CORRELATIONS BETWEEN THE MECHANICAL PROPERTIES OF RUNNING SHOES AND THE SENSORY EVALUATIONS BY DISTANCE RUNNERS IN RELATION TO THE WEAR OF OUTSOLE

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INTRODUCTION
The wear of running shoe sole causes runners the deterioration of perception significantly and may affect their decision makings to stop usage. In this study, the traction characteristics of running shoes were investigated by conducting slip tests and by analysing runners’ sensory evaluations on shoes. These tests and evaluations provide information on how the traction characteristics of running shoes are affected by the amount of wear and how the mechanical properties are correlated with the sensory evaluations by distance runners.

PROCEDURES
Six types of sample shoes, which were worn out by machine at three different parts, as shown in Figure 1, and at two different level of wear, were prepared for mechanical tests and sensory evaluations and were compared with the shoes of not worn out. Table 1 shows identification worn out shoes tested.

Traction characteristics were determined by the coefficient of static friction between shoe soles and the surface by using a slip testing machine as shown in figure 2. A constant vertical force 500N was applied via last. The coefficient was defined by the ratio of maximum tangential force to vertical force. The coefficient was measured at the three different parts of outsole and asphalt was used as a testing surface.

Sensory evaluations for the sample shoes were carried out by twelve distance runners based on Scheffé's method of paired comparison. Comparisons were made by six possible combinations out of the four shoes, that is, the three different types of worn out shoes and one shoe.

<table>
<thead>
<tr>
<th>Part of wear</th>
<th>Level of wear</th>
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<tbody>
<tr>
<td>Toe</td>
<td>Fore</td>
</tr>
<tr>
<td>1</td>
<td>T1</td>
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<tr>
<td>2</td>
<td>T2</td>
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Table 1 Identification of worn out shoes tested
without wear. And then three combinations out of the three shoes, that is, the two different levels of worn out shoes and one shoe without wear. The runners made rating on traction evaluation of each shoes by running on an asphalt surface. Data processing for sensory evaluations was conducted based on Scheffe's method.

RESULTS AND DISCUSSION
Figure 3 shows the results of the static friction coefficient and the sensory evaluation on the traction characteristics regarding each worn out part. Significant difference can be seen between T2 and F2. The coefficient of static friction of T2 is bigger than F2 and sensory evaluation has a similar trend to the coefficient of static friction in case of T2 and F2. It is considered that runners' evaluations are affected by the wear of fore outsole where maximum ground reaction force is produced, and they can sense the decrease in the coefficient of friction.

Figure 4 shows the results of the static friction coefficient and the sensory evaluation on traction characteristics regarding the level of wear at the toe and the fore respectively. The worst evaluation is given for T1, which has the lowest friction coefficient among the three types of shoes. The sensory evaluation is similar to the trend of the friction coefficient. Runners seem to be sensitive on traction characteristics, that is, the friction coefficient.

On the other hand, regarding the wear of fore, runners' evaluation becomes worse as the level of wear increases. It is anticipated that runners' evaluations at the fore depend not on the friction coefficient but on the level of wear. Thus it is necessary to study correlations between runners' evaluation and the digitized level of outsole wear.

REFERENCES

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