

## **TRANSLATOR'S DECLARATION:**

I, Karin Reinhold, [Certified Translator from German to English, Certified Court Interpreter - German/English,] a Member in good standing of the Society of Translators and Interpreters of British Columbia (STIBC), hereby attest that I am proficient in German to English translation and that, to the best of my knowledge and belief, the following document is a true, correct and complete translation of a Research Study by K. Knobloch and P.M. Vogt in German from Germany, a copy of which is attached herewith.

Square brackets [...] signify either translator's notes if in English, or untranslatable words if in German.

Signed and sealed at North Vancouver, British Columbia, this 29<sup>th</sup> day of November, 2012.

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## **Nordic Pole Walking Injuries – Nordic Walking Thumb as Novel Injury Entity**

**Background:** Nordic pole Walking (NW) as trend sport is associated with beneficial effects on the cardiovascular system. Data regarding the injury and overload injury rates are pending.

**Methods:** 137 athletes (74 % females,  $53 \pm 12$  years, weight  $73 \pm 13$  kg, height  $169 \pm 11$  cm) were prospectively asked using a two-sided questionnaire. Mean NW experience was 212.8 weeks with  $2.9 \pm 1.8$  hours/week. The overall exposure was 29 160 h. **Results:** NW injury rate was 0.926/1000 h. Falls were evident in 0.24/1000 h. The upper extremity was involved more frequently (0.549/1000 h) than the lower extremity (0.344/1000 h). The most severe injury was a concomitant shoulder dislocation and luxation of the proximal interphalangeal joint of the index finger after a fall. The most frequent injury in NW was a distortion of the ulnar collateral ligament of the thumb (0.206/1000 h) after fall. Shoulder injuries account for 0.171/1000h with 0.069/ 1000 h shoulder dislocations.

There was one distal radius fracture after a fall (0.034/1000 h). Supination trauma of the upper ankle joint occurred in 0.0343/1000 h, at the same rate as pain in the tibia in the form of shin splints. Muscle injuries were encountered to the M. gastrocnemius only (0.137/1000 h) but not to the M. quadriceps or the hip muscles.

No knee ligament injuries were noted.

95% did not need a break after injury, 3% stopped for up to 3 weeks, and only 2% paused for more than 3 weeks.

Nordic Walking is a safe sport. The most frequent injury in Nordic Walking is a distortion of the ulnar collateral ligament of the thumb after a fall during which the pole acts as hypomochlium. Modifying the construction of the Nordic Walking pole handle, avoiding holding onto the pole in the event of a fall, as well as education could be preventive measures.

### **Key words**

Nordic (pole) Walking · Injury · skiers' thumb · shoulder · pain

### **Introduction**

Nordic Walking developed out of the 'Ski Walk', an alternative technique applied by cross-country skiers during summer training in the 1950s to imitate diagonal strides. In 1997 the Nordic

Walking pole, mostly made of carbon fibre or aluminum, including an adapted strap and specific pole tips for different surface conditions, was introduced in Finland. Data from Finland from 2001 show that a minimum of 500,000 Finns, equalling 10% of the total population [8], performed Nordic Walking at least once a week. By now, approximately 1.2 Million Germans perform Nordic Walking in their leisure time. In Austria and Switzerland 1 Million people have very consciously opted for this sport. According to trend estimates, the number of active Nordic Walkers in Germany will more than quadruple (five million) over the next three years.

When measuring physiological performance parameters on the treadmill – with comparable treadmill speed and inclination – it was shown that maximum oxygen uptake (VO<sub>2</sub>max), caloric consumption, as well as lowered corresponding lactate levels have positive effects on the cardiovascular system [5, 14]. It appears as though the additional use of arms in Nordic Walking achieves more favourable caloric results in comparison to Walking. Furthermore, the use of Nordic Walking poles is found to be more favourable when it comes to putting load onto or relieving it from joints, such as the knee or hip joints, especially in overweight individuals, whereby initial biomechanical tests did not prove a definite relief of these joints [16].

There is currently no data available regarding the risk of injury or damage from overuse through Nordic Walking. This is the the first paper that looked into the investigation of injuries and damage from overuse through Nordic Walking.

## **Methods**

The analysis was performed with a two-page questionnaire with a total of 137 Nordic Walking participants. All 137 participants were informed in advance about the background and purpose of this survey to capture injuries and damage from overuse through Nordic Walking. The participants could voluntarily take part in this free survey, also anonymously, without any financial or material benefit.

Third parties that were not involved in the study did not and do not have access to the personal data of the participants in this study. The questionnaire, developed by the author, was designed as a multiple-choice questionnaire. Participants were asked about their individual medical history with an emphasis on orthopaedic and trauma injuries, current medication, and impairment of well-being within the last 12 months; injuries and damage from overuse during or after Nordic Walking were also recorded. In addition, it was inquired about the weekly frequency of Nordic Walking in hours, as well as the start of the Nordic Walking career, to capture the total individual time of exposure for each of the 137 interviewees. Finally, questions were asked about personal equipment with respect to Nordic Walking poles, personal heart rate monitors, associated sports, and preferred surfaces or problems on specific surfaces. Therefore, all injuries are self-reported health disorders without compulsory medical diagnostics.

These two-page questionnaires designed by the author were distributed via handouts in different Nordic Walking clubs, such as the Präventionssportverein Hanover, or at events, such as the opening of the Nordic Walking Center Clausthal-Zellerfeld (Fig. 2) of the Lower Saxony Ski Federation. Further questionnaires were offered on the Internet at <http://www.eccentrictraining.com> and integrated accordingly. The survey period, including the distribution and return of the questionnaires, was five months long, from May to September 2005. After entering the data into a spreadsheet (Microsoft Excel) the survey responses were evaluated by calculating mean values and standard deviations, as well as individual and total exposure time in hours.

The frequency of the different medical conditions induced by or resulting from Nordic Walking, e.g. after a fall, was indicated accordingly by means of the total time of exposure of 29,160 hours for all 137 participants of this survey as “ $\times$  injuries/1,000 hours of exposure” in order to establish comparability with the injury rates of different sports in the first place, which is not

possible when indicating pure percentages without taking into consideration the time spent in training and competition, i.e. the total time of exposure.

Fig. 1 Nordic Walking is a healthy sport with a low rate of injury

Fig. 2 Nordic Walking is a sport for the young and old. Opening of the Nordic Walking Centre of the German Ski Federation in Clausthal-Zellerfeld in the Upper Harz area.

### **Nordic Walker Characteristics**

A total of 137 participants were included in this study (Table 1). The average age was  $53.5 \pm 12$  years, with 74% female participants. The mean weight was  $73.2 \pm 13$  kg with a height of  $169 \pm 11$  cm. Based on personal anamnesis, 16% complained about a history of neck pain, 37.5% ( $n = 51$ , 41 right, 32 left) complained about pain in the shoulder region with 5% ( $n = 7$ ) shoulder luxation, all independent of Nordic Walking. Eleven participants (8%) complained of a prior wrist distortion, 6 (4.4%) of a distal radius fracture, no one of an injury to the ulnar collateral ligament of the thumb. 14.7% ( $n = 20$ ) reported pain in the thoracic and lumbar spine, and 4 participants had a total hip endoprosthesis (2.9%, 2 right, 2 left). None of the participants had a knee endoprosthesis. In the medical history, independent from Nordic Walking, muscle strains of the M. biceps femoris (11.7%,  $n = 16$ ) were more frequent than of M. quadriceps (5.9%,  $n = 8$ ). 15.4% ( $n = 21$ ) had knee ligament injuries in their history with 8 frontal cruciate ligament injuries (6 right, 2 left). Independent of Nordic Walking, affections of the lower leg muscles, known as "shin splints", the second most common injury for long-distance runners after peripatellar frontal knee pain, were rare with 1.4% (2%). 23.5% ( $n = 32$ ) indicated a history of an upper ankle distortion after supination trauma independent of Nordic Walking. No participant had suffered a stress fracture at any point independent of Nordic Walking.

### **Nordic Walking Background**

Seventy-eight of the 137 respondent Nordic Walkers performed their sport organized in a club (57%). Overall, 77.3% had completed a Nordic Walking course ( $n = 106$ ); 17 (12.4%) participants were certified Nordic Walking instructors.

### **Time of Exposure to Nordic Walking**

On average, the 137 polled participants performed Nordic Walking for  $2.89 \pm 1.86$  hours per week, i.e.  $2.18 \pm 1$  times for an average of  $1.28 \pm 0.3$  hours. The total time of exposure amounted to 29,160 hours of Nordic Walking.

### **Statistics**

Data is presented as mean value  $\pm$  standard deviation. The total exposure time is, as defined above, the minimum time that all 137 participants cumulatively spent with Nordic Walking in their lives, when injuries or strains could arise during and/or after Nordic Walking. Where indicated, a Student t-test for normally distributed cohorts was applied. A significance level of  $p < 0.05$  was considered significant, SPSS 13.5 was used.

## **Results**

### **Impairment of Well-Being within the Last 12 Months, Independent of Nordic Walking**

In the last 12 months 8.8% ( $n = 12$ , 11 right, 1 left, Table 2) of the 137 participants with a total exposure time of 29,160 hours of Nordic Walking complained of discomfort in the groin area, 18% ( $n = 24$ , 17 right, 12 left) in the hip, 29% ( $n = 39$ , 30 right, 19 left) in the knee, 35% in the

neck (n = 48), 56% in the back (n = 76), 35% (n = 47) in the shoulder, and 38% (n = 51) complained of headache, independent of Nordic Walking.

### **Nordic Walking Injuries**

The overall injury rate in Nordic Walking after 29,160 hours of total exposure was 0.926/1,000 hours of exposure (Table 3). In 0.24/1,000 h there was a fall (n = 7) without the occurrence of a first degree or more serious traumatic brain injury. The most common injury in Nordic Walking during the 29,160 hours of total exposure with 137 Nordic Walkers was the distortion of the ulnar collateral ligament of the thumb without a complete rupture in 6 participants, corresponding to 4.4%. This equals a frequency of 0.206/1,000 h of exposure. There was no case requiring surgery of a total tear of the thumb's ulnar collateral ligament with increased clinical gapping vs. the opposite side, a bony avulsion and/or a Stener lesion. All injuries healed within a maximum of two weeks by means of conservative splint immobilization. The injury rate of the upper extremity (0.549/1,000 h) was higher than that of the lower extremity with 0.344/1,000 hours of exposure.

The upper extremity was injured at the shoulder in 5 cases (0.171/1,000 hours of exposure). In two cases, corresponding to a frequency of 0.069/1,000 hours of exposure, there was a shoulder dislocation after a fall, which was the first incidence of a luxation in both cases and was readjusted under analgosedation in hospital. A Hill-Sachs lesion was identified in one patient. The 64-year-old woman fell during Nordic Walking (with 50 hours Nordic Walking experience at the time of the accident) and also dislocated the opposite index finger in the proximal interphalangeal joint, which underwent closed repositioning and immobilization by means of a finger splint. Magnetic resonance imaging was recommended in each case; however, the team of authors did not have the images at their disposal. Both athletes were over 45 years of age, so that conservative therapy was initiated, which was not carried out in the authors' clinic. One Nordic Walker fractured his wrist after a fall (0.0343/1,000 hours of exposure), which was treated conservatively by means of a forearm cast. Two Nordic walkers complained about blisters on their hands (0.069/1,000 hours of exposure).

Table 1 Characteristics of the 137 participating Nordic Walkers

Age	53.5 ± 12.3 years
Height	169 ± 11 cm
Weight	73.2 ± 13.2 kg
Gender	74 % women
Nordic Walking in a club	57 % (n = 78)
Nordic Walking course completed	77 % (n = 106)
Nordic Walking instructor	12 % (n = 17)
Own Nordic Walking poles	77 % (n = 105)
Own heart monitor	48 % (n = 65)
Surface: Asphalt	26 % (n = 36)
Forest soil	90 % (n = 123)
Sand	9 % (n = 12)
Mountains	6 % (n = 8)
Ever had surface related issues	5 % (n = 7)
Regularly does other sports	77 % (n = 104)
Nordic Walking per week	2.18– ± 1.1-times
Per Nordic Walking unit	1.28 ± 0.3 hours
Total per week	2.89 ± 1.9 hours
Average experience	213 hours (16 – 1,630 hours)
Total exposure	29,160 hours

Table 2 Impairment of well-being of 137 Nordic Walkers within the last 12 months independent of Nordic Walking

<b>Impairment</b>	<b>Frequency within the last 12 Months</b>
Headache	38% (n = 51)
Neck pain	35% (n = 48)
Back pain	56% (n = 47)
Shoulder pain	35% (n = 47)
Groin pain	9% (n = 12)
Hip pain	18% (n = 24)
Knee pain	29% (n = 39)

### **Nordic Walking Injuries of the Lower Extremity**

The overall injury rate of the lower extremity from Nordic Walking was 0.344/1,000 hours of exposure. Strains of the M. gastrocnemius occurred at a frequency of 0.137/1,000 hours of exposure, while problems of the ventral Tibia and Fibula musculature, known as "shin splints" in long distance running, occurred for only one participant, which corresponds to 0.0343/1,000 hours. There were no fatigue fractures in the examined group of 137 Nordic Walkers. In the lower extremity, no injuries or strains to the hip were reported; 4 participants had a total hip endoprosthesis. Furthermore, no injuries to the M. quadriceps, no knee ligament injuries, and only one upper ankle joint sprain as supination trauma, which equals a frequency of 0.0343/1000 hours of exposure, were reported

### **Injury Period – Returning to Sports**

Of the 137 surveyed Nordic Walkers, seven (5.1%) had to pause their sporting activities as a result of an injury associated with Nordic Walking, 1.5% for less than a week, 1.5% for 1-3 weeks, and 2.2% for more than three weeks. All surveyed Nordic Walkers returned to their sports after their injuries.

Table 3 Number of injuries through Nordic Walking based on 1.000 hours of exposure to Nordic Walking

<b><i>Injury</i></b>	<b><i>Injury rate/1000 hours of exposure</i></b>
Total injury rate	0.926
Upper extremity	0.549
Lower extremity	0.344
Fall	0.240
Distortion of the ulnar collateral ligament at the metacarpophalangeal joint of the thumb	0.206
Shoulder distortion	0.171
Shoulder luxation	0.171
Distal radius fracture	0.069
Hand blisters	0.034
Strain M. gastrocnemius	0.069
Shin splint as tibia pain	0.137
Distortion of upper ankle joint	0.0343

### **Surfaces for Nordic Walking – Equipment – Accompanying Sports**

The vast majority of Nordic Walkers prefer forest ground for their sporting activities (90.4%, n = 123), followed by asphalt (26.4%, n = 36), sand (9%, n = 12) and mountain terrain (5.9%, n = 8). 5.1% of Nordic Walkers (n = 7) complained about problems on one surface, without exception on asphalt. 77.2% of the participating Nordic Walkers had their own Nordic Walking poles (n = 105), 47.8% their own heart-rate monitor (n = 65). 104 of the 137 surveyed Nordic Walkers pursued at least one other sport (77%), most commonly gymnastics.

## Discussion

Nordic Walking is a very safe sport: The overall injury rate for self-reported injuries and strains is 0.926/1,000 hours of Nordic Walking exposure. At a rate of 0.549/1,000 hours of exposure the upper extremity is affected more than the lower extremity with 0.344/1,000 hours of exposure. The risk of falling (0.23/1,000 h) is responsible for the major injuries in the study group of 137 Nordic Walkers. Numerically, the most frequent were sprains of the ulnar collateral ligament of the thumb with 0.206/1,000 hours. The complete tear of the ulnar collateral ligament of the thumb along with abduction and hyperextension of the thumb as a result of a fall on the hand is known as a skier's thumb in skiing. Typically, this arises from falling, while holding onto the pole and the pole acting as a hypomochlion, as the thumb, which is in a abduction and extension position, leads to the injury of its ulnar collateral ligament.

To date, no data has been published concerning the frequency of injuries in Nordic Walking, so that – based on the use of the pole – skiing can be studied comparatively despite its higher speed of movement. In a frequency analysis of 500 thumb injuries in an alpine ski resort in Northern Vermont, USA, the rupture of the ulnar collateral ligament in the thumb base joint occurred in 391 cases, corresponding to 10.6% of the total injury count of 3,690 recorded injuries [6]. A detailed list of different degrees of severity of ulnar collateral ligament injuries during an alpine skiing season in the U.S. showed 34.8% first-degree sprains, 47% sprains as partial rupture and 18.2% as complete rupture of the ulnar collateral ligament [1]. In Vermont, the injury to the ulnar collateral ligament of the thumb appeared as the most common injury altogether among adolescent alpine skiers [2]. Similar figures are available from Innsbruck. Over a period of eight years, 11% of a total of 17,999 ski injuries were of a similar kind and were treated there [13]. Ulnar collateral ligament injuries of the thumb have recently been described even during indoor skiing in ski domes, whereby a higher rate of thumb injuries actually seems to occur than during outdoor skiing [7, 18]. However, in almost all cases comparability is limited due to a lack of information about the time of exposure, which establishes comparability of the injury rate in different sports in the first place.

In 2000, during a total of 19,962 days of Telemark skiing, 32 thumb injuries occurred [19], which corresponds to an injury rate of 0.200/1,000 hours of Telemark exposure, the same rate we observed in Nordic Walking. Injuries of the ulnar collateral ligament of the thumb are also described in cross-country skiing [12, 15], but without information on the exposure time. Overall, even with the much lower speed of movement in Nordic Walking, in comparison to alpine, cross country or Telemark skiing, there still is a certain risk of injury to the ulnar collateral ligament of the thumb (0.2/1,000 hours of exposure) due to the pole holding technique and the athlete's reaction in the event of a fall. Modifications to the Nordic Walking pole strap and its trigger mechanism, as proposed for alpine skiing, might possibly contribute to a reduction of the most common injury to the ulnar collateral ligament [10]. The influence of handle designs, e.g. the big panel covering the handle found in alpine skiing in the 80s, resulted in more frequent skier's thumb injuries [3]. Evidence-based data on this issue, however, is not currently available.

Even more serious injuries to the musculoskeletal apparatus can occur after a fall in Nordic Walking, as the two shoulder dislocations as first incidences of a luxation demonstrate. In alpine skiing, shoulder injuries between 0.2 and 0.5/1,000 days of skiing [9] are being reported. We documented shoulder injuries during Nordic Walking at a rate of 0.171/1,000 hours of exposure, with shoulder dislocations after a fall during Nordic Walking occurring with a frequency of 0.069/1,000 hours of exposure. Cross-country skiing with a speed of movement of 6 m/sec in a

classic diagonal stride technique and 8-9 m/sec in skating technique or double pole thrust [15], the total injury count lies between 0.59 and 5/1,000 days of skiing [17], whereby the knee ligament and the ulnar collateral ligament of the thumb are the most common structures injured in cross-country skiing. At the moment, there is no information available on the number of shoulder injuries with time of exposure to cross-country skiing. It is presently unknown to what extent the pole handling technique or the handle and strap design may have an influence.

Fortunately, injuries of the lower extremity are less frequent than those of the upper extremity in Nordic Walking. No injuries due to strain in the sense of fatigue fractures of the tibia or metatarsus were observed to date, which could possibly be caused by the lower axial load when compared to running. Only one Nordic Walker complained of pain in the front of the tibia in terms of a "shin splint", which is the second most common overuse phenomenon of the lower leg for long-distance runners. As a result of the lower speed of movement in Nordic Walking as compared to cross-country skiing, for example, there appear to be fewer injuries to the lower extremity. In cross-country skiing, injuries to the lower extremity, particularly to the inner lateral ligament of the knee, happen in the event of a fall on the ski slopes, which are often covered with ice [4]. It is currently unknown to what extent the Nordic Walking experience plays a role in the likelihood of injuries. It is apparent in the ski sport that experience in alpine skiing and snowboarding can have a significant protective effect: the relative risk is 0.5 (0.3 to 0.83) with one week experience in ski sports and with more than 8 weeks experience it is reduced to 0.43 (0.25 to 0.73), which corresponds to a risk reduction of 57% [11]. The 137 participants in our Nordic Walking study have an average of 212 hours of Nordic Walking experience, which should correspond to 26.5 days based on eight hours of Nordic Walking per day, which is equivalent to almost four weeks of "full-time experience"; therefore, we are not confronted with inexperienced Nordic Walkers in this injury analysis.

**Knobloch K, Vogt PM. Nordic Walking Verletzungen ... Sportverl Sportschad 2006; 20: 137 – 142**

### **Conclusions for Practice**

Nordic Walking is a safe sport: The overall injury rate was 0.926/1,000 hours of exposure. Falls occur at a frequency of 0.24/1,000 hours. The most severe injuries observed were shoulder dislocations at a frequency of 0.069/1,000 hours. With a frequency of 0.206/1,000 hours, the most common injury in Nordic Walking is the distortion of the ulnar collateral ligament of the thumb, the skier's thumb. This is equivalent to data on the injury frequency in alpine skiing, cross-country skiing and telemark skiing, despite the lower speed of movement in Nordic Walking. Modifications to the design of a Nordic walking pole handle, as well as fall exercises including education and avoidance of holding onto the pole in the event of a fall could be preventive approaches, just like a proprioceptive training of the lower extremity to help reduce supination trauma during off-road Nordic Walking.

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