

Analysis of Physiologic Effect of Snowboard Deck in Snowboarders

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Abstract

The purpose of this study is to provide evaluation data to examine and verify the effectiveness of the materials through physiological comparison and analysis of the new prototype snowboard deck with the existing equipments. In order to achieve the purpose, blood lactate concentrations and energy metabolic variables were measured from the targeted snowboarders. Five male snowboarders (Slope-style) volunteered to participate in the experiment. The experiment was conducted in slope-style course of "W" Ski Resort located in Gangwondo, Korea. One prototype deck and two existing deck were chosen for analysis. Each subject performed three runs with each "B", "S" and "Y" deck. Blood samples were collected twice from the finger-tip at rest and immediately after completing the run in order to determine the lactate concentration. In order to analyze the energy metabolic variables i.e. heart rate (HR), oxygen uptake (VO₂), metabolic equivalent (MET) and total energy consumption (TEE), portable wireless gas analyzer and Polar heart rate monitor was used at rest as well as during the run. The result obtained from the analysis showed increased blood lactate concentration as well as higher oxygen uptake (VO₂) at the point of Lactate Threshold (LT) when performing runs by installing "B" and "Y" decks than "S". Furthermore with the increase in speed, depletion of energy sources as well as increased concentration of muscle fatigue substance also appeared in "B" and "Y" deck than "S" where blood lactate concentration and oxygen uptake are indicators of mobilization capacity of lactic acid system during energy metabolism.

Keywords: Snowboard Deck, Blood Lactate Concentration, Energy Metabolic Variables

1. Introduction

With increasing economic condition, more and more people are being involved in winter sports. This has especially lured younger generation who seek for thrill and freedom through it [6]. Furthermore, its popularity has been added as the event takes a significant portion in 2018 Pyeongchang Winter Olympics with 10 gold medals out of total 93 Golds. Thus, making the sports much more competitive due to which countries around the world are investing in researches in different field such as Sports training, Sports biomechanics, Sports nutrition etc as well as in developing better equipments for athletes to get the best score. As Korea is

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hosting next 2018 Winter Olympics, domestic technology based products can contribute to develop the winter sports industry not only in Korea but also internationally further increasing our technological competitiveness [9]. As snowboarding is an outdoor sporting event, influences of external environment *i.e.*, quality of snow; temperature *etc.*, poses numerous limitation in analyzing physiological variables in actual sites [10]. In a previous study conducted [2] on six male athletes, degree of muscle glycogen was much more increased during exercise on snow than in the laboratory. Furthermore, rapid accumulation of lactic acid by fatigue on snow was also reported by [3]. Thus, these researches pointed out that performing experiment regarding the blood lactate concentration and energy metabolism in the field will be much more important on indicating the energy consumption than in laboratory condition. Based on these facts, the study aims to provide evaluation data for examining and verifying the effectiveness of the materials through physiological comparison and analysis of the new prototype snowboard deck with the existing equipments.

2. Methods

The experimental methods conducted in order to achieve the purpose of the study are presented as follows.

2.1. Subjects

Five male Slope-style snowboarders who are currently enrolled in the Korea Snowboard Association were chosen as subjects. Physical characteristics of the subjects are presented in Table 1.

Table 1. Physical Characteristics of the Subjects

Height(cm)	Weight(kg)	Age(yrs)	Experience(yrs)
172.60±1.52	63.40±4.72	30.00±5.48	5.80±2.49

2.2. Experimental Design

The test took place in the advanced Slope-style course at “W” Snowpark, Gangwondo Korea. The experimental slope was 420m in length with average pitch of 20° to maximum pitch of 30° Figure 1.



Figure 1. Experimental Slope

The weather was cloudy on the day of experiment with the temperature of 9.5°C, humidity of 63%, winds blowing from the northeasterly at the speed of 2.6m/sec. All subjects complied

with the process of a life ethics. Before the experiment, the purpose and procedures of the study were explained in detail to all subjects. In addition, subjects were fully explained regarding the processing of the data and the disadvantage to the study in case of absence. The participants who fully understood and who were willing to participate voluntarily signed the experiment consent form. Prior to the experiment, subjects were given sufficient amount of time to perform pre workout with stretching and warm-up. A twin tip freestyle snowboard deck constructed by “B” Co. was compared with the existing two products from “S” and “Y” company each. In order to control biasness to the study, Double Blind Test was performed on the subjects as well as the researchers involved in the study. Each subjects installed “B” “S” “Y” decks and performed three runs on the slope. Furthermore, the subjects were allowed 30 minutes to rest after completing each run.

2.3. Data Analysis

2.3.1. Blood Lactate Concentration

Before getting on the lift to the slope, subjects’ blood samples at rest were collected at 7:30 am below the slope. The subjects were instructed to perform runs without stopping in the middle of the slope. In order to analyze the blood lactate concentration, second blood samples were collected with extreme care from each subject immediately after completing the run from the finger- tip using heparinized capillary tube without forming any bubbles. The collected samples were immediately packed in the tube and were analyzed by injecting into a lactate analyzer (Biosen C-line sport, EKF Diagnostic, Germany).

2.3.2. Energy Metabolic Variables

In order to analyze the heart rate (HR), oxygen uptake (VO_2), metabolic equivalent (MET), total energy expenditure (TEE) in real time during experiments, subjects were equipped with Polar Heart Rate Monitor around the chest and a face mask attached with Portable Gas Analyzer (K4b2 CosMed, Italy). “K4b2” gas analyzer has been used in a various activities to measure exercise intensity and was proved to be suitable for the measurement of oxygen uptake and energy consumption [4]. Before conducting each run from top of the slope, subjects were given resting period on a chair for 3-5 minutes after which they performed the runs.



Figure 2. Gas Analyzer Experimental

3. Results

3.1. Blood Lactate Concentration

The changes of the blood lactate concentration during the resting period and immediately after performing the turn are presented in Figure 3.

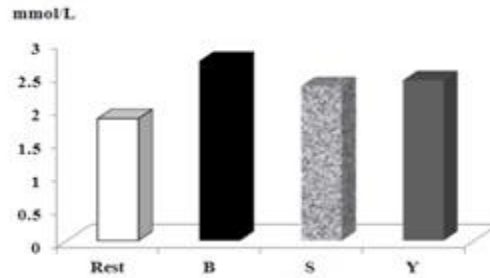


Figure 3. Changes of the Blood Lactate Concentration

Overall, right after performing the runs with “B”, “S” and “Y” decks, increased blood lactate concentration was observed than comparing to at rest ($1.84 \pm 0.32 \text{ mmol/L}$). In particular, blood lactate concentration when wearing “B” ($2.71 \pm 0.67 \text{ mmol/L}$) and “Y” ($2.42 \pm 1.02 \text{ mmol/L}$) decks was much higher in comparison to “S” ($2.33 \pm 0.59 \text{ mmol/L}$) deck.

3.2. Energy Metabolic Variables

The changes of the metabolic variables in lactate threshold (LT) and maximal oxygen uptake (VO_2max) during rest and after performing the runs are presented in Figure 4-7.

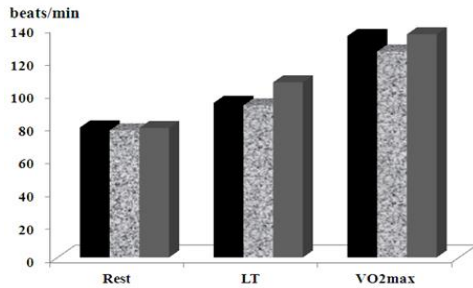


Figure 4. Changes of the HR

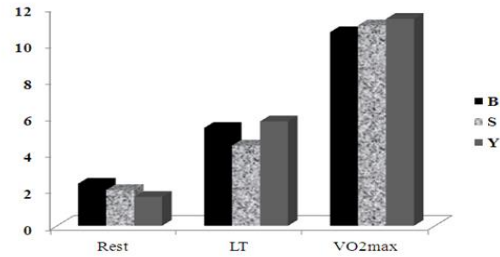


Figure 6. Changes of the MET

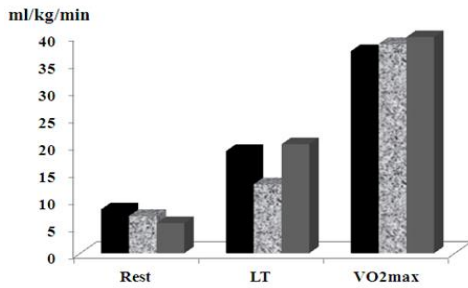


Figure 5. Changes of the VO_2

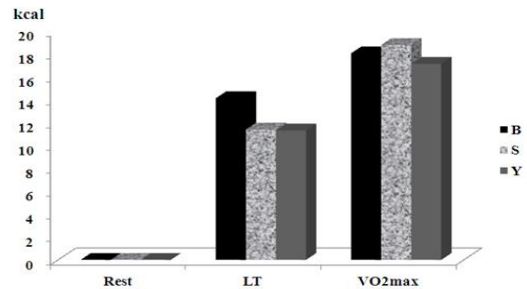


Figure 7. Changes of the TEE

When installing “B”, “S” and “Y” decks, heart rate (HR) was higher in the state of VO₂max (134.75±24.25bpm, 125.25±22.19 bpm, 135.75±27.24bpm) than at rest (79.00±4.16bpm, 77.25±6.40bpm, 78.75±6.40bpm) and at the state of lactate threshold (94.00±6.27bpm, 92.50±3.00bpm, 106.50±17.29bpm). VO₂ and MET were much higher in the state of lactate threshold (LT) (5.37±.76, 4.41±1.24, 5.73±1.18) than at rest (8.07±2.86ml/kg/min, 6.84±2.56ml/kg/min, 5.54±1.31ml/kg/min, 2.31±.81, 1.96±.73, 1.58±.38). Furthermore, VO₂ and MET appeared highest at state of VO₂max (37.20±4.76ml/kg/min, 38.51±3.49ml/kg/min, 39.78±3.24ml/kg/min, 10.63±1.36, 11.00±1.00, 11.36±.93) than in the state of lactate threshold (LT). On the other hand, oxygen intake was increased when installing “B” (18.80±2.64ml/kg/min) and “Y” (20.06±4.11ml/kg/min) decks than performing runs on “S” (12.70±3.68ml/kg/min) deck in the state of the lactate threshold (LT). Also when installing “B” and “Y” decks, TEE was much higher in the state of lactate threshold (LT) (14.12±7.11kcal, 11.30±2.74kcal) and VO₂max (18.04±7.29kcal, 17.13±2.14kcal) than at rest. In case of “S” deck, it was much higher in the state of lactate threshold (LT) (11.39±3.22kcal) than at rest and it was much higher in the state of VO₂max (18.77±7.50kcal) than in the state of lactate threshold (LT).

4. Discussion and Conclusion

It is considered that this study has provided significant physiological evidence data to improve snowboard deck products though examining and verifying the effectiveness of “B”, “S” and “Y” deck by measuring the blood lactate concentration and the changes of the energy metabolism variables of male snowboarders. Different researches [7, 8] have mentioned about “Lactic acid” a fatigue material which evaluates the physical intensity or the load as well as physiological changes when performing activity, is used as a reference value for improving the performance of athletes, analyzing the effectiveness of training, a degree for excessive training as well as to control the exercise intensity [5]. According to the results obtained from the study, increased blood lactate concentration was observed after performing runs than at rest on all decks *i.e.*, “B”, “S” and “Y”. Particularly, higher blood concentration was observed in “B” and “Y” decks than “S”. It is considered that these results are indicators that represent the mobilization capabilities of the lactic acid system during energy metabolic process which appeared due to depletion of energy sources as well as due to the increase in fatigue substance concentrations in the peripheral muscles through the performed activity. When snowboarding, high lactate levels are caused in part by occlusion during continuous isometric contractions which results in restriction of blood flow of vastus lateralis [11]. In addition, according to the individual fitness level, intensity of muscle contraction and the type of muscle contraction, the angle of the turn or even the radius of the action *etc.*, drastically affects stimulates physiological response due to which stresses the muscles [1]. In order to analyze the intensity of exercise in snowboarding, better insight in the concentration of lactate acid can represent complex physiological functions than only relying on heart rate data that is mainly affected by the stimulation around the heart due which may lead to misinterpretation of the data. Lactate threshold (LT) is a useful indicator for the evaluation of athletic ability. According to the result obtained from this study, the oxygen uptake when installing “B” and “Y” decks were much higher than when installing “S” deck at the state of lactate threshold. On the other hand, the MET of snowboard athletes are reported to be 7-11 [3]. The results obtained from our experiment regarding the MET of the subjects were 10- 11 level at the state of VO₂max proves the intensity of the experiment performed.

As environmental condition such as temperatures, snow conditions, the change in areas *etc.*, influence deeply on the physiological responses of the exercise intensity. The study

conducted can be a significant reference data to analyze the physiological effects targeting snowboarders in laboratory conditions too.

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