At least just as important as the purchase of the right school furniture is ensuring that every child can actually sit on the appropriate furniture. As long as no-one feels themselves responsible for this, the old caretaker principle will probably apply: "one size fits all". With a view to the increase in posture-related damage among children and young people, the experts therefore recommend the following:

- The school management and teaching staff should regard it as their task to adapt the school furniture to the child's physical height in the context of health care.
- In classrooms permanently assigned to a single class the tables and chairs should be adapted every six months with the active involvement of the pupils.
- The teaching staff should make sure that pupils sitting together at double desks are as far as possible of equal size.
- In special subject classrooms, the chairs should be height-adjustable and should be individually adjusted before every lesson.

Behavioural prevention

Ergonomic items of school furniture are great. But they are a waste of money if they are not adjusted for sitting at the same time. The times are fortunately over when school benches were invented where children were strapped in sitting upright. Even so, sitting is still the predominant working posture in modern schools.

What should be common practice everywhere in offices and other sitting locations also applies here:

- Introduce movement breaks!
- Explain and encourage dynamic sitting!
- Tolerate 'lolling around' on the chairs – this is of course not true for dangerous rocking!

And – of course only from the point of view of back health – 'standing in the corner', which has understandably gone out of fashion, is to be preferred to sitting in detention. After all, corporal punishment was banished from schools long ago ...

The connection between unsuitable chairs and continuous sitting, on the one hand, and posture-related damage, on the other, is now acknowledged. Numerous projects at schools attempt to counter the 'hunching' and lack of movement on the part of children and young people by taking appropriate measures. Under the heading "Das bewegte Klassenzimmer" (The Mobile Classroom), the Federal Working Group for Posture and

Size	Physical height (cm)	Ident. colour	Table height (cm)	Seat height (cm)
0	80–95	White	40	21
1	93–116	Orange	46	26
2	108–121	Purple	53	31
3	119–142	Yellow	59	35
4	133–159	Red	64	38
5	146–176.5	Green	71	43
6	159–188	Blue	76	46
7	174–207	Brown	82	51

Note: The dimensions are given in EN 1729-1 from 2006.

Sitting at school

Movement Promotion at Primary Schools shows, for example, how learning can be combined with movement so that body and mind are in a state of balance. The approach is based on the following modules:

- Sitting in motion: Promotion of dynamic sitting, provision of different sitting facilities, improvement of ergonomic design by means of desk mountings and wedge cushions, use of special ‘reclining chairs’.
- Learning in motion: Here, for example, numbers and letters are depicted physically by children. Tasks are resolved in the form of movement activities, such as running dictation or arithmetical gymnastics.
- Movement breaks: These are inserted flexibly into the teaching routine, activities involving motion alternate with relaxation breaks. The school yard is divided up into playing zones and quiet zones.

In many federal states in Germany such ‘mobile’ schools have joined together to form an ‘opus’ network (German acronym for Open Participation Network and School Health) in order to exchange experience and propagate methods. This is highly meaningful and not only promotes back health but can also lead to an improvement in school grades. A study underscores that if children have to sit still most of the time, their attention flags. If the children are at least able to race around during the break, their concentration remains constant. If the pupils have the benefit of lively and mobile lessons, they may even improve their grades.

a way that they can be reached as comfortably as possible, and primarily from the seated position. This ‘grasping space ergonomics’ was intended to actually increase efficiency, since someone who did not waste his time with ‘superfluous’ running about can do more work. Well, that’s the theory. It is now clear that sitting a lot does not also mean working a lot – and certainly not efficiently! Studies testify to the fact that more movement at the workplace increases motivation, the willingness to work and efficiency and, on the other hand, reduces the times lost due to illness. So let’s clear the frequently used working utensils out of the grasping space! The printer, for example, does not necessarily have to be located directly at the workplace. Similarly, the ringing of a telephone located a few metres from the worker’s desk can serve as a signal to move and stimulate the worker to stand up. Many office workplaces and computer workstations also offer sufficient activities which can also be handled in the standing position, e.g. reading, writing, phoning and even short meetings. In some Japanese companies there has already been a move to conduct meetings in general while standing. These ‘standing sessions’ are also much shorter with the same or greater efficiency than the former ‘sittings’...

Work organisation geared to more movement demands, of course, a workplace design which facilitates a changing posture at work. This includes in the ideal case a desk whose height is easily adjustable (e.g. by means of electric motors) which facilitates working while sitting and standing. A standing desk may also be appropriate, integrated directly into the workplace. To ensure that this is not only used as another surface to carry the usual

office knick-knacks, however, but is actually used by the 'office occupants', behavioural training and education are essential. Standing up is a matter of awareness – even it is not for the purpose of exploring the truth, but only of moving! It is thus not sufficient to create the technical conditions for more movement at the workplace and then to hope that the established patterns of (im-)mobility of workers change of their own accord. If, on the contrary, the ergonomic equipment of the workplace is accompanied by competence training, changes in behaviour will set in permanently. Studies have shown that people who work at a computer workstation with integrated standing desk sit around 30% less. Here only 56% of the working time is spent sitting, 24% standing and 20% in motion.

The aim of this so-called dynamic standing-sitting is improved health, well-being and also performance. The matter is especially efficient if

- there are two to four changes in posture per hour;
- the individual standing phases do not last longer than 20 minutes;
- and static standing is avoided.

In practice, dynamic standing-sitting has already proven itself. In companies which have established such programmes, company doctors report of workers who have since maintained their composure, whose discs slip less often and who don't only breathe out deeply when the boss leaves the room. In addition, such 'dynamic' companies have experienced an evident rise in job satisfaction and efficiency. So many good reasons should not only bring the company management to their feet...

Tips for ensuring movement during the working day

- If possible, cycle to work!
- If you go by car, park a little way away and walk to the office!
- Use the stairs instead of the lift!
- Remove whatever you use frequently out of your reach!
- If you have to sit, do it actively and dynamically!
- Use the height adjustment of standing-sitting desks as often as possible!
- Use a standing desk for everything that doesn't require you to sit down!
- Invariably conduct brief meetings, read mail and make phone calls standing up!
- Within the office do not deal with everything by mail or phone, but go personally to the person you want to communicate with!
- Use breaks as an opportunity to move!



More than just a bench against the wall ...

Ergonomic aspects of the office chair

Democratic sitting

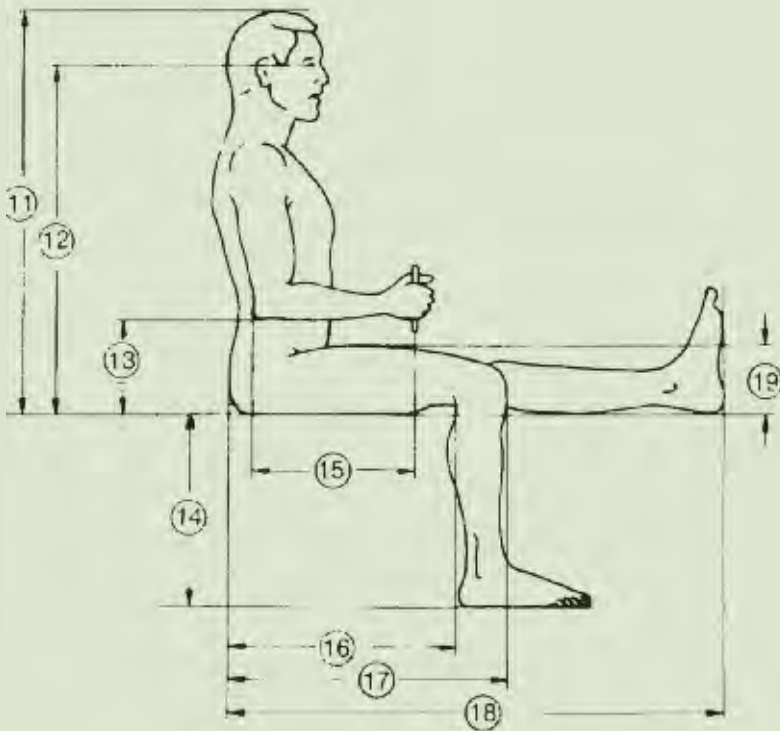
“To sit down all I need is a bench against the wall. Anything additions are a matter of personal conscience.” Nowadays we don’t see it quite dramatically as the Dutch furniture designer and architect Gerriet Rietveld (1888–1964) did; his provocative bon mot was undoubtedly a side-swipe at the baroque sitting monstrosities of the imperial age so hated by the Bauhaus. On the contrary, it is unprincipled today to deny the many millions of seated workers those ‘additions’ which turn a ‘bench against the wall’ into an ergonomic and, as far as possible, health-promoting sitting facility. Gone are the times when administrators still laid down from which income grade armrests were permitted. There are allegedly still bosses who lay great store by having a higher backrest as a visible expression of the prevailing hierarchies, but this is no longer the rule, and for well understood self-interest. After all, backache is democratic and costs companies a lot of money. One day lost in the office costs around 400 euro – this means that an ergonomic office chair as a means of countering back complaints will soon pay for itself. Ergonomic office chairs should therefore no longer be a matter of establishing deliberate differences in status! But differences in sitting are still not the exception in offices today – not every ‘ergonomic’

office chair delivers what the manufacturers promise. But how can we recognise a good office chair and which ones should we leave behind in the shop?

The standardised human

Nearly everyone will know this scene from the cinema: The bad guy and the sheriff face each other for a show-down, legs apart, the right hand hovering just above the pistol grip. Suddenly a small figure steps out of the crowd, wearing a black top hat, a worn frock coat and striped trousers. He ambles over to the sheriff (or bad guy), pulls out a tape measure and measures his client. After all, the coffin has to be the right size ...

These times are long gone. Bespoke work is the exception nowadays. Everything from a suit or car to an office chair is off the peg. The fact that most things fit quite well, even though nobody has personally taken the measurements is due to anthropometrics, the theory of determining and applying human physical dimensions. The results, prepared by ergonomics and implemented in, for example, DIN standards and other agreements, ensure that office chairs are designed and can be adjusted in such a way that the feet of most users do not have to swing in the air or their knees are not forced up around their ears.



Absolutely indispensable for the chair designer: The 'dimensioned' person from the 'Small ergonomic data collection'. On the basis of this the range of possible settings for a chair is developed with the certainty that approx. 90% of future sitters will find the appropriate chair settings. It is possible to sit quite well on such an individually adjusted chair for quite some time. But the principle is: the shorter the 'sitting time', the better! Switching between sitting, standing and walking is essential for the health of your back and for your circulation. This is not changed in any way by the ideally adjustable office chair!

However, really big and really small people can and must resort to bespoke work even in our standardised world. Normally when determining and specifying dimensions, one makes do with the proportion of measurements which is representative of the majority of customers. In practice all body heights from the 5th to the 95th percentile of 18 to 65 year olds are taken into account, corresponding in women to a body height of 151.5 cm and 191 cm in men. Anyone who is substantially bigger or smaller will seek in vain the lever on the office chair that will make it fit. A small consolation is that some manufacturers have discovered this deficiency and therefore offer special adaptation facilities (e.g. shorter or longer gas pressure springs).

Short glossary of office chair terms

What makes a good office chair? What should its characteristics be? What can and should the owner expect? If you take the relevant EN standard 1335 for office chairs as your basis, you'll certainly be on the right road, but you should consider that standards only define minimum requirements. They always represent a compromise in which the wide-ranging interests of, for example, authorities, the social partners, the manufacturers, occupational health care etc. are incorporated. You should also keep in mind that standards can never take account of individuals and also have to be revised constantly if they are to incorporate the latest knowledge. And finally: Who reads standards? And so here are the most important matters relating to office chairs in a nutshell!

Every office chair should have **armrests**! And to ensure that the weight of the user's arms does not

hang off the shoulder girdle despite the armrests and can actually rest on them, they should be height-adjustable, depth-adjustable and hence capable of being set to individual measurements and conditions. It is also highly advisable to have armrests that can be moved laterally. The two things together will ensure that the shoulder muscles are relieved and that the lower arm, hand and fingers stay movable for the job they have to do. The length of the armrests should be at least 20 cm, the width at least 4 cm. If they are also mounted about 20 to 25 cm above the sitting surface, the chair designer will have done his homework.

Backrests on office chairs should not be less than 360 mm wide and they should reach at least to the shoulder blades. In addition the backrest should follow the hopefully untamed urge of the 'leaner' to move without losing its support function. A suitable means of achieving this, for example, is a mechanism which synchronously and automatically adjusts the slope of the sitting surface and backrest when the user is seated. On the one hand, this will prevent the user's feet from lifting off the floor when he leans back, and on the other, his shirt will stay tucked in his trousers, which is often not the case for non-synchronous mechanisms. Here the lumbar padding slips a few centimetres upward when the sitting posture is laid back and the user's buttocks will slip forward, which means that the thoracic spine is supported but the support for the transition between the sacrum and the lumbar spine is lost. To give optimum support to the urge to move, the backrest should be inclined backwards by at least 15 degrees. And of course it should be possible to adjust it to the

individual weight of the person leaning on it, thus ensuring optimum pressure on the rest. The lumbar padding already mentioned – often only a small kink in the backrest – is today a matter of good style and serves to support the physiological lumbar lordosis in the transitional area from the sacrum /L5 to L3 – or in other words: at approximately girdle height or 17–22 cm above the sitting surface. To enable the lumbar padding – also known as lumbar support – to do its job and to make sure it doesn't simply apply pressure at some point or other, it can also be height-adjustable – as an alternative, the whole backrest can also be adjustable in height.

Neck supports, height-adjustable of course, can complement the backrest and support the cervical spine zone if the backrest can be inclined a long way backwards – in an extreme case as far as the supine position.

Sitting surfaces should ensure through their anatomical form that the owner uses the whole surface to the fullest possible extent and has 'full contact' with the backrest. Anatomical form means:

- Shallow, rounded front edge of the seat (front edge radius less than or equal to 60 mm). This prevents pressure points on the thighs and impairment of blood circulation in the calves.
- Contrary to earlier views of sitting at an exact right angle, many ergonomists today recommend, according to the activity concerned, a sitting surface inclined slightly forward in order to encourage circulation and to maintain the form of the spine. Some office chairs therefore have a sitting angle adjustment which can adjust forward and backward.



The sedentary society has created the appropriate sitting facility for every activity and almost every occasion. Here is a small selection which visitors to the DASA can try out for themselves!

- Some sitting surfaces have been equipped to encourage movement during sitting – a facility that is often felt to be a pleasant extra. These include sitting surfaces equipped with a tilting and rocking mechanism, for example. Even more movement is achieved with a swinging mechanism, by which sitting on a chair approximates quite closely the free movement on a fitball. It's worth trying it out, because you can get used to this movement.

The seat depth of 380 mm recommended by EN 1335 should be taken as an absolute minimum. However, with a view to increasing growth in size and the clear individual differences between users, seats with movable sitting surfaces, allowing for a change in sitting depth, are more suitable.

The correct **upholstery** of an office chair is always a bit like trying to square the circle. If it's too hard, painful pressure points will develop after a few hours, and sitting will become uncomfortable accordingly. If it's too soft, the support function is lost and the pressure of the body will not be distributed evenly over the greatest possible area – which

is also bad. The upholstery should thus provide 'soft' sitting comfort, yet still be firm. This is certainly not easy to put into practice ...

The **upholstery covering** should be permeable to water vapour and air, antistatic, non-slip and replaceable. This will guarantee a pleasant sitting climate, even on the 'critical' office days in summer. This makes clear that only someone thinking in hierarchical terms will stick (literally) to the topic of 'leather'.

Safety in terms of stability is, of course, especially important for the sitter in motion. Office chairs on rollers must therefore have five feet to enable the sitter to play 'Fidgety Philip' without falling over! And to ensure that the chair does not roll away – even when the sitter gets up in the correct fashion – the rollers must be adapted to the floor covering and braked.

Control elements – as knobs, switches and levers are called in the field of ergonomics – must, of course, be easy to reach when the subject is sitting and they must be easy to move. Control element experts give priority to pushbuttons and rocker controls to rotating knobs and they lay great store by a rough or knurled surface to stop the fingers slipping.



The **sitting height** must be adjusted in such a way that both feet are standing completely on the floor and that the angle between the thighs and the calves is at least 90 degrees; a little more would be better. While DIN EN 1335 assumes that a height adjustability of 40 – 51 cm is sufficient for this purpose, there are recommendations for a greater variation range with a view to the needs of ‘small’ and ‘big’ office workers. What applies to all DIN and other standards applies here as well: better, higher, faster and further than the standard specified can’t be wrong! But on no account should anything be less ...

Footrests are not directly a component of an office chair, but since they are in fairly widespread use they should be mentioned here. Whereas they previously tended to lead an inconspicuous existence under the desk in offices, in recent times critics have turned a glaring spotlight on them! Their criticism is that footrests force users to adopt a certain position with the feet and a certain leg posture, and that this restricts freedom of movement, rendering dynamic sitting impossible. The adverse effects of rigid sitting outweigh the positive ones in

the view of footrest opponents. They therefore plead for a rejection of footrests in favour of a height-adjustable desk. There is no doubt there’s something to be said for this view. But the boss often doesn’t agree! After all, height-adjustable desks, possibly with an electric motor, have their price. And if the boss doesn’t want to pay it, the ones who have drawn the short straw draw it again – and have to resort to footrests. And so it should be said here that the use of footrests is better for small people than not having a height-adjustable desk! Footrests must be at least 45 cm wide and 35 cm deep. Larger areas are, of course, better and at least they facilitate partially dynamic sitting. A footrest is correctly adjusted when the user’s feet rest on it over their complete area and – as usual – the thighs and calves are at right-angles to one another. There are now a whole series of different forms of footrest intended to facilitate changing body postures (e.g. with calf contact). Once again it is worth checking out the goods on the market before going for a standard solution.

A standing ovation for your standing desk!

There are standing desks and there are standing desks. There are differences in design and in accessories. To make sure that standing desks don't just stand around, but are used, they should fulfil the following criteria:

- The standing desk should be adequately capable of growing with you. Height adjustments of 120 cm should be possible at least, and even better is a maximum height of 131 cm.
- The desk top should tilt towards you! It should therefore have a tilting mechanism which is easy to adjust and which permits a slope angle of between 0 degrees and at least 8 degrees, top of the list of wants. And to make sure that nothing slips off you should make sure there are facilities for holding important items fast (straps, non-slip inserts etc.).
- The desk top should not be too small! It should be at least DIN A 3 and bigger is of course better!
- Extras are welcome! It should be possible to add various accessories to the standing desk, e.g. phone arm, shelves, workplace lamp etc.
- Free-standing desks should have an integrated footrest. This will take the load off the spine and improve your posture – just like standing at the bar!
- Mobility is an advantage! A mobile standing desk with lockable rollers can be moved to where the work is and will be used more frequently as a result. But be careful – stability must of course be assured (even at the highest setting)!
- Flexibility promotes movement! Standing desks integrated in a normal desk should be at your disposal when you need it – but they should disappear again quickly when you've had enough. It therefore makes sense to have desk tops mounted on a swivel arm. But this must not adversely affect stability of course.



Desks, chairs and the rest

The chair is a sociable item of furniture and is rarely alone – mostly there is a desk nearby. On the desk there is often a computer, a keyboard and other items of equipment. How does this best go together? By adjusting them to one another. You only have to do this once when you have your own workplace (and there is no height-adjustable standing-sitting desk to hand). It must be a daily ritual if a number of individuals use one and the same workplace. Unfortunately, many people fail to adapt the furniture to their needs and physical dimensions and prefer to adapt themselves to the furniture or to the physical dimensions of the previous occupant. The aim here is to encourage a change of attitude on the part of the sitting workers so that the chairs and desks will also undergo a readjustment. So here is a 'laundry list' for an ergonomic computer workstation:

1. You are the measure of all things, and it is against you that everything also has to be measured. First sit down on your office chair. Are you sitting? Good. But are you sitting comfortably? You will be if the height is set so



that both feet are flat on the floor – and if your thighs are horizontal and are completely utilising the sitting surface and backrest. If the angle between your thigh and your lower leg is equal to or greater than 90 degrees and your hand fits between the inside of your knee and the front edge of the seat, then your chair fits you.

2. The next thing is quite simple if the desk in front of you is height-adjustable. According to DIN EN 527 you will then have a variable height of between 68 and 76 cm available to you. Adjust the height of the table so that the angle between your upper and lower arms is 90 degrees or a little more. Make sure that your upper arms are hanging loosely and that your lower arms can be held in an approximately horizontal position in relation to the keyboard.
3. If the desk is not height-adjustable, but 72 cm high according to the standard, you, as a small person, have no choice but to provide a footrest (see above) to compensate as necessary for the difference between the desk height and the floor. The typing tables previously in common use with a height of only 65 cm are unsuitable for use as

an office desk even for small people and are out of the Stone Age in ergonomic terms! With regard to big people, perhaps you can find creative (but safe!) solutions when trying to raise your desk.

4. The keyboard in front of you should not be sloping (in other words you should fold any 'support feet' it may have away), otherwise your hands will be at an unfavourable angle. It is better to have the keyboard about 10 to 15 cm away from the edge of the desk in front of you and to use the area in front of the keyboard to rest the heel of your hands. A hand heel rest can take the strain off your wrists, but it is only useful of course if your fingers don't circle above the keys like an eagle looking for its prey!
5. The screen should stand in front of you in such a way that you have an overview of everything without having to turn your head. If you want to work in a relaxed fashion you should also hold your head in a relaxed position. This will be so if you are looking in a slightly downward direction. A rule of thumb is that the top line you can read must be below eye height! The viewing distance is geared to the size of the screen and with a 15"



screen it should be at least 50 cm, with a 17" screen around 60 cm and with a 21" screen about 80 cm. The optimum solution is when the software can also be adjusted in such a way that the script and symbols are easily identifiable at the viewing distance you prefer. If the depth of the desk is now sufficient so that the monitor does not project beyond the edge of the desk, that's a big gain.

6. A useful accessory for ergonomic working at the computer screen is a copy holder. Then the copy will not constantly turn your head! The copy holder will be in a correct position if it is right next to the screen so that the viewing distances and viewing direction are as similar as possible. This will save you tiring eye work which arises when your eyes constantly have to adjust to changing viewing conditions.

Shaken up day after day! – Whole-body vibrations on drivers' seats

The 'father' of occupational medicine, the Italian physician Bernardino Ramazzini (1633–1714), was already aware that man is not made for whole-body vibrations. Ramazzini established when examining the occupation of 'horse tamer' that "all the intestines are shaken by the force and shifted almost completely from their natural position". At this point we will leave it open as to whether this is actually the case. But the fact is that nowadays many people are violently shaken up in their occupation, especially drivers of heavy goods vehicles, forklift trucks, earth-moving machines, agricultural tractors etc. It is also a fact that being subjected to whole-body vibrations over a number of years can give rise to numerous health problems:

- problems with the spine
- stomach and intestinal complaints
- diseases of the urinary tract
- headaches

The spine and intervertebral discs in particular suffer considerably from the constant up-and-down motion and exhibit premature wear and tear, in a similar way to an overworked shock absorber. This is hardly surprising when vertical vibrations acting on seated humans, such as those caused by potholes, are transferred directly through the seat into the spine. Those at special risk are people who have prior damage, those who are still growing (until the age of 23!) and those whose intervertebral discs are already showing signs of ageing.

The double load in the driver's cabin – the sitting itself and the whole-body vibrations – imposes especially rigorous ergonomic and technical requirements on drivers' seats of, for example, heavy goods vehicles. The basic design features of drivers' seats are:

- to the greatest possible extent large-area and anatomical support of the contact surfaces between the driver and the seat by means of an optimised sitting depth and rest length. On the one hand, this relieves the load on the muscles due to static holding work and, on the other, fewer pressure points which may impair blood circulation develop.

- an individually adjustable backrest shape, i.e. the backrest should have a lumbar padding which can be adjusted pneumatically or mechanically in terms of height and concavity and it should also have a neck and head support. Both these support the neck and lumbar lordosis and help avoid an inappropriate load on the intervertebral discs.
- seat coverings which are permeable to water vapour and air. They will ensure an acceptable microclimate in the sitting area even if the driver sits continuously for a long period. In addition, the seat and backrest foam can be perforated to encourage air circulation. Fully glued surfaces acting as a water vapour barrier should be avoided. Textured surfaces of the upholstery, so-called climate channels, are absolutely essential in particular with waterproof coverings, e.g. on tractor seats, if the driver is not to stew in his own juice!

When reducing the vibration load, the driver's seat plays the crucial role. It is the link between the vibrations of the chassis and the transfer of these vibrations via the seat surface to the driver's body. In other words: whether the driver to a certain extent sits 'restfully' or whether his intervertebral discs give up the ghost will be determined by the equipment at the driver's disposal! What is important is the choice of the correct, vibration-damped seat, since otherwise the natural vibrations of the human body and those of the vehicle/driver's seat will be superposed reciprocally – and will therefore get worse! Something similar happens when the driver's seat and driver do not suit one another. The adjustment possibilities of vibration-damped seats are therefore not only restricted to height, slope of the sitting surface, position of the backrest etc., but also cover the driver's weight. And here no-one should allow his vanity to make him set his dream weight instead of the real one. This will then mean that not only will the seat's damping action be lost, but that exactly the opposite effect may possibly set in! If the driver and the seat fit well together, the vibration load can be reduced by as much as two thirds.



Sitting differently?

Alternatives in the office

Sitting alternatives

The prolific writer Johann Wolfgang von Goethe (1749–1832) liked to maintain an upright posture at least while working: like Schiller and Einstein, he worked mainly at his standing desk. But unlike these two, Goethe also had a piece of furniture made especially for this purpose, and this was perhaps one of the first alternative seats ever: the upright seat. It consisted of a stand with four legs on which a long 'sitting surface' to enable the user to be supported on part of the buttocks without taking his weight off his feet. Today there is a wide range of sitting-standing aids available, looking sometimes like a saddle with rollers, sometimes like a mushroom with a tapered base – There is surely something for every taste...

Now sitting-standing aids are by no means the only alternative to the common design of office chair. Innumerable designers and DIY fans try to tackle the problem and to liberate man from the 90-degree posture of conventional sitting. The result includes high-chairs, kneeling chairs, swinging and gyrating designs, pendulum chairs and fitballs. There are no real alternatives in the office to sitting as the basic working posture, but there are certainly plenty of alternatives to classic sitting. The aim of these alternative items of sitting furniture is to re-

duce constant postures and to ensure more movement while sitting. In practice, however, many alternative seats have shared the fate of Goethe's works: A lot of people know them by their reputation, but only a few use them themselves! Modern offices no longer look like the 'gallery workplaces' in the open-plan offices of the 1920s, where there were rows and rows of desks and the office supervisor could oversee everything – although many a 'modern' office workplace harks back to this. Whatever, we are still a long way from the 'mobile' office. Many companies – and also workers – do not exploit the existing prevention potential, or only inadequately, and thus jeopardise employees' health as well as employability and competitiveness.

Fitball and similar possibilities – competition at the office workplace?

We all sense it: actually we should move more. The fact that we don't do it is often because we feel too comfortable. But our sluggishness is always the fault of others. Sometimes it's the weather that is the reason why we spend the afternoon on the couch watching the television, sometimes it's the flat tyre on our bike – and sometimes ourselves! And in the office the boss is the guilty one of course

The VDU Work Ordinance



With the VDU Work Ordinance in 1996 a piece of legislation came into force in Germany which helps to effectively tackle the loads on workers in the office. Since nearly 90% of office workplaces are now equipped with 'colleague computer', the VDU Work Ordinance sets ergonomic, safety and health criteria for nearly all office workplaces. Criteria, however, which have not been applied everywhere and still aren't. According to the Deutsches Büromöbelforum 2003, around 5 million office workplaces are still waiting for their deficiency analysis. So there's still a lot to do. But someone who satisfies the requirements of the VDU Work Ordinance regarding work equipment, software, furniture and working environment will not have gone a long way toward the prevention of disorders of the support and motor apparatus, contrary to the widespread view. After all, a well designed VDU workstation which takes account of all aspects of the VDU Work

Ordinance, is a necessary, but by no means adequate condition for a health-promoting and back-friendly office workplace. The VDU Work Ordinance does not deal with movement as the most important source of prevention for back disorders and muscular tension. It only obliges the employers to ensure that the organisation of work facilitates regular breaks and changes of activity. There is no mention of how the breaks should be used or what activity should break up the VDU work. Here there is a need and call for health awareness on the part of workers (use of breaks for gymnastic exercises) or the employers (development of movement-promoting job arrangements).

when it comes to our quasi-symbiotic relationship with a chair. After all, he could provide alternative sitting that arouses our dormant urge to move around. Is this really true? Is it really only due to the lack of sitting alternatives in the office that we are so unwilling to leave our traditional seat?

The Federal Institute for Occupational Safety and Health wanted to find out more about it. In the context of a research project of the Fraunhofer Institute for Industrial Engineering IAO which the BAuA proposed and funded, the issue was the preventive potential of alternative seating as compared to the classic, standardised rotating office chair and sitting-standing concepts in competition with a conventional sitting desk according to DIN EN 527. The test subjects – 42 office workers – were able not only to compare alternative possibilities with ‘the usual’, but also to mix sitting furniture with sitting-standing facilities. An assessment was made of both objective criteria, such as the load on the spine and muscle work, and of the ‘perceived’ degree of well-being or discomfort, which was determined with the help of questionnaires.

The results were relatively sobering. The fitball and similar possibilities were not generally better with respect to the so-called musculoskeletal stress-strain situation than an office chair to DIN EN 1335, although they were certainly capable of providing for alternating movements and hence a change of load. But in practice this did not in fact arise because the sitting alternatives were rejected after only a short time and were consequently no longer sat on. Only the high chair was approved of, but this is no good at normal desks and requires an extremely height-adjustable desk.

The items of furniture based on the sitting-standing philosophy suffered a similar fate. They were also not able to play out their undoubted potential because the standing desks fully lived up to their name – and largely stood around unused. Three to five times a day the test subjects went to the standing desk and remained there on average for only 5 minutes – not really an appreciable contribution to greater movement in the office! The desk with extreme height adjustment did better in the practical test since it prompted the sitters to do an average of 30 minutes standing work each several times a day. This was the only item of furniture the users said they wouldn’t want to be without in future.

The results of the study show that the appropriate furniture alone does not stimulate the classic 90-degree sitter either to swing a leg or to do a balancing act; the standing desk by itself also fails to provoke a standing ovation. Only the extremely height-adjustable desk and the high-chair were accepted and consequently also used.

From body posture to body movement!

So the provision of standing desks is not sufficient to promote dynamic standing and sitting in the office – the average office worker simply doesn't use them! If you want to counter a lack of movement and constrained postures in the office in a sensible way, you should therefore first think about alternative ways of arranging tasks for the workers. A job is only 'mobile' if it involves sitting, standing and moving phases – the keyword here is: mixed work. Work scientists take this to mean the amalgamation of different activities to form a new work arrangement. The extent to which mixed work can help create physical and mental 'mobility' also depends on the range of the approach selected. The choice is between the following models:

Job rotation: Several workers rotate at several workplaces with different tasks which are compar-

able in terms of the qualifications required. But this only makes sense if different requirements are imposed physically and mentally.

Job enlargement: A number of qualitatively equivalent activities are consolidated at one workplace. The range of tasks becomes greater and this will possibly facilitate a variation of physical and mental load.

Job enrichment: Activities with different qualitative requirements are consolidated, including planning, control and inspection tasks involving different physical and mental activities. It is clear that the workers also have to fulfil the relevant conditions to prevent the development of overstrain.

Group work: A number of workers form a group to which a certain task is assigned. Performance, assignment of tasks, time schedule etc. are the responsibility of the group within a certain

Mixed work promotes health and job satisfaction – and ensures better back health.

framework. The possibilities for mental and physical mobility are greatest here, but their introduction places the greatest demands – also with respect to group member qualifications, of course.

There can be little objection to trying out mixed work in the office – in whatever form. All studies show that mixed work – correctly introduced and implemented – promotes health and that it increases job satisfaction and productivity. And incidentally it provides for movement and hence back health.

Strengthen your backbone!

Changes in ergonomics and work organisation which promote movement at the workplace offer the workers the opportunity to adopt forms of behaviour at the workplace which will protect their back and promote health in general. Whether they take up this offer or not will depend on the workers' problem awareness. Only someone who informs himself and is convinced of the sense of the changes will question his habits and perhaps change his behaviour. A targeted qualification programme in health protection should therefore supplement and back up the ergonomic and organisational design measures. Only the linking of circumstantial and behavioural prevention can ensure that the frustration with sitting will one day give way again to the joy of sitting. The BAuA study mentioned above showed that workers who had been forced by lumbago or something similar to take care of their back tended to be more willing to try out alternative sitting furniture and standing-sitting systems. For all those who wish to take a less painful route to this state of realisation are well advised to attend a

training course on back problems. Here they will get everything a healthy back needs:

- Information on the human posture and movement apparatus
- Behavioural training in back-friendly posture and movement in all life situations
- Targeted compensatory exercises

So-called workplace-related back training is especially appropriate in this context. The basis for such a training course is a tour of inspection of the workplace followed by analysis and the rectification of any ergonomic design deficiencies found. If the 'hardware' is right, the working sequences come into focus. Together with the worker, back-friendly posture and movement sequences are developed and rehearsed. Further subjects in the course relate to correct, i.e. dynamic sitting, the advantages of dynamic sitting and standing and the correct setting-up and adjustment of work equipment. To ensure that the whole effort is worthwhile and yields really long-lasting changes in the persistent sitters' behaviour, a workplace-related back training course should be part of a workplace health promotion programme in which the workers are actively involved.

A look forward

In former times sitting was considered a privilege of those with power and influence. Unfortunately this aura of esteem, greatness and authority for sitting has persisted until the modern day. The sitting person has a higher status here than the standing person. This certainly encourages the perception that sitting is also not really a problem – despite the now unmistakable health consequences

of continuous, long-term sitting. If we continue to sit as we have done to date, our body will perhaps adapt by evolution to the sedentary way of life one day. If we look at the chronological dimension of evolutionary changes, this may take a few hundred thousand years, however. If you don't want to wait that long, you should change your attitude to sitting. After all, sitting is only a necessary evil, and not a privilege.

Anyone who thinks the problem can be solved by means of an ergonomic office chair alone is mistaken. This is only the first step and further ones are essential. The aim must be to drastically reduce the proportion of work spent sitting and to stimulate more movements at the workplace and in the working sequences. Dynamic sitting by itself helps little to counter the strains from constant sitting – genuine dynamism, in other words standing up and

moving, is called for! The possibilities for this are many and varied, both in one's free time and at work. However, to exploit them, it is necessary to adopt a different attitude to sitting and to moving. If this brochure can help promote this change of attitude, it will have achieved a lot.

View of the 'retreat zone' of a future office landscape. Here creativity is actively supported because subconscious intuition emerges more easily if the atmosphere is more casual and stimulated.



Annex

Links and References

The links presented here only represent a small selection from numerous websites on the subject of sitting in the office. The selection should not be considered as implying any rating. The same applies to the list of references.

www.baua.de

Site of the Federal Institute for Occupational Safety and Health with extensive information, and not only on the subject of ergonomics and VDU work.

www.buero-forum.de

This site is maintained by the furniture manufacturer's association Verband Büro-, Sitz- und Objektmöbel e.V. and gives information interactively on any topics relating to offices.

www.ergo-online.de

The technical information service of the Hesse Social Network deals extensively and informatively with many aspects of office work.

www.gesuenderarbeiten.de

Site of the Joint Initiative for Healthier Work (Gemeinschaftsinitiative Gesünder Arbeiten). Under the menu item 'Healthier at the PC' there are a lot of tips for corporate practice.

www.inqa-buero.de

Site of the New Quality of Office Work Initiative where companies, social partners, Berufsgenossenschaften (institutions for statutory accident insurance and prevention), health insurance bodies and the Federal Ministry of Economics and Labour have come together with specialist articles, event notices, an information pool and numerous links on the subject of offices and office work.

www.learn-line.de

Site of the Landesinstitut für Schule (State Institute for Schools). Here there is an interesting contribution on the subject of sitting in schools.

www.vbg.de

Site of the Verwaltungs-Berufsgenossenschaft (institution for statutory accident insurance and prevention in the administrative sector) with many aids to action on the subject of safety and health.

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DIN EN 1335-3 ‘Office furniture. Office work chair – Part 3: Safety test methods’

DIN EN 527-1 ‘Office Furniture – Work Tables and Desks – Part 1: Dimensions’

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The action group 'New Quality of Office Work' (INQA Büro) was constituted at the ORGATEC 2002 as an independent contribution of the national initiative INQA. The founding partners were the Bundesarbeitsgemeinschaft für Sicherheit und Gesundheit bei der Arbeit (Basi – Federal Association for Occupational Safety and Health) as a combination of the top organisations in occupational safety and health in Germany, the Verband Büro-, Sitz- und Objektmöbel (BSO – Association of Office, Seating and Office Facility Furniture) as a manufacturers' organisation, and the German Trade Union for the Metalworking Industry, IG Metall, as the social partner for the office furniture industry. www.inqa-buero.de



The Federal Institute for Occupational Safety and Health (BAuA) is a central facility of the federal government for research into safety and health at work. The observation and analysis of working conditions in companies and administrations are also part of its remit, as are the development of solutions to problems using safety and ergonomic knowledge and epidemiological and occupational-medical methods. www.baua.de



The Verwaltungs-Berufsgenossenschaft (institution for statutory accident insurance and prevention in the administrative sector) is the body responsible for statutory accident insurance. By all suitable means it performs its many varied tasks – the prevention of work accidents, occupational diseases and work-related health hazards, the restoration of health and financial compensation. It provides this comprehensive cover to more than 500,000 member companies with around 7 million insured. www.vbg.de



The European Network for Workplace Health Promotion (ENWHP) was founded in 1996, co-ordinated by the Federal Institute for Occupational Safety and Health, with the aim of propagating and implementing the idea of workplace health promotion in Europe. Under the heading 'Healthy Employees in Healthy Organisations' the ENWHP constitutes a forum to support the exchange of information and experience between the various players in Europe. www.baua.de/whp-net



The registered association Verband Büro-, Sitz- und Objektmöbel e.V. (BSO), Düsseldorf, encompasses more than 70 companies who manufacture office furniture in Germany. It represents the common interests of its member companies. The BSO maintains an Internet site with information on everything to do with the improvement of office work through optimum office and workplace design. A regular electronic information service ('YourOfficeLetter') can also be obtained there free of charge. www.buero-forum.de



The Bundesverband Bürowirtschaft (BBW – Federal Association of the Office Industry) is the body which represents the interest of the office supplies trade and service companies from stationery shops to ITC specialists or office equipment. www.buerowirtschaft.info

