

The contribution of sports medicine to the improvement of performances*

by Professor Ludwig Prokop

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We should like to thank Professor Ludwig Prokop for his first contribution to the "Olympic Review".

Born in 1920 at St. Pölten (AUT), medical doctor, he has been professor of medicine at the Faculty of Vienna since 1950. He currently heads the Austrian Institute of Sports Medicine (1970) and the Institute of Physical Education at the University of Vienna (1974).

Founder-President in 1952 of the Austrian Federation of Sports Medicine, he was medical supervisor of the Austrian Olympic delegations from 1947 to 1968.

Member of the Medical Commissions of the IOC (since 1967), IAAF, FISA, IIHF and UIPMB, he succeeded Professor La Cava in 1976 as President of the International Federation of Sports Medicine (FIMS).

The time when sport was nothing more than an enjoyable recreation for individuals is irrevocably past. The phenomenon of sport today intervenes in many fields of human endeavour and very often even holds a central position. Sport has thus experienced an enormous extension qualitatively as well as quantitatively, with many positive but also negative aspects. Apart from health sports with their special significance as a prophylaxis against civilisation damage and as a many-sided therapy, there is high performance sport. Nowadays unfortunately it is too often used as a means of political demonstration and as a pretext for commercial intentions. Apart from that it very often has nothing to do with health.

Sport, the ideal model of human performance

The specialisation and intensification of sport necessarily demands an absolutely serious and professional foundation. This necessity has led to the development of special sports sciences covering the needs of medicine and physiology, motion mechanics, training theory, pedagogics and sociology, as well as some other marginal areas.

Sports medicine is however the most important because it touches most directly on some of man's most vital areas, and in relation to its scientific foundations it is of peak importance due to the number and quality of its scientific publications. Sports medicine has therefore achieved decisive importance and has become irreplaceable because of the extensive field it covers and through its direct relationship with health and functional capability. Within the framework of medicine it has a special position because, like no other medical field, it has to deal intensively and universally with all aspects of the human organism and with man as an entity.

The fact that sports medicine has to deal scientifically with the functional capability of man makes it a valuable aid to labour medicine. This is obvious because sport is akin to work, although it is or should be pleasurable. Experience has shown that sports medicine is able to register the performance and functional capability of man better than labour medicine, because only sport represents the ideal model of human performance. Certain results of sports-medical research may have a secondary influence that is nevertheless often decisive in other fields of medicine, e.g. cardiology and in many other aspects of human health. However the primary task of sports medicine is to work for sport and to see to it that sport is optimally

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conducted both in theory and in practice. This is as true for performance sports as it is for health sports, because for the untrained person health sports may be a much greater subjective and objective strain than hard performance training for top athletes.

This is often the case where people under family or professional stress rush into sports as a compensation for their personal problems. Then sports will no longer serve as recreation and balance, but rather increase tension and fatigue.

The limits to the pathological

The extreme performance principle in modern high performance sports makes the task of sports medicine, of bringing man to his optimal performance without passing the limits to the pathological, all the more difficult. The difficulties are primarily due to the fact that the patho-physiological limits of man can only be established in very isolated cases, while sports of today are doubtlessly taking place in biological border areas. The incidence of damage and injuries caused by sports during the last few years is impressive. There is no need to prove in particular that the extreme forcing of performance today with the attendant complete exhaustion of psychic and physical strength potential will usually result in lasting disadvantages.

Every increased performance demands increased commitment; increased commitment in its turn leads to increased stress. Any stress beyond a certain level, in man as well as in material technology, leads to increased wear of the tissues thus strained. In most cases unfortunately, particularly in the apparatus of motion, this will cause an irreversible negative change involving sports damage.

Sports medicine may only be used to increase performance as long as this does not lead to serious exploitation without any regard for losses. That means that the sports physician must never demean himself to become the handyman of fanatics or of unscrupulous sports managers sacrificing people to performance and success for reasons of national prestige, personal ambition or for commercial interests.

Problems will however ensue from the attempt to establish performance limits of individuals and the fixing of still permissible loads, making great demands on the sports physician's professional knowledge and his readiness to accept responsibility. Thus he is led to the basics of medicine and ethics,

where the supreme maxim determining his action in all circumstances will have to be the demand for the *Primum nihil nocere*" (First do not harm).

The most important contributions of sports medicine to the problem of human performance lie primarily in the area of heart circulation, of the physiology of performance and of metabolism in its broadest sense and increasingly in the physiology and pathology of the apparatus of motion. Theory and practice have rapidly shown that there are large-scale differences between the possibilities of various organ systems with regard to their development through training and thereby with regard to the physiological limit load that is still reasonable. There is a very clear lack of congruence as to functional capability, training capacity and purely physical organ stress in the different tissues under intensive training. There is a particularly great divergency between the development capabilities of the heart, the musculature and the passive apparatus of motion. As has been proved by sports heart research there are scarcely any limits to the training capacity of the healthy heart. It possesses a practically unlimited performance reserve, effectively preventing it from being overstressed and thereby damaged. It cannot be endangered even by extreme muscle work, because skeletal muscles tire long before there are any problems for the heart.

This decisive knowledge has been used to develop those methods of endurance training for runners, cross-country skiers, swimmers and cyclists, serving today as the basis of the long distance performance explosion.

The methods of Spiro-ergometrics and telemetrics developed by sports medicine for the control of heart and circulation, which, at present, are the only basis for an objective performance assessment, have in the meantime become an indispensable diagnostic component of clinical cardiology and pulmonology.

The surely greater effects of these scientific bases lie within the field of prevention and the therapy of cardiac/circulatory diseases, e.g. the prevention and treatment of cardiac infarction. Sports-medical findings that the human heart' can be trained all through life according to age, constitution and condition, are of enormous vital importance for a society where the people have lost the habit of exercising and thus find themselves limited. While trained persons are found to be 10 to 20 years younger than their actual age despite heart-circulatory alterations

creeping in slowly, inactive persons reduce their life expectancy. Not only do they accept the risk of a small and inefficient heart, but they also slip into the vicious circle of lack of exercise—overweight-inability to master one's own body-functional weakness-further inactivity-resignation-illness. From a socio-political point of view the effect of these research results is of enormous importance, because early incapacity and invalidity due to degenerative heart and circulatory diseases have reached unmanageable dimensions.

Sports medicine can contribute decisively to an extension of life, but also to the retention of health and functional capability making life more meaningful and liveable.

The apparatus of motion

The apparatus of motion is the biggest problem, still showing many unmanageable aspects. While the musculature can be enormously increased hypertrophically through training and many other possibilities, the passive apparatus of motion offers little opportunity for organic and functional development. This disproportion in functional adaptability results in today's very frequent states of irritation of muscular insertions, tendons, periosteum and articular cartilage and bones. These conditions are usually very refractory to therapy. Classical examples, more or less typically localised according to the type of sports, are the tibial pains of gymnasts, the patellar border pain of basketballers, weightlifters, wrestlers and fencers, the pain in the inguinal region of footballers and the arm pain of tennis players and throwers. The misunderstood interval and weight training, long carried on without any scientific foundations according to the principle of "the more, the merrier", was and still is a real problem.

A well-developed muscular corset is a necessary precondition. Sports-medical research has also been able to give valuable pointers for the development of technique in many other fields. These not only contribute to performance improvement, but also decisively to the reduction of risk.

The so-called synthetic syndrome is another example of special topicality. The notable increase of pathological effects including injuries due to the use of synthetic tracks for training and competition in the last few years has made scientific clarification of the specific causes necessary. Problems of the "Tartan syndrome" are not limited to athlet-

ics and competition games but have, due to its relevance for school sports, a further effect on a rather large group of persons.

Our studies have shown very clearly that at the moment when the foot touches down on the synthetic track, either when running or taking-off in jumping, there is a complete lack of the short slide phase encountered on a cinder track. Due to deformation of the highly elastic track and the lack of any damping, an enormous storage of energy results. At the same time vibrations up to 100 Hz appear due to the elastic deformation balance, and the high adhesive friction at the moment of touch-down can cause retardation of up to 20 g. depending on the kind of surface. This energy storage causes this catapult effect, making the track quicker, especially for sprinting and jumping, but at the same time it causes a great mechanical load especially on different tissues of the leg. The "Tartan syndrome" confirms the old factual experience that everything conducive to performance will always cause serious sports-medical problems related to the apparatus of motion. Synthetic tracks remaining a continuing reality, it was necessary that sports medicine should be able to offer a solution to protect the athletes. This consists in the design of a sufficiently damping shoe sole with a slight adhesive friction and high sliding friction. At the same time it will be necessary to reduce training on these tracks and in some cases there will be need for a change in technique. The shoe industry has so far dragged its heels in the realisation of this sports-medical demand of the highest prophylactic importance, mainly for reasons of price and technology. This example in addition shows that the solution of some problems connected with high performance sports is not possible through efforts of sports medicine alone, but that other sciences will also have a decisive role to play.

The study of heredity

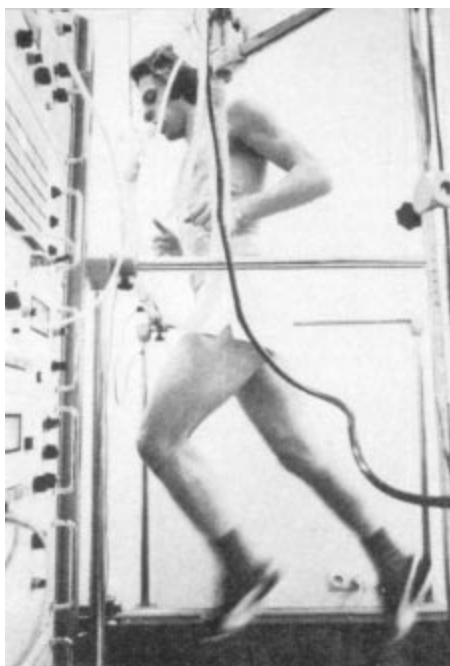
The constitutional complex of factors doubtlessly has an important role to play with regard to training capacity, as well as resistance to negative and unphysiological loads. Genotypical characteristics of the apparatus of motion, the circulation, metabolism and the nervous system, given by hereditary predisposition, make up to two-thirds of the basis for top performances, always depending on the kind of sport practised. Because many of these endogenous, and in principle

fixed, given factors preclude certain performances from the start, it is of the greatest importance to make a proper choice of children and young people for later performance training. The type of constitution and bodily development not being readily discernible at the age where a decision for later performance sports has to be made, there is need for special examinations, e.g. evaluation of the state of maturity of the carpal bone, together with an exact medical and sporting family anamnesis to be used for prognosis. This type of research is already being undertaken in some countries very thoroughly and with great success, but unfortunately it is not yet generally applied in practice to the extent that would be necessary to avoid misinvestments of health, time and money, and to prevent the most severe frustration of wrongly trained children.

As the constitution largely determines the possibility of functional adaptation and thereby real training capacity, it must be concluded that the chances of performance development to be achieved through training cannot basically be the same for everybody.

Continuous care for the athlete

Constitutional factors however also play an important role in the stress system based on the hypophysis and the supra-renal cortex, giving man his individual adaptability. Our studies have shown that with extreme endurance training, where the heart has already reached its maximum weight, the supra-renal cortex continues to enlarge still further. The weight increase of the suprarenals noted is therefore almost exclusively due to the supra-renal cortex, which is decisive for adaptation. This is not only responsible for man's adaptation to performance and especially for top sports performances, but also for the mastery of numerous other exogenous demands from everyday stress to certain diseases. Too high adaptation demands in the performance sector will of necessity give rise to difficulties in the defence sector. Due to an overload of his stress system, the individual will then be unable to cope fully with infections, adaptation to climatic changes, changes in the tempo of life, nutrition and the psychic situation. Resulting from this it is understandable that the highly trained person, as is demonstrated by the reduction of certain immune bodies, will be more easily affected by common infections than the average person. It would therefore be wrong to claim



special toughening and resistance for highly trained sportsmen. This in turn means that highly trained individuals need special health guidance and continuous preventive treatment.

The study of fatigue

The great complex of fatigue is a central field of sports-medical research that can be directly transferred to people's everyday strain especially at work. Fatigue is a decisive factor because it plays a role not only in performance improvement, but may at the same time, due to the unphysiological wearing which results, negatively influence life expectancy. Any work done in a state of fatigue not only impairs human work capacity directly but also life capacity.

Work and training in a state of fatigue is the first step to an accelerated consumption of human substance and particularly in top performance sports the cause for premature exhaustion. The problem of reduction of fatigue or alternatively of a speeded-up recovery is all the more topical because Of

the fact that man with his extended span of life shows rather a retrograde tendency in his working and sporting abilities.

This is not only true of acute fatigue, which is a real limiting factor for topical functional capacity, but even more of chronic fatigue. The phenomenon known in sports as overtraining and as managerial disease in professional life is enormously complex in aetiology as well as symptomatology. In the course of high performance training as in the stress of professional life it demands a highly specialised and continuing diagnosis. The fact of performance reduction in a state of fatigue is less problematic than the general loss of economy, the appearance of sometimes irreversible local structural changes in tissues and organs, as well as the general disturbance of co-ordination in the course of reflex automatisms. Chronic fatigue very often is not the result of physical overstress but of additional, uncontrolled strain of physical and psychic origin. Faulty nutrition, style of life, climatic adaptations and lack of recreational facilities, psychical stress of the most varied origin cause conditional disturbances that make the effects of overtraining truly problematic. The consequences extend from an increased susceptibility to infectious diseases, e.g. tuberculosis, complaints of the cardiac muscles, hormonal disturbances, particularly with the sexual glands, to increased accident proneness. This can have the most serious effects in sports requiring high speed and fast reactions, for example skiing, cycling, but also gymnastics.

Against doping

Problematic overstress is very often heightened by the gap existing between ability and intention on the physical, as well as on the psychic level. This unfortunately very often occurs where intelligence and purely physical prerequisites diverge too greatly. The age-old "cerebrum-biceps" antagonism has thus become a topical problem of joint concern to sports physicians, pedagogues and psychologists that can only be solved by all of them together. In practice it is not at all rare that, with absolutely normal or even above average intelligence of the athlete, overstress results because the athlete has been wrongly assessed in his biological capabilities. This results in the athlete, often against his better conscience, being rushed into situations by his manager, trainer or the sensationalist press where he is forced into

overstressing performances. This also includes the enforcement of a sports performance through hypnosis or extreme external suggestion, which is not only biologically problematic but also foreign to the sporting ideal per se. Where the personality of the athlete, which should alone be decisive in sports, is excluded and he himself is turned into a remote-controlled robot, this is a situation far removed from sports. The sports physician with his rejection of such problematic methods is unfortunately very often a prophet in the desert.

The struggle against doping as a method of unphysiological performance increase through various pharmaceuticals and drugs is heading in the same direction. Doping truly shows the unhealthy development of extreme performance sports where there is no serious sports-medical control. The often cited reference that sports doping is really nothing but a model case for the forcing and manipulation rampant today in everyday life and professional life, by means of medication and stimulants, is anything but an exculpation. Based on illuminating and partly tragic examples, the basic question is raised of the extent to which man is entitled to force himself or others beyond a normal and adequate performance. It is a sad fact that physicians have decisively participated in the development of doping and the introduction of doping substances, and have sacrificed their medical conscience and the necessary care practised by the physician to personal interests out of ambition, commercial interest or national fanaticism. What is paradoxical and tragically ironical is that, as numerous experiments with doping agents in double blind tests and those with ineffective placebos have shown, the mechanism of effect is almost exclusively auto-suggestive. Thus the application of the toxic substances usually used in doping is not only dangerous but, with very few exceptions, absolutely useless.

Together with analytical chemistry it is to the merit of sports medicine that it has worked out methods of proof which today allow us to check on the observation of doping prescriptions. Even the most burning issue, the use of anabolic hormones, is in principle under control. The necessary consequences resulting from this cycle of problems are still subject to certain organisational and financial difficulties. Nevertheless it may be claimed that, as with classical doping, which can be said to have been mastered, there will be an end to the era of anabolics sooner or later.

Improving the human personality

Bodily condition is a concept of importance for every individual which has been worked out specially by sports physicians in theory and practice. Here condition, as the topical general physical and psychic readiness for performance, is the prerequisite for every good specialist performance. Condition is necessarily subject to great variations, due to many labile factors impinging upon it. Many hundreds of individual factors of general life conditions, tempo of life, nutrition, conditions of training and work, recreational opportunities, family situation, sickness, injury and other exogenous influences, as for example those of climate, are in continuous motion. According to a summation of positive or negative factors the initial situation of a performance will be better or worse.

In the face of these important tasks of sports medicine it is understandable that we need the co-operation of pedagogues, psychologists, pharmacologists, chemists and physicists.

With all the progress made by sports medicine we cannot hope to defuse all the dangers inherent in the situation of top performance sports, particularly because the scientific methods of improvement of performance capacity bring man ever closer to his physio-pathological limits, so that even the slightest unforeseen strain may already mean exceeding the pathological limits. Nevertheless we should not overestimate the risk of physical overstrain which is finally always smaller than that of understrain. It is furthermore among the fates of man to be subject to risk and to pass through a development using up his substance during the passage of time. Any absolute prophylaxis in this respect would in principle exclude any real calling. Danger and risk in some ways exert a positive influence on the personality of man and make him a real sportsman in the true sense of the word.

Sports medicine today decisively contributes in theory and practice to the task of any humanist science worthy of the name, the improvement of man's total personality.

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