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Study

The effectiveness of cooling down using the Water Walker

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Abstract

Cooling down after exercise is considered to be crucial to recovering from fatigue and to ensuring venous return. Activities like walking or stretching are normally used to cool down. In addition, aquatic exercise is recommended because it is effective at increasing venous return and reducing strain on joints such as the knees as a result of the effects of buoyancy in water and water pressure. Thus, the aim of the current study was to examine the effectiveness of cooling down by walking in water, using the Water Walker (the Water Walker & Spa, or WWS), after exercise. Subjects were a typical male and female adult. Exercise involved running on a treadmill at a speed of 6-8 km/h to reach a target heart rate calculated as 75% HRreserve based on the resting heart rate. After running, subjects cooled down by walking for 15 min either in the WWS or on the treadmill, and subjects then rested in a seated position for 15 min. The lactate level and heart rate were measured 4 times : at rest, immediately after exercise, after walking, and after resting in a seated position. Heart rate was about the same immediately after exercise. Heart rate was lower when cooling down for 15 min by walking in the WWS. Walking in the WWS or on the treadmill resulted in similar lactate levels. These findings revealed that walking on land or in the WWS helps to cool down and lower the lactate level. Moreover, findings revealed that heart rate decreases more in the WWS than on land. In addition to cooling down, being subjected to water pressure helped to ensure venous return to the heart and presumably contributed to high and low levels of lactate in the liver.

Key words; aquatic treadmill, cooling down, lactic level, heart rate

I. Introduction

Typically, cooling down after exercise is considered to be crucial to recovering from fatigue and to ensuring venous return. Normally, cooling down involves a decrease in the main exercise load or a less intense activity like walking or stretching[1) 2) 3)]. The aim of recovery from fatigue is to reduce

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lactate that accumulates in active muscle primarily after exercise. Exercise of low to moderate intensity helps to use lactate accumulating in the muscles or blood as an energy source and is known to lower lactate levels in the blood more than resting after exercise. In addition, two actions are crucial to ensuring venous return : returning blood sent to active muscle to the heart via the pumping action of the heart as well as muscle pumping action that extrudes blood when veins are compressed by muscle activity. Cooling down by walking helps to return blood pooling in the lower limbs to the heart[10].

An increasing number of people are walking it water in swimming pools at fitness centers and other facilities. Aquatic exercise is recommended for a wide range of ages because it is effective at ensuring venous return and reducing strain on joints such as the knees as a result of the effects of buoyancy in water and water pressure. Aquatic walking may help to cool down, given the properties of water that are not available on land. Recently, aquatic treadmills have been developed and are being increasingly used for training and rehabilitation, but few studies have examined the effectiveness of cooling down.

Thus, the aim of the current study was to examine the effectiveness of cooling down using a treadmill on land or in water after exercise.

Ⅱ. Methods

Subjects were 2 typical adults (1 male, 1 female). Their physical characteristics are shown in Table 1. Heart rate and blood pressure were measured at rest. In order to set the exercise load, the 75% HRreserve was determined based on the resting heart rate. The target heart rate (maximum heart rate = 220 − age) was determined based on exercise intensity (75%) × (maximum heart rate − resting heart rate) + resting heart rate. Neither subject had suffered a physical condition for at least half a year, and both subjects agreed to aspects of the study, such as the purpose of the measurements and safety considerations[4) 5)]. At the start of the experiment, the purpose of the study, its methodology, and safety concerns associated with the experiment were fully explained to subjects, and then their consent to participation in this experiment was obtained in writing. This study was approved by the Research Ethics Assessment Committee of Kokushikan University's Graduate School of Sport Systems.

Measurement began with the main exercise, which was running on a treadmill (C956i, Precor) at 75% HRreserve. Subjects ran for 30 min at a speed of 6-8 km/h in light of heart rate variability between the subjects. In the first attempt after running, subjects walked on the land-based treadmill

Table 1. Physical characteristics of subjects.

	Age (yrs)	Body height (cm)	Body weight (kg)	BMI (kg/m^2)
Male	30	168.5	68.2	24.0
Female	43	165.0	57.4	21.1

BMI: Body mass index.

at a speed of 4 km/h to cool down. Subjects ran for 30 min and then performed the second attempt, which involved walking on an aquatic treadmill (Water Walker & Spa Pro, denoted here as the WWS, Natural Create) (Fig.1) at a speed of 1.5 km/h to cool down. Jets in the front of the WWS were activated (20 L×8 jets per 1 min). The water level was 110 cm. For the cool down, subjects walked on land or in water for 15 min. Afterwards, subjects rested in a seated position for 15 min.

Items measured were the heart rate and lactate level. The heart rate and lactate level were measured a total of 4 times : at rest, upon conclusion of the main exercise, after cooling down for 15 min by walking on land or in water, and after resting in a seated position for 15 min. Heart rate was also measured 5 min, 15, and 25 min after the start of exercise, after walking for 5 and 10 min, and after resting for 5 and 10 min. The exercise protocol is shown in Fig. 2. Heart rate was measured with a heart rate meter included with the land-based treadmill and a heart rate monitor placed on the index finger. The lactate level was measured using the Lactate Pro simple blood lactate monitor (Arkray). A special needle pricks the fingertip (the puncture site is about the size of a grain of rice) to draw blood, and that blood is suctioned by a sensor at the bottom of the monitor. Subjects were instructed to finish eating at least 2

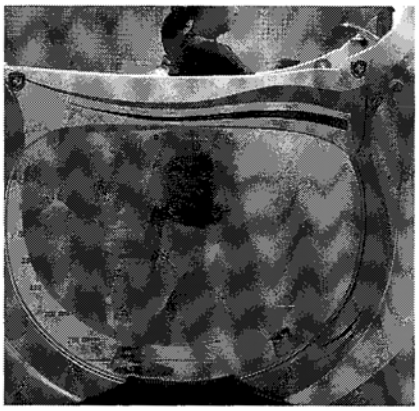

Fig. 1. The Water Walker & Spa aquatic treadmill

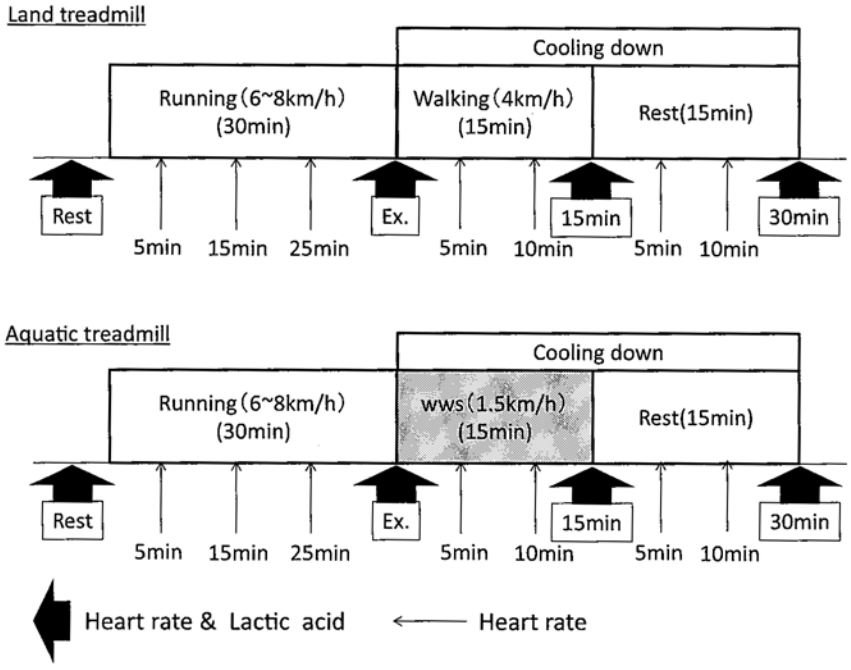

Fig. 2. Experimental protocol.

h prior to measurement of their lactate levels.

In addition, subjects were verbally asked about fatigue in the hips, knees, or lower limbs during cool down and upon the conclusion of each exercise. Fatigue was scored on a 5-point Likert scale, with 1 indicating considerable fatigue, 2 indicating some fatigue, 3 indicating normal fatigue, 4 indicating very little fatigue, and 5 indicating hardly any fatigue.

Ⅲ. Results

Changes in heart rate are shown in Figs. 3 and 4. The target heart rate for the male subject was 157.5 bpm, and his heart rate immediately after exercise was 157 bpm. The target heart rate for the female subject was 153 bpm, and her heart rate immediately after exercise was 155 bpm. The heart rate while walking in the WWS was about 20 bpm lower for the male subject and about 30 bpm

Fig. 3. Changes in heart rate in the male subject.

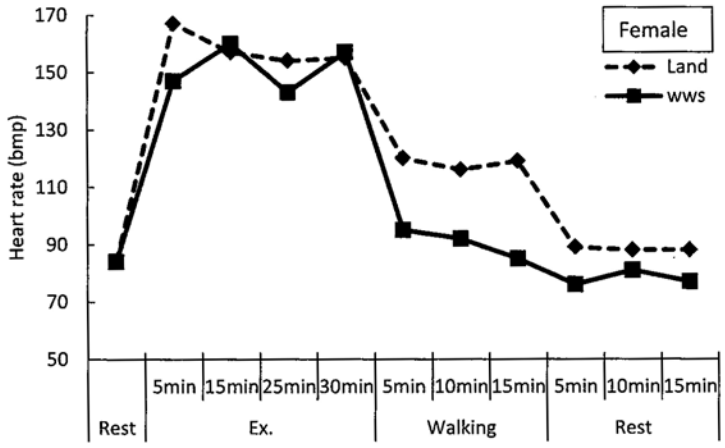

Fig. 4. Changes in heart rate in the female subject.

lower for the female subject compared to their heart rates while walking on land. Walking in the WWS also resulted in a lower heart rate during subsequent rest in a seated position.

Changes in lactate levels are shown in Figs. 5 and 6. The lactate levels of the male and female subject were about 2 mmol at rest. Immediately after exercise, the level rose to about 19 mmol in the male subject and to about 12 mmol in the female subject. Similar decreases were noted during subsequent walking and resting in a seated position ; the lactate level declined to a level equivalent to that at rest.

Assessments of fatigue in the hips, knees, and lower limbs during cool down and upon the conclusion of each exercise are shown in Table 2. The male subject's average score for fatigue at those 3 sites was 2.3 on land and 4.3 in the WWS. The female subject's average score for fatigue at those 3 sites was 1.7 on land and 4.7 in the WWS.

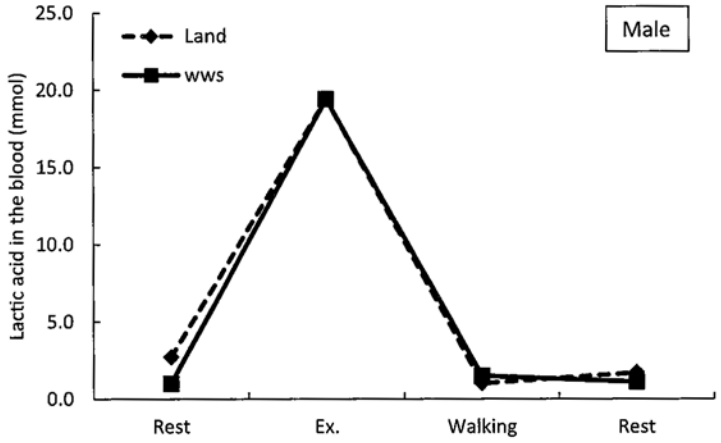

Fig. 5. Changes in lactate in the blood of the male subject.

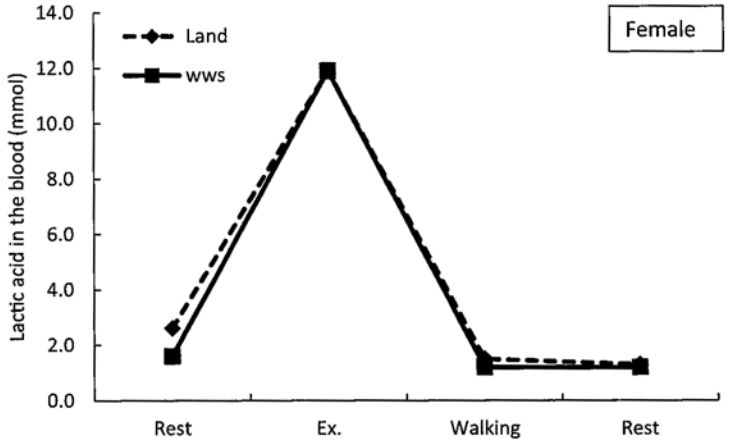

Fig. 6. Changes in lactate in the blood of the female subject.

Table 2. A survey about fatigue when cooling down.

		Hip	Knee	Lower limbs	Ave.
Male	Land	4	1	2	2.3
	wws	5	4	4	4.3
Female	Land	2	1	2	1.7
	wws	4	5	5	4.7

5…Excellent, 4…Very good, 3…Good, 2…Average, 1…Poor.

Ⅳ. Discussion

Typically, cooling down after exercise is considered to help recovery from fatigue and ensure venous return. Recovery from fatigue helps to reduce lactate. Ensuring venous return helps to return blood accumulating in active muscle to the heart via muscle pumping action. Cool down is effective at both recovering from fatigue and ensuring venous return ; moreover, not cooling down after exercise leads to a decrease in blood pressure due to a decrease in peripheral vascular resistance and to blood pooling in active muscle. As a result, blood flow to the brain decreases, carrying the potential risk of cerebral anemia-like symptoms such as vertigo and syncope. This is why cooling down after exercise is crucial[6) 7)]. Cooling down involves a decrease in the main exercise load or a less intense activity like walking or stretching. Aquatic treadmills have been developed over the past few years, and they are mainly used to work out. Nevertheless, few studies have examined the effectiveness of cooling down, and the current results should provide basic data for aquatic exercise as part of an exercise course or rehabilitation.

In the current study, running on a land-based treadmill was exercise at an intensity of 75% HRreserve, resulting in a heart rate close to the target heart rate[8) 9)]. This aerobic exercise was presumably of sufficient intensity to strengthen myocardium by burning fat. Substantial differences in lactate levels were not noted when cooling down on land or in water. This indicates that the WWS used in this study provided an effective cool down to reduce lactate in muscles. That said, findings indicated that the heart rate of the male and female subject decreased about 25 bpm when cooling down on the aquatic treadmill. There were similar changes in lactate levels, but cooling down in water reduced the heart rate sooner and it was physically relaxing. Cooling down in water may have lowered the heart rate to its resting level sooner than cooling down on land. This is presumably due to the effects of water pressure.

On the land-based treadmill, venous return to the heart is ensured by muscle pumping action of the leg muscles while walking, but on the aquatic treadmill water pressure augments compression of blood vessels in the lower limbs. This presumably results in muscle pumping action with less muscle activity. Moreover, buoyancy reduces strain on joints of the lower limbs, helping to increase joint range of motion and to relax antigravity muscles such as the triceps surae. Accordingly, cooling

down using an aquatic treadmill leads to a low heart rate but it reduces lactate to the same extent as cooling down using a land-based treadmill. In a process known as the Cori cycle, lactate accumulating in the body is resynthesized into glucose in the liver, and that glucose is then transported to tissues via blood circulation. Cooling down may have made the steps in that process more efficient.

In a survey after exercise, subjects indicated that they had "hardly any fatigue" or "very little fatigue" in the legs and knees when using the aquatic treadmill. Results also indicated that the aquatic treadmill helped to reduce physical fatigue from running.

These findings indicated that cooling down on an aquatic treadmill is effective at lowering the lactate level and that this form of cooling down resulted in a lower heart rate than cooling down on land, allowing the heart rate to return to its level at rest sooner. The current authors hope to obtain even more significant findings by continuing this research in the future.

V. Conclusion

Cooling down after exercise is considered to be crucial to recovering from fatigue and to ensuring venous return. Activities like walking or stretching are normally used to cool down. In addition, aquatic exercise is recommended because it is effective at increasing venous return and reducing strain on joints such as the knees as a result of the effects of buoyancy in water and water pressure. Thus, the aim of the current study was to examine the effectiveness of cooling down by walking in water, using the WWS, after exercise. Subjects were a typical male and female adult. Exercise involved running on a treadmill at a speed of 6-8 km/h to reach a target heart rate calculated as 75% HRreserve based on the resting heart rate. After running, subjects cooled down by walking for 15 min either in the WWS or on the treadmill, and subjects then rested in a seated position for 15 min. The lactate level and heart rate were measured 4 times : at rest, immediately after exercise, after walking, and after resting in a seated position. Heart rate was about the same immediately after exercise. Heart rate was lower when cooling down for 15 min by walking in the WWS. Walking in the WWS or on the treadmill resulted in similar lactate levels. These findings revealed that walking on land or in the WWS helps to cool down and lower the lactate level. Moreover, findings revealed that heart rate decreases more in the WWS than on land. In a process known as the Cori cycle, lactate accumulating in the body is resynthesized into glucose in the liver, and that glucose is then transported to tissues via blood circulation. Cooling down may have made the steps in that process more efficient.

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