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iPad Exercise Application for Home-based Workers with Individually Optimized Exercises

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***Abstract*— With the aim of improving work productivity of home-based workers, we developed exercise menus that can be performed and evaluated easily at home and are individually optimized. We investigated exercise frequency of the exercises via our original iPad application.**

***Clinical Relevance*— The study will contribute to developing exercise applications for home-based workers to improve work-productivity.**

I. INTRODUCTION

Considering the increase in working from home due to the Covid-19 pandemic, we focused on the decline in work productivity due to lack of exercise. When regularly exercising, mental and cognitive functions as well as motor functions will improve, increasing productivity.

To have workers exercise regularly, we emphasize the following two points. First, exercise can be easily done in a small space at home. This enables home-based workers to exercise frequently without much effort. Second, because office workers in a wide age range have various athletic levels, exercise must not be uniform, and the difficulty level should be optimized for each person.

We developed an iPad exercise app with exercise menus that can be carried out at home and be individually optimized for improving work productivity. We then investigated exercise frequency.

II. METHODS

We developed exercise menus that can be performed in a small space of 2 x 1 m and expected to improve physical /cognitive/mental functions on the basis of prior studies. Our iPad app "Remote Exercise for Workers" teaches, records, and evaluates the exercises as shown in Fig. 1.

The exercise menus have four levels from Step 0 to Step 3 (Table I). Each step consists of warm-up, core training, muscle training, and cool down. All users start from Step 0 and step up in accordance with their achievements. This is inspired by intelligent physical exercise training (IPET) [1], a theory of sports science that provides an optimal exercise menu for individuals by repeating the evaluation and training of the exercises alternately.

To improve work productivity, the exercise menus include the following five features in accordance with previous studies: (i) continuous stimulation and (ii) increased heart rate induced by motion at the appropriate speed repeated every four second for improving cognitive functions, (iii) motions combined with breathing and (iv) rhythmical repetitive motions for improving mental health, and (v) stretching targeting the shoulder and lower back muscles for improving physical condition.

During exercises, our iPad app recognizes the skeleton of the user by using the position estimation AI library, VisionPose (NEXT-SYSTEM Co., Ltd.) as shown in Fig. 1.

The experiment was conducted during an eight-week period involving 41 workers who worked mainly at home (15 women, 41.9 ± 7.3 years) at Central Research Laboratory, Hitachi Ltd. We instructed them to exercise three or more times per week. Their data were obtained in accordance with the standards of the internal review board of the Research & Development group, Hitachi, Ltd.

Exercise continuation rate was evaluated on the basis of the number of exercises per week (exercise frequency).

III. RESULTS

Figure 2 shows the time series of the exercise frequencies of all participants. Among the 41 participants, 5 (12%) quit before starting exercises due to physical, business, family reasons; 11 (27%) dropped out during the period; 25 (61%) continued the exercise until the end of the period — 19 (46%) exercised three days or more per week and 6 (15%) less than three days per week.

IV. DISCUSSION & CONCLUSION

We investigated the exercise frequency when home-based workers use our iPad app that includes four-level exercise menus inspired by IPET. We will improve the exercise menus and our app to increase the exercise frequency for work-productivity improvement.

REFERENCES

[1] Sjøgaard, Gisela, et al. "Exercise is more than medicine: The working age population's well-being and productivity." Journal of Sport and Health Science 5.2 (2016): 159-165.

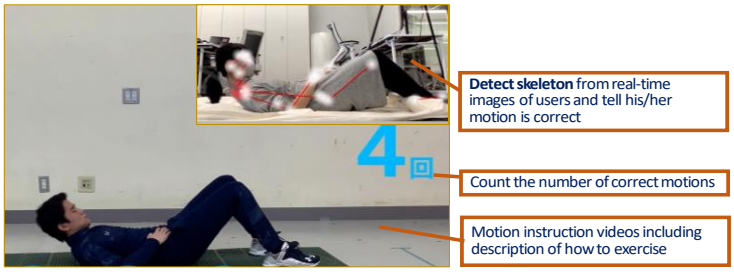

Figure 1. iPad monitor during exercise

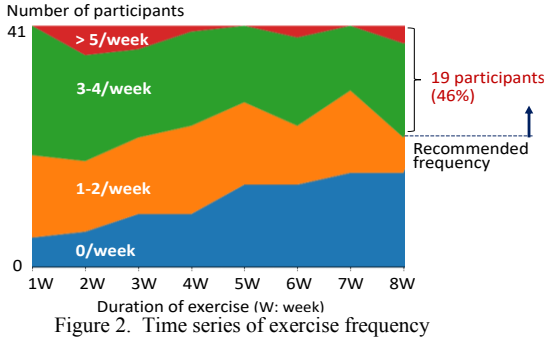

Figure 2. Time series of exercise frequency

TABLE I. EXERCISE MENUS (AME: ABDOMINAL MUSCLE EXERCISE, L/R: LEFT AND RIGHT, "X" MEANS TIMES OF MOVEMENTS)

Category	Warming up	Core training	Muscle training	Cool down
Target	Waist	Core	Muscle	Neck and shoulders
Step 0	—	Easy AME by just looking down at navel (20x) Stretching hands/legs diagonally (20x)	Squats (20x)	Easy protraction of scapula (10x)
Step 1	Bending forward from the waist (5x for L/R)	Twisting AME (20x) Stretching and bending hands/legs diagonally (20x)	Hip lifts (20x), Squats (20x) Side-to-side weight shifts (20x)	Protraction of scapula (10x) Cat & dog (10x)
Step 2	Bending forward from the waist (5x for L/R)	Twisting AME (20x) Stretching and bending hands/legs diagonally (20x)	Single-leg hip lifts (10x for L/R) Heel-lowering squats (20x) Side-to-side weight shifts by stepping outward to the side (20x)	Rotating scapula (10x) Cat & dog (10x)
Step 3	Bending forward from the waist (5x for L/R)	V-shaped AME (10x for L/R) Stretching and bending hands/legs diagonally (20x)	Single-knee-bending hip lifts Split squats (10x for L/R) Side-to-side weight shifts by crossing legs and stepping outward to the side (20x)	Rotating scapula (10x) Cat & Dog (10x)

Easy → Step up → Difficult

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