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THE IMPACT OF DIGITAL GAMING APPLICATIONS ON GRIP STRENGTH AND FUNCTIONAL REACH IN RECOVERING STROKE SUBJECTS: - AN EXPERIMENTAL STUDY

SHAH C[1], KUKREJA Y[2*] AND BHAVANA GADHAVI B[3]

1: PhD, Associate professor (Neurological and Psychosomatic disorders), Department of Physiotherapy, Parul Institute of Physiotherapy, Waghodiya, Vadodara, India

2: MPT Scholar, Neurological and Psychosomatic Disorders, Parul Institute of Physiotherapy, Waghodiya, Vadodara, India

3: Dean & Principal, Musculoskeletal and Sports, Parul Institute of Physiotherapy, Waghodiya, Vadodara, India

***Corresponding Author: Dr. Yukta Kukreja: E Mail: Yukta0609kukreja@gmail.com**

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ABSTRACT

Background: Stroke is one of the most common causes of neurological impairment in adults; approximately 50% of patients are left with disabilities, making them dependent on others. In particular, upper limb dysfunction makes stroke survivors dependent on others for assistance with activities of daily living (ADL). Regaining the lost function in the upper extremities may be more difficult to achieve than returning the normal function of ambulation to the lower extremities. Game based therapy would be good option for stroke rehabilitation. Conventional therapy for upper limb function recovery is boring and monotonous. Hence, Aim of the study is impact of Digital Gaming Applications on Grip Strength and Functional reach in recovering Stroke subjects.

Method: total 19 subjects were recruited, as per inclusion criteria. Subjects were pretested with functional reach test and hand held dynamometer. Intervention was given in the form of mobile gaming application (fruit ninja gaming application & Flower splash gaming application) for Protocol was of 30 minutes per session, 10 sessions of therapy 5 days/week for 2 weeks.

Result and Conclusion: There is significant increase in grip strength of upper limb in recovering stroke subjects.

Keywords: Functional reach test, repetitive task training, hand held dynamometer, virtual reality

INTRODUCTION

One of the main causes of impairments is stroke. The condition causes thousands of working-age adults to become partially or completely disabled every year, which has a negative socioeconomic impact on the health systems as well as emotional suffering for the patients and their families. Individuals who have suffered a stroke may exhibit multiple disabilities, with motor impairments being the most prevalent and impacting the ability to perform activities of daily living **[1]**.

After a stroke, most people do not fully recover from their impairment, and about half of them end up disabled and dependent on others. Specifically, stroke patients who experience upper limb disability become dependent on others to help them with activities of daily living (ADL). It might be more challenging to restore the lost function in the upper extremities than it is to restore the lower extremities' typical ability to walk **[2]**.

The rehabilitation of the upper extremities in stroke survivors is hampered by this condition. As a result, the recovery of upper limb function is the subject of extensive research. Numerous studies have emphasised the value of intensive training tailored to a particular task and repeated practice. Rehab after a stroke must be focused, rigorous, and repetitive. In order to get the best possible recovery after a stroke, stroke rehabilitation is essential. Rehabilitation enhances the physical, mental, and emotional well-being of stroke patients, enabling them to restore their independence **[3]**.

Muscular weakness has been found to be significantly correlated with both activity constraints and social involvement restrictions among the detected motor impairments.

Particularly, significant functional constraints result from weakness of the upper limb muscles (UL), which are involved in numerous fundamental, instrumental, occupational, and recreational activities. A functional impairment affects about 70% of people who have paresis of the UL muscles. Moreover, stroke victims show difficulty carrying out their regular activities once the hemiparesis sets in. Hence, the UL muscle strength has emerged as an important outcome that needs to be assessed and taken into account during the clinical decision-making process for rehabilitation **[4]**.

Even those with extremely weak muscles can perform some kind of training by setting up repetitive practice assignments with minimum equipment. Walking, reaching, and object manipulation are examples of repetitive tasks that are essential to stroke therapy. Robotic devices, body-weight supported treadmill walking, and constraint-induced movement therapy are a few

methods that encourage repetitive practice **[5]**.

The concepts of repetitive practice and progressive resistance training differ greatly because these interventions are usually carried out with a focus on high repetitions and no additional resistance to movement. Several systematic reviews have confirmed the effectiveness of repetitive practice in lowering activity restrictions. However, less is known regarding the effects of repetitive practice on strength following stroke, and no systematic reviews have particularly explored this problem.

Strengthening therapies after a stroke have been studied in eight systematic reviews including meta-analyses. These reviews covered research that did not particularly concentrate on repetitive practice, but rather employed gradual resistance training or an artificial drive of muscular contraction (i.e., electrical stimulation without attempting to move a limb) as an intervention. Given that rehabilitation following a stroke frequently involves and recommends repetitive practice, it's critical to determine whether such interventions are successful in enhancing strength **[6]**.

For those who are recovering from a stroke, muscle strength is essential to perform everyday tasks. One method that is frequently used in clinical settings to evaluate muscular strength is manual muscle testing, or MMT. The method is inexpensive to use and sticks to a set procedure. However, a significant drawback of this method of measurement is that, instead of being graded on a continuous scale, muscle strength is measured on an ordinal scale, which makes it challenging to identify minute variations in muscle strength. When employing MMT, medical interns and less experienced doctors in particular could have trouble recognising minor increases in muscular strength **[6]**.

HAND HELD DYNAMOMETER

Another method used for determining muscular strength is handheld dynamometry. When compared with MMT, one significant benefit of handheld dynamometry is its ability to measure even minute variations in muscle strength. Furthermore, a prior study discovered that weaker patients demonstrated superior test-retest reliability when compared to stronger individuals, suggesting that handheld dynamometry may be a more appropriate option for patients who are bedridden. This has therapeutic significance because, even though post-stroke muscle strength gains might not show up on the MMT ordinal scale, these modest gains could be enough to change the training regimens or objectives established for stroke victims **[7]**.

FUNCTIONAL REACH TEST:

The Functional Reach Test (FRT) was designed in 1990 by to test the limits of stability of persons while reaching forward

in a standing position. The FRT was developed by researchers who wanted to replace laboratory measurements of stability limits with a quick, simple, low-cost clinical test that could be used in a variety of situations and required few resources. Age, body composition variables (height, weight, arm and leg length), physical factors (lower flexibility and strength), and psychological factors (demotivation, depression, and fear of falling) can all lead to variations in performance and normative values for the FRT **[8]**.

A beneficial approach for stroke recovery would be game-based therapy. For the recovery of upper limb function, conventional therapy is tedious and repetitive **[9]**.

NEED OF THE STUDY

Researchers have shown the relationship between repetitive task training and muscle strength in lower limb as compared to upper limb. Game-based therapy can promote patients engagement in rehabilitation therapy as a more interesting and a motivating tool but is not much used clinically and also not much prescribed for home based therapy.

Mobile gaming applications would provide interesting and engaging therapy sessions for the subjects suffering from stroke.

Therefore, Aim of the study is to see the impact of digital gaming applications on grip strength and functional reach in recovering stroke subjects.

AIM AND OBJECTIVES

- **AIM**: The aim of this study is to see the impact of digital gaming applications on grip strength and functional reach.
- **OBJECTIVES:**

  1) To find out the effect of digital gaming applications in improving the upper extremities grip strength.

  2) To find out the effect of mobile gaming applications in improving the functional reach

MATERIAL AND METHODOLOGY

- SOURCE OF DATA: Parul Sevashram Hospital
- STUDY DESIGN: An Experimental study
- SAMPLING METHOD: Random sampling
- SAMPLE SIZE: 19

INCLUSION CRITERIA:

1. Patients diagnosed with stroke (1 to 6 Months)
2. Subjects able to understand verbal and written commands.
3. Subjects able to stand independently.
4. Subjects able to voluntarily lift both hands to nose.
5. Subjects able to partially move their fingers.

6. Subjects/ family member should have 1 smart phone.

EXCLUSION CRITERIA:

1. Subjects that are Medically unstable to participate in active rehabilitation (Blood pressure,
2. No impairments or diseases other than stroke that influence the upper limb movements (any deformity of fingers, trauma and fracture)
3. Patients unable to follow commands because of severe cognitive impairment.
4. Patients having visual disturbance.

MATERIALS:

- STOOL
- PILLOW
- MOBILE PHONE
- HAND HELD DYNAMOMETER
- MEASURE TAPE

OUTCOME MEASURES

1) Forward reach test (FRT) **(Figure1)**

Figure 1

2) Hand held Dynamometer **(Figure 2)**

Figure 2

ETHICAL CLEARANCE:

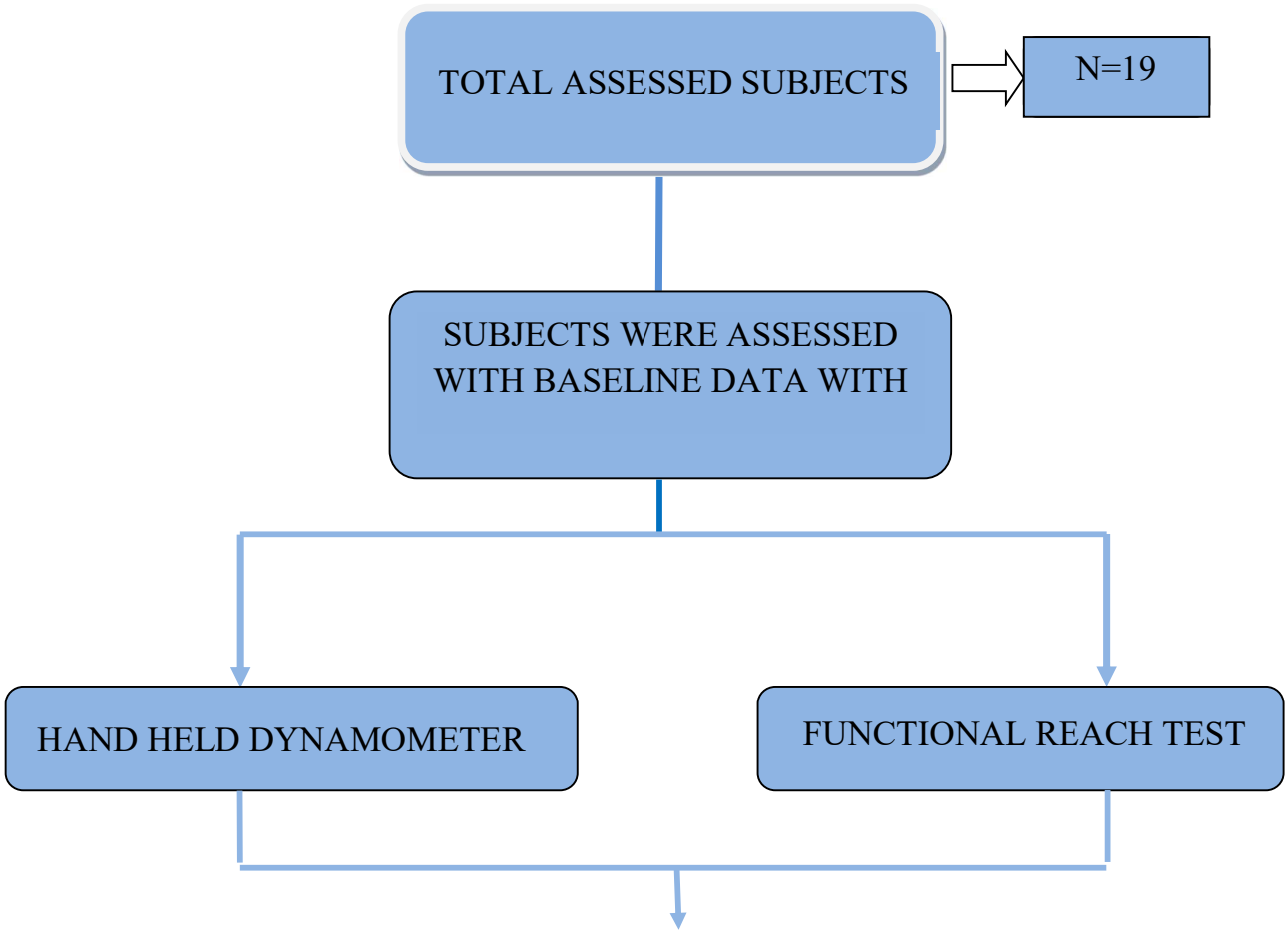
Ethical clearance is obtained from the ethical committee of institution and institution where the subjects belong. Also, written consent will be taken from each subject who participates in study. Ethical

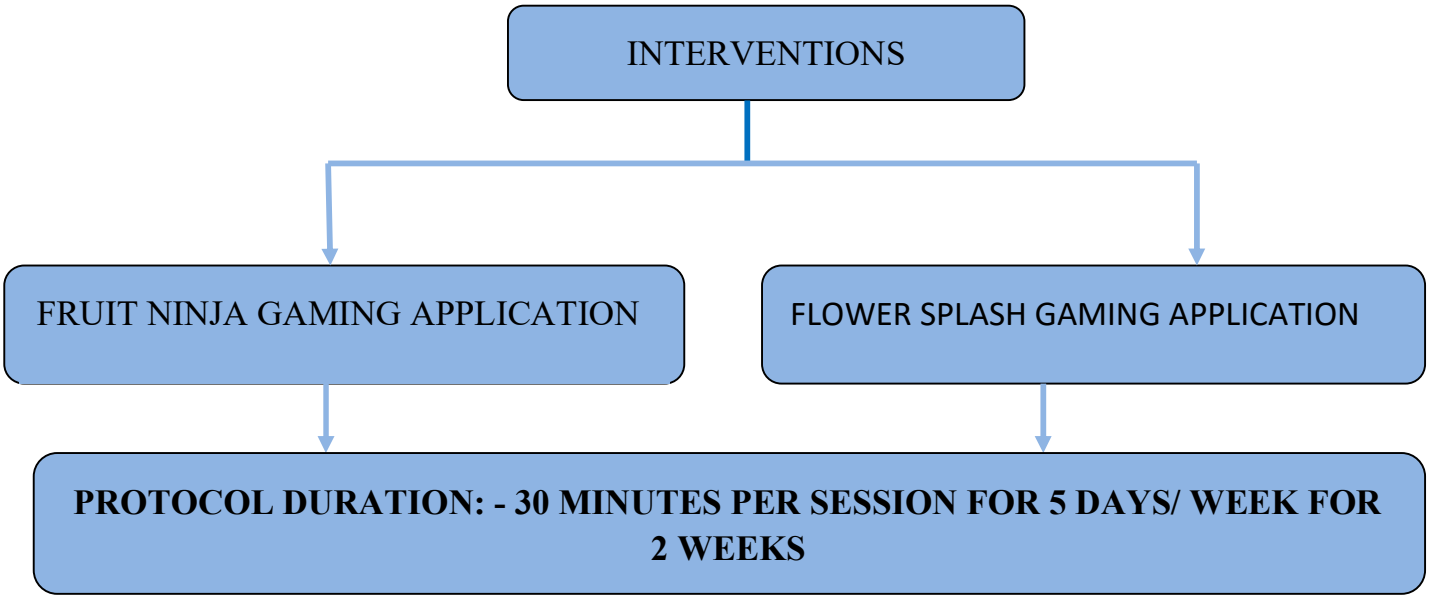
clearance was acquired from ethical committee of Parul University Institutional Ethical Committee for human research (PU IESHR).

PROCEDURE:

Subjects were taken from Parul Sevashram Hospital. The age of the contestants ranged between 41-65 years. Participants who fulfilled the inclusion-exclusion criteria were selected and assessed before starting the intervention. A written consent about enrolment in the study and maintaining adequate privacy and confidentially was taken from all members involved in the study. After the participant agreed to join, He/she was required to sign the informed consent form before participating in the study. Before starting the intervention, pre-data were taken.

FLOWCHART





RESULT AND CONCLUSION:

STATISTICAL ANALYSIS:

SPSS software version 25 was used for the statistical analysis. The normal distribution of variables was analysed and was not following normal distribution, hence the data analysis was done using Wilcoxon signed rank test.

EXPERIMENTAL GROUP

1) FUNCTIONAL REACH TEST

	SAMPLE SIZE	MINIMUM	MAXIMUM	MEAN	STD. DEVIATION
FRT (PRE) (inch)	19	6.20	7.30	6.7944	0.35058
FRT (POST) (inch)	19	6.80	8.20	7.4778	0.43866

2) HAND HELD DYNAMOMETER:-

	SAMPLE SIZE	MINIMUM	MAXIMUM	MEAN	STD. DEVIATION
HAND HELD DYANAMOMETER (PRE) (kgs)	19	6.40	8.50	7.2158	0.61216
HAND HELD DYANAMOMETER (POST) (kgs)	19	7.90	10	8.6053	0.60688

CONCLUSION OF EXPERIMENTAL GROUP:

FUNCTIONAL REACH TEST: - In the experimental group, the minimum value for pre-measure was **6.20** and the maximum value was **7.30**. which increased to the minimum value of **6.80** and a maximum value of **8.20**. Also, the mean was **6.7944** at

the time of the pre-measure with SD **0.35058**, which was increased in the post-measure to **7.4778** with SD **0.43866.**

HAND HELD DYANAMOMETER: - In the experimental group, the minimum value for pre-measure was **6.40**, and the maximum value was **8.50**. This increased a minimum value of 7.90 and a maximum value of 10. Also, the mean was **7.2158** at the time of the pre-measure with SD **0.61216**, which was increased in the post-measure to 8.6053 with SD 0.60688

DISCUSSION

The study Conducted at Parul Sevashram Hospital, the aim of the study was to evaluate the effect of digital gaming applications on grip strength and functional reach test in recovering stroke survivors. The two weeks intervention program was designed to measure various outcome parameters. The analysis of results revealed a significant improvement in both the groups, highlighting enhanced grip strength and functional reach. Consequently, the study concludes that the implemented intervention effectively contributed to positive changes in these key aspects.

The study was conducted over a span of two weeks. This study involved 19 subjects engaging in a mobile gaming application for 2 weeks, 5 days /week, every day 30 minutes session was given. The research design incorporated pre-test and post-test measurements to capture the changes over the intervention period.

The positioning for the assessment of handgrip strength, in most studies, followed the recommendation of the American Society of Hand Therapists, with the participant seated, shoulder adducted, elbow flexed to 90°, forearm in neutral position, wrist between 0° and 30° of extension, and 0°and 15° of ulnar deviation, The contraction time for the handgrip strength, it was about 5-6 seconds. The most common intervention studied in most of the articles was task-specific training and the result was in favour of task-specific training on strength.

Davide G de Sousa *et al* in his study Interventions involving repetitive practice improve strength after stroke: a systematic review, provides evidence that interventions involving repetitive practice improve strength after stroke and also provides evidence that interventions involving repetitive practice do improve strength after stroke, and these improvements are accompanied by improvements in activity. This suggests that repetitive practice should be prioritised as an intervention that can improve both strength and activity in people after stroke **[10]**.

As the repetitive task training could be boring and monotonous for the patient, game based therapy can provide better result and has found more interesting, enjoying,

more playful and interacting for the patient and patient can engage more in his/her therapy sessions.

Therefore, concluded that null hypothesis is rejected and alternate hypothesis is accepted as we see the significant improvement in grip strength following recovering stroke survivors.

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LIMITATIONS

This study's sample size is modest; further study is needed.

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