Audio and Visual Feedback Interventions on Respiratory Exercise Efficacy in Student with High Cervical Spinal Cord Injury

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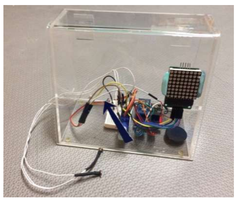
Introduction

High cervical spinal cord injury(SCI) patients are a group of people who are often overlooked in leisure activities or exercises. Most of them stay at home for the rest of their lives. The participant, due to his illness, could not participate in nearly any activities. The only exercise he could do was respiratory exercise, and it was boring, which led the researcher wonder from what help he could benefit to actually enjoy his exercise.

Objective

The objective of the study was to compare the efficacy of two different sensory interventions on respiratory exercise for one student with C1-C4 high cervical SCI. The researcher used an audio/visual feedbacks respiratory exercise device in the study, an Arduino-based device works as regular flow-oriented respiratory spirometer and also provides with audio and visual feedbacks. In addition, during the experiment, the device was programmed to give two sensory feedbacks alternatively in order to study the efficacy of each intervention solely. The researcher adopted single-subject alternating treatment design.



Research Process

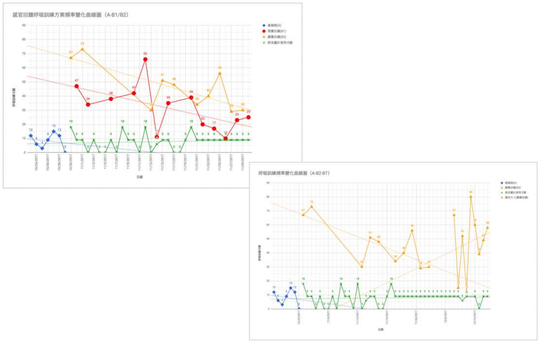
In the study, two sensory feedback interventions are the independent variables and daily respiratory training counts is the dependent variable.

The experiment underwent three phases, including baseline, alternating treatments and final treatment phase. First off, in baseline phase, the participant received respiratory exercise using regular flow-oriented incentive spirometer handheld by the caregiver. The number of respiratory training were counted and uploaded to an online database in the form of Google sheet by the caregiver. There were 9 data points collected during baseline. At the end of the phase, the researcher trained the participant to use the self-made incentive spirometer and explained benefits from respiratory exercise. Secondly, in the alternating treatments phase, the participant used the new flow-oriented incentive spirometer, redesigned by the researcher, to get respiratory exercise. Unlike regular incentive spirometer, the new device was attached to an overbed table, so the participant could go through respiratory exercise independently. The Wi-Fi module built-in device automatically recorded and uploaded data, including of date, time, duration time of breathing-in, to Google cloud database every time the participant took a deep breath and successfully triggered the microswitch.

After the records were uploaded to the cloud, Google sheet automatically updated daily frequency and calculated mean performance of each day. With a total of 32 data points collected in the second phase, it showed that audio feedback intervention was more effective than visual feedback intervention on daily training frequency. The participant also claimed that he preferred exercising with audio feedbacks. Therefore, the researcher chose audio feedback intervention in final treatment phase. Lastly, the participant carried on respiratory exercise with audio feedback intervention until data points showed upward trend after 9 data points, hence termination of the experiment.

Results

The researcher analyzed the quantitative data via graphical methods, visual analysis, and calculating effect size, along with surveys from participant and his caregiver for social validity assessment. The results of the study indicate that both sensory feedback interventions have positive effect on raising daily respiratory exercise counts in student with high cervical SCI, and the audio feedback intervention has better overall effect. The participant and caregiver both hold positive attitudes toward multi-sensory feedback respiratory exercise interventions. The participant claimed he liked the fact that the new device allowed self-reliance. He could exercise without bothering his caregiver. He also noted that although both sensory feedbacks were fun, the visual feedback were so quiet that it became dull after a while.



Conclusion

In conclusion, audio and visual feedback interventions are beneficial for user to maintain motivation in respiratory exercise. It is also crucial in provision of care and encouragement by caregivers. While multi-sensory feedbacks cause instant effect, care and encouragement from others help high cervical SCI patient focus on the exercise itself rather than constant thought about how long the tiresome work will take. The researcher utilized auto-upload during alternating treatments phase for Google sheets collect and calculate data. The author used the method so the caregiver wouldn't have to input data manually. The cloud-based tracking system gives high cervical SCI patient a chance of self-empowerment to self-evaluate the efficacy of exercise progress.