

S. Ishihara, Y. Fujiwara, K. Ishihara. *Washer-dryer for every person: ergonomics and bio-mechanical interventions*. *Gerontechnology* 2008; 7(2):130. Recently, the 'Washer Dryer' type of washing machines with horizontal or slant drum has become popular in Japan. Traditionally, Japanese washing machines have had vertical drums and these types are still popular. Users of vertical drum washers have to bend their back and stretch their arm to put in and take out laundry. Meanwhile in Europe, horizontal drum type washing machines have always been popular. This type requires the crouching posture for putting in and taking out laundry because of its lower height. The washer-dryer type washing machines have rather different mechanisms than the vertical drum washing machines, and therefore require a completely new mechanical design. These new washer-dryers have a horizontal or slanted rotational axis of the drum. Thus, the shape of the washing machine was greatly changed to make loading operations easier by modifying the door's position. In this research, physical loads and usability between the washer-dryer, the traditional drum type and European type washing machines were compared. This comparison was performed using subjective evaluations, 3D motion capture and estimation of body part loads using a human kinetics computer model. **Methods** We measured and analyzed posture while using the washing machines with 3 dimensional motion capture measurement devices. Subjective Kansei and usability questionnaires were also used. After the measurement, measured working postures were analyzed with the human kinematic model (3D SSPP<sup>1</sup>) that can estimate theoretical value of the muscle tension and loads on the lumbar vertebrae, knees and ankles. Three types of washers (European type; box shape and horizontal drum, conventional Japanese type; a vertical drum, and a new type; slant drum with higher profile) were used for the experiment. 12 female participants, both younger and older adults took part in the evaluation. **Results and discussion** From the subjective evaluation, new slant drum has superior evaluations on many questionnaire items, with statistical significance. Theoretical muscular forces (%MVC; percent of maximum voluntary contraction which is a percentage of the maximum muscular force of 50 percentile female) on elbow, hip, knee and ankle were estimated. Sum of the %MVC of the new type was 116, European type was 133 (knee tension is high) and conventional Japanese type was 284. Ankle tension is 110, which exceeds the limit. The new type requires only 40% of the muscular force required for the conventional Japanese type. From the subjective evaluation, the new type was better than the European type washer and conventional type on subjective fatigue evaluation and general evaluation, with statistical significance with one-way ANOVA

## References

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**Address:** Hiroshima International University, Japan; E: i-shige@he.hirokoku-u.ac.jp



Figure 1 Motion captured posture of picking laundry from drum bottom. Left to right; Slant drum (New product), Vertical drum (conventional type which popular in Japan) and horizontal drum (European type)