European Athletics Innovation Awards2012

Running with poles

as an efficient training method

eliminating overstraining of athlete's feet

Index

1. Introduction

Running has not only been the base of the athletics, but also other sports. It is basically suitable for anybody – either professional sportsmen or those who run occasionally for keeping themselves healthy, for a good feeling, or in order to reduce extra weight. From this point of view, running is an ideal and a highly efficient sports activity.

However, unlike other endurance activities, running is also physiologically quite demanding, mainly due to involvement of a large group of muscles. The musculoskeletal system - mainly support joints - is heavily strained while running and has to amortize the gravity at the moment when the foot touches the ground. Unfortunately, professional and performance oriented sportsmen, resp. athletes, frequently suffer from injuries or damages in the most strained areas due to long-lasting cummulated strain. They often suffer stress fractures, tendon and muscle damages. Most of injuries involve heel bone, shank, Achilles tendon, knee, ankle, calf tendons etc. Due to overstraining or injury, the efficiency of the training process is unavoidably decreased. The athlete has to reduce the training both in quantity and quality, but sometimes - depending on the range of problems - has to undergo (often lenghty) treatment and rehabilitation.

In order to improve this situation we tried to combine the experience of two sportsmen: an active runner experimenting with different running styles, and a professional bio-mechanic expert specialising in running. Our cooperation resulted in a proposal to incorporate the method of running with poles into the training, as it is not only highly efficient and increases the physiological impact of running itself, but most importantly, diminishes the leg-joint overstraining and helps to eliminate orthopaedic risks.

A certain analogy in development can be obviously found with Nordic walking, where there had been a need for stronger support, higher stability and relief of a musculoskeletal system, which is based on fitness walking with poles. Contrary to Nordic walking running with poles has been so far medically, methodologically and even training-wise completely ignored.

We would like to change the situation mentioned above. Therefore we are presenting this thesis, which is based on our previous experience with running with poles. The main objective of our thesis is to give reason and exact proof on how running with poles eliminates the athlete's feet overstraining. Hence we have compared the force impact and pressure changes on feet during the support phase while running with or without poles in an experiment.

We would also like to point out other benefits of running with poles. This method significantly decreases the possibility of athlete's injury and generally increases safety while running in more difficult conditions. Moreover, regardless of the runner's level of performance, it increases running intensity and energy consumption. The general contribution of running with poles can be seen in widening the range of current training methods used in particular athletics disciplines.

In the submitted thesis we will first point out the specifics of running with poles compared to cross-country skiing and Nordic walking. Furthermore, we will describe the process of the experimental measurement of running with poles that has been conducted (objective, hypotheses, methods, results). In the discussion we will confront the hypotheses, mention other significant benefits of running with poles and some other special varieties of usage. In the conclusion we will give the reason why the method running with poles should be incorporated into the athletics training and finally we will give specific recommendations for particular groups of athletes.

2. Running with poles – the specifics

In the analysed sports activity, running with poles, three corresponding activities are combined: running, classical cross-country skiing and Nordic walking. These activities may be considered as common and methodically analysed. However, neither of these can suit to the activity described here, either methodically or by its equipment.

The advantage of running and classic style cross-country skiing is reaching relatively high intensity, so they can both allow for high energy consumption. This applies both considering the training goals and body-fat reduction. As for running, there is a disadvantage of a quite high impact on the musculoskeletal system; according to the running speed, the runner's foot must absorb two- to three-times their weight with every footstep.

Classic style cross-country skiing, which can be considered as a very convenient training or cross-training method during the winter season, does not overstrain the main joints so much. However, this activity requires prepared trails, which can often be very limiting (most of the runners or other active people are not lucky enough to live just next to a skiing trail or track).

Compared to standard walking Nordic walking - by involving the poles and arms - relieves a part of the impact put on the main leg joints (ankle, knee, hip). Nevertheless, by using standard poles for this activity, the higher intensity, which is necessary for reaching training goals in the athletics training effectively, is not guaranteed. Moreover, it is not possible to purchase Nordic walking poles in the length required for running with poles to reach the proper technique.

Running with poles, unlike the above mentioned activities, is different in some of the key movement phases. It requires a longer running step (not ultra-endurance step, which is shorter). The take-off phase at running with poles is shorter both in time and space than it is at classic style cross-country skiing, or it can be compared to its middle phase (i.e. without moving the arms considerably in front of the body and behind it).

The poles should be approximately 10cm shorter than classic style ski poles. The grip and correct stroke movement require a narrow profile and smooth surface of the handle, which allows the hand to slide gently – similarly to the classic style of cross-country skiing. The pole is planted approximately at the level of the opposite leg´s heel. When running uphill, the body is slightly leaned forward, the pace is lighter and shorter (rebounding more from the tiptoe), the pole planting is more dynamic.

3.Experiment

3.1 Objective and hypotheses

The objective of our experiment is to compare the force impact and pressure changes at feet during the support phase while running and running with poles, as well as evaluation of potential changes in foot pressure distribution onto the pad concerning the health prevention aspects.

Hypothesis A: When running with poles at the same speed, the impact on the foot (resp. the musculoskeletal system) is diminished.

Hypothesis B: When running with poles, the foot pressure distribution onto the pad is changed.

3.2 Methods

The thesis is set as an experiment. The measurement was done on one test subject, an athlete-runner (weight 74 kg, height 180 cm). An analysis of the foot pressure distribution onto the pad has been conducted during the supportive phase of running and running with special poles. The measurement was conducted on a grass surface, a track at the length of 100m, which was repetitively run through by the test subject, at the same pace of 4:20 min/km. The analysis is based on the average result of the measured parameters within 30 steps.

The test subject had pressure-measuring insoles with Pedar-X system by the Novel company in his running shoes. The system enables to scan the foot pressure during the foot strain. The device is therefore able to detect and assess the pressure changes between the foot and the pad during the supportive phase of walking or running, with the frequency of 50 Hz. Using this system, the foot pressure on the pad as well as other time-space characteristics of the foot strain can be recorded and displayed. The changes of these characteristics during the supportive phase of the activity can also be assessed.

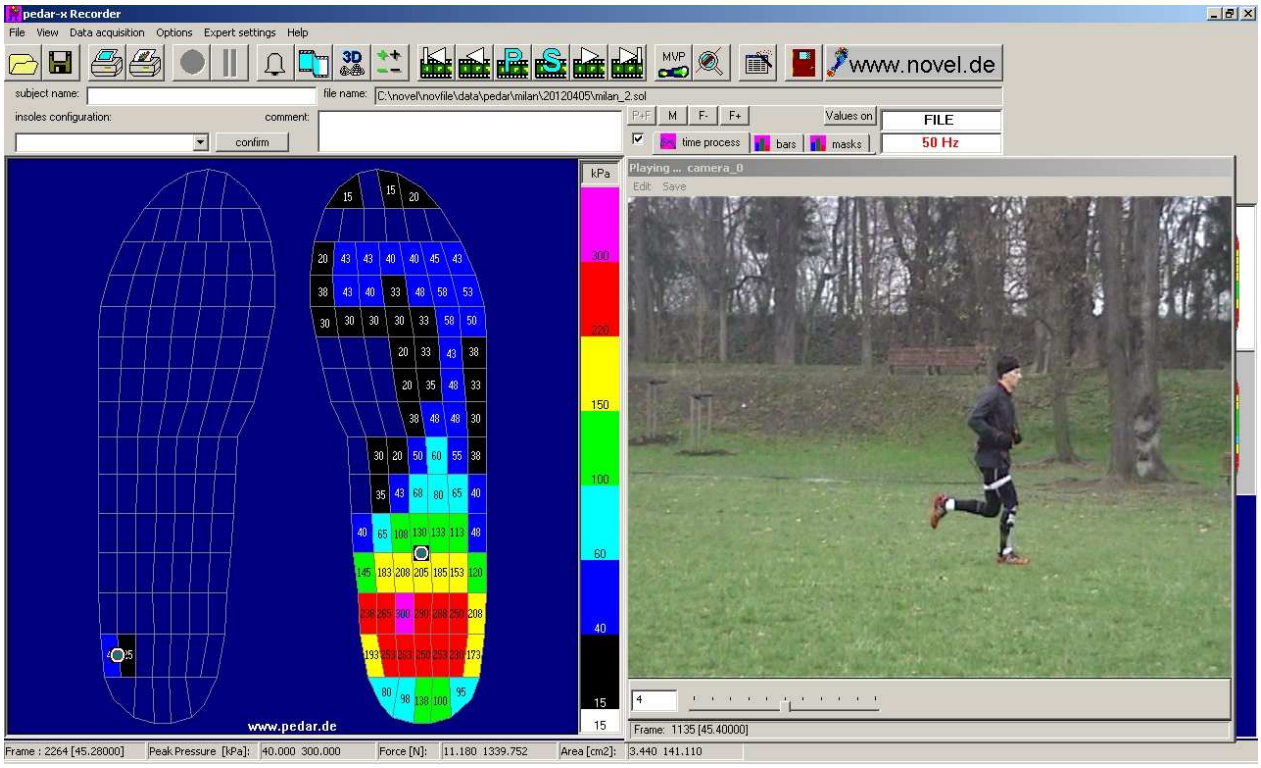
The Pedar-X system constitutes of two elastic pressure-measuring insoles, a recorder with inner Bluetooth system, a memory unit and software for processing and evaluating of the data. The shoe insoles cover fully the stepping area of the foot. Each insole's surface is divided into 99 small fields, in which there are force sensors to measure current vertical force.

Both insoles are interconnected by cables with a recorder, which is attached to the examined person's waist by a belt (Picture 1). The Pedar-X system can be connected to a computer by an optical USB cable. Its mobile usage enables the ability of the device to communicate with a computer or a laptop via Bluetooth signal. The inside memory unit with capacity of 32 MB can also store the data, which can later be downloaded to a computer.

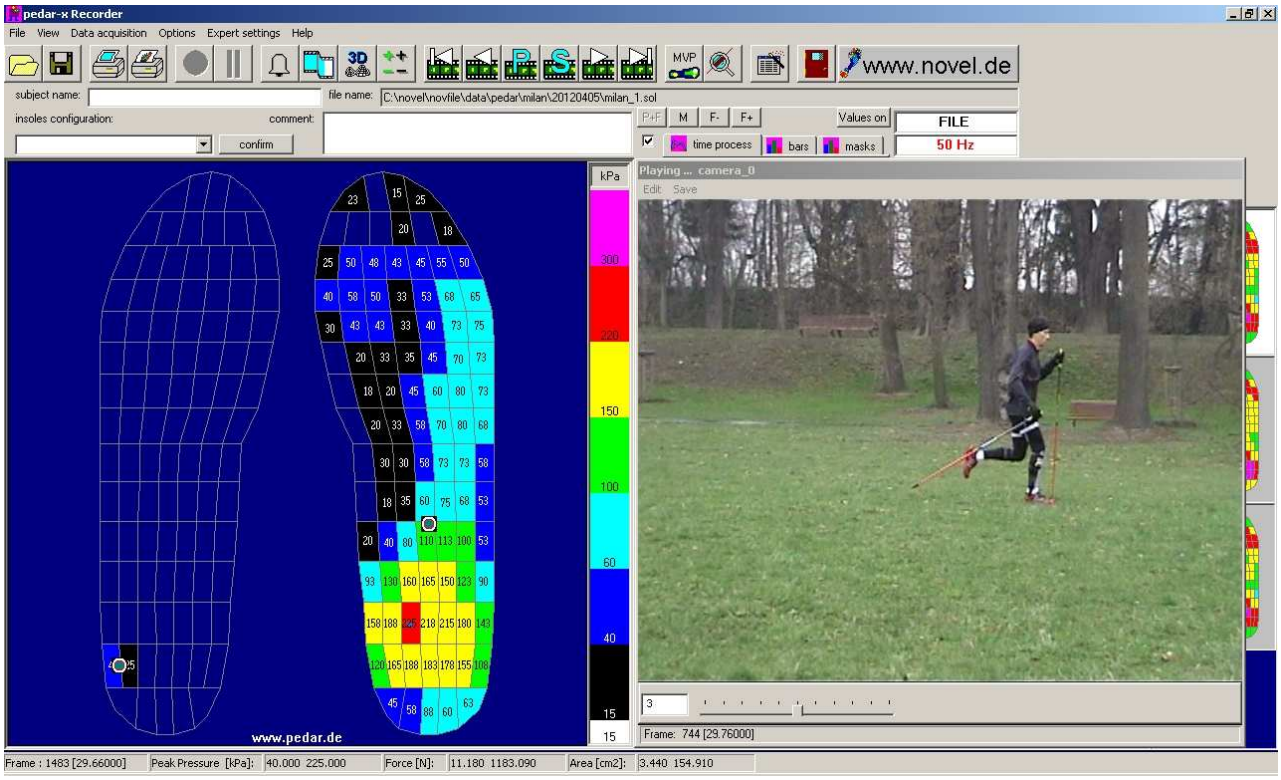
Picture 1: Pedar-X system

For more detailed analysis, the insole surface is divided into 7 segments: medial heel area, lateral heel area, middle foot, medial forefoot, lateral forefoot, big toe and other toes. Software enables to assess all the measured constants both for each segment separately and all together. Furthermore, it enables to observe the data immediately on the computer screen or to process and assess the data through the database module Novel database essential.

Picture 2: Measuring with Pedar-X system when running without poles



Picture 3: Measuring with Pedar-X system when running with poles



3.3 Results

When running without poles, the average maximal force affecting the left foot reached 1616N and 1700N for the right foot (Chart 1). When using poles, the force was diminished to 1538 N, or 1610 N (Chart 2). In the first case, the difference is 78N (4.8%), in the second it is 90 N (5.3%).

Chart 1: Average maximal force when running without poles

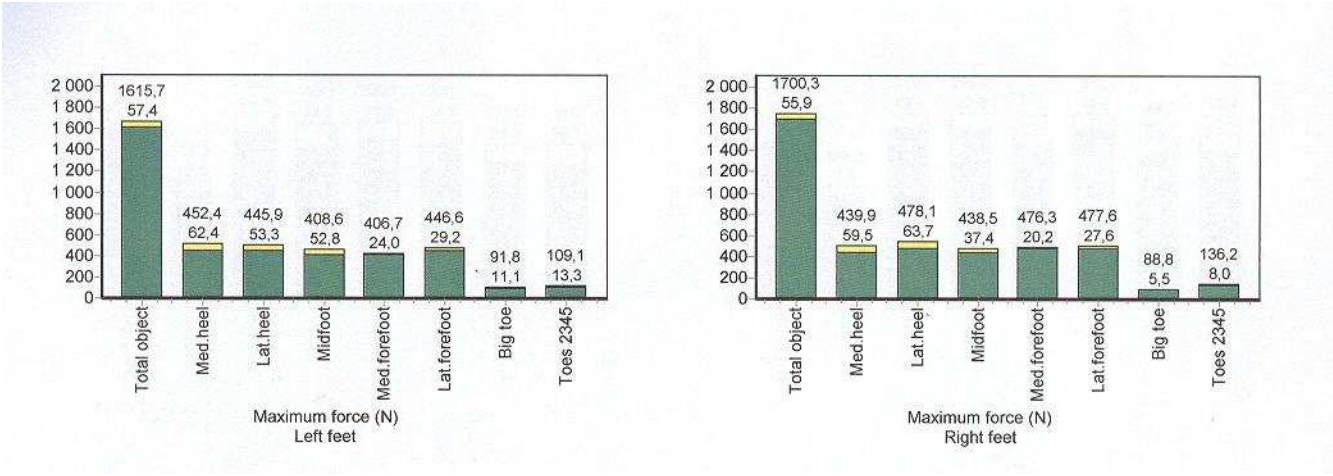
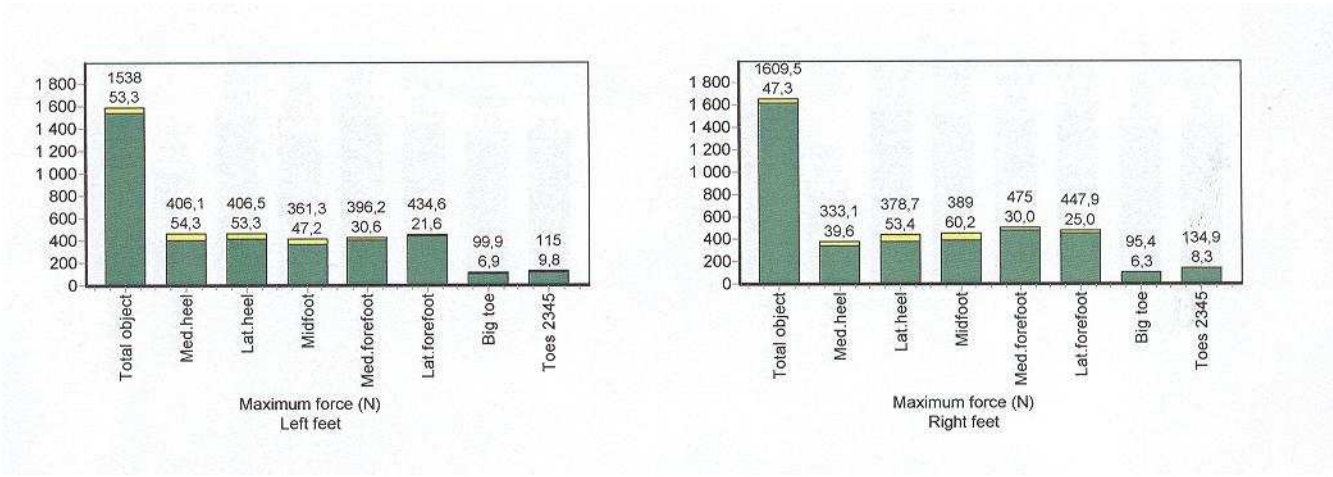


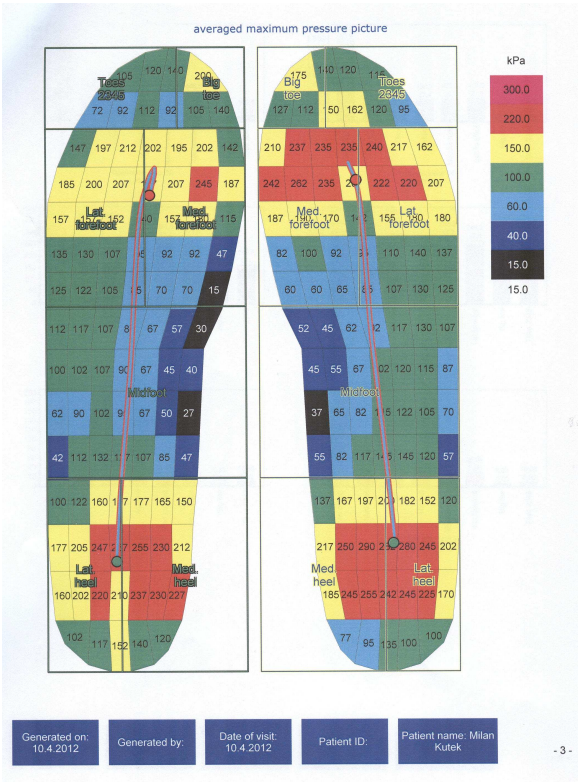
Chart 2: Average maximal force when running with poles



Concerning the functional changes of feet, those in their particular segments are also very significant. When using poles, the pressure centre moves more to the front part of the feet. The average maximal force has significantly decreased in the heel and mid-foot area, while the differences in the forefoot are relatively small. The following pictures demonstrate that concerning the pressure redistribution when running with poles, the area of maximum figures on heels (red colour) is significantly diminshed.

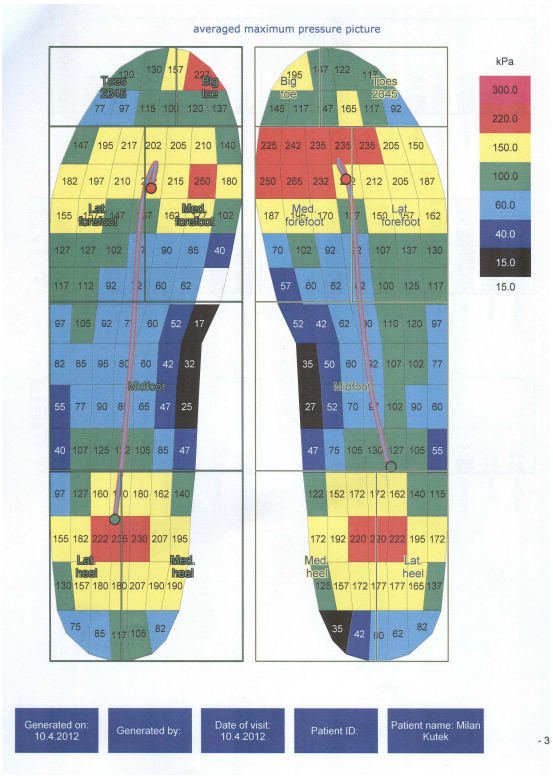
Picture 4:

Pressure redistribution when running without poles



Picture 5:

Pressure redistribution when running with poles



Complete measuring results are to be found in separate appendices 7.1 and 7.2.

4. Discussion

4.1 Hypotheses confrontation

Hypothesis A

The experiment has shown a decrease of musculoskeletal system strain when running with poles. This can be resulting from involving the arms, which not only causes a relieve of the musculoskeletal system, but also higher stability of the runner. The decrease of musculoskeletal system strain at given pace (4:20 min/ km) within one movement cycle is relatively small (approximately 5% of the overall maximum force), however, we can presume that it will have a significant health-preventive effect with longer runs, where the overall musculoskeletal main joint strain is cummulated. According to the distance covered (be aware that a few kilometres mean several thousands of steps), the result figures of the decreased strain would be measurable in tons, resp. tens of tons.

Based on the assumtion that vertical forces are also influenced by the runner's weight and running pace, we can presume there would be bigger differences (higher relief of the musculoskeletal system) at heavier athletes (putters). Bigger differences can also be expected on harder surfaces.

Hypothesis B

When using the poles, the whole moving technique changed. The pressure centre moved more forward, yet without increasing strain on the front area of the foot as it can be observed when running on the front part of the foot. The vertical force decrease is significant mainly during the first supportive phase. This means that running with poles does not overstrain the musculoskeletal structure involved in the step amortization (mainly heel and Achilles tendon) so much.

4.2 Increasing stability and intensity

The results of the experiment prove our previous subjective experience with running with poles, resp. the feeling of better stability when running. Based on a year-round running with poles we can unequivocally state that it helps to keep stability even in a soft uneven terrain (parks, grass, fields, forest paths etc.) and on the snow in winter. Thus it significantly decreases risk of injury which is often caused by slipping or spraining. Empirical statement: after two years of practising running with poles, a runner – co-author of this thesis confirms to have completely avoided injuries (contrary to previous years) and that positive effect of the running with poles manifested itself by strengthening of the hock- and calf tendons and muscles (which helps further to prevent injuries).

Concerning other subjective knowledge of practising running with poles, we have to point out mainly its training effect resulting from the increased running intensity. A runner with poles gives higher performance and therefore has a significantly higher energy consumption than when only running. Breathing is more intensive, breast muscles, shoulders and arms are more involved. When running with poles, the athlete is not only running, but also works out naturally more. And contrary to cross-country skiing, when the arms relax while going downhill and legs relax while double poling on a flat surface, when running with poles, neither arms nor legs relax at any time.

Therefore it can be seen as a great advantage for professional athletes – especially, but not only, during winter season – that the training time spent at one training unit with required energetic intensity is significantly cut down (the energy consumption is the same in shorter time). Moreover, there can be no discussion about the price of the time saved, especially with nowadays busy daily routine; let alone the fact that sportsmen could "invest" this time in rehabilitation and regeneration.

4.3 Special options

According to our present knowledge, involving the poles in a runner's training brings also a range of other options how to take advantage of them. One of them can be warm-up and stretching before running itself, or after. The poles allow us e.g. to bend forward in order to stretch lower back and upper back muscles as well as calf muscles (Picture 6). Furthermore, side squats seem to be convenient as they help to stretch hip joints, knees, thigh muscles as well as shoulder girdle muscles (as we lean on the poles).

When using poles, other basic running exercises (so-called running ABC) can be successfully made, mainly skipping, leg curl or forward-skipping. When carried out properly, we have higher chance to reach the correct torso and leg position as we relieve the force by leaning on the poles at the moment. More proficient and daring athletes can be furthermore recommended to try running take-offs on a safe flat terrain or snowy track, which brings both coordination boost and unconventional fitness training (Picture 7).

Picture 6:

Picture 7:

5. Conclusion

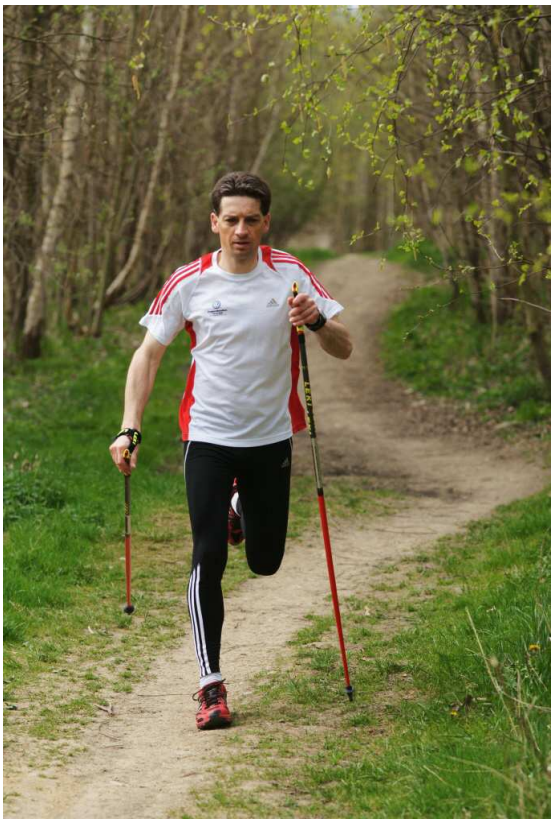
The above mentioned theoretical reasons, practical subjective experience and the experimentally confirmed results clearly lead us into conclusion that the method of running with poles should be incorporated in the athletics training.

This method is universal (it can be used by any athlete at all performance levels or age groups), efficient (it increases quality of the running training and brings higher energy consumption during the training unit lasting the same time), and cheap.

When carried out with a proper movement technique and given that appropriate poles are used, running with poles is first and foremost a method which is preventive regarding health. By provably diminishing the leg joint strain while running, it helps to eliminate orthopaedic risks. Therefore it can become an effective means of decreasing the number of injuries with professional athletes.

As a limiting fact of our previous research of running with poles is that there are no poles produced specially for this sports activity. Therefore we had to use alternative options – ski poles or Nordic walking poles. Neither of these types of poles suit fully to the presented sports activity since they do not allow year-round practising of running with poles and the proper technique (ski poles - because of the basket and flex tip - are suitable only for snow conditions; Nordic walking poles are unsuitable mainly due to the shorter length and inconvenient grip and strap).

The experimental measurements were carried out with specially modified LEKI Carbon Vario poles. We can recommend these poles as the only suitable poles for trail running; however, there are some details to be worked out for other ways of use. Our thesis can be therefore seen as an inspiration and impulse for sports equipment producers to consider developing poles for the analysed activity. We would be happy to cooperate and offer them our present experience and findings in this field of study so that we can make use of the high potential of running with poles.



6. Recommendations

To be more explicit, we would like to present five main groups of athletes that can, from our point of view, make the best use of running with poles, giving specific reasons.

Athletes after injuries

A very large target group are - unfortunately - athletes recovering after injuries, trying to regain their pre-injury fitness level, or athletes who have to reduce their training programme due to overstrain of a particular leg area. We are convinced that, apart from the medical advantages themselves, the psychological aspect is also very important: a sportsman, used to regular sports activity, will not be only walking with poles (which could lead to frustration), but will be able - within the realms of possibility - to run with a stable support of sports poles. Presumably, the activity would be carried out only on safe and flat tracks.

Putters

Shot putters, javelin, discus and hammer throwers usually have a more robust body, which brings problems with keeping stability during running. Although putters prefer workout to running out of stadium, endurance running is nevertheless a necessary basic of their general fitness training. The method of runing with poles is therefore very convenient for them since it hepls them increase running stability as well as strengthen their arms and shoulders.

Endurance runners

In case of endurance runners, running with poles should become one of the regular forms of their training, mainly in difficult terrain and weather conditions (mud, snow etc.) as it enables the runner - unlike standard fartlek od free running - to reach submaximal speed without any injury risks. Thus could running with poles widen the range of commonly used training methods and by combining running with arm workout it could also suitably liven up the runner's training, which otherwise threatens to become a bit monotonous after some time.

Other athletes

Endurance development as a basic physical training is a key element also for other athletes – sprinters, jumpers and multi-event competitors. Running with poles enables them to combine running exercises with dynamical elements to develop bouncing force and power endurance (e.g. bouncing and steep uphill running). Their training is then extended with very intense outdoor training units, which they would obviously not carry out without poles.

Sportspeople with limited physical condition

We cannot leave out the people, whose current physical condition does not enable them to make full training effort. It involves mainly overweight people, running beginners and occasional runners who practise only jogging. In their case it is possible to incorporate running with poles as an activity, which extends simple walking and walking with poles (Nordic walking) by its higher intensity and emphasizes the health-preventive contributions – mainly relieving of the musculoskeletal system.