

# ORAL PAPER PRESENTATION 3: PHYSICAL AND MENTAL HEALTH

## Development of a PC game to support expiratory muscle training

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**Purpose** Respiratory rehabilitation improves dyspnea, exercise tolerance, anxiety and depression, and improves health-related quality of life and health status (The Japan Society for Respiratory Care and Rehabilitation, Japanese Society for Respiratory Physical Therapy, The Japanese Respiratory Society, 2018). Expiratory muscle training (EMT) has been shown to increase maximum expiratory pressure, improve respiratory function, ventilatory function, and exercise capacity, and reduce dyspnea during inspiratory loading, daily activities, and exercise. A device using a valve to apply constant expiratory resistance or a party horn is often used for EMT. However, many dropouts occur even during one to two months of respiratory rehabilitation in the elderly. The authors therefore created a PC game as an alternative to party horn, aiming to maintain motivation. At the beginning of the game, the maximum pressure is measured, and then several game scenes are developed in a virtual storyline that imposes a load of 75% of the maximum pressure of exhalation; hereafter abbreviated as PEmax. Each scene provides animated visual feedback and a score to indicate achievement. **Method** This PC game is played by detecting exhalations blown into an aluminum pipe that imitates a fire starter with an exhalation sensor attached to the end of the pipe and a microcontroller Arduino, and transmitting the data to a PC. Wind Sensor Rev. C (Modern Device) was used as the exhalation sensor. A disposable filter which is used in pulmonary function testing machines (Mouth Filter PIF-2A, Minato Medical Science) was put in as an embouchure of the pipe, which can be removed to ensure hygiene. The game was developed in Unity 2018.4 (LTS) and the asset Ardity (W.Daniel) was used for serial bidirectional communication in Unity to send data from the exhalation sensor via Arduino. The training content performed in the game was based on the method used by Maki et al. (2017) and Fukuoka et al. (2011) to train swallowing function using an expiratory resistance valve, with the addition of real-time feedback using CG animation. The game begins with the measurement of PEmax, followed by a virtual storyline of the camp. Scene 1: Fire starting (practice to produce PEmax) A fire set appears, smoke is produced when exhalation is detected, and wood is ignited when exhalation pressure equivalent to PEmax is measured. Scene 2: Bath heating (75% or more of PEmax for 10 seconds) Water with a temperature of 20°C is in the tub, and if the expiratory pressure is 75% or more of PEmax, the water temperature rises, but if the expiratory pressure is less than that, the water temperature falls. Snapshots is shown in Figure 1. Scene 3: Bath water temperature (the longer the time the expiratory pressure was 55-90% of PEmax in 30 seconds, the higher the score). **Results and Discussion** As a preliminary survey, we asked 10 healthy men and women in their 20s to try out the PC games we developed and the traditional blow back, and asked them about the fun, difficulty, and whether they could continue every day in five stages. Eight people were positive about PC games as to whether they could continue, mainly because the scores were visualized in real time. On the other hand, one person was negative about the PC games because it was troublesome to start. Six people were positive about the blow back, because it is simple; three people were negative because it was monotonous and lacking a sense of accomplishment. These improvements are considered to be even more important for the elderly. From this trial result, if we makes it easy to start up in a PC game that visualizes expiratory pressure in real time by movement using 3-D computer graphics, and introduce multiple difficulty levels in the game which blow-back training does not have, it was suggested that it could be used for continuous training.

### References

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Figure 1. Snapshots of the EMT game. Scene 1(Left) and Scene 2 (Right).