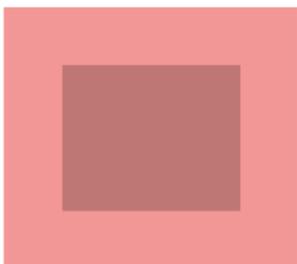


ISSN 2423-9208



2019 no. 8

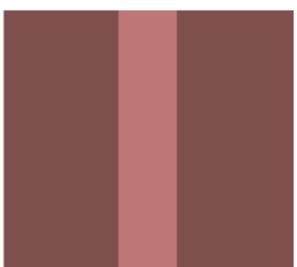
Journal of Nordic Walking



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【Medical Nordic Walking Vol.1】



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Title : Journal of Nordic walking ,J. Nord. Walk

Place of publication (country code) : JP

ISSN : 24239208 ISSN-L : 24239208

Language: (ISO639-2 : jpn : Japanese)

Journal of Nordic Walking

Issuer : Kawauchi M E-mail : nordic-walk@umin.ac.jp

Address of correspondence: 3-5-4 Higashi-Ikebukuro Toshima-ku, Tokyo,
Japan 〒170-0013

Editor : Editor in Chief Kawauchi M

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Kawauchi M

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► Preface

The Nordic Walking technique was developed in Europe. The Medical Nordic Walking technique was later devised in Japan. Medical Nordic walkers extend their arm forwards and place their poles while their arms are at the handshake position. Then the walkers push the pole softly while stepping forward. The Medical Nordic walkers exercise their upper body and core muscles in addition to the leg muscles while relieving some impact on the lower body.



Nordic Walking and Medical Nordic Walking increase the cardiac output 8-20% compared with usual walking in the same speed. This relief of the impact as much as 30% from the lower body and benefits the patients with the problems of hip, knee legs and vertebrae. Using the upper limbs, the stride is wider than normal walking, and the walking speed is also increased. The Nordic walking has increased ventilation volume, oxygen uptake, and heart rates as compared to walking at the same speed. The same lactic acid concentration, heart rate, oxygen uptake can be achieved at a lower walking speed than usual walking. You can walk slowly and safely with Nordic Walking/Medical Nordic Walking when doing the same aerobic exercise.

Nordic Walking is recognized as an aerobic exercise that can be performed by patients with heart disease, and listed as one of the exercise items in the cardiac rehabilitation guide line in Germany and Europe.

Clinical Rehabilitation 2008; 23: 995-1004

Effects of Nordic Walking training on exercise capacity and fitness in men participating in early, short-term inpatient cardiac rehabilitation after an acute coronary syndrome - a controlled trial

Piotr Kocur Department of Kinesiotherapy, Ewa Deskur-Smialecka, Małgorzata Wiik and Piotr Dylewicz Department of Cardiac Rehabilitation, University School of Physical Education, Poznań, Poland

Received 13th January 2008; returned for revisions 15th March 2008; revised manuscript accepted 17th April 2008.



▶ Japanese Style Nordic Walking

About Japanese style Nordic Walking

The results of rehabilitation by Nordic Walking with patients of cardiovascular disease were presented at overseas conferences, but there was a problem in explaining how to walk. When I used the words Nordic Walking, foreign people thought of the competition type Nordic Walking that I learned in Germany. When I explained to them the details of how to walk with Nordic poles at my rehabilitation hospital in Japan, they told us the walking was not Nordic Walking but Japanese-style Nordic Walking. That's why it became Japanese Style Nordic Walking. The term Medical Nordic Walking is also great, but I was worried whether healthy elderly people would use the name or not. We usually walk smoothly and easily. But if we might be involved in the traffic accident and get injured, then it would be difficult to walk and long and hard rehabilitation will be required. Once we lose our walking capability, our quality of life deteriorates to 'Frail'. 'Frailty thy name is woman' is one of the very famous words of William Shakespeare.

Various Japanese Nordic walking



Japanese Style Nordic Walk

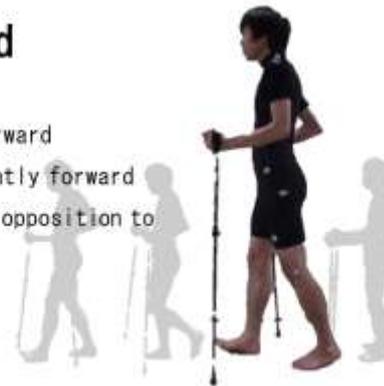
1 Starting Position

- ① Upright Posture
- ② Your hand is Handshake position
- ③ Look Straight Ahead



2 Step Forward

- ① Step your right foot forward
- ② Extend your left arm gently forward
- ③ Place your left pole in opposition to the right forefoot



3 Load on the Forefoot

- ① Load on your right forefoot
- ② Pull the front pole towards the body
- ③ Do not bent forward



4 Step off the Back Foot

- ① Step off the ground with your toes
- ② Do not lower your buttock



Instructor's Nordic Walking

Nine Nordic Walking instructors of Japan Nordic Walk League were analyzed by 3D analysis system(MAC3D)at Japan Institute of Sports Sciences (JISS).

Their normal walking and Japanese Style Nordic Walking were compared at comfortable walking speed. Nordic poles used in this study were devised in Japan.

• Result

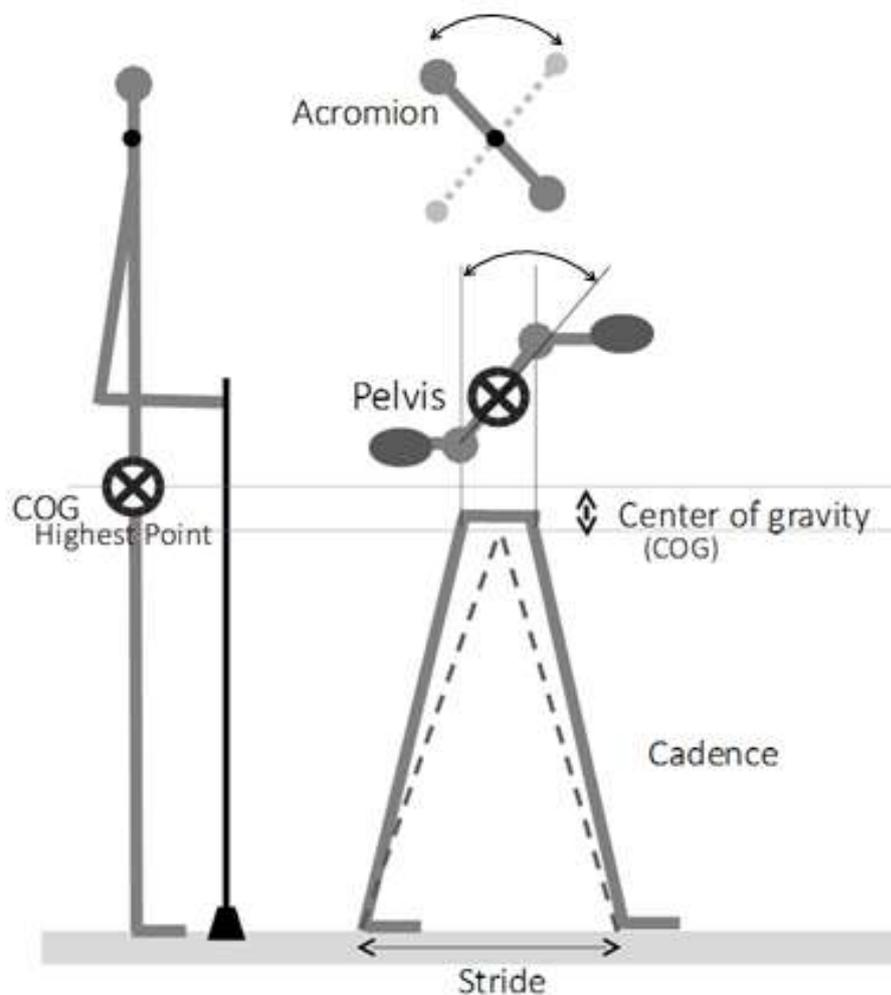
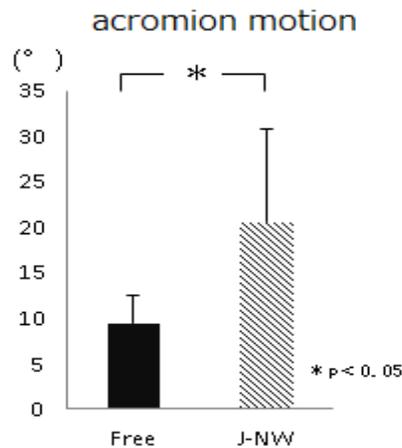


Fig. Japanese Style Nordic Walking model

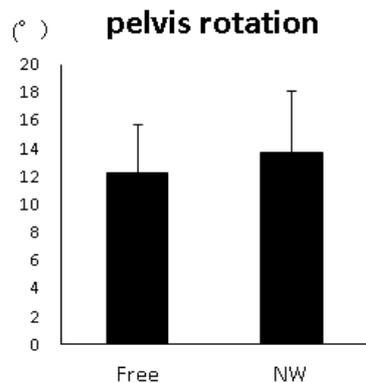
1. Acromion

From the acromion markers, The axial rotation is larger in Nordic walking than in normal walking (normal walking vs J-style Nordic Walking, 9.45 ± 2.97 vs. $20.50 \pm 10.26^\circ$)($P < 0.05$)



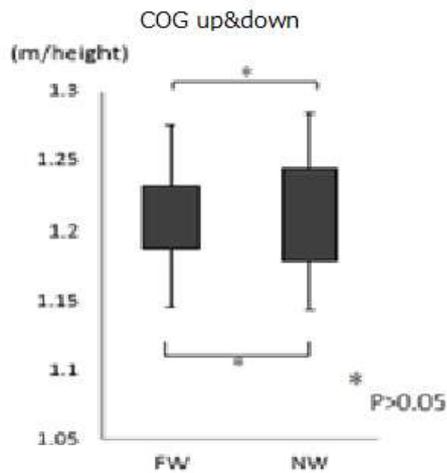
2. Pelvis rotation

Pelvis rotation movement, Pelvic rotation is almost same in the Nordic Walking and free walking (Free gait vs J-style Nordic walking, $12.26 \pm 3.45^\circ$ vs. $13.72 \pm 4.36^\circ$, n.s) .



3. Center of gravity (COG)

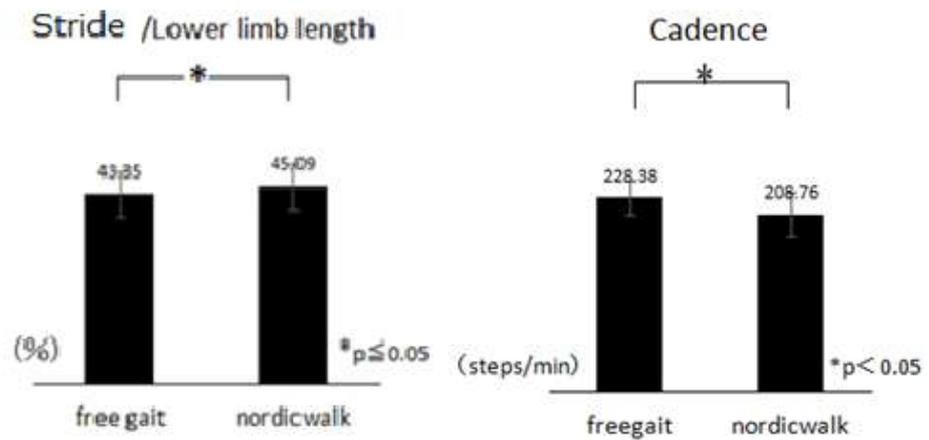
The vertical movement of center of the gravity in the Nordic Walking is larger than that of free walking (Free gait vs J-style Nordicwalking, 1.23 ± 0.04 vs 1.24 ± 0.04 (cm/TMD) ($p < 0.05$)) .



4. Stride

As the Nordic Walking increased the Stride (Free gait vs J-style nordicwalking, 43.35 ± 4.84 vs 45.09 ± 5.13 (Step/Lower lib%), $p < 0.05$). And, Nordic Walking also decreased the cadence.

(Free gait vs J-style Nordicwalking, 228.38 ± 20.15 vs 208.76 ± 25.77 (Step/min), $p < 0.05$).



► Cardiovascular Disease

Exercise for Patients of Cardiovascular Disease

Exercise related sudden death is common in middle-aged and elderly men and it happens during or immediately after exercise. The mortality during jogging is reported to be seven times as high as that of the predicted heart attack rate during normal life. The main causes of sudden death during sports are ischemic heart disease and acute heart failure, and also cerebrovascular disease. Even though middle-aged or elderly men have excellent exerciseability, it is not the evidence that they have no heart disease. There is also a report that there were several runners who died of heart disease within a few weeks after they finished the 90km marathon. If you have symptoms such as chest pain, heart palpitations, shortness of breath, fatigue, dizziness, you should not start exercise and consult with your doctor. One should stop exercise and give priority to treatment. If patients with impaired cardiac function gain the body weight of 2kg or more within 3 days, if the shortness of breath on exertion is exacerbated, there is a high possibility that heart failure has aggravated. Then the patient should seek the opinion of their doctor. On the other hand, the correct exercise therapy not only improves the risk factors of cardiovascular disease but also prevents it. Even a person with a cardiac disorder can safely perform aerobic exercise such as walking or Nordic walking when described properly. It is also reported that the risk of sudden death does not increase during appropriate exercise.



So, how much exercise should we do? The aerobic exercise about 20-30 minutes three times a week is recommended. As better than no, the American Society of Sports Medicine also accepts exercise for 10 minutes two or three times a day. At the beginning of exercise, it is easy to understand and also safe to start with exercise intensity (METs) equivalent to the daily life activity.



Nordic Walking for patients with Cardiovascular disease

Paracelsus University in Salzburg Austria reported a systematic and comprehensive literature search performed between November 2010 and May 2012. Sixteen RCTs with a total of 1062 patients and 11 observational studies with 831 patients were identified. The current analysis revealed that with regard to short- and long-term effects on heart rate, oxygen consumption, quality of life, and other measures, Nordic walking is superior to brisk walking without poles and in some endpoints to jogging. Nordic walking exerts beneficial effects on resting heart rate, blood pressure, exercise capacity, maximal oxygen consumption, and quality of life in patients with various diseases and can thus be recommended to a wide range of people as primary and secondary prevention.

Nordic walking uses the upper body muscle to increase the forward driving power, and the stride and walking speed increase compared to normal walking, and oxygen consumption also increases by 20% to 23% of walking. This also means that the same lactate concentration, heart rate, and oxygen intake can be achieved at a slower rate in Nordic Walking than in walking, which means that you can walk slowly in Nordic Walking, even if you perform the same aerobic exercise.

J-style Nordic Walking, devised in Japan, targets on preventing falls and maintaining balance by placing the pole in front of the body, usually around the forefoot, with emphasis on braking power rather than driving.



Walter and Porcari reported in 1996 that at a given speed, the use of Nordic walking poles can safely increase the intensity of walking exercise in Phase III/IV cardiac rehabilitation patients. Walking with Nordic poles significantly ($P < .05$) increased the energy cost of walking by 21% (3.8 mL/kg/min) compared to walking without poles. There were also significant ($P < .05$) increases in HR (14 bpm), SBP (16 mm Hg), and DBP (4 mm Hg) when comparing conditions. Calculated oxygen pulse (mL O₂/heart beat) values indicated that changes in HR were consistent with the increase in VO₂ and were not related to a pressor response mechanism. The only dysrhythmias noted were isolated PVCs, with no differences in the frequency of occurrence between trials. There were no adverse ST segment changes with either trial.

Even in elderly patients with cardiovascular disease in our cases, it was observed that blood pressure and heart rate increased during 100m Nordic Walking compared with T-cane walking.

Hypertension

Treatment of high blood pressure by aerobic exercise is a pillar of non-drug treatment as well as diet and exercise therapy in mild hypertension where systolic blood at rest is just more than 140 mmHg. Severe hypertension whose systolic blood pressure at rest is 180 mmHg, is controlled by drug treatment. However, as far as the hypertension is well controlled and life style disease, the addition of exercise therapy is effective not only for the improvement of high blood pressure itself but also for treatment of lifestyle-related diseases. When you stop exercising, the effect disappears.



Not only at the beginning but also during exercise, high blood pressure is a problem often encountered in aerobic exercise prescriptions. In patients with high blood pressure, it is recommended to measure the blood pressure before exercise.

When the blood pressure is over 180mmHg, only the stretching is possible and patients should refrain from aerobic exercise. If the blood pressure is more than 200 mmHg before exercise, consult with a doctor and instruct patients to have treatment. If a patients has symptoms such as chest pain, palpitations, shortness of breath, fatigue, dizziness, lightness etc, you should not start exercise or stop your exercise and consult with your doctor even if the blood pressure is below 180mmHg. If the blood pressure exceeds 200 mmHg during exercise, reduce the intensity so that the blood pressure is less than 180 mmHg. In case the blood pressure exceeds 200 mmHg even if the exercise intensity is reduced, exercise should be discontinued. At the end of the exercise, if the blood pressure is 200 mmHg or more, and if there are no chest pain, palpitations, shortness of breath, fatigue, dizziness, dizziness or other symptoms, rest slowly about 5-10 minutes, and return home if the blood pressure comes down below 180 mmHg. Arrange for a doctor's visit for patients who have blood pressure that is not readily falling or who have symptoms.



Ischemic Heart Disease

(Angina Pectoris, Myocardial Infarction)

Aerobic exercise with appropriate intensity not only improves the physical condition that triggers ischemic heart disease but also causes the progression of arteriosclerotic lesions and sometimes even ameliorates coronary artery stenosis. Nordic Walking is listed as one of the aerobic training events in the guidelines for cardiac rehabilitation and prevention and treatment of cardiovascular disease in Germany. In a study of 80 patients with acute myocardial infarction in Poland, significant improvement in exercise capacity was observed when Nordic walking was added to the 3-week hospitalized cardiac rehabilitation program. Ischemic heart disease is caused by the progression of arteriosclerosis in the coronary arteries of the heart. Oxygen and energy necessary for contraction of the heart are supplied through coronary artery which arises from the root of the aorta. When metabolism is increased during exercise or bathing, oxygen demand in the myocardium is increased. Myocardial oxygen consumption is proportional to the double product which is the product of systolic blood pressure and heart rate. Aerobic exercise is an effective method for preventing the arteriosclerosis in the coronary artery, but it is important to exercise in the range where systolic blood pressure does not become too high nor heart rate increases too much.

An 81-year-old man with a history of coronary artery bypass grafting has a leaning forward standing posture. has a very short stride, and has a rush type walk. The adjustment of walking speed was also impossible, and angina and electrocardiogram change occurred at about 200 m. When his trunk was raised by Japanese-style Nordic walking and the forward lean posture is corrected, The static balance was improved, the stride length also spread, and he walked at a slow pace (2 km / h). These changes made him possible to walk without an increase in heart rate and blood pressure. And when he continued walking for

more than 1 km, angina pain and ECG change did not appear. In addition, a cardiopulmonary exercise test could be conducted and Nordic walking at a heart rate below the ischemic threshold of 80 / min was prescribed.



A 72-year-old woman with a history of cardiac bypass surgery for angina pectoris developed effort angina again. She visited my outpatient clinic. As the evaluation revealed her disease is mild, so we decided to use Nordic walking exercise therapy in combination with an increase in drugs for angina pectoris. I prescribed Nordic Walking at 100 beats per minute, which was 70% of heart rate when chest pain appeared. Seven years after the prescription, She can enjoy the Nordic walking of 30-40 minutes without chest pain.

Heart Failure

In patients with chronic heart failure, symptoms such as breathlessness, sweating, edema, should be checked during Nordic Walking. Heart failure develops not only during Nordic Walking but on the following day, or after the following day. Therefore, heart failure improvement or aggravation is judged by weight change (weight gain of 2 kg or more within 3 days) or cardiac shadow size of chest radiograph etc. Cardiovascular specialist should manage such patients. If you have heart disease, even mild, you can consult with your cardiovascular physician before you begin your Nordic Walking habits.

Instructors can ask patients with heart disease how things are going their daily life. As the exercise intensity in daily life corresponds on the degree of oxygen uptake, so we can judge how fast and how long the can walk. For example, A person who can eat and wash by oneself can walk as fast as 30 meters per minute. You let him walk for 5-10 minutes and observe the his condition. If you feel he is comfortable and relaxed, you can gradually extend his Nordic Walking time

A male patient aged 86-year old had a lumbar compression fracture, and was admitted to our hospital for rehabilitation. He also had a mitral valve heart disease. First, I performed stretching exercise and started gait training after alleviating lumbar back pain. By introducing the Nordic walking, He became possible to walk 400m after 4 weeks of rehabilitation.



Arteriosclerotic Obstruction (ASO) and Intermittent Claudication

Arteriosclerotic obstruction is the disease which cause stenosis and/or obstruction of the arteries in the lower extremities With the progression of arterial stenosis, if you walk at a distance your leg muscles may become sore and sore and you will not be able to

continue walking. When you stop walking, then the pain releases. But pain relapses at the same distance as resuming walking. This is intermittent claudication which limits the patient's walking distance and lowers quality of life. Nordic Walking was reported to be effective against intermittent claudication. Oakley reported that Nordic Walking immediately enabled patients with intermittent claudication further with less pain. Collins reported that, Nordic Walking of 30-45minutes 3 times a week decreased the pain in intermittent claudication and increased traveling distance and walking speed. Thus, the symptoms of intermittent claudication will be improved by repeating a certain degree of Nordic Walking. As the coronary artery disease is often complicated, so it is important to obtain the permission of the physician and monitor the electrocardiogram during exercise.

Sports Exercise Therapy in Groups

What is the risk of doing sports exercise therapy? Van Camp and others surveyed 167 cardiac rehabilitation programs in the United States, within 1 million people x time, there were 8.9 people with cardiac arrest, 3.4 with myocardial infarction and 1.3 with heart death. Makita also reported that in his 12 years of exercise therapy with of 267 patients (average age 63.5 years, average rehabilitation participating organization 37 months), he had experienced no major accident including cardiac death during exercise.

We have Group Nordic walking in gait training in convalescent rehabilitation. The purposes are creating a place for social interaction during long hospitalization and acquiring exercise habits for maintaining health after discharge.. Fifty-six patients with cerebrovascular disease, 45 patients with orthopedic disease, and three others, a total of 104 people from 29 to 87 years old (average 64.2 years old) have participated so far. Participant criteria is the ability to walk over 1.2km continuously with Nordic poles.

There are the 3-course ; Okamoto Taro course (1.85km) Kitahara Hakushu course (1.85km) navy course (2.35km) inside the Tama Relic garden just located in front of the hospital. As a part of outdoor walking training, one patient will be accompanied by one therapist. The walking time is about 40 minutes, and it walks while putting one break and hydration on the way. The average heart rate increased from 73/minutes to 96/ min. An increase in heart rate of 30% was recognized as the appropriate exercise load. The age group of the Nordic Walking class is wide, and men and women are also involved. There are various purposes such as “I want to walk a long distance”, “I am interested”, and “I am interested in the Nordic walking”, but I enjoy the Nordic walking peacefully while chatting with the patients and staff. After the Nordic Walking class, the voices from the patients were, "It became a good exercise" "I was able to feel the season" "I want to do a Nordic walking even after discharge" "It became a good memory before discharge" "It became a good refreshment" We

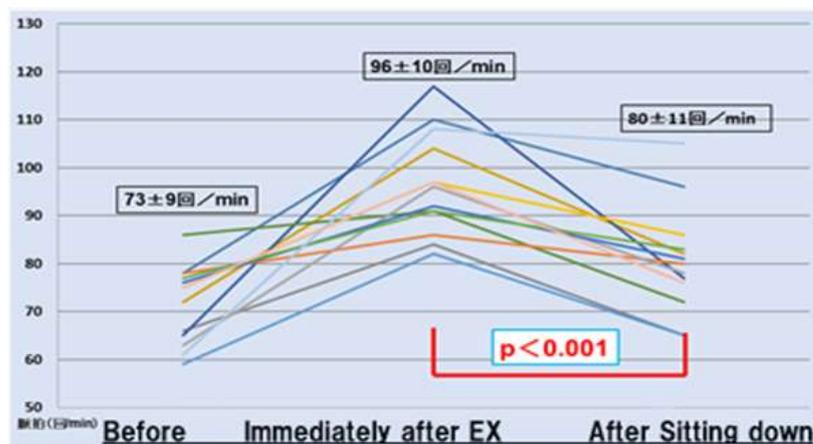
could hear various positive impressions. There are also many greenery along the Tama cemetery and the Nogawa river, and patients could do the Nordic walking while feeling the seasons such as cherry blossoms in spring and autumn leaves in autumn. Patients also could improve the mental energy for discharge.



Heart Rate Measurement during Exercise

The aerobic exercise load is usually prescribed as heart rate. Then we often measure the pulse rate to confirm the exercise load. On the other hand, the decrease in heart rate one minute after aerobic exercise is about 60%. As the heart rate decreases rapidly after the end of exercise, so if the pulse is not measured without delay, we can not know whether the exercise load is appropriate or not.

In the study of healthy adults, the pulse measurement using electronic sphygmomanometer after sitting on the chair showed significantly lower pulse rate compared to the pulse count immediately after Nordic walking. The heart rate decay of patients with severe heart disease takes longer compared to healthy adults, especially the exercise load is severe. Heart rate (pulse) management is mandatory with patients with heart disease.

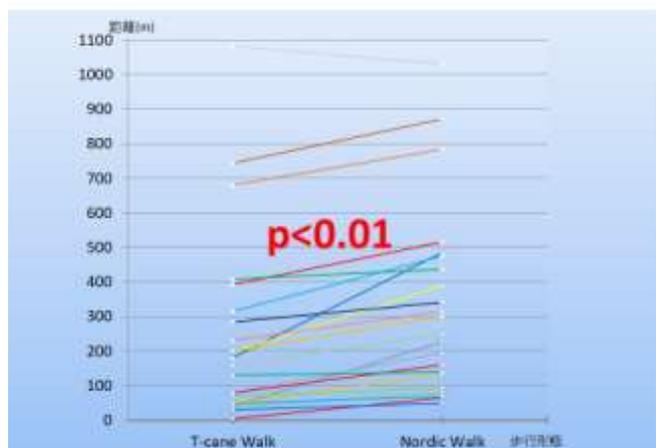


► Orthopedic Disease

Compression Fracture (CF)

Nordic walking is reported not only for its exercise effect, but also for its usefulness in the field of rehabilitation such as spinal compression fractures.

Wendlova at Dere University calculated the effect of reducing gravity on the spine, using a J-style nordic poles with the elbow at right angles and the tip at right angles to the ground. The 44% of the static pressure due to gravity goes to the poles and then the static pressure on the spine is reduced to 56%. Nordic poles reduce the load on the legs by 30% compared to walking and jogging.



Twenty three patients with vertebral compression fractures, who were 65 years of age or older were investigated to determine the maximal walking distance with NW compared walking with T cane. Their average age was 83.2 ± 5.3 years, and they were 3 males, 20 females. The maximum walking distance of the T-shaped walking stick was 5m-1083m, the average of 238.8m, and the maximum walking distance of the NW was 50m-1030m, the average of 325.6m ($P < 0.01$).

Patients with Spinal Cord Injury

There were also cases with spinal cord injury and in which independent gait was obtained early by incorporating the Nordic Walk into the rehabilitation program

A case study: A male patients in his fifties.

He fell from a height of 5m when landing with a hang-up rider, and was injured. A marked decrease in muscle output and sensory impairment below the 4th lumbar level was noted due to paresis in both lower limbs. At the time of admission to our rehabilitation hospital, he was at the walker-assisted walking level with the short leg brace attached. Incorporating NW into the rehabilitation program from the 12th day of admission to our hospital, we were able to obtain stable and powerful walking. With regard to stability, it was thought that the light touch effect was affecting the imbalance caused by severe sensory impairment from the soles of both legs to the back of the thighs and lower legs. The light touch effect means that by touching the fixed point lightly with a finger tip, Nordic pole etc., the posture fluctuation during standing posture is reduced.

His standing balance declined because of the decrease in the ankle plantar flexion power. Since a man walks with 4-point support in NW, the support base surface expanded from T-shaped cane, and the stability increased. Gradually, both lower extremity muscle strength, perception impairment, balance ability improved. From the sixth week of hospitalization, it became possible to walk by NW within the ward. Finally he walked 1.5km with Nordic poles outside the hospital. After discharge our hospital, he commutes for reinstatement while using the NW.



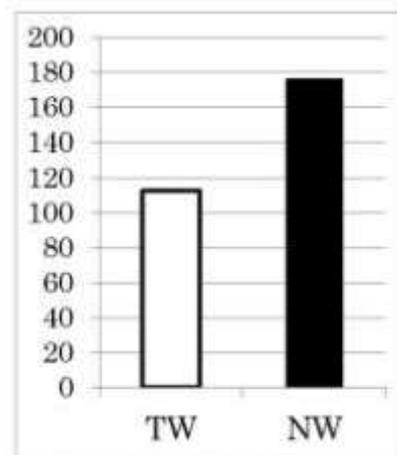
Osteoarthritis

Yoshimura reported the reduction of the lower limbs burden of the NW for 10 healthy adult men around 20 years old. In the floor reaction force of the NW, the peak value of the floor resilience at the mid-term standing decreased by 8.7% of the body weight compared to the normal walking. Distributing the load to the poles, the NW decreased the vertical burden on the lower limbs. Furthermore, NW improves the stability in the horizontal direction. NW is eligible for walking exercises in various diseases such as osteoarthritis of the lower extremities, rheumatoid arthritis, and ataxia.

Yoshimura compared the effect of NW with T-cane walking on maximum walking distance in postoperative patients with knee osteoarthritis. The patients were 19 women with age 70 or older (mean age 80.2 ± 4.2) and without cognitive problems.

The maximum walking distance of the NW was $176.4\text{m} \pm 129.9\text{m}$, and was significant longer than that of the T-cane walking stick ($112.8\text{m} \pm 71.7\text{m}$ ($p < 0.05$)).

(m)



TW: T-cane Walking, NW: Nordic Walking

Degenerative Hip Arthropathy

The usefulness of NW for patients with degenerative hip arthropathy has been proved in a very large number of patients. Please refer to Dr. Yano's report for details



Relationship between Nordic Walk and Basic Motion

Tazaki et al. evaluated Relationship between J-style Nordic Walk Effect and Stand up motion in 20 elderly patients (age85-93) with orthopedic disease. We examined the group of patients who could improve walking by Nordic Walking (groupA) , and the group that decreased walking (groupB). There was a significant difference in the Stand up motion ($X^2<0.01$).

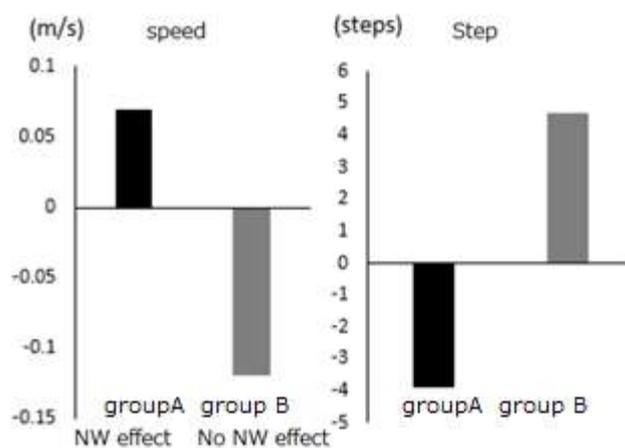


Fig. Grouping in the immediate effects of the Nordic Walk

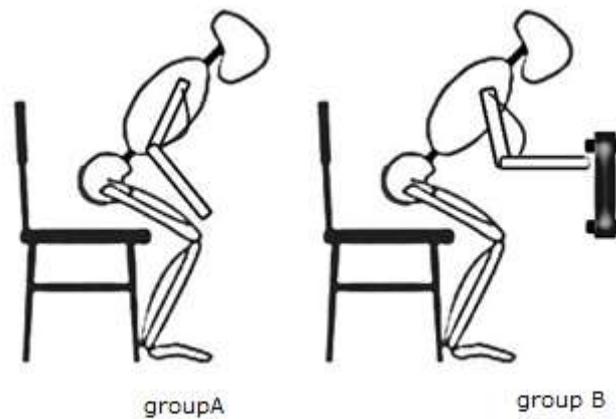


Fig. Difference in the Stand up motion

Patients in group A could stand up from the chair independently. Patients in group B needed to support by hand action their stand up motion.

► Neurological Disease

Parkinson's Disease

NW is known as a very effective method of walking for patients with Parkinson's disease. We held a symposium with the patient of Parkinson's disease at Walking Grand Festival in Kanazawa held in 2016. And Dr. Ryuji Marutani gave a lecture on how to teach NW to Parkinson's disease.

In technical guidance, more than 60 patients with Parkinson's disease walked at the same time together with Dr. Marutani and instructors from Tokyo and Ishikawa NW Federation.



Unilateral Use of Nordic Pole on Patients with Stroke

Comparison with T cane

Since NW is performed by holding the pole on both upper limbs, it is often excluded when the functional decline of the upper limbs are accompanied. Hirota Y. et al reported the feasibility of unilateral Nordic pole (following: NP) use on walking. They compared unilateral Nordic Walking with the walking practice using T-cane based on the result of 10 m walking time and the number of steps.

Eight patients, six men and two women, with brain stroke and in the rehabilitation hospital were included in the study. Their average age is 65.8 ± 12.9 years. The original diseases were cerebral infarction in 6 patients and cerebral hemorrhage in 2 patients. The exercise capacity were Brunnstrom stage IV in 1 patients, V in 4pts. and VI in 3. Those with severe higher brain dysfunction, severe cognitive decline, and limited range of motion were excluded.

Ten-meters walks (comfortable walking speed) were performed twice using T-cane and using unilateral NP. The height of the cane was adjusted to the height of T-cane for the large trochanter and NP for the height multiplied by 0.63 of body height (Photos 1, 2). In addition, the walking style adopted Japanese style Nordic walking.

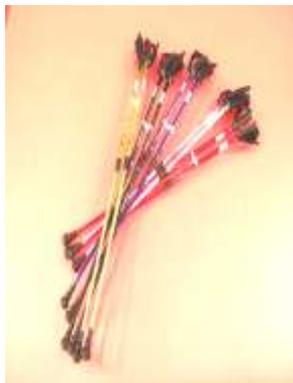


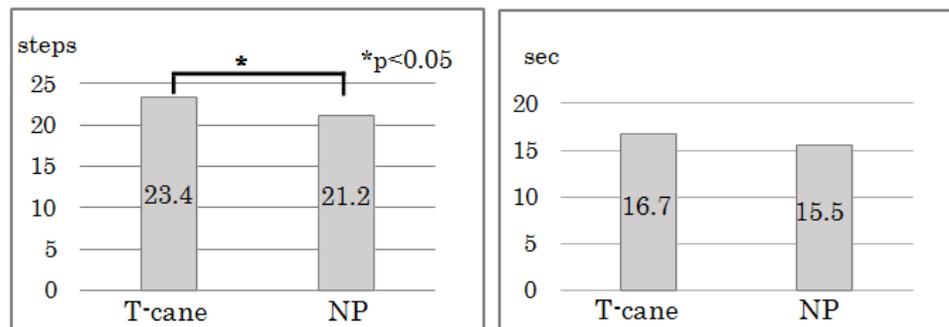
Photo1



Photo2

Walking with unilateral Nordic pole showed a significant decrease in the number of steps for 10 m walking compared with walking using T-cane (T-cane walking: 23.4 steps on average, NP walking: 21.2 steps on average, $p < 0.05$).

Although no significant difference was found, the walking time also tended to be shorter with the unilateral NW. Seven out of eight patients decreased the number of steps and shortened the walking time with unilateral NW.



The use of the Nordic poles have been reported to promotes the extension moment of the trunk and influences the extension angle of the trunk and the hip joint.

The case of unilateral NP, was also considered that the 10m walking time was shortened and the number of steps was reduced along with the extension angle of the hip joint during walking. In addition, the extension of the hip joint raises the center of gravity, which means an increase in potential energy, and along with the extension of the large lumbar muscles that are hip flexors. As the swinging performance of the pendulum movement mainly based on the intrinsic inertia force. The extension angle of the hip joint might also lead to a good results.

► Resistance Training

Since 2000, the American College of Cardiology has recommended that not only aerobic exercise but also muscle strengthening (resistance exercise) should be prescribed for patients with cardiovascular disease. The representative effect of resistance exercise is not only a muscle strengthening effect, but also for prevention from fall over in the elderly. And moreover, it increases the maximal oxygen uptake, especially activating the basal metabolism.

Not only aerobic exercise but also resistance training of appropriate strength are safe for patients with cardiovascular disease. Resistance training is usually assessed on the basis of 1 RM (1 repetition maximum), the maximum load only for one time. Resistance training, 50-80% of 1 RM, improves muscle strength, balance, endurance. From the hemodynamic point of view, it is considered safe even for the patients up to the age of 90.

Resistance trainings are recommended to start from a light load which can be easily repeated 20 times and “light” in the Borg index” (20-30% of maximum repetition weight), and then gradually increase the load. For the first, the patients are recommended to start from ten times a set and progress to 15 times a set.

For elderly people and people with weak muscle, it is desirable to prescribe a light load and increase the number of exercise thereafter. Fardy introduced in his book “Sports rehabilitation for heart disease”, that Nordic walking is effective in providing muscle strength and endurance in the upper limbs and is also extremely useful in improving energy consumption.



Nordic walking uses the upper body strength as compared to normal walking, which means that you are already doing upper body resistance training with Nordic walking. The Nordic poles can reduce the load of the trunk and legs by 30-40%. Then, the elderly and weak muscle patients can participate resistance training with Nordic poles.

Heart warming up: **Resistance Training**

1) Heel Raise (Lower thigh triceps)



Raise your heels slowly then transfer your weight on the ball of the thumb and stand on tiptoe.

1 set 10times. You can wait 5 seconds on tiptoe.

2) Toe Up (Tibialis anterior)



Point the foot up. Put your strength on the muscle in front of lower leg, tibialis anterior muscle. Once at the top, stand still a moment. Ten times a set.

3) Lower Thigh Up



Float your right foot, and kick 10 times with your knee joint as the fulcrum. (Quadriceps)

Let's also do your left foot 10 times.

Then you kick up behind 10 times for each foot (Biceps femoris)

4) High Knee



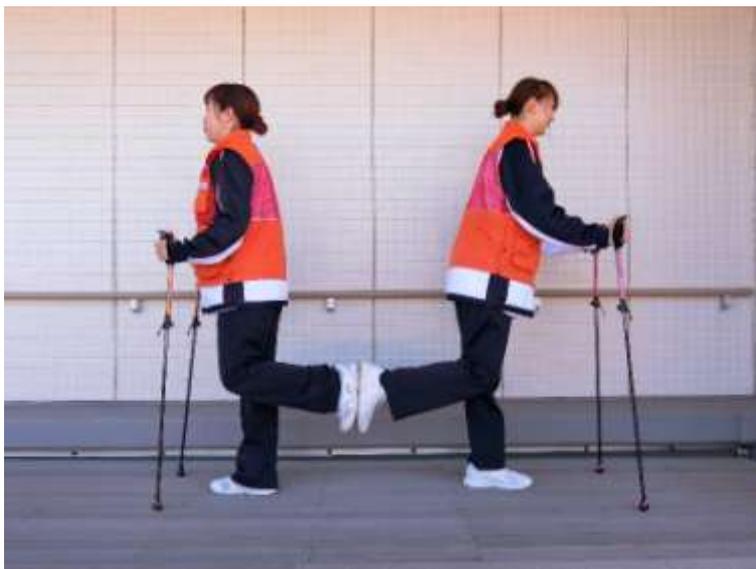
Raise your knee up slowly and carefully 10times for each side. (Iliopsoas muscle) Easy height for those who are not used to do. The knee will be right angle for those who accustomed.

5) Body Twist (Trunk Muscle, Oblique muscle)



Carrying Nordic poles on the shoulder behind your neck. Bend your knees slightly and the turn the trunk right and left.

6) Gluteal Muscle Strength



Stand with your back to the partner. One lifts the right foot and the other lifts the left foot. And then hold each other's foot firmly together. You can support your bodies. Ten seconds for each side.

7) Adductor Muscle of the Leg



Open your legs back and forth. Press the inside of your knee with your partner and push mutually, 10 seconds for each leg.

Advanced training: Press the inside of your ankle with your partner and push 10 seconds as well.

8) Abductor muscle of the leg



Press the outside of your knee with your partner. Force on the muscles outside (Gluteus muscle and thighs outside) and push 10 seconds for each leg.

Advanced training: Press the outside of your ankle with your partner and push 10 seconds as well.

9) Plunge Hip Joint



Bend your knee slowly and keep your knee behind the foot. Five times for each side. Let's drop your waist deeply when you get used.

10) Squat (Muscles of Body trunk, Hip, Thigh Lower legs)



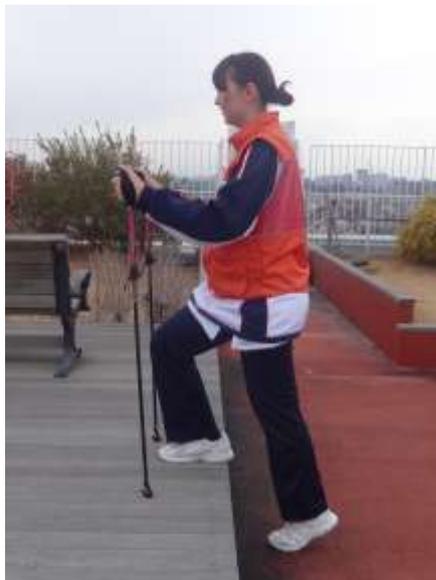
Keep your feet at the shoulder width, open the toes at 10 and 2 O'clock position. Place the poles in front of your feet. Balance yourself with your hip backwards and sink your body. Do not stand on your tiptoe while moving up and down. Start with 5times and proceed to 10 times a set.

11) One Leg Squat



Stand on one leg with your ankle and knee slightly bent. The free leg come out forward and the knee is at same height with buttocks. Keeping your trunk straight, bend the buttock, knee, and ankle of the support leg.

12) Step Climbing



The height setting is 10cm at the begging. Ten times for each leg alternately.

► Infants and kids



The Nordic Walk, which has been widely used in Japan in recent years, has also been launched for children and also for infants. The Nordic Walking, walking while operating the hand, is also attractive as an element of children's play. There has been no report in the infancy stage, then I would like to explore the structure of the Nordic walking whether it can be introduced as a play in the infancy stage.

Nordic Walking Growth

Nordic Walking growth process, and pole works. The outward pole abduction tended to disappear while children grow up. I showed a response to the Nordic walking in the rapidly developing early childhood. The Nordic Pole has two simple shapes, such as holding the hand straight, reaching out and touching and manipulating the simple NW pole in the sensorimotor phase. As in the recorded gait, children raised their hand wide and balanced while walking.

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< Days age 569 689 1280 >



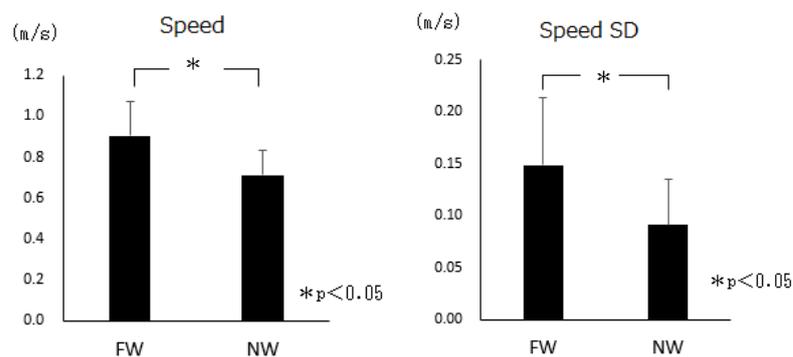
About Nordic Walking Infant's movement

We examined Nordic Walking of Infants (days age: 1578 (\pm 727.6) ,weight: 15.9 kg (\pm 5.7) , Height: 100.9cm (\pm 17.1)) by 3D analysis system.



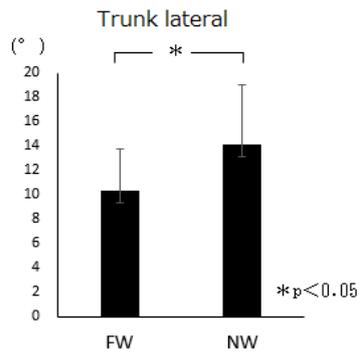
1. Speed

The walking speed in one walking cycle was significantly reduced in the Nordic walking compared to free walking (Speed: free gait v.s NW, $0.904 (\pm 0.170)$ v.s $0.715 (\pm 0.121)$ (m/s), $p < 0.05$) (Speed SD: free gait v.s NW, $0.149 (\pm 0.065)$ v.s $0.091 (\pm 0.044)$ ($^{\circ}$), $p < 0.05$) .



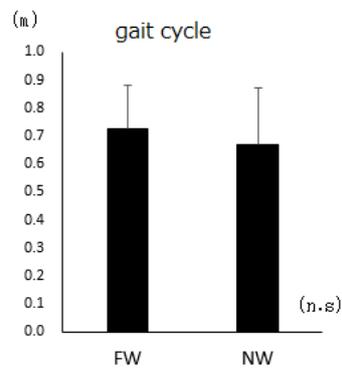
2. Lateral balance

Nordic Walking significantly expanded to trunk lateral flexion while walking compared to free walking (free gait v.s NW, $10.30 (\pm 3.5)$ v.s $14.13 (\pm 4.87)$ ($^{\circ}$), $p < 0.05$) .



3. Stride

The Nordic walk showed a decreasing tendency compared to the free walking during one walking cycle in the right heel (free gait v.s NW, $0.070(\pm 0.156)$ v.s $0.669(\pm 0.201)$ (m), n.s) .



Rehabilitation model

In child's posture control, putting Nordic Walking poles on a stable floor with a slight force is effective. It will be the influence of effect of light touch.



Journal of Nordic Walking No.8
Medical Nordic Walking Vol.1

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