

**THE EFFECT OF GAME BASED ACTIVITIES ON UPPER
EXTREMITY FUNCTIONAL RECOVERY IN STROKE
SURVIVORS: A RANDOMIZED CONTROLLED TRIAL**

by

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ABSTRACT

Background: The World health organization definition of a stroke is a rapidly developing clinical sign of focal disturbances of cerebral function lasting more than 24 hours with no apparent cause other than that vascular origin. Stroke is one of the major leading cause of death and disability in India. Stroke is a common global health-care problem that is serious and disabling. The most common and widely recognized impairment caused by stroke is motor impairment, which can be considered as a loss or limitation of function in muscle control or movement or a limitation in mobility. So this type of impairment affects a person's ability to perform and complete the daily activities. Upper extremity motor function improvement after stroke is difficult and confusing.

Objective: Primary objective is to evaluate the effect of game-based rehabilitation on upper extremity functions in stroke survivors and the secondary objective is to explore the patient experiences of using game-based rehabilitation as a medium in rehabilitation.

Methodology: Ethical clearance from IEC was taken and the sample was collected from the Department of Neurology (OPD &IPD) and Physiotherapy OPD, PMR of JSS Hospital. Randomization was done with SNOSE allocation method, allocated 24 patients equally into two groups 12 experimental and 12 control. It was a single-blinded study. Outcomes measures ARAT was used for assessment of hand function. The total intervention time period was 4 days per week for 5 weeks. The assessment was taken at 3 times baseline post at 2 ends of the 2nd week and after 5weeks.

Result: There was no significant improvement in any component of ARAT (all four components of ARAT scale), within subjects, within the group, in between group and both groups significance of P value being more than 0.05.in all components.

Conclusion: In conclusion the joystick video games are interesting but when it comes to the patient point of view it requires minimal muscle power is required to control the game. So further studies are required with large sample size, more duration and most sensitive outcome measure to find out the minimal changes in hand functional activities.

Keywords: Stroke, CVA, upper extremity hand functions, game therapy, video game therapy.

List of abbreviations

ARAT	Action Research Arm Test
CVA	Cerebro Vascular Accident
FM-UE	Functional Measurement of Upper Extremity
ICF	International Classification of Functioning
MCID	Minimal Clinically Important Difference
PNF	Proprioceptive Neuromuscular Technique
RGS	Rehabilitation Gaming System
SNOSE	Sequentially Numbered Opaque Sealed Envelopes
VR	Virtual Therapy
WMFT	Wolf Motor Function Test
ADL	Activities of Daily Living
CT	Control Therapy
SIS	Stroke Impact Scale
CPT	Cognitive Processing Therapy
OT	Occupational Therapy
MCID	Minimally Clinically Importance

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1. INTRODUCTION

1.1 Background

The term 'stroke' is synonymous with Cerebro Vascular Accident (CVA). The World health organization definition of a stroke is a rapidly developing clinical sign of focal disturbances of cerebral function lasting more than 24 hours with no apparent cause other than that vascular origin. Stroke is one of the major cause of death and disability in India. The estimated prevalence rate of a stroke range from 84-262/100,000 in rural areas and 334-424/100,000 in urban areas. The incidence rate is 119-145/100,000 based on the recent population-based studies.¹

Stroke is the one of the most common health maintenance problem around the worldwide that is a very serious and disabling condition. Most of the patients with stroke survive was the beginning damage. It largely effects on patients which is usually through long-term disability, restriction of activities and reduced participation. The most frequent and widely identified impairment caused by a stroke was motor impairment, which is also considered as a loss or restriction of function in muscles that leads to decrease in muscle function and limitation in mobility. This motor function loss can be originated by an ischemic or hemorrhagic lesion to the areas in the motor cortex, premotor cortex, motor tracts, or related pathways in the cerebrum or cerebellum. This type of impairments influences an individual's ability to complete daily activities (disability).²

After a stroke, the motor impairment will definitely affect the control of the following functions such as movements of the face, arm, and leg of one side of the body and it usually affects around 80 percent of patients. In post-stroke patient's motor

recovery is complex and unclear. There were many types of treatments have been evolved to try for improvement in motor functions i.e. recovery from impairment and associated functions. There are many randomized controlled trials and systematic reviews have been done on this area.²

The main target in post-stroke patients was upper extremity function. This is one of the main objectives of stroke survivors, it is the most important to performing activities of daily living. Approximately around 80 percent of stroke survivors have upper extremity limitations, and these limitations continue nearly half of these survivors in the chronic stages.³ Rehabilitation should start early for upper limb when a person is in an acute stage. There was a wide range of interventions that can be delivered in an attempt to improve the function of the upper limb after stroke. Such interventions aimed at impairments or functional abilities.⁴

In recent years, video games were popular in video game-based therapy. Which is commonly used in both research and clinical settings? Video games were initially designed for recreation, but recently some collective video games have been specially designed for rehabilitation. It helps to provide the participant with multisensory feedback which requires a various level of action from the participant. Although there is a lack of information and facts regarding the efficacy of video game-based therapy and virtual reality training in rehabilitation, the high quality and the low cost of the commercial consoles are the main reasons for the increased attention reserved to their use of video games in clinical and research settings.⁵

Gaming is a fun and meaningful activity which patients enjoy. It motivates patients to participate in their rehabilitation and it offers a variety of particular use for stroke patients to be able to give a fun alternative to more than traditional treatment methods. Gaming can be played with others encouraging social interaction and competition. Gaming can encourage upper limb movement and coordination as well as develop other skills and function. It can be a good way of encouraging movement using a fun activity. Self-practice and families often have access to gaming and patients could continue rehabilitation at home easy to set up and use. There is a need to incorporate video game therapy to stroke patients which is cost-effective, more enjoyable to patients and to improve upper extremity function.⁶

1.2. Need for the study

Upper limb recovery after stroke has poor in the outcome and many stroke survivors have lasting upper limb dysfunction. It is necessary to come up with effective strategies that can target this area. Rehabilitation strategies must be evidence-based and hence there is a need to add existing evidence to video game therapy through the use of low-cost gaming devices. In game therapy almost all studies are conducted on VR gaming and commercial gaming devices which are not cost-effective, so compared to VR gaming equipment's and high ended gaming systems the Logitech extreme 3D pro joystick is very less cost. So there is a need to study the effect of video games in upper limb rehabilitation in stroke survivors.

1.3. Significance

The gaming device (Logitech extreme 3d pro joystick) is cost effective when compared to VR gaming, Sony play station, and other high-end devices. It is also available in the market and it's easily portable. As it has recreational value and it can be a pleasant experience to the patient and increases the interest and attention towards the rehabilitation.

1.4. Assumption

The assumptions of the study are Logitech extreme 3d pro gaming joystick video gaming will be acceptable to patients as rehabilitation intervention.

1.5. Objectives of the study

- 1) Primary objective - To evaluate the effect of game-based rehabilitation on upper extremity functions in stroke survivors.
- 2) Secondary objective - To explore the patient experiences of using game-based rehabilitation as a medium in rehabilitation.

2. REVIEW OF LITERATURE

2.1. The methodology of literature review

A literature search was conducted from electronic database viz Cochran database, PubMed, and Google Scholar. The databases were searched for articles with no time limits. Mesh terms and keywords included were selected for the individual section with and without Booleans Operator – AND, IN, NOT etc.

2.2. Search Strategy:

Google, PubMed, Cochran database. The search was narrowed by specifying the English language. Inclusion criteria for this review were all types of study related to video game therapy on upper extremity functions in stroke survivors and video game therapy rehabilitation like VR gaming therapy, Sony play station, and Kinect gaming, joystick video games were included and quality of articles more than 60% of Critical Appraisal Skill Programme (CASP).

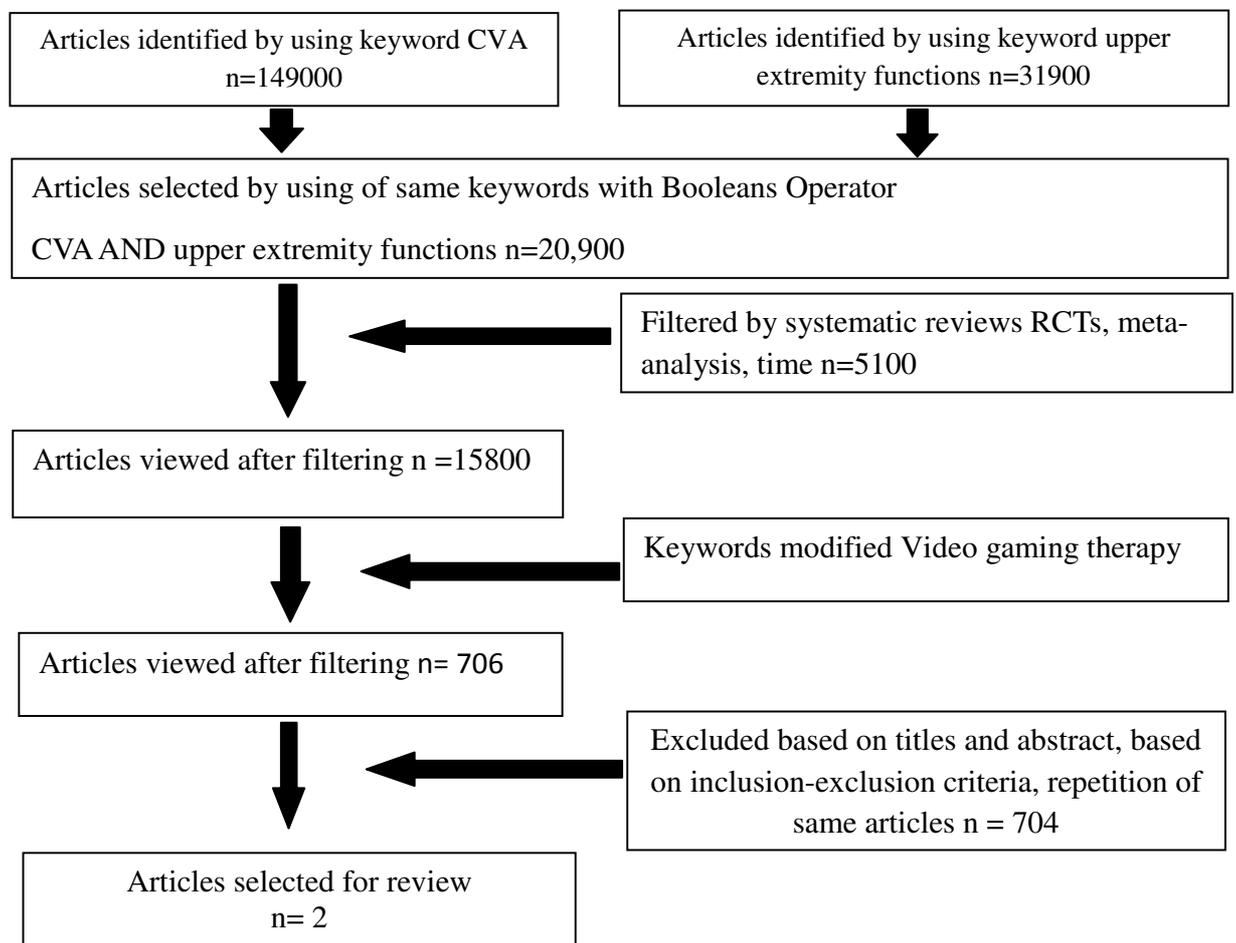
Exclusion criteria for this review are languages other than English, duplicate articles and articles not relevant to this study (a study of management of stroke, drugs and surgical management etc.) and quality of the article less than 60% CASP. A quality search of keywords was selected for each section. The results of the review section are described in the following pages under relevant sections.

2.3. Section 1: Upper extremity functional rehabilitation programs and video game therapy in stroke survivors.

Objective: To review the various types of rehabilitation programs on upper extremity functions and different types of video game therapy in stroke survivors.

Keywords- CVA, upper extremity, video game therapy.

Google Scholar



Pub Med

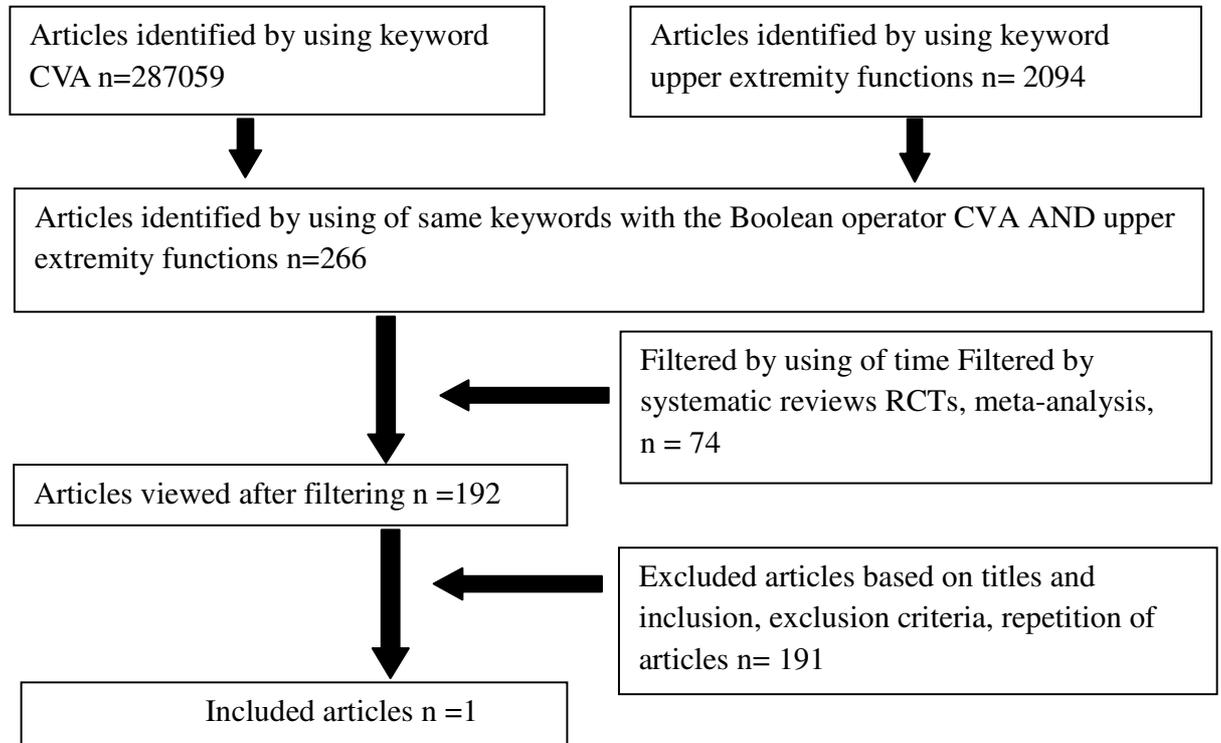


Figure 1. Google Scholar and PubMed Search strategy adopted to select articles pertaining to video-based game therapy in stroke survivors

A study reported about nature of video game as interventional therapy for people with stroke. The affected upper extremity motor impairments were related to movement acceleration to control if participants were using their potential during the session. The study concluded that video games produced more upper extremity purposeful repetitions and higher acceleration of movements matched with traditional therapy in individuals with chronic stroke patients.³

The commercial video game VR movement therapy was as effective as conventional OT for the recovery of upper extremity gross motor function and ADL in

subacute stroke patients with moderate to severe motor impairment. Commercial video game-based VR movement therapy would be an effective alternative to high-intensity, task-oriented, repetitive training after a stroke. These results indicated that VR movement therapy had significant effects on ADL and arm function, but not on hand grip strength.⁷

Another study observed patients using a home-based virtual reality system to provide rehabilitation of the upper limb following stroke. In this study, they used the virtual glove and the intervention was developed based on motor learning theory and aimed to increase the number of repetitions of functional movements while providing games that are challenging.⁸

Technical issues that arose included the glove being a prototype glove could be disrupted by bright sunlight or excessive infrared emission from other equipment in the participant's home. Another limitation was technical confidence and experience if low, limited use of the equipment. Dependence on someone to help with equipment could be a barrier to use however participants found this intervention flexible and motivating, indicating its potential for improving the opportunity for rehabilitation of the upper limb following stroke.⁸

Level of evidence – 1b/2b/4

2.4. Section 2: Commercial gaming protocols used on upper extremity functions in stroke survivors

Objective: To review different types of games and protocols used in commercial gaming devices and upper limb rehabilitation in stroke survivors.

Keywords: CVA, commercial gaming, upper extremity

Cochrane database

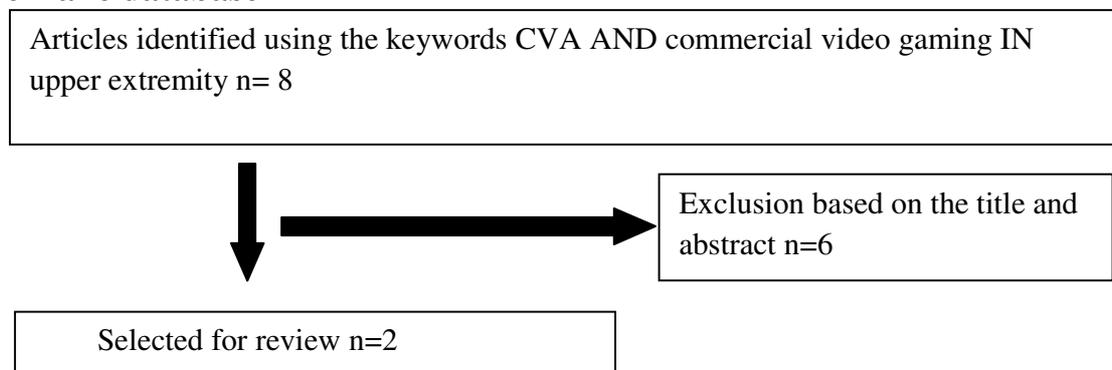


Figure 2. Cochrane Search strategy adopted to select articles pertaining to video-based game therapy in upper limb rehabilitation.

In this study, they concluded commercial gaming can provide high-intensity upper limb practice however there is insufficient evidence to reach generalized conclusions about benefits on ADL, upper limb function or movement. However, evidence suggests some benefits to upper limb rehabilitation. It also suggests that use of commercial gaming can be feasible, enjoyable and safely tolerated for 180 minutes per week. Further research into both effects and experience of commercial gaming for stroke upper limb rehabilitation is required.⁶

There was insufficient evidence to reach conclusions about the effect of virtual reality and interactive video gaming on grip strength, gait speed or global motor function. It is unclear at present which characteristics of virtual reality are most important and it is unknown whether effects are sustained in the longer term.³⁰

Level of evidence - 1a

2.5. Section 3: Virtual reality game therapy in upper extremity functional recovery in stroke patients

Objective: To review the effect of VR games on upper extremity functions in post-stroke patients.

Keywords- VR gaming, stroke, upper extremity

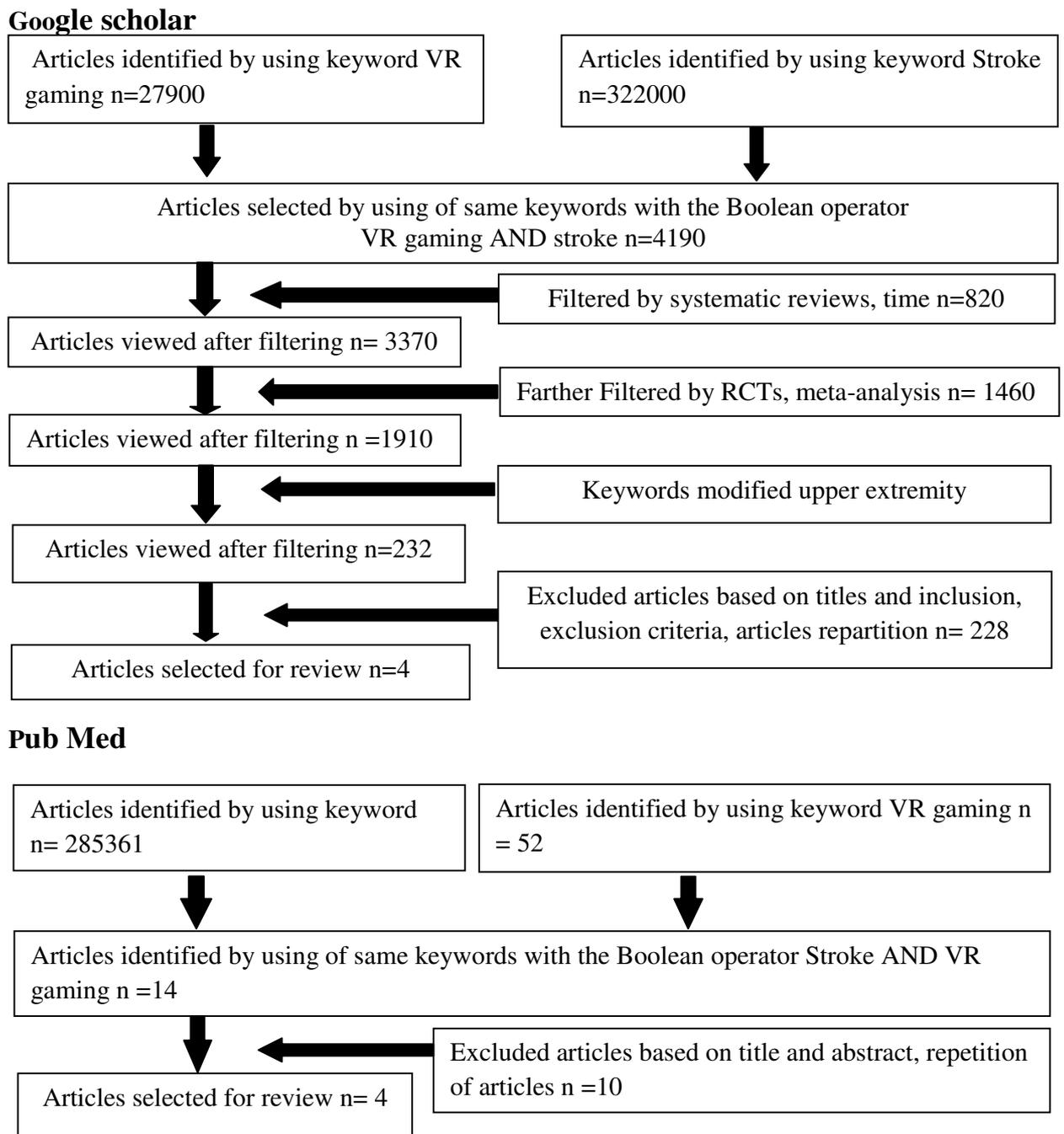


Figure 3.Googles scholar and Pub Med Search strategy adopted to select articles pertaining to virtual reality game therapy in upper limb rehabilitation in stroke survivors

The VR systems may play a role in intervention gap, creating therapeutic alternatives that are low cost and it leads to decrease the hospital expenses over a lifetime.¹⁸ The VR-based therapy exhibits the great potentiality in rehabilitation for upper limb recovery in post-stroke patients and it can be effectively used in an acute inpatient care setting.²⁰

Its giveaway to the rehabilitation process, it includes improved patient motivation and engagement is necessary. The immediate quantitative feedback which will help to the sensitive trace of patients' recovery. Further research needed to find out the efficient type, timing, setting of VR based therapy.²⁰

Level of evidence -1b/4

Some studies recommended that the conclusion of well-designed RCTs will finally advance information about the best rehabilitation strategy for post-stroke patients.⁵ In rehabilitation virtual environment and commercial game, therapy was using, but there was no evidence showing that time post-stroke decreased the benefits of virtual reality therapy. But these results are limited by a high degree of unevenness between studies.⁹

In this study author assessed that virtual reality -centered rehabilitation shared with standard occupational therapy influence maybe more effective than amount-matched conventional rehabilitation for improving distal upper extremity function. Therefore, the Smart Glove system used in virtual reality -based rehabilitation power may be a perfect rehabilitation tool for the upper extremity in post-stroke survivors.⁹

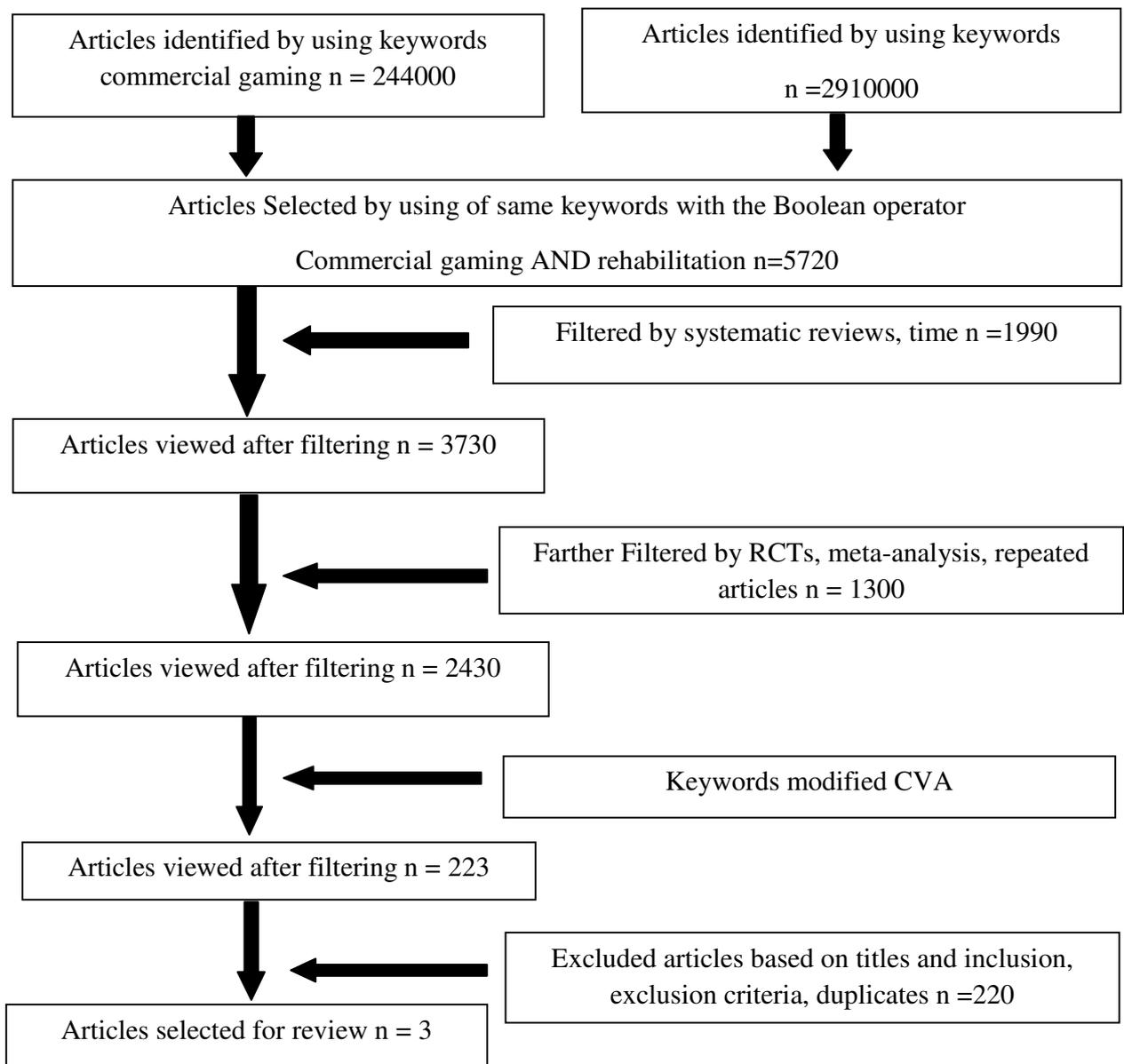
Level of evidence 1a/1b

2.6. Section 4: Upper limb rehabilitation in stroke survivors through commercial gaming.

Objective: To review how commercial games will play role in upper limb rehabilitation strategy of post-stroke survivors

Keywords- commercial gaming, rehabilitation, CVA

Google Scholar



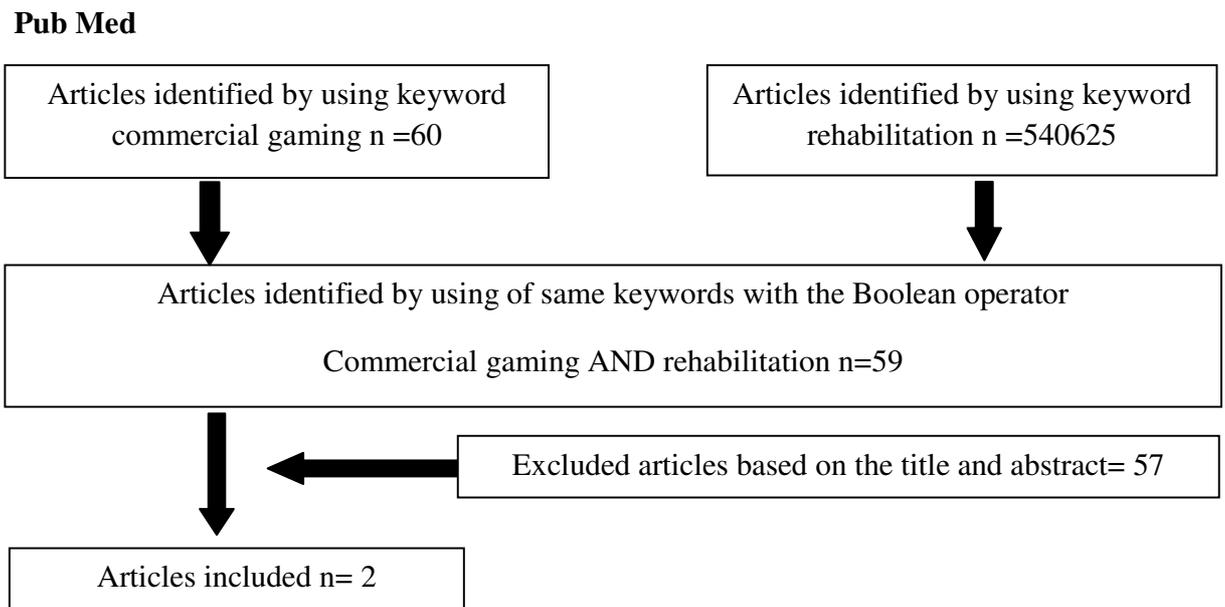


Figure 4. Google scholar and Pub Med Search strategy adopted to select articles pertaining to commercial gaming in upper limb rehabilitation in stroke survivors

A study conducted on video games and it concluded that using video games in rehabilitation will produce additional upper extremity purposeful movements with more repetitions and greater acceleration, compared with traditional therapy in chronic stroke patients. There are more revisions of studies are compulsory to assess the usefulness of this type of intervention on motor recovery in post-stroke patients.³

One more study compared with conventional therapy procedures, it is largely available and reasonably low-cost and it doesn't need any special resources like assistance, or transportation to a specified facility. Generally, it takes the potential to improve access to post-stroke patient rehabilitation in limited areas by physical or financial limits. However, there is a need for a large trial like well-designed randomized

studies to find out the role and use of commercial video games in upper limb rehabilitation in post-stroke patients.²⁴

Another study defined the expansion of a task-specific collaborating game with virtual reality rehabilitation system, usually, it's called as called rehab master and presented the results of a usability test and clinical trials. The rehab master showed to be a feasible, safe in rehabilitation. This device will increase the motor function among patients in several stages of recovery in stroke.¹²

A study did on video games and the Authors have resolved that little drive and commitment with physical therapy are very real and noticeable concerns, but promising evidence has shown that games can be a powerful therapeutic device when logically combined into rehabilitation and it can help contest with these problems. In addition to improving acceptance, the games can also fulfill the values of motor learning and induce/modulate neuroplasticity alterations in the brain. Both commercial and custom-made game systems have been re-purposed for use in upper limb stroke rehabilitation.¹³

The evaluation of technology that implication of setup of games in a home like home-based therapy for better rehabilitation in post-stroke stances tasks not seen in other evaluations. There is a need to be measured in the design of future studies in this aspect. In final conclusion, this possibility study found that enrolment rates were so low that an impossibly long enrolment period would be essential to achieve the sample size showed by the outcome measures. In spite of great variation in outcome measures, a suggestively greater change from baseline to the post-intervention group was found on the outcome measure of Wolf Grip strength. To reach the required sample size indicated a complete

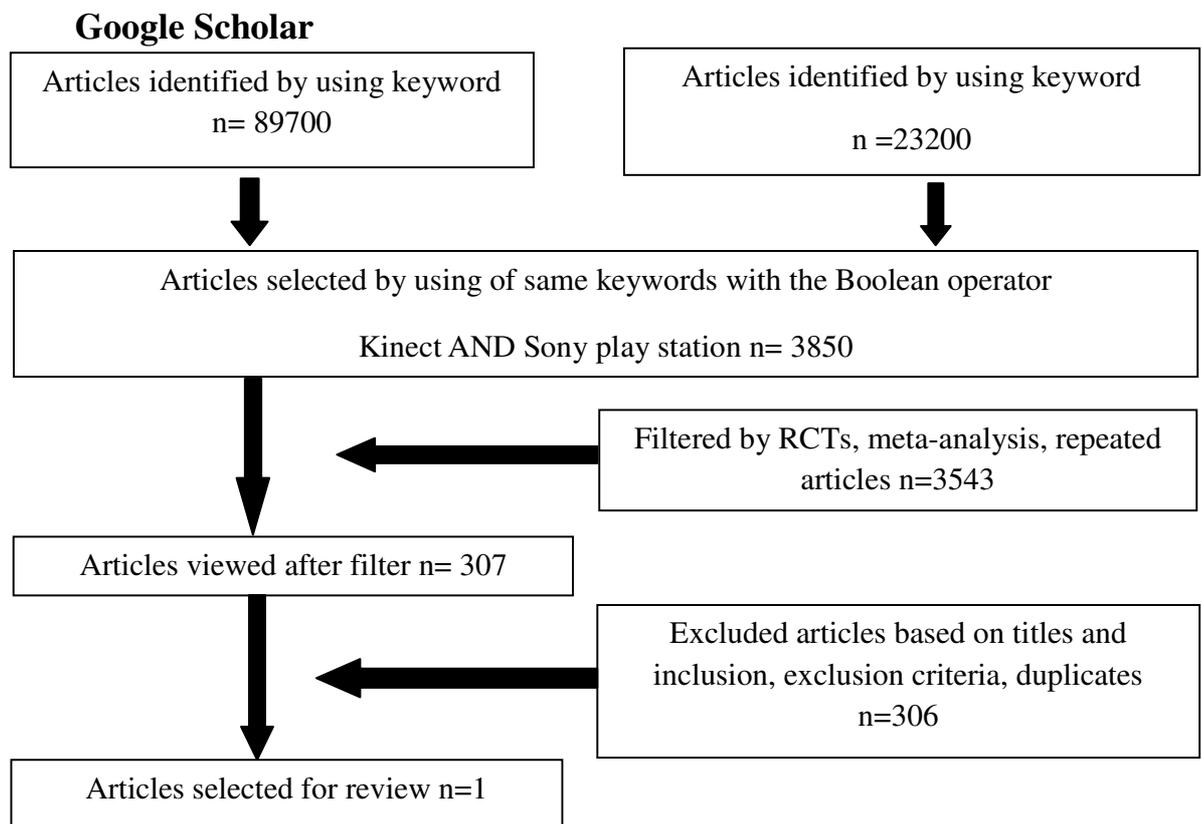
home-based trial would involve additional plans to increase recruitment rates and would have to take into the suitable resources for patient support.¹⁴

Level of evidence – 1a/1b/4

2.7. Section 5: Types of game devices.

Objective: To review types of gaming experience in stroke patients and effects on upper limb functions.

Keywords- Kinect, Sony play station



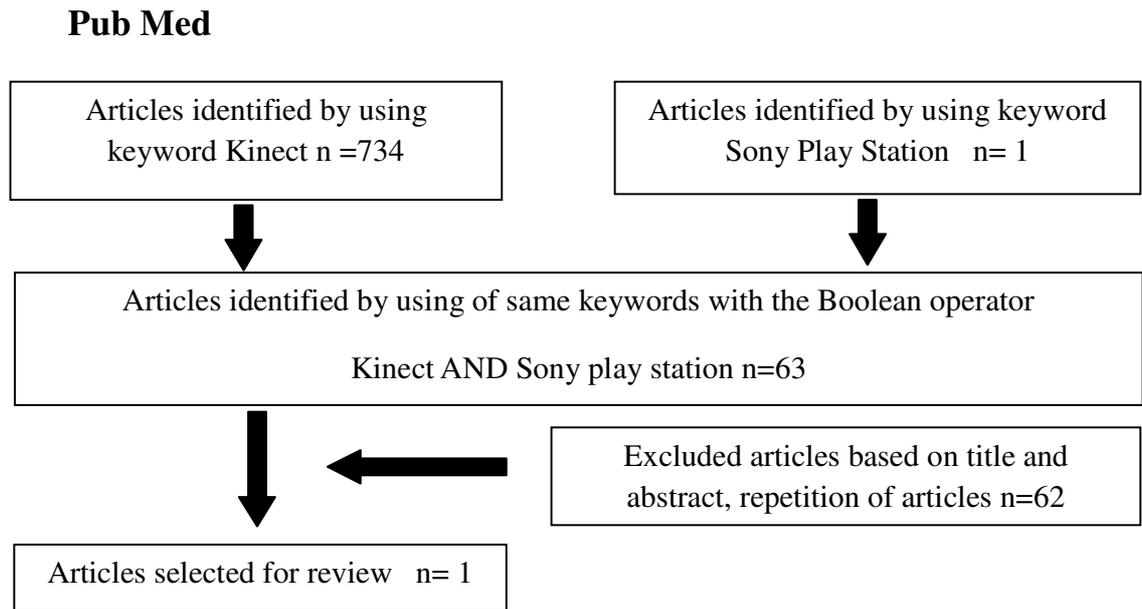


Figure 5.Google scholar and Pub Med Search strategy adopted to select articles pertaining to types of gaming experience in upper limb rehabilitation in stroke survivors

A randomized, controlled study, with 12 sittings of extra upper limb exercises via NW gaming or CT therapy. But it has improved in upper limb function recovery in subjects within 6 weeks of post-stroke. The authors proposed that future studies should take into concern stratification of the type and severity of upper limb impairment with the addition of subjects with mild upper limb impairment and greater power of intervention as the majority of subjects enrolled had severe upper limb impairment. Finally, the results of this study are not appropriate to subjects with mild to moderate upper limb impairment.²¹

Home exercise programs have been suggested as an excellent and economical for stroke survivors to unite the activity, exercise into part of their daily schedule. A

customized, in-home, game-based intrusion called magical key for persons with chronic post-stroke.²²

A systematic review to elicit the effects of virtual reality interventions on post-stroke patients based on the specific ICF domains. Concluded that more high-quality clinical trials are needed to confirm the effectiveness of virtual reality in the domains of activity and participation.²³

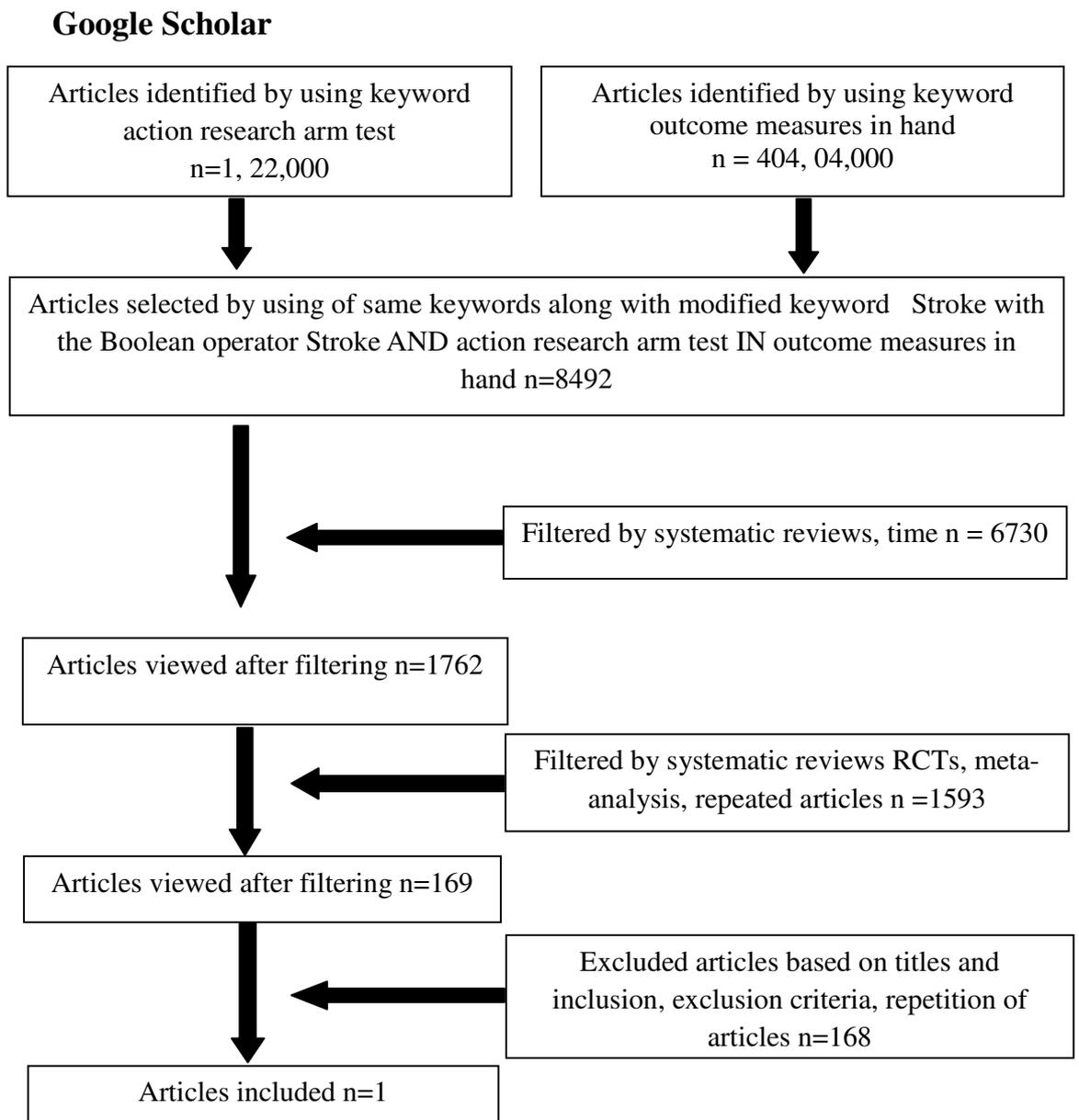
Another gaming device called as Kinect for Xbox 360 games are also available for game therapy and it is encouraging and hypothetically challenging. The routes for different types of rehabilitation users. The range of the games and their progress for well healthy populations suggests that busy clinicians may want this assets to support choice making about mingling into rehabilitation in a clinical setup. It is significant for clinicians to be easy enough with the equipment to evaluate its efficacy and to adjust it to altering requirements.¹⁵

Level of evidence -1a/4

2.8. Section 6: Outcome measures used for a hand in post-stroke survivors.

Objective: To review outcome measures used for a hand in post-stroke survivors.

Keywords: Stroke, action research arm test, outcome measures in hand.



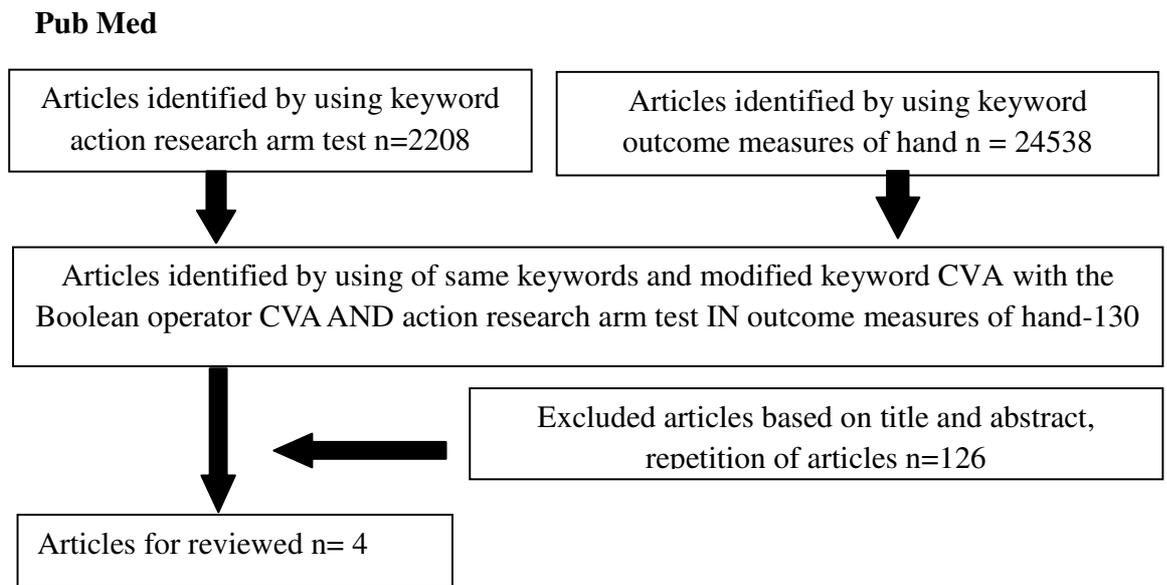


Figure 6. Google scholar and Pub MedSearch strategy adopted to select articles pertaining to outcome measures of hand function in stroke survivors.

The ARAT is an outcome measure which is an extremely reliable observational rating scale at the item level after stroke. The ARAT replicates measurement at the activity area level. The ARAT has outstanding interrater and test-retest reliability for assessment in chronic stroke, and strong evidence of sensitivity.³⁰ Like the FM-UE and WMFT scales, there is evidence for the validity of the ARAT in chronic stroke patients.²⁵ Consciousness regarding the small systematic deviations demonstrated in some things is suggested when using ARAT.²⁶

The ARAT consists of 4 areas grasp (lifting up unlike size objects), gripping (holding and moving objects), pinching (picking up small objects), and gross movement (e.g., hand to mouth) concerning 19 movements. Reliability, validity, and responsiveness have been explored and conveyed to meet mentioned criteria and it has been

comprehensively examined in contradiction of other procedures and is used as a "gold standard" for the contrast of other upper limb measures.¹⁶

Level of evidence-1a/4/5

2.9. Table 1. Summary of literature review

1	
Sl. No	1
Author	Thomson et al 2014
Journal	Topics in stroke rehabilitation
Study design	Systematic review
No. of Subject	105
Result	In this study, the mean age was 57.5 ± 9.8 years. The subjects were registered and their mean 13.7 ± 8.9 days of post-stroke. The baseline means FMA score was 16.4 ± 14.2 . After the analysis, there was no difference in FMA scale scores in between all 3 groups. At the end of the intervention after, 4 and 8 weeks. Comparable findings were also found for the secondary outcome measures.
Conclusion & Limitation	<p>There are 12 settings of increased upper limb exercises via NW gaming or conventional therapy is done in a 3-week duration was not effective in improving upper limb motor recovery compared to control group.</p> <p>LIMITATIONS</p> <p>The findings and results of this study were not appropriate to subjects with mild and moderate upper limb weakness. Secondly, they did not mention the quantity of therapy received after the end of the intervention.</p>
Quality of Article	CASP- 10/12 83%
2	
Sl. No	2
Author	Palma S D C Get al 2016

Journal	Topics in stroke Rehabilitation
Study design	Systematic review
No. of Subject	1811
Result	The accepted studies included 1,811 participants. In total, 39 studies recruited subjects with a chronic stroke, 7 recruited subjects with a sub-acute stroke, 7 recruited subjects with an acute stroke, and 1 recruited a subject with both an acute and a chronic stroke. Regarding the type of immersion, 7 studies were classified as using an immersive virtual environment, 21 a semi-immersive, and 26 a non-immersive. Virtual environments can range in their degree of immersion of the user.
Conclusion & Limitation	The effects of virtual reality on stroke rehabilitation based on the ICF framework are positive in Body function and Body structure, and that the effects are mainly related to the upper limb. However, the results related to Activity and Participation are insufficient. So more high-quality clinical trials are needed to confirm the effectiveness of virtual reality in Activity and Participation, as well as the contextual Factors, need to be included in future studies. LIMITATIONS Smaller sample size.
Quality of Article	CASP- 7/10
3	
Sl. No	3
Author	Randa D et al 2014
Journal	Neural rehabilitation and neural repair
Study design	Comparative study
No. of Subject	29

Result	There are 92 percent patients in the video game therapy group and 77% of the patients in the traditional therapy group were evaluated their level of satisfaction from the therapy from “badly” to “enormously.”
Conclusion & Limitation	<p>The use of video games in therapy facilitates five times more replication of focused movements, and twice the speed related to traditional therapy. In individuals with mild to severe impairment, these difference was greater. So video games can be used as a therapy to increase the number of Upper Extremity functions of individuals with chronic stroke. There is a need of studies are compulsory to measure the efficiency of this type of interposition on motor regaining of the impaired upper extremity of individuals.</p> <p>LIMITATIONS</p> <p>Small sample size</p>
Quality of Article	CASP- 5/8
4	
Sl. No	4
Author	Barrett N et al 2016
Journal	Journal of Rehabilitation and Assistive Technologies Engineering Volume
Study design	Systematic review
No. of Subject	123
Result	The making of a video game is a multifaceted and complex procedure, and the standard for current design is the result of more than half a century of careful research and complete growth. The result of aside literature study, there is a few studies of essential influences of game design were refined and conversed in detail significant play, response, goal line, prizes, task, trouble, letdown, and flow. These aspects could be as essential to the making of customized games for stroke patients in rehabilitation.
Conclusion & Limitation	The making of video games was very complex and difficult in procedure and there is a need to develop the most available video games for rehabilitation with high technology.

	<p>LIMITATIONS</p> <p>The main limitation was size was Small in numbers, varying and reported results.</p>
Quality of Article	<p>CASP-</p> <p>5/10</p> <p>64%</p>
5	
Sl. No	5
Author	Stand PJ et al 2016
Journal	Clinical Rehabilitation
Study design	Randomized controlled trial
No. of Subject	47
Result	There were two groups Sample size design based on outcome measure Wolf Motor Function Test, shown a must for 38 in each group. There was a significantly more change from baseline to post-intervention.
Conclusion & Limitation	<p>To attain the essential sample size, an ultimate home-based trial would need added policies to increase enrolment charges and satisfactory resources for patient support.</p> <p>LIMITATIONS</p> <p>There was a number of dropouts from the intervention group. In the control group, only one of those randomized was lost after completing borderline of outcome measures.</p>
Quality of Article	<p>CASP-</p> <p>8/10</p>
6	
Sl. No	6
Author	Keith R et al 2014

Journal	Plus One
Study design	A Systematic Review and Meta-Analysis
No. of Subject	Included 24 studies
Result	There are 26 studies met the inclusion criteria. In body function outcomes, there was a significant advantage of VR therapy matched to conventional therapy controls and there was no significant difference between virtual environment and Commercial gaming interventions p-value was (P=0.38). For other activity outcomes, there was an important benefit of VR therapy and there was no significant change between virtual environment and Commercial gaming interventions (P=0.66).
Conclusion & Limitation	Virtual reality therapy establishes an important reasonable benefit in body functions, activities and when it comes to outcomes, compared to control therapy. There was no clinical significance. LIMITATIONS The analysis was founded on a small number of studies and This review was in complete by some risk of publication unfairness in the involved studies.
Quality of article	CASP- 8/10
7	
Sl. No	7
Author	Kong K et al 2016
Journal	Topics in Stroke Rehabilitation
Study design	A Randomized, Controlled Study
No. of Subject	105
Result	The mean and standard deviation of the baseline FMA score was 16.4±14.2. The results show There was no change in FMA scores among all 3 groups at the completion of the intervention, and at four and eight weeks after the completion of the intervention. Related findings were also renowned for the secondary outcome measures.

Conclusion& Limitation	<p>After giving of 12 weeks of augmented upper limb exercises by through NW gaming or conventional therapy has done a 3-week duration was in effect in improving upper limb motor recovery matched to control.</p> <p>LIMITATIONS</p> <p>After data analysis, the results of the study were not significant and not applicable to subjects with mild to moderate upper limb impairment.</p>
Quality of Article	CASP-7/10
8	
Sl. No	8
Author	Saposnik G et al 2010
Journal	Aha journals
Study design	Meta-analysis
No. of Subject	35 studies included
Result	Interventions were delivered within 4 to 6 weeks in 9 of the studies and within 2 to 3 weeks in the remaining 3. Eleven of 12 studies showed a significant benefit toward VR for the selected outcomes.
Conclusion& Limitation	VR and video game applications are novel and potentially useful technologies that can be combined with conventional rehabilitation for upper arm improvement after stroke.
Quality of Article	CASP-9/12
9	
Sl. No	9
Author	Penny J et al 2014
Journal	American physical therapy association
Study design	Prospective cohort study plus qualitative analysis

No. of Subject	29
Result	There are seventeen patients were enrolled in the study who are allocated equally into two groups. Four people did not complete sufficient exercise to start the intervention. The results of this study show that there was no significant improvement.
Conclusion & Limitation	<p>Level of use is variable and can fall far short of recommendations.</p> <p>Opposing obligations was the barrier to use of the tools but the participants who are participated in this study they reported that the intervention was flexible and inspiring.</p> <p>It will not uniform everyone, but some participants documented high levels of use.</p> <p>Limitations</p> <p>Small sample size.</p>
Quality of Article	CASP 7/10
10	
Sl. No	10
Author	Choi HJ et al 2014
Journal	Annals of Rehabilitation Medicine
Study design	A randomized, single-blind study
No. of Subject	20
Result	There were no significant differences in the baseline between the two groups. After 4 weeks, both groups showed significant improvement and correct detection of auditory continuous performance test. However, grip strength was improved significantly only in the case group. There were no significant intergroup differences before and after the treatment.
Conclusion& Limitation	The commercial gaming-based VR therapy was as effective as conventional OT on the recovery of upper extremity motor and daily living function in subacute stroke patients

	LIMITATIONS Small sample size.
Quality of article	CASP-9/10
11	
Sl. No	11
Author	Vinasdiz S et al 2016
Journal	Neurologia
Study design	Systematic review
No. of Subject	565
Result	The author concluded that VR improves upper limb motor functions, as well as the performance of ADL .none of these studies, get adverse effects.
Conclusion & Limitation	They concluded that the studies included their review the optimal levels of evidence and grades of recommendation, but further studies with large sample sizes are needed to draw a more reliable and robust conclusion. They need more studies focused on resolving whether changes cortical recognition. LIMITATIONS
Quality of article	CASP-7/10
12	
Sl. No	12
Author	Shin H et al 2016
Journal	Journal of Neuro-Engineering and Rehabilitation
Study design	A single-blinded, randomized controlled trial
No. of Subject	46
Result	In this study Fourty six participants involved, in that 33 finished the 4-week

	intervention of programs and Throughout the study 5 & 8 members from the SG and CON groups, correspondingly, did not complete the intervention programs. There were no severe adverse events, and only one participant from the CON group dropped out.
Conclusion & Limitation	<p>The VR gaming therapy and pooled with ordinary OT influence be more active than conventional rehabilitation for successful distal upper extremity function in stroke survivors. Therefore, the Sony Gaming system used in VR-based rehabilitation might be a perfect rehabilitation device for the distal upper extremity in stroke survivors.</p> <p>Limitation This study had many limits. First, the changes in the FM scores did not beat the MCID value of 6.6 points. Moreover, the signs of progress in the JTT and PPT scores were not met MCID values.</p>
Quality of Article	CASP- 8/10
13	
Sl. No	13
Author	Levac D et al 2018
Journal	American Physical Therapy Association
Study design	Usability study
No. of Subject	15
Result	<p>In this study, the Participants had better skill spending time with the Wii and comparatively little knowledge applying Kinect games in a clinical setup. They stated that their present method of choice making to use games is to decide patient impairments. The games select games that seem to encounter these wants. Washington place therapists were all aware of Wii, and only one therapist used Kinect for recreational purposes for patients.</p> <p>These therapists described that they consider patient safety, attention in games, and their own previous experience with the games when before making decisions of the practice of games.</p>
Conclusion &	Kinect for Xbox 360 games is available, inspiring, and possibly interesting

Limitation	choices for a variety of rehabilitation clients. The variety of games and their growth for healthy population samples that busy clinicians may need funds to support choice making about integration into rehabilitation clinical practice. LIMITATIONS The Small sample size was one of the limitations
Quality of article	CASP- 7/10
14	
Sl. No	14
Author	Baker K et al 2011
Journal	American Heart Association
Study design	Systematic review
No. of Subject	45 measures are reviewed
Result	The three outcome measures were recognized that finest met their review standards. The Stroke Rehabilitation Assessment of Movement, Chedoke Arm, and Hand Inventory. After the last stage of scale appraisal, two additional upper limb scales (Fugl-Meyer and Action Research Arm Test) were counted based on clinical content and study design.
Conclusion & Limitation	This review method seems to be a theoretically useful methodology for evidence-based scale choice in stroke rehabilitation studies. LIMITATIONS
Quality of article	CASP-6/11
15	
Sl. No	15
Author	Cameirao SM et al 2010
Journal	Journal of neuro-engineering and rehabilitation

Study design	Usability and validity
No. of Subject	41
Result	This study the results reported that here also show a reliable transmission of movement kinematics among physical and virtual tasks given by the therapist. Moreover, the usability assessment displays that the RGS is extremely recognized by stroke patients as a rehabilitation device.
Conclusion & Limitation	They familiarize a novel VR based example for neuro rehabilitation, RGS, which association with exact rehabilitative ethics with a psychometric assessment to deliver modified and automated training. The results show that the RGS efficiently regulates to the individual structures of the users, allowing for an unverified deployment of individualized rehabilitation protocols.
Quality of Article	CASP- 6/11
16	
Sl. No	16
Author	Flynn S et al 2007
Journal	JNPT
Study design	Case report
No. of Subject	1
Result	The device used in this study was feasible. In clinically applicable progress were found on the upper extremity Functional Index, Motor Activity Log, and Beck Depression Inventory.
Conclusion & Limitation	A cost-effective VR system was simply used in the home. In the upcoming, it may be used to recover sensory/motor regaining following stroke as an aide to usual care of physical therapy.
Quality of article	CASP- 8/12

17	
Sl. No	17
Author	Shin J et al 2014
Journal	Journal of neuro-engineering and rehabilitation
Study design	A participatory design and usability test
No. of Subject	16
Result	The prerequisite of VR gaming system for stroke rehabilitation was established and incorporated into rehab master .the reported benefits from the usability tests were better attention the immersive flow practice and individual intervention .the first clinical trial showed that the rehab master intervention enhanced and the second trail not significant.
Conclusion & Limitation	This study showed that rehab master was feasible and harmless virtual reality system for improving upper extremity functions in post-stroke. LIMITATIONS In this study, there were several limitations. One of the limitations is intervention was different interval's leads to variation in their results.
Quality of article	CASP- 7/11
18	
Sl. No	18
Author	Samuel SG et al 2015
Journal	Singapore Med
Study design	Case report
No. of Subject	1
Result	In this study the FIM better from baseline to post-intervention and Fugl-Meyer motor score upgraded from baseline to post-intervention signifying that clinically significant improvement showing in the results.

Conclusion & Limitation	At the end of the study, VR-game based intervention displays great potential as adjunctive therapy to rehabilitation in upper limb stroke regaining and can efficiently be used in an acute inpatient setup. Its influence to the rehabilitation procedure includes better patient motivation and commitment, instant measurable response and probably more subtle following of patients' regaining. Therefore further research needs to be carried out to control the most effective type, timing, setting and period of VR based therapy.
Quality of Article	CASP- 7/12
19	
Sl. No	19
Author	Proffitt R et al 2015
Journal	International Journal of Telerehabilitation
Study design	Feasibility study
No. of Subject	4
Result	In this study all the patients who played the games with reasonably high pleasure. Participant response helps to find out the obstacles to use and possible improvements. in home-based system virtual reality game intervention to deliver rehabilitative exercises for persons with chronic stroke.
Conclusion& Limitation	In the final conclusion, home exercises are outstanding and cost-effective for post-stroke survivors to include activates and exercise into their daily lives. We explored the feasibility of using a modified, in-home, game-based therapy intervention called Mystic Isle for persons with chronic stroke. This study established that Mystic Isle is very feasible in-home exercise choice for at least some persons with chronic stroke. Future studies are essential to control the intervention's impact on patient function, activity, and involvement. Limitation The small sample size
Quality of article	CASP- 6/11

20	
Sl. No	20
Author	Pietrzak E et al 2014
Journal	Stroke journal
Study design	Systematic review
No. of Subject	13 studies were included
Result	In this study, the Nintendo Wii seems to deliver the highest benefits to patients, with enhancements seen in upper extremity functional measures such as joint range of motion in all joints in upper extremity hand motor function, grip strength, and dexterity. Three studies indicate that video therapy appears to be safe and that long-term improvements continue at follow-up.
Conclusion& Limitation	At present, the evidence that the use of commercial video games in rehabilitation improves upper limb functionality after stroke is very limited. However, this approach has the potential to provide easily available and affordable stroke rehabilitation therapy in settings where the entrance to therapy is restricted by physical or financial constraints.
Quality of Article	CASP-6/10
21	
Sl. No	21
Author	Nordin A et al 2014
Journal	J Rehabil Med
Study design	Intra rater and reliability study
No. of Subject	195
Result	The satisfactory intra-rater, the inter-rater promise was noted for all objects except item 19, it was just beneath the satisfactory level of within and between raters, were small but no insignificant and systematic differences were established for items 11, 14, 19 and for items 1, 4, 17, 19, correspondingly. There was no difference due to random modification within or between raters.

Conclusion & Limitation	The outcome measure ARAT is an extremely reliable rating scale at the item level after stroke. Responsiveness regarding the small systematic disagreements verified in some items is, however, recommended when using ARAT. Limitation One limitation of this study was the twisted distribution on the ARAT scale. Many of the 19 items are too tough for patients with severe stroke and we, therefore, found it unprincipled to expose more.
Quality of Article	CASP-7/11
22	
Sl. No	22
Author	Bushnell C et al 2015
Journal	European Spine Journal
Study design	Expert Panel Recommendations
No. of Subject	115 clinical trials
Result	A systematic literature review of 115 clinical trials was produced for upper and lower extremity function in chronic stroke patients. In this total 34 outcomes were used. In this 7 of these had published MCIDs and were highly recommended. Those scales are the Wolf Motor Function Test, Action Research Arm Test, Ten Meter and Fugl-Meyer Upper Extremity and Lower Extremity scales, Six Minute Walk Tests, and the Stroke Impact Scale. These are the scales.
Conclusion & Limitation	At the end of the study, they concluded the recommends that the Fugal-Meyer Upper and Lower Extremity scales be used as main outcomes in intervention trials directing motor function in chronic stroke populations. The other six measures are also suggested as a secondary outcome.
Quality of article	CASP- 4/10
23	
Sl. No	23
Author	Santisteban L et al

Journal	Polos one
Study design	Systematic review
No. of Subject	477 studies reviewed
Result	In this study, there are 48 different outcome measures were found. In that only 15 outcome measures were used. In that only 5 percent all outcome measures. The Fugl-Meyer Test was the most usually used measure (in 36% of studies). Most of the studies 72 percent were combined with many outcome measures. MT combined with the Motor Activity Log and also the Wolf Motor Function Test, the Action Research Arm Test, but uncommonly pooled with the Motor Assessment Scale or the Nine Hole Peg Test. The Key modules of manual dexterity such as selective finger movements were infrequently measured.
Conclusion & Limitation	In this study, the results displayed a large variety of outcome measures used through studies. However, a growing number of studies used the FMT, neurological test with worthy psychometric properties. For thorough assessment, the FMT needs to be combined with functional measures. These are the outcomes illustrate the need for plans to build international consent on suitable outcome measures for upper limb function after stroke. Limitation The main limitation of this study was only a few included intervention studies and data from longitudinal studies or from cross-sectional studies was not limited for the enclosure to intervention studies in order to capture measures that clinicians and scientists consider suitable to follow changes in upper limb recovery over time.
Quality of article	CASP-6/10
24	
Sl. No	24
Author	Murphy A M et al 2015
Journal	BMC Neurology
Study design	Systematic review
No. of Subject	13 studies included
Result	They include 13 systematic reviews, 53 measures were identified, 13 met the

	standardized criteria, the strongest level of measurement is the action research arm test.
Conclusion & Limitation	This review provides a comprehensive systematic synthesis of evidence on outcome measures. Limitation Primary studies are not retrieved, the overlap of primary articles.
Quality of Article	CASP- 6/12
25	
Sl. No	25
Author	Rinne1 P et al 2016
Journal	PLOS ONE
Study design	Randomized control tail
No. of Subject	87
Result	In this study, the total participants were 345 with upper extremity weakness were separated. The standard reason for the elimination of 51 percent was a cognitive loss or physical comorbidities. It's significant and adequate to make it unfeasible and unethical to test patients.
Conclusion & Limitation	In this study, they concluded that the hand and arm, exercise Applications were played on conventional mobile devices. Which is very helpful for the stroke patients Technical adaptations such as grip-control can allow more rigorously affected subjects to involve with self-training software.
Quality of article	CASP-7/11

2.10. Summary

The studies on upper extremity functional recovery in stroke patients by using video game therapy are promising but the gaming devices used in all studies are costly. Low-cost devices have not been tested with adequate research. An excellent outcome measure of hand function after stroke is the ARAT.

3. METHODOLOGY

The methodology employed in this study is described as follows

3.1. Study design: RCT (Randomized Control Trial)

3.2. Sampling source: Department of Neurology (OPD &IPD) and Physiotherapy OPD, PMR of JSS Hospital.

3.3. Sampling strategy: Convenience sampling based on strict criteria. Allocation to experimental and control groups was done by block randomization (6 blocks of 4 each).

3.4. Allocation: Six blocks with four chits equally distributed between control and experimental groups was generated and randomly arranged. Each block was numbered sequentially and sealed in an opaque envelope. A computer-generated random numbers table between one and six was generated. As a patient becomes available, a person blinded to the study had picked the block that is the first number in the random numbers table. Then he/she had picked the topmost chit and the patient was assigned to the relevant group (control or experimental).

3.5. Sample Size: Minimum sample size of 24 was calculated using G*power 3.1.9.2 software.³⁴

Sample size calculation

The sample size was generated by using G*power 3.1.9.2 software.

The input was:

Statistical test: Wilcoxon –Mann-Whitney test (two groups)

Effect size $d = .7$

$\alpha = 0.05$

Power ($1 - \beta$ err prop) = 0.75

Allocation ratio N2/N1=1

No. of groups = 2

Total sample size = 24

3.6. Participants characteristics

Inclusion criteria

- I. Both male and female clients with sub-acute stroke to chronic (15 days to 6 months).³⁵
- II. Individuals with age ranging from 30 – 70 years.
- III. The patients who have voluntary control grading grade 2 to grade 5.³⁶

Exclusion criteria

- I. Individuals who had undergone recent upper limb surgeries.
- II. Individuals with upper extremity fractures.
- III. Individuals have been diagnosed with cognitive impairments.
- IV. Dislocation and subluxation of the shoulder of Grade II & III.

3.7. Outcome measures

- I. Action research arm test (ARAT).¹⁶(Appendix. F)

3.8. Materials required

- I. Lenovo Laptop. (Appendix. G)
- II. Logitech extreme 3d pro gaming joystick. (Appendix. G)
- III. Power Socket.
- IV. One table and one chair.
- V. Mirror box.

3.9. PROCEDURE

Permission for the study was obtained from the IRC of JSS College of physiotherapy and ethical clearance was obtained from the ethical committee of JSS Medical College. Permission from the Medical superintendent, JSS hospital and Head of the department of neurology was obtained. Patients who were admitted to the neurology inpatient department and outpatient department of neurology and physiotherapy, JSS hospital was selected for the study. Written informed consent was given to all patients who were potentially eligible for the study.

Patients were selected based on inclusion and exclusion criteria and their willingness to participate. Twenty four patients were recruited for the study. The patients were allocated in the experimental group (12) and the control group (12) using block randomization method as described in 3.4. The randomization was done by the person who is not involved in the study. Baseline measurements of ARAT were done by (Tester-1). The physiotherapist (Tester-2) gave the game therapy for experimental group as well as the control group received conventional treatment.

The experimental group (Game therapy)

Before going to the main study a pilot study on normal subjects and patients was done to standardize the operating procedure. After the pilot study, we modified the procedure and duration of game therapy based on the problems faced. The position of the patient is sitting in a chair and the joystick was placed on the stool, keeping in front of the patient at a comfortable position to the appropriate patient height.

The laptop was placed on a table in front of the patient with a minimum distance of 1 meter. The game played was Ace combat, before playing the game the clear Instructions was given to the participants about the handling of joystick, game, levels, targets, and goals of the game. The total duration of the session was 30 minutes period. The first 5 minutes for instructions and a trial period of 5 minutes was given to the patients who played for the first time. Once done with the trail, patients played the game for 30 minutes as per instructions. The 30 minutes duration was divided into 15 minutes for unaffected hand followed by 5 minutes of rest and then 10 minutes for affected hand. The patient starts the game with unaffected hand followed by affected hand.

The patients played the game as per commands are given by the therapist. In this game, the jet plane has to be moved using the joystick to be followed by finding and shooting of enemies is the task. The total duration of the intervention was 4 days a week for 5 weeks.



Plate 1.Trail on normal individual's



Plate 2.Trail on normal individuals



Plate 3.Playing game by a stroke patient



Plate 3.Playing game by a stroke patient



Plate 5.Playing game by a stroke patient



Plate 6.Playing game by a stroke patient

The control group (Mirror therapy)

The position of the patient was sitting position in a chair, mirror box placed on the table at the patient height. Patients can watch the mirror image of unaffected arm. The patient keeps the affected arm inside the box and unaffected arm outside the box. During the therapy, the patient should watch the mirror and observe the image and follow the commands given by the therapist. Before starting the therapy, instructions were given to the patient that the patient should watch the mirror while doing the exercises.

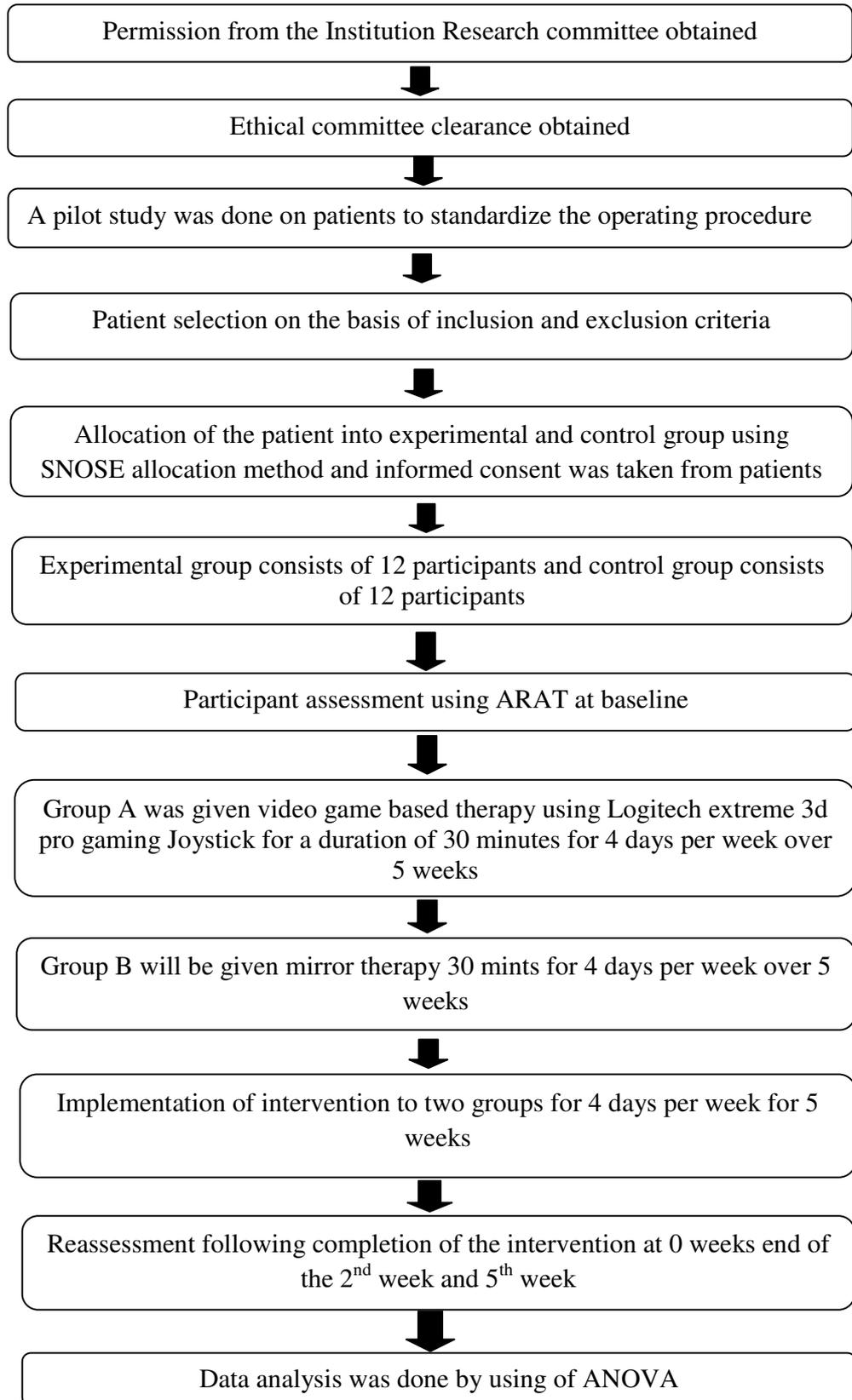
The exercises that are given to the patient was fingers flexion and extension, wrist flexion-extension, opponents of all fingers, supination, and pronation of hand, writing or drawing circles, squeezing ball. Each exercise duration for 2 minutes and the total duration was 30 minutes. After completing one set of exercise i.e.12 mins of exercise and 6 mins of the rest period, again one more repetition of exercises was given. The total duration of this intervention for the control group was for 4 days a week for 5 weeks.²



Plate 7. The patient was doing mirror therapy exercises



Plate 7. The patient was doing mirror therapy exercises



3.10. DATA ANALYSIS

In this study, we have used one outcome measure. The outcome measure is ARAT to measure the hand functions. For Outcome measures, descriptive statistics were calculated. Data analysis was done using SPSS version 22.0 software. A repeated-measures ANOVA was used to compare the effect of joystick video game therapy on upper extremity function with conventional training.

Group (between-subjects factor), time (within-subjects factor), and Group \times Time were entered into the model, time (0 weeks is a baseline, end of the 2nd week is the post and after 5 weeks is final) post and final). The demographical data also analyzed to know the mean value and standard deviation this software. An additionally differences between groups were tested to find out whether there is any significance by using a paired t-test. The significance level α was set at 0.05 for all tests (using IBM SPSS Statistics).

4. RESULT

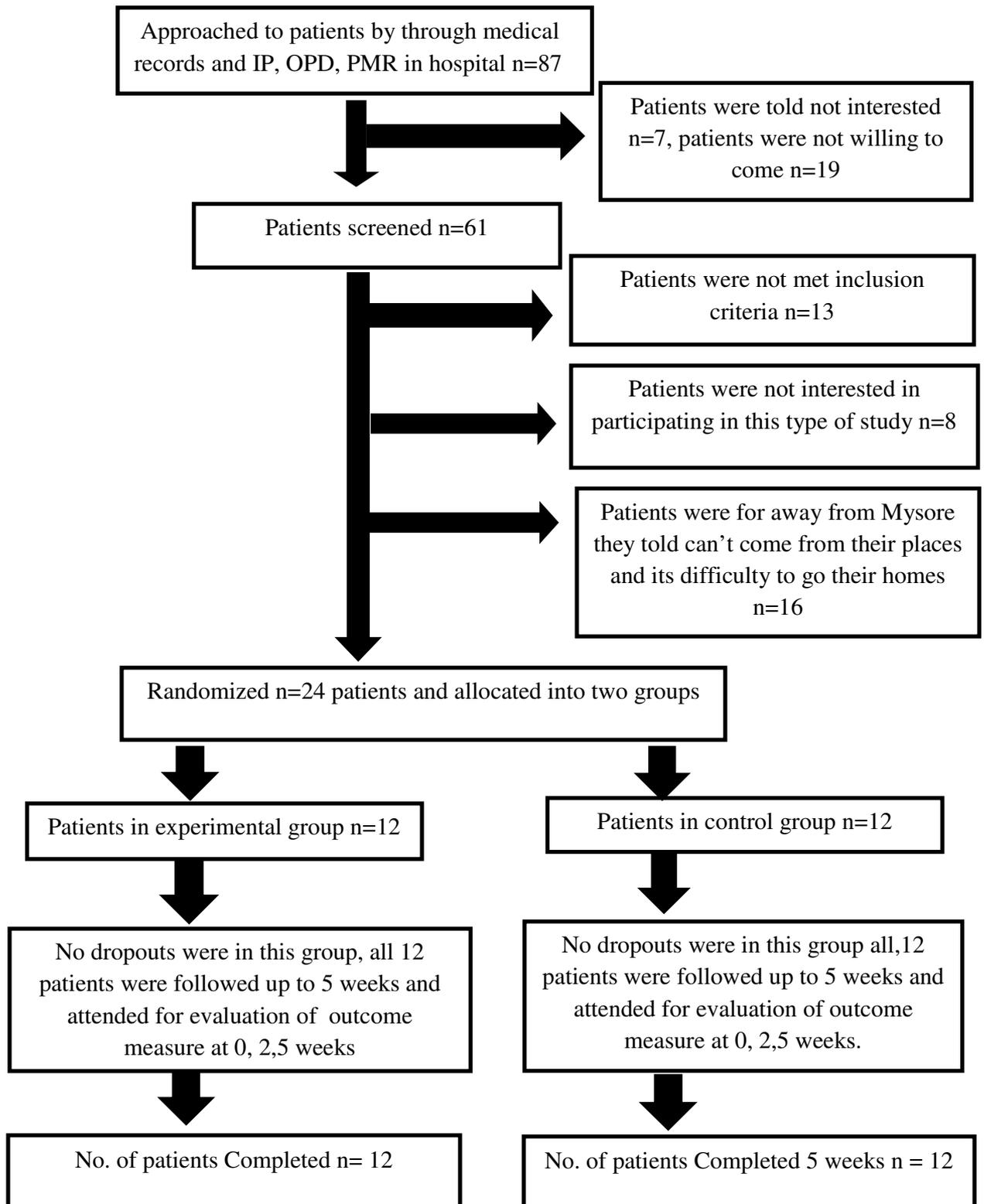
Participants

A total of 24 four patients were included in the study, all participant had completed the study protocol twelve patients in experimental and twelve patients in the control group. The two group's demographical data manage, duration of the stroke, distribution of right and left hemiplegia were showed in table 2. The average age distribution in the experimental group is 50.83 and 48.75 in the control group. The standard deviation of both the groups was 49.38 ± 7.950 years. The duration of stroke in months was 4.25 months in the experimental group and 3.66 months in s conventional group. The standard deviation of both groups were 3.96 ± 908 . The right-handed affected patients were 10 and left-handed patient were 14.

Table 2.Demographical data of both experimental and control group patients.

Sl.No	groups	No of patients	Age Mean and Standard deviation	Time from stroke Months Mean age and Standard deviation	Right /left Hemiplegia
1	Experimental group	12	50.83	4.25	7R/5L
2	Control group	12	48.75	3.66	3R/9L
	Total	24	49.38 ± 7.950	3.96 ± 908	10R/14L

Figure 7. Study flowchart



Outcome measures

The outcomes values were taken at the three times in whole intervention period of 5 weeks, that was a baseline, after 2 weeks and post-intervention i.e. is after 5 weeks. The scores of the patients from baseline to post-intervention there was slightly increased but it was no increased and it's not significant statistically improvement in both groups and within the groups, the p-value is more than 0.05, there were no significant differences in the scores of all the ARAT in all components ($P = > 0.05$).

The mean and standard deviation of grasp component in baseline and post-intervention that is after 2 weeks are given in table 3. The comparison between the baseline and post line of both experimental and control group. The mean and standard deviation in the control group were showing no significant improvement in all 4 components of the ARAT scale. There is a minute deviation in total seconds of 4 components in scale i.e. after 5 weeks. There is no difference in score in all components within the subjects.

Table 3: The mean and standard deviation of outcome measures scores in the Experimental group at baseline, post, and final.

Mean and standard deviation of Control group (baseline, post line, final)				
Sl. no.	Component, Score, Time	Baseline mean and slandered deviation	Post line mean standard deviation	The final mean standard deviation
1	Grasp Total score	15.50 ±3.090	15.00±3.133	15.00±3.133
	Grasp Total sec	73.917±97.3012	96.758± 107.32	92.975± 104.56
2	Grip Total score	10.33±2.060	10.00±2.089	10.00±2.089
	Grip Total sec	50.22±65.026	207.183±553.69	62.830 ± 70.99
3	Pinch Total score	11.00±65.026	10.75±3.49	10.67±3.447
	Pinch Total sec	188.5±116.10	189.35±116.37	209.847 ± 106.74
4	Gross Total score	8.00±1.47	8.25±1.86	8.00±1.477
	Gross Total sec	16.108±18.56	44.39±91.93	16.450±18.7508

Table 4.The mean and standard deviation of outcome measures scores in the Experimental group at baseline, post, and final

Experimental group mean and standard deviation of the baseline, post, final				
Sl. no.	Component, Total Score, Total time	Baseline mean and Standard deviation value	Post line means and the standard value	Final mean and standard deviation
1	Grasp Total score	12.33±3.08	12.58±2.906	12.83±2.480
	Grasp Total sec	20.908±106.2641	202.57±103.029	348.508±564.1292
2	Grip Total score	7.80±1.931	7.67±1.826	8.08±1.505
	Grip Total sec	137.275±53.223	8.92±4.461	131.383±57.8251
3	Pinch Total score	8.92±4.461	9.0±4.328	9.83±4.629
	Pinch Total sec	230.892±116.73	239.45±115.9	234.242±115.8082
4	Gross Total score	6.75±1.357	6.75±1.357	6.75±1.357
	Gross Total sec	69.117±47.67	64.67±1.357	56.725±39.2835

In the above table 4, there was no difference in baseline to final mean and standard deviation in the experimental group. Showing no significant improvement in scores of all 4 components of the ARAT scale. But there was a small change in total scores of grip and pinch from baseline to final. There was also a minute deviation in total seconds of grasp Grip components in scale i.e. after 5 weeks. There is no difference in all score in all components within the subjects.

Table 5. Comparison from baseline, post and final outcome measures values of within subjects (experimental and control group)

Experimental and Control group f values and p values (within subjects)							
Sl. no.	Component, Total Score, Total time	Baseline F value	Baseline P value	Post F Value	Post P value	Final F value	Final P value
1	Grasp Total score	.132	.720	.132	.720	.131	.721
	Grasp Total sec	.105	.749	.844	.369	.051	.824
2	Grip Total score	.125	.727	.404	.532	.896	.355
	Grip Total sec	.155	.698	.073	.790	4.330	.050
3	Pinch Total score	.221	.643	.377	.546	.513	.482
	Pinch Total sec	1.483	.237	.500	.487	.500	.487
4	Gross Total score	.848	.367	.057	.814	.693	.415
	Gross Total sec	.227	.639	.332	.570	.076	.786

In the above table 5, the p-value and f values of within the subjects of two groups were showing that there was no significant difference in all components of ARAT in 24 patients.

Table 6. Comparison from baseline, post and final outcome measures values of within groups (experimental and control group)

Experimental and Control group all f values and p values (with in group)							
Sl. no.	Component, Total Score, Total time	Base line F value	Base line P value	Post F Value	Post P value	Final F value	Final P value
1	Grasp Total score	1.066	.314	.020	.888	2.335	.141
	Grasp Total sec	5.140	.034	2.349	.140	.986	.332
2	Grip Total score	3.445	.078	2.414	.135	.041	.841
	Grip Total sec	1.749	.200	2.056	.166	1.620	.217
3	Pinch Total score	.497	.488	2.247	.149	.051	.823
	Pinch Total sec	.155	.698	4.429	.048	2.608	.121
4	Gross Total score	3.617	.071	.005	.945	4.262	.052
	Gross Total sec	.891	.356	2.063	.166	2.921	.102

In the above table 6. It's a comparison between two groups from the baseline to post and final. The p-value and f values of between two groups show there was no significant difference in all components of ARAT

Table 7. Simple paired t-test, compression in between groups (Experimental and control)

Experimental and Control group t values and p values (in between group)			
Sl. no.	Component, Total Score, Total time	Comparison between the baseline to post within groups p values and t values	
		t value	p-value
1	Grasp Total score	.000	1.000
	Grasp Total sec	-1.020	.318
2	Grip Total score	-.549	.588
	Grip Total sec	-.968	.343
3	Pinch Total score	-.762	.454
	Pinch Total sec	-1.201	.242
4	Gross Total score	2.495	.020
	Gross Total sec	-435	.034

After doing of repeated measures of ANOVA we got to know that there is no significant difference in within subjects and within the group, so we did a simple paired t-test to find out there is any significant difference in between groups but we found that there is no significant difference in between groups also. Here we concluded that there are no values of above given in tables were not showing any significance i.e. ($P = >0.05$).

5. DISCUSSION

Our results showed that a video game based therapy performed using Logitech extreme 3d pro joystick is not significantly effective in enhancing the hand functions and upper extremity functional activities. In above the review of some studies done on a video game based therapy with high ended devices like (VR, SONY PLAYSTATION) used to improve hand functions and those are showing improvement, that may be due to the high sensors, more graphics and number of session duration of the game may influence their Improvement. Whatever studies done up to now is also used high ended devices then we come up with a new idea of using joystick video games to improve in upper extremity functions. For that we reviewed some systematic reviews Cochrane reviews. They concluded that game therapy is a significant improvement in hand functioning. As a reference of above studies we proceeded with joystick type of game therapy which is easily available and cost-effective. Then we were searching for the low-cost joystick, finally, Logitech Company had to provide many types of joysticks in that one type of joystick which is low cost to buy i.e. Logitech extreme pro 3D.

At the beginning of this study we found the difficulty of finding games for compactable to the joystick and interesting to play for patients, after searching of many different games to suit the patients as well as a joystick, then we selected a game called Ace Combat. Ace combat is suitable for joystick and it's easy to play and understand the game for the patient. Once the selection of game, we did a trail on normal subjects to find out the difficulties of the game and interest towards the game. We found that the game is an interesting and challenging totem, they gave feedback about game and gaming experience. Then we did a pilot study on 3 stroke patients to find any difficulties, interest

towards the game and also for standardizing the standard operating procedure. There we found that patients have more difficulty to hold the joystick continuously for 13 minutes with affected hand, sitting and placement of laptop and joystick position. After the pilot study, we modified the duration of gaming that is 15 mints to unaffected side and 10 mints to affected side with in-between 5 mints rest. We added a trial period of 5mints for who is playing the first time. The placement of joystick and laptop was changed with respect to the subject height.

Once the pilot study did we started the recruiting the patients into the study where we had a problem with different age groups acute stroke cases which did not meet my inclusion criteria and many people are not locals they were not able to come for 4 days per week up to 5 weeks. Then later we recruited who is willing to participate in the study. Most of the people who are willing to participate in this study were staying within 7 to 10 km distance from the hospital. Some of the people were not educated and they had no idea about games and they said not interested to play games that to affected hand. Lateran, screening, and patients were recruited according to the SNOSE allocation method with single blinding. The recruited patients were distributed into two groups i.e. Control and experimental, intervention in both groups started at the same time. We took all the requirements for game therapy and portable, foldable mirror for mirror therapy to the patient house. We have modified the height of chair and table according to the patient comfort in their home with pillows. In the experimental group, patients felt difficulty while playing during the initial first few days i.e. is the 1st week. We had given a trial period of 5 mints for every patient up to one week and giving them continues commands while playing the game, for familiarizing and understanding the game and how to control

the joystick. Each session 30 minutes of game therapy for the experimental group and 30 minutes for the control group up to 4 days per week for 5 weeks. In both groups, the total no of hours spent by each patient in 20 sessions was 10 hours.

Due to the lack of education or lack of interest on games patients were started reducing the game duration with more number of mission fails in game and they were completing half an hour duration of game with both affected and unaffected side hand. We faced the problem of carrying equipment to every once housing and in Indian setup there were different type of chairs and tables so it's very difficult to standardize the chair and table for the game therapy as well as mirror therapy. Few people showed interest, they were educated and they had previous gaming experience in their mobile and computer system. After observing this we found that there was a lack in understanding of gaming in uneducated patient and previous experience of gaming also effects on interest. To attain the patient attention toward games it requires high ended devices with full sensors along with games contain high graphics which will give much more attention and interest to the patient for play the gaming and it's easy for the patients to control also.

There might have been a chance of improvement if we could have increased the number of session of the games, duration, and recruitment of patients based on the dominant hand. Other factors like the duration of the stroke, type of stroke, cognition, including upper extremity function measures such as joint range of movement, hand motor function, grip strength, and dexterity may affect directly or directly on the result which we didn't consider. The result of this study showed no significant improvement in within subjects and between groups. While doing analysis, we faced a problem in entering into SPSS there are four subcomponents outcome measure and it consists of

score and time, it will become eight variables, which had to be repeated 3 times (0 weeks, baseline, 2nd week post, and 5th week final values).after entering into the SPSS all the values the analysis was done.

There was another major problem with the ARAT outcome measure which all most all patients got the same score from baseline to post and there is a change in time taking to perform the task, in during analysis also we faced problem to put so many variables for calculate both scores and time so it's quite a little bit difficult and confusing while analyzing data. As per p-value there is no significant improvement in total score of all components in ARAT and according to total seconds of all components there are changes in time taking to complete the task, but it won't be considered as an improvement. Because it's very minute that to in seconds, so Measure the minute improvements which were observed in reduction of time taken to complete in ARAT the task but did not shows statistical significance.

5.1. Strengths

The main strength of this study was a cost-effective gaming device and feasible for this study, it occupies less space, and portable type and easy to set up. Interesting to the patients who had previous gaming experience and few are enthusiastic towards the game to play.

5.2. Limitations

- I. The main limitation of our study was less duration of the intervention. We didn't take according to hand grip strength, because the patient was not able to hold the joystick for 30 minutes duration continuously.

- II. Considering the cognition for a better understanding of game and commands given by the therapist. The size of the laptop monitor was small. Because of the laptop size 15.6 inches which is not much attractive, if it was a big monitor there may be a chance of more interest and patients could have shown much more interest towards the game.
- III. Appropriate outcome measure to measure minute changes in hand function improvement, unstandardized furniture for game therapy and mirror therapy so there is no slandered size of table and chair for game therapy, it was changed according to patient comfort.

5.3. Clinical significance

After data analysis, the results of this study shows that there was no significant improvement in patients. But there was a minimal change in the time taken by the patient while performing the task i.e. the total time scores in 4 components of ARAT scale. Few of the patients were showed interest towards the game therapy as they felt and told it was more enjoyable.

5.4. Future research Implication

- I. This study only begins to reveal how patients will experience the gaming and interest towards the games, especially low-cost gaming device Logitech joystick extreme 3d pro.
- II. There is a need to study on game therapy in rehabilitation of post-stroke patients with large sample size and an effective period of stroke for therapy to improve upper extremity functions.

III. It would be better if there is standardize setup for every patient with comfortable positions which is easily modifiable and cost-effective. It would be more effective if we do in clinical setup because carrying equipment is not always easy and moving frequently may cause damage to equipment.

6. CONCLUSION

This study concludes that the joystick type video games are interesting but when it comes to the patient point of view it requires minimal muscle power is required to control the game. So further studies are required with large sample size, more duration and most sensitive outcome measure to find out the minimal changes in hand functional activities.

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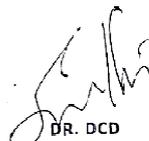
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APPENDICES

Appendix A: RGUHS review

ACA/DCD/SYN/JJSCOP-M/T046/2017-18

4	KAVADI NARESH	MRS.NAGINA NIKATH.M DESG:ASST-PROF	The effect of game based activities on upper extremity functional recovery in stroke survivors - A Randomized Controlled Trial	<p>Status: Prov. Registered</p> <p>Observations: Described And Well Structured However The Numbering Of The Side-Heading Is Not Correct As Per RGUHS Synopsis Proforma. It Should Be As Below Brief resume of the intenced work: 6-6.1 need for the study 6.2-review of literature 6.3 -objectives of the study 7-7.1 Source of data 7.2-Method of collection of data(including sampling procedure, if any) 7.3-Does the study require any investigations or interventions to be conducted on patients or other humans or animals? 7.4-Has ethical clearance been obtained from your institution in case of 7.3 8-List of references CORRECTION IS MADE WITH REFERENCE PROFORMA FOR REGISTRATION OF SYNOPSIS FOR DISSERTATION</p> <p>Remarks : Follow the Proforma for registratlion of synopsis for dissertation RGUHS</p>	<p>PROVISIONALLY REGISTERED</p> <p>STATUS OF ADMISSION - APPROVED</p>
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DR. DCD

Appendix B1: Institutional Ethical Committee certificate

JSS MEDICAL COLLEGE
(Constituent College)
JSS Academy of Higher Education & Research
(Deemed to be University)
Accredited 'A' Grade by NAAC



JSSMC/IEC / 3107 / 11 NCT /2018-19

Date: 06.08.2018

Members

Dr. M.Premanath
MD. General Medicine
Chairman

Dr.H.Basavana Gowdappa
MD. General Medicine
Member

Dr. R.Rajalakshmi
MD Physiology
Member

Dr.M.Guruswamy
MS. ENT
Member

Dr. Pratibha Pereira
Prof of Medicine
Member

Sri.NagendraMurthy M.P
B.Com. LL.M, M.Phil.
Member

Smt. Sudhaphaneesh
M.A., B.Ed.,(Ph.D)
Member

Dr.Madan Ramesh,
M.Pharm, PhD
Member

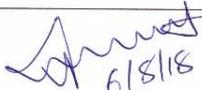
Sri. R.S.Nagaraj
B.Sc, MBA
Member

INSTITUTIONAL ETHICAL COMMITTEE

CERTIFICATE

This is to certify that the below mentioned Project was discussed and reviewed and the same has been cleared and approved by the Institutional Ethical Committee at its meeting held on 31.07.2018 at College Council Hall, JSS Medical College, Mysore.

Title of Project	"The effect of game based activities on upper extremity functional recovery in stroke survivors: A Randomized Controlled Trial
Principal Investigator	Mr. Kavadi Naresh Ist Year MPT Student JSS College of Physiotherapy Mysore
Guide	Mrs. Nagina Nikath M, MPT Assistant Professor JSS College of Physiotherapy Mysore


6/8/18
MEMBER SECRETARY
Member Secretary,
Institutional Ethical Committee
J.S.S. Medical College, S.S. Nagar
MYSORE-570 015

Sri Shivarathreeshwara Nagara, Mysuru - 570 015, Karnataka, India
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E: jssmc09@gmail.com | www.jssuni.edu.in

Appendix B2. Permission from Medical Superintendent

From,

Date: 23.08.2018

K.Naresh
First year MPT
JSS College of physiotherapy
Mysuru -570008

To,

Dr. Guruswamy
Medical Superintendent
JSS hospital
Mysuru -570008

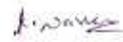
Respected sir,

Subject: Seeking Permission to take the patients of hospital as samples for MPT thesis.

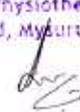
I am a student of JSS College of physiotherapy pursuing master's degree (Neurology and Psychosomatic disorders). As a part of my studies, I am planning to conduct a study. The title of this proposed study is "**The Effect of Game based activities on Upper Extremity Functional recovery In Stroke survivors: a randomized controlled trail**". Video game joystick is a device which has been used for rehabilitation therapy treatment in order to retrain the upper extremity function. The aim of my study is to evaluate the effect of game based rehabilitation on upper extremity functions in stroke survivors and to explore the patient experience of using game based rehabilitation as a medium in rehabilitation strategy. If proven effective, it can be used in the routine clinical setting for the betterment of patient's condition. This study requires stroke patients who are admitted to the Inpatient and outpatient department of Neurology. I have received the clearance from institutional ethical committee of JSS Medical College, Mysuru as well from the Head of Department of Neurology. Hence, I request your good offices to kindly consider my request and grant permission to conduct this study.

Thanking you,

Yours sincerely,


K.Naresh

*Approval granted
xoxo neurology is
Nandotom up to the
Project is complete
G. Guruswamy
23/8/18*


Principal
JSS College of Physiotherapy
Ramanuja Road, Mysuru-04
Guide: 

JSS COLLEGE OF PHYSIOTHERAPY
Ramanuja Road, Mysuru-04
570008

**Appendix B3. Permission from Head of the Department
(Department of neurology)**

From,

Date: 23.08.2018

K.Naresh
First year.MPT
JSS College of Physiotherapy
Mysuru -570008

To,

The Head of the Department
(Department of Neurology)
JSS hospital
Mysuru -570008

Respected sir,

Subject: Seeking Permission to take the patients of hospital as samples for MPT thesis.

I am a student of JSS College of physiotherapy pursuing master's degree (Neurology and Psychosomatic disorders). In order to complete the criteria of course completion, I am planning to conduct a study. The title of this proposed study is "**The Effect of Game based activities on Upper Extremity Functional recovery In Stroke survivors: a randomized controlled trail**". Video game joystick is a device which has been used for rehabilitation therapy treatment in order to retrain the upper extremity function. The aim of my study is to evaluate the effect of game based rehabilitation on upper extremity functions in stroke survivors and to explore the patient experience of using game based rehabilitation as a medium in rehabilitation strategy. If proven effective, it can be used in the routine clinical setting for the betterment of patient's condition. This study requires stroke patients who are admitted to the Inpatient and outpatient department of Neurology. I have received the clearance from institutional ethical committee of JSS Medical College, Mysuru Hence, I request your good offices to kindly consider my request and grant permission to conduct this study.

Yours sincerely,

K.Naresh

*Forwarded to
Dr. Gunderling
Medical Superintendent
JSS Hospital
Mysuru*
Dr. S. MARSHA MD, DM
Professor & Head, Dept. of Neurology
JSS Medical College, Mysuru
25.8.18

Principal:

Guide:

R. L. M.
PRINCIPAL
JSS College of Physiotherapy
Ramanuja Road, Mysuru

JSS COLLEGE OF PHYSIOTH.
RAMANUJA ROAD,
MYSORE-570 004

Appendix C-1: Informed Consent (English)

Research title: The Effect of Game Based Activities on Upper Extremity Functional Recovery in Stroke Survivors - a Randomized controlled trial

Principal investigator: Kavadi Naresh

Designation: Post-graduate student (Neurology and Psychosomatic disorders)

College: JSS College of Physiotherapy, Mysore

Phone number: +91 9490719502

Please read this form carefully. If you don't understand the language or any information in this document, please discuss with principal investigator, Kavadi Naresh will be available from 9am-5pm at JSS College of Physiotherapy, Mysuru. Your participation in this study is voluntary, and you can enquire about all details before giving your written consent to participate in this study.

- 1. Purpose of research:** To know the effect of game based rehabilitation on upper extremity functions in patients of sub-acute stroke to explore the patient experiences of using game based rehabilitation as a medium in rehabilitation.
- 2. Procedure:** I understand that **Mr. Kavadi Naresh** will give treatments like video games and mirror therapy technique to upper extremity. I may withdraw from the study without any reasons if i want.

3. **Benefits:** If proven effective, game based activities can be routinely used in rehabilitation of patients with stroke and to explore the patient experiences of using game based rehabilitation as a medium in rehabilitation.
4. **Injury statement:** I understand that it is unlikely to get injured directly during my participation in this study, and in such case first aid will be given but no further compensation would be provided by the department or hospital. I am aware that by agreeing to participate in this study, I am not waiving any of my legal right.
5. **Confidentiality:** I understand that medical information produced by this study will become a part of my hospital records and will be subject to confidentiality and privacy regulations of the hospital. If the data are used for publication in medical literature or for teaching purposes, no names will be used and photographs/videos will be used only with my special written permission.
6. **Request for more information:** I understand that I can ask any questions about the study at any time to Mr. Kavadi Naresh at the following Phone number +91 8095294027

If you have any questions about the study process or your rights as a participant, you may contact **Mrs. Nagina Nikath**, MPT who is an assistant professor in JSS College of Physiotherapy, Mysuru in the following mobile number- +91 9986729786

7. Refusal or withdrawal of participation: I understand that my participation is voluntary and that I can refuse my participation or withdraw consent and discontinue at any time during the period of study.

I have explained to.....the purpose of the research ,the procedures required, and the possible risks and benefits to the best of my ability.

Investigator:

Date:

I confirm that **Mr. K. Naresh** has explained to me the purpose of research, the study procedures that I will undergo, the possible risks and discomforts as well as benefits I may have. Alternative to my participation in the study have also been discussed. I have read and understood this consent form. Therefore, I agree to give my consent for my participation as a participant in this research project.

Participant:

Date:

Witness 1:

Date:

Witness 2:

Date:

Appendix C-2: Informed Consent (Kannada)

ಮಾಹಿತ್ತಿಯುಕ್ತ ಸಮ್ಮತಿ ಪತ್ರ

ಶೀರ್ಷಿಕೆ: ಸ್ಪ್ರೋಕ್ಟಿಂಡ ಬದುಕುಳಿದ ರೋಗಿಗಳ ಕೈ ಚಟುವಟಿಕೆಗಳ ಮೇಲೆ ಆಟ ಆಧಾರಿತ ಪುನರ್ವಸತಿ ಪರಿಣಾಮ.

ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿ : ಕಾವಾಡಿ ನರೇಶ್

ಸ್ಥಾನಿಕರಣ: ಸ್ನಾತಕೋತ್ತರ ವಿದ್ಯಾರ್ಥಿ (ನ್ಯೂರೋಲಜಿ ಅಂಡ್ ಸೈಕೋ ಸೋಮಟಿಕ್ ಡಿಸಾರ್ಡರ್ಸ್)

ವ್ಯಾಸಂಗ ಮಾಡುತ್ತಿರುವ ಕಾಲೇಜು : ಜೆಎಸ್ಎಸ್ ಫಿಸಿಯೊಥೆರಪಿ ಕಾಲೇಜು ,ಮೈಸೂರು

ದೂರವಾಣಿ ಸಂಖ್ಯೆ: +91-9490719502

1. ಅಧ್ಯಯನದ ಉದ್ದೇಶ:

ಸ್ಪ್ರೋಕ್ಟಿಂಡ ಬದುಕುಳಿದ ರೋಗಿಗಳ ಕೈ ಚಟುವಟಿಕೆಗಳ ಮೇಲೆ ಆಟ ಆಧಾರಿತ ಪುನರ್ವಸತಿ ಪರಿಣಾಮ ಆಧಾರಿತ ದಚಟುವಟಿಕೆಗಳ ಮೇಲೆ ರೋಗಿಗಳ ಅನುಭವವನ್ನು ಅನ್ವೇಷಿಸಲು.

2. ಕಾರ್ಯವಿಧಾನ:

ಶ್ರೀಯುತ ಕಾವಾಡಿ ನರೇಶ್ ರವರು ನನ್ನ ಕೈಗಳ ಚಟುವಟಿಕೆಗಳನ್ನು ವೃದ್ಧಿಸಲು / ಸುಧಾರಿಸಲು ತರವಾರಿಯಾದ ವೀಡಿಯೋ ಗೇಮ್ಸ್, ಮಿರರ್ ಥೆರಪಿ ಚಿಕಿತ್ಸೆಗಳನ್ನು ನೀಡುತ್ತಾರೆ ಹಾಗೂ ನಾನು ಅಧ್ಯಯನದ ಯಾವುದೇ ಸಮಯದಲ್ಲಾದರೂ ನನ್ನ ಸಮ್ಮತಿಯನ್ನು ಹಿಂತೆಗೆದುಕೊಳ್ಳಬಹುದು.

3. ಪ್ರಯೋಜನಗಳು :

ಈ ಅಧ್ಯಯನವು ಸಾಬೀತಾದರೆ ಆಧಾರಿತ ಚಟುವಟಿಕೆಯನ್ನು, ಸ್ಮೋಕ್ ರೋಗಿಗಳ ಪುನರ್ವಸತಿ ಬಳಸಬಹುದು ಮತ್ತು ಆಟ ಆಧಾರಿತ ದಚಟುವಟಿಕೆಗಳ ಮೇಲೆ ರೋಗಿಗಳ ಅನುಭವವನ್ನು ಅನ್ವೇಷಿಸಲು.

4. ಅಪಾಯಗಳ ಕುರಿತು:

ಈ ಅಧ್ಯಯನದ ಪಾಲ್ಗೊಳ್ಳುವಿಕೆಯ ಅವಧಿಯಲ್ಲಿ ನೆರವಾಗಿ ಗಾಯಗೊಳ್ಳುವ ಸಾಧ್ಯತೆಯಿಲ್ಲ ಎಂದು ನಾನು ಅರ್ಥ ಮಾಡಿಕೊಂಡಿರುತ್ತೇನೆ. ಗಾಯವಾದ ಸಂದರ್ಭದಲ್ಲಿ ನನಗೆ ಪ್ರಥಮ ಚಿಕಿತ್ಸೆ ನೀಡಲಾಗುವುದು, ಆದರೆ ಇಲಾಖೆ ಅಥವಾ ಆಸ್ಪತ್ರೆಯಿಂದ ಮತ್ತಷ್ಟು ಪರಿಹಾರವನ್ನು ನೀಡಲಾಗುವುದಿಲ್ಲ.

5. ಗೌಪ್ಯತೆ:-

ಈ ಅಧ್ಯಯನದ ಪರಿಣಾಮವಾಗಿ ಉತ್ಪತ್ತಿಯಾದ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯವಾಗಿ ಪರಿಗಣಿಸಲಾಗುತ್ತದೆ ಎಂದು ನನಗೆ ಅರ್ಥವಾಗಿದೆ. ನನ್ನ ಲಿಖಿತ ಅನುಮತಿಯಿಲ್ಲದೆ ಯಾವುದೇ ವ್ಯಕ್ತಿಗೆ ಅದು ಬಹಿರಂಗಗೊಳ್ಳಬಾರದು. ಅಧ್ಯಯನದ ಸಂದರ್ಭದಲ್ಲಿ ದೊರೆತ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯತೆಯನ್ನು ಗಮನದಲ್ಲಿರಿಸಿ ಸಂಖ್ಯಾ ಶಾಸ್ತ್ರೀಯ ವಿಶ್ಲೇಷಣೆ, ಪ್ರಕಟಣೆ ಅಥವಾ ಬೋಧನಾ ಉದ್ದೇಶಗಳಿಗಾಗಿ ಬಳಸಬಹುದು.

6. ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ ವಿನಂತಿ:

ಅಧ್ಯಯನದ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ ನಾನು ಯಾವುದೇ ಸಮಯದಲ್ಲಾದರೂ ವಿನಂತಿಸಬಹುದು ಹಾಗೂ ಶ್ರೀ ಕಾವಾಡಿ ನರೇಶ್ ರವರು ನನ್ನ ಸಂಶಯಗಳನ್ನು ಉತ್ತರಿಸಲು ಜೆ.ಎಸ್.ಎಸ್ ಕಾಲೇಜ್, ಫಿಸಿಯೋಥೆರಪಿ ವಿಭಾಗದಲ್ಲಿ ಲಭ್ಯವಿರುತ್ತಾರೆ ಎಂಬುದರ ಅರಿವು ನನಗಿದೆ.

ಈ ಮಾಹಿತಿ ಸಮ್ಮತಿ ಪತ್ರದ ಬಗ್ಗೆ ಯಾವುದೇ ಪ್ರಶ್ನೆಗಳಿದ್ದಲ್ಲಿ ಮತ್ತು ನಿಮ್ಮ ಭಾಗವಹಿಸುವಿಕೆ ಬಗ್ಗೆ ನೀವು ಶ್ರೀಮತಿ ನಗೀನಾ ನಿಖತ್ ಎಂ , ಎಂ.ಪಿ.ಟಿ ಸಹಾಯಕ ಪ್ರಾಧ್ಯಾಪಕರು, ಜೆ.ಎಸ್ ಎಸ್ ಫಿಸಿಯೋಥೆರಪಿ ಕಾಲೇಜು ಮೈಸೂರು ಅವರನ್ನು ಸಂಪರ್ಕಿಸಿ.

7. ಭಾಗವಹಿಸುವಿಕೆಯ ನಿರಾಕರಣೆಯನ್ನು ಕುರಿತು:

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನನ್ನ ಭಾಗವಹಿಸುವಿಕೆ ಸ್ವಇಚ್ಛೆಯಾಗಿದ್ದು, ಯಾವುದೇ ಸಂದರ್ಭದಲ್ಲಾದರೂ ನನ್ನ ಭಾಗವಹಿಸುವಿಕೆಯನ್ನು ಹಿಂತೆಗೆದುಕೊಳ್ಳಬಹುದು ಎಂಬುದರ ಅರಿವು ನನಗಿದೆ.

ನಾನು ಶ್ರೀ/ಶ್ರೀಮತಿ _____ ಅವರಿಗೆ ಅಧ್ಯಯನದ ಉದ್ದೇಶವನ್ನು, ಆಗುವ ಅನುಕೂಲ/ಅನಾನುಕೂಲಗಳ ಬಗ್ಗೆ ನನ್ನ ಸಾಮರ್ಥ್ಯಕ್ಕನುಗುಣವಾಗಿ ಹೇಳಿದ್ದೇನೆ/ವ್ಯಕ್ತಪಡಿಸಿದ್ದೇನೆ.

ತನಿಖೆದಾರರ ಸಹಿ:

ದಿನಾಂಕ:

ಶ್ರೀ ಕಾವಾಡಿ ನರೇಶ್ ರವರು ಈ ಅಧ್ಯಯನದ ಸಂಪೂರ್ಣ ಮಾಹಿತಿಯನ್ನು ನನಗೆ ನೀಡಿದ್ದಾರೆ. ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವುದರಿಂದ ನನಗಾಗುವ ಅನುಕೂಲ, ಅನಾನುಕೂಲಗಳ ಬಗ್ಗೆ ಮಾಹಿತಿಯನ್ನು ನೀಡಿದ್ದಾರೆ.

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನಾನು ಸ್ವಇಚ್ಛೆಯಿಂದ ಭಾಗವಹಿಸುತ್ತಿದ್ದೇನೆ ಹಾಗೂ ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ನನ್ನ ಸಂಪೂರ್ಣ ಅನುಮತಿ ಇದೆ.

ಸ್ಪರ್ಧಿ :-

ದಿನಾಂಕ :

ಸಾಕ್ಷಿ :-

ದಿನಾಂಕ :

ಸಾಕ್ಷಿ :-

ದಿನಾಂಕ :

Appendix C-3: Patient Information Sheet (English)

Title of the study: The Effect of Game Based Activities on Upper Extremity Functional Recovery in Stroke Survivors – a Randomized Controlled Trial

Principal investigator: Kavadi Naresh

Designation: Student pursuing Masters of physiotherapy in Neurology and Psychosomatic disorders

Mobile number: +91 9490719502

Please read this form carefully. If you don't understand the language or any information in this document, please discuss with principal investigator. Your participation in this study is voluntary, and you can enquire about all details before giving your written consent to participate in this study.

1. Introduction to the study

This study aims to prove the effect of game based activities in improvement of the upper extremity functions by using the joystick video game. The game duration is 13 minutes will be given to the patient to the unaffected side hand and the rest time is 4 minutes. The same set of instructions will be given to the patient and repeat on the affected side hand with the duration of 13 minutes to the affected side. The game activities will be given 4 days per week with respective of 5 weeks. The outcome measure, Action Research Arm Test (ARAT) will be

administered. The values will be taken base line and every week from 1st to 5th week.

2. Purpose of the study

To evaluate the effect of game based rehabilitation on upper extremity functions in stroke survivors and to explore the patient experiences of using game based rehabilitation as a medium in rehabilitation

3. Information about the study as a whole

Study will be conducted at patient's home, Mysuru. The screening of the patients will be done before inclusion in this study. The Patients who are admitted in IP Neuro ward with sub-acute stroke will be included in the study as per inclusion criteria. The participant will be a part of the study only for up to 5 weeks. The participant will be asked to do a particular joystick game for 30 minutes to with affected and unaffected side hand. The outcome measure Action Research Arm Test (ARAT) will be used every week from 1st week to 5th week to check your hand function. There will be a therapist who will be supervising the participant to ensure the safety during the study.

4. Your role/ responsibility in the study:

- Provide accurate information whenever asked.
- Inform the study doctor about any problem/side effects experienced during the study
- Follow the investigator's instruction

- If you want to discontinue from the study, principal investigator should be informed.

5. What are the potential benefits of participating in the study?

You may or may not get benefit from participating in this study. It is possible that your arm function may get better or may stay the same.

6. What are the alternative treatments available?

If you decide not to participate in this study, your non participation will not affect your treatment in any way

7. Confidentiality of information:

Information from the study records including your name, address, medical records, results of tests, study results will be kept confidential and will be reviewed only by authorized personnel from the sponsor or their representative, Ethics Committee or regulatory bodies. The data will not be made available to another individual unless you specifically give permission in writing. Information and results from this study may be presented at meetings or published in journals without including your name and personal identifications. No reference will be made in oral or written reports which could link you to the study.

8. New information about the study:

Any new information available during the course of the study will be informed to you if it has relevance to your decision regarding continuing in the study. Results of your participation will be disclosed to you if you indicate your desire for it.

9. Voluntary participation:

Your participation in this study is voluntary; you may decline to participate at any time and you need not give any reason for the same, and such withdrawal shall be without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study prior to its completion, you will receive the usual standard of care for your disease, and your non-participation will not have any adverse effects on your subsequent medical treatment or relationship with the treating physician. If you withdraw from the study before data collection is completed, your data collected until you indicated withdrawal will be used in the study report. The investigator may stop the research or your participation in it at any time for some or other reason without your permission.

10. Whom to contact in case of any questions:

If you experience adverse effects as a result of participating in this study, you may contact the Principal Investigator, **Kavadi Naresh**, as detailed above.

If you have any questions about the informed consent process or your rights as a participant, you may contact **Mrs. Nagina Nikath**, MPT who is an assistant professor in JSS College of Physiotherapy, Mysuru in the following mobile number- +91 9986729786.

Appendix C-4: Patient Information Sheet (Kannada)

ರೋಗಿಯ ಮಾಹಿತಿ ಪತ್ರ

ಶೀರ್ಷಿಕೆ: ಸ್ಪ್ರೋಕ್ಲಿಂಡ ಬದುಕುಳಿದ ರೋಗಿಗಳ ಕೈ ಚಟುವಟಿಕೆಗಳ ಮೇಲೆ ಆಟ ಆಧಾರಿತ ಪುನರ್ವಸತಿ ಪರಿಣಾಮ.

ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿ : ಕಾವಾಡಿ ಸರೇಶ್

ಸ್ಥಾನಿಕರಣ: ಸ್ನಾತಕೋತ್ತರ ವಿದ್ಯಾರ್ಥಿ (ನ್ಯೂರೋಲಜಿ ಅಂಡ್ ಸೈಕೋ ಸೋಮಟಿಕ್ ಡಿಸಾರ್ಡರ್ಸ್)

ವ್ಯಾಸಂಗ ಮಾಡುತ್ತಿರುವ ಕಾಲೇಜು : ಜೆಎಸ್ಎಸ್ ಫಿಸಿಯೊಥೆರಪಿ ಕಾಲೇಜು ,ಮೈಸೂರು

ದೂರವಾಣಿ ಸಂಖ್ಯೆ: +91-9490719502

ಈ ಮಾಹಿತಿಯ ಪತ್ರವನ್ನು ದಯವಿಟ್ಟು ಗಮನಿಸಿ ಓದಿ.ನಿಮಗೆ ಯಾವುದಾದರೂ ವಿಷಯದ ಬಗ್ಗೆ ಮಾಹಿತಿ ಬೇಕಾದಲ್ಲಿ ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿ ಯಾದ ಕಾವಾಡಿ ಸರೇಶ್, ಜೆಎಸ್ಎಸ್ ಫಿಸಿಯೊಥೆರಪಿ ಕಾಲೇಜು ಸ್ನಾತಕೋತ್ತರ ವಿಭಾಗದಲ್ಲಿ ವಿದ್ಯಾರ್ಥಿಯಾಗಿ ಮಾಡುತ್ತಿದ್ದಾರೆ. ಇವರನ್ನು ಬೆಳಿಗ್ಗೆ 9 ರಿಂದ 5 ಗಂಟೆ ಸಮಯದಲ್ಲಿ ಸಂಪರ್ಕಿಸಬಹುದು. ನಿಮ್ಮ ಭಾಗವಹಿಸುವಿಕೆ ಸ್ವಯಂ ಪ್ರೇರಿತವಾಗಿದ್ದು ಮಾಹಿತಿ ಪತ್ರವನ್ನು ಸಹಿ ಮಾಡುವ ಮುನ್ನ ನಿಮಗೆ ಬೇಕಾದ ಎಲ್ಲ ಮಾಹಿತಿಯನ್ನು ತಿಳಿದುಕೊಳ್ಳಬೇಕಾಗಿದೆ.

1. ಅಧ್ಯಯನದ ಶೀರ್ಷಿಕೆ ಬಗ್ಗೆ ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ:

ಈ ಅಧ್ಯಯನವು ಕೈನ ಕಾರ್ಯಗಳನ್ನು ಸುಧಾರಿಸುವಲ್ಲಿ ಆಟದ ಆಧಾರಿತ ಚಟುವಟಿಕೆಗಳ ಜಾಯ್ಸ್ಕಿಕ್ ವೀಡಿಯೋ ಗೇಮ್. ಪರಿಣಾಮವನ್ನು ಸಾಬೀತುಪಡಿಸಲು ಉದ್ದೇಶಿಸಿದೆ. ಈ ಜಾಯ್ಸ್ಕಿಕ್ ಆಟವನ್ನು ಮೊದಲು ಭಾದಿತವಾಗದ ಕೈಗೆ ಆಡಲು ಹೇಳಲಾಗುತ್ತದೆ. ಆಟದ ಸಮಯ 13 ನಿಮಿಷ ಗಳಾಗಿದ್ದು, ಇದರಲ್ಲಿ ನಾಲ್ಕು ನಿಮಿಷಗಳ ವಿಶ್ರಾಂತಿ ಇರುತ್ತದೆ. ನಂತರ ಇದೇ ಆಟವನ್ನು ಬಾಧಿತವಾದ ಕೈನಲ್ಲಿ ಆಡಲು ಹೇಳಲಾಗುವುದು. ಈ ಆಟವನ್ನು ವಾರದಲ್ಲಿ ನಾಲ್ಕು ದಿನಗಳಂತೆ ಐದು ವಾರಗಳವರೆಗೆ ನೀಡಲಾಗುವುದು. ಆಕ್ಸನ್ ರಿಸರ್ಚ್ ಆರ್ಮ್ ಟೆಸ್ಟ್ ಅನ್ನು ಬಳಸಿ ನಿಮ್ಮ ಕೈಗಳ ಕಾರ್ಯವನ್ನು , ವ್ಯಾಯಾಮದ ಮೊದಲು ಮತ್ತು 1 ನೇ ವಾರದಿಂದ 5 ನೇ ವಾರದ ವರೆಗೆ ಪರೀಕ್ಷಿಸಲಾಗುವುದು.

2. ಅಧ್ಯಯನದ ಉದ್ದೇಶ :

ಸ್ಪೋರ್ಟ್‌ನಿಂದ ಬದುಕುಳಿದ ರೋಗಿಗಳ ಕೈ ಚಟುವಟಿಕೆಗಳ ಮೇಲೆ ಆಟ ಆಧಾರಿತ ಪುನರ್ವಸತಿ ಪರಿಣಾಮ ಮತ್ತು ಆಟ ಆಧಾರಿತ ದ ಚಟುವಟಿಕೆಗಳ ಮೇಲೆ ರೋಗಿಗಳ ಅನುಭವವನ್ನು ಅನ್ವೇಷಿಸಲು.

3. ಅಧ್ಯಯನದ ಮಾಹಿತಿ :

ಈ ಅಧ್ಯಯನವನ್ನು ರೋಗಿಗಳ ಮನೆಯಲ್ಲಿ ನಡೆಸಲಾಗುವುದು. ಸೇರ್ಪಡೆಯ ಮೊದಲು ರೋಗಿಗಳ ಸ್ಟ್ರೀನಿಂಗ್ ಅನ್ನು ಮಾಡಲಾಗುತ್ತದೆ. ಸೇರ್ಪಡೆಯ ಆಧಾರದ ಮೇಲೆ ನ್ಯೂರೋಲಜಿ ಒಳರೋಗಿಗಳ ಇಲಾಖೆಯಲ್ಲಿ ಅಡ್ಮಿಟ್ ಆಗಿರುವ ರೋಗಿಗಳನ್ನು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಸೇರ್ಪಡಿಸಲಾಗುತ್ತದೆ. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವ ರೋಗಿಗಳು ಐದು ವಾರಗಳ ವರೆಗೆ ಮಾತ್ರ ಅಧ್ಯಯನದ ಒಂದು ಭಾಗವಾಗಿರುತ್ತಾರೆ. ರೋಗಿಗಳಿಗೆ 30 ನಿಮಿಷಗಳವರೆಗೆ ಜಾಯ್ಸ್ಕಿಕ್ ಆಟವನ್ನು ತಮ್ಮ ಬಾಧಿತ ಮತ್ತು ಬಾಧಿತ ವಾಗದ ಕೈನಿಂದ ಆಡಲು ಹೇಳಿಕೊಡಲಾಗುತ್ತದೆ. ಆಕ್ಸನ್ ರಿಸರ್ಚ್ ಅನ್ನು ಬಳಸಿ ಪ್ರತಿವಾರದ ಒಂದನೇ ವಾರದಿಂದ ಐದನೇ ವಾರದ ವರೆಗೆ ನಿಮ್ಮ ಕೈಗಳ ಕಾರ್ಯವನ್ನು ಪರೀಕ್ಷಿಸಲಾಗುತ್ತದೆ.

4. ಅಧ್ಯಯನದಿಂದ ಆಗುವ ಉಪಯೋಗಗಳು:-

ಈ ಅಧ್ಯಯನದಿಂದ ನಿಮ್ಮ ಕೈ ಚಟುವಟಿಕೆಯು ಹೆಚ್ಚಾಗಬಹುದು ಅಥವಾ ಹಾಗೆಯೇ ಇರಬಹುದು.

5. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನಿಮ್ಮ ಪಾತ್ರ ಅಥವಾ ಹೊಣೆಗಾರಿಕೆ :

ಅಗತ್ಯವಿದ್ದಾಗ ಯಾವುದೇ ಸಂಕೋಚವಿಲ್ಲದೆ ಸರಿಯಾದ ಮಾಹಿತಿಯನ್ನು ಕೊಡತಕ್ಕದ್ದು. ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಯಾವುದೇ ಅಡಚಣೆಗಳು ಅಥವಾ ತೊಂದರೆಯಾದಲ್ಲಿ ನಿಸ್ಸಂಕೋಚವಾಗಿ ವೈದ್ಯರಿಗೆ ಅಥವಾ ಥೆರಪಿಸ್ಟ್ ರವರಿಗೆ ಹೇಳತಕ್ಕದ್ದು. ತನಿಖಾಧಿಕಾರಿಗಳು ಹೇಳುವುದನ್ನು ಸರಿಯಾಗಿ ಪಾಲನೆ ಮಾಡಬೇಕು. ಅಧ್ಯಯನದಿಂದ ಹೊರಬರಬೇಕಾದರೆ ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿಯದ ಕಾಪಾಡಿ ಸರೇಜ್, ರವರಿಗೆ ವಿಷಯವನ್ನು ತಿಳಿಸತಕ್ಕದ್ದು.

6. ನಿಮಗೆ ದೊರೆಯುವ ಇತರ ಚಿಕಿತ್ಸೆಗಳು :

ನೀವು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸದಿದ್ದರೂ ಕೂಡ ನಿಮಗೆ ಅಗತ್ಯವಿರುವ ಇತರ ಚಿಕಿತ್ಸೆಗಳು ನಿಮಗೆ ಕಂಡಿತವಾಗಿಯೂ ದೊರಕುವುದು ಅಧ್ಯಯನದಿಂದ ಹೊರಬರಬೇಕಾದರೆ ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿಯದ ಮುಕುಂದ ರವರಿಗೆ ವಿಷಯವನ್ನು ತಿಳಿಸತಕ್ಕದ್ದು.

7. ಗೌಪ್ಯತೆಯ ಮಾಹಿತಿ:

ಯಾವುದೇ ಸಂದರ್ಭದಲ್ಲಿಯೂ ಸಹ ನಿಮ್ಮ ವೈಯಕ್ತಿಕ ಮಾಹಿತಿಯನ್ನು ಯಾರಿಗೂ ತಿಳಿಸಲಾಗುವುದಿಲ್ಲ. ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ದೊರಕುವ ಮಾಹಿತಿಯನ್ನು ನಿಮ್ಮ ಸಹಿತ ಸಮ್ಮತಿಯ ಮೂಲಕವೇ ರಿಸರ್ಚ್ ಕೆಲಸಗಳಿಗೆ ಉಪಯೋಗಿಸುತ್ತೇವೆ.

8. ಸ್ವಯಂ ಪ್ರೇರಿತ / ಸ್ವಇಚ್ಛೆಯಾ ಭಾಗವಹಿಸುವಿಕೆ :

ಅಧ್ಯಯನದಲ್ಲಿ ನಿಮ್ಮ ಭಾಗವಹಿಸುವಿಕೆ ಸ್ವಇಚ್ಛೆಯಾಗಿದ್ದು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ನಿಮ್ಮ ಭಾಗವಹಿಸುವಿಕೆಯನ್ನು ನೀವು ನಿಲ್ಲಿಸಬಹುದು ಇದರಿಂದಾಗಿ ನಿಮಗೆ ದೂರಕಬೇಕಾದ ಚಿಕ್ಕಿತ್ನಗಳಲ್ಲಿ ಯಾವುದೇ ರೀತಿಯ ಬದಲಾವಣೆ ಅಥವಾ ತೊಂದರೆ ಆಗುವುದಿಲ್ಲ. ಡಿಸ್ಟಾನ್ಸ್ ಮೊದಲು ಲಭ್ಯವಿರುವ ಮಾಹಿತಿಯನ್ನು ನಿಮ್ಮ ವೈಯಕ್ತಿಕ ವಿಷಯಗಳನ್ನು ಬಳಸದೆ ರಿಸರ್ಚ್ ಕೆಲಸಕ್ಕೆ ಉಪಯೋಗಿಸುತ್ತೇವೆ.

9. ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ದೂರಕುವ ಹೊಸ ವಿಷಯಗಳ ಬಗ್ಗೆ :

ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಲಭ್ಯವಾಗುವ ವಿಷಯಗಳನ್ನು ನಿಮಗೆ ಖಂಡಿತವಾಗಿಯೂ ತಿಳಿಸುತ್ತೇವೆ.

10. ಸಂಪರ್ಕಿಸಬೇಕಾದ ವ್ಯಕ್ತಿ :

ಯಾವುದೇ ರೀತಿಯ ತೊಂದರೆ ಆದಲ್ಲಿ ನೀವು ಸಂಪರ್ಕಿಸಬೇಕಾದ ವ್ಯಕ್ತಿ ಕಾವಾಡಿ ಸರ್ಕೆಸ್, ಅವರ

ದೂರವಾಣಿ ಸಂಖ್ಯೆ:+91-9490719502

ಈ ಮಾಹಿತಿ ಸಮ್ಮತಿ ಪತ್ರದ ಬಗ್ಗೆ ಯಾವುದೇ ಪ್ರಶ್ನೆಗಳಿದ್ದಲ್ಲಿ ಮತ್ತು ನಿಮ್ಮ ಭಾಗವಹಿಸುವಿಕೆ ಬಗ್ಗೆ ನೀವು ಶ್ರೀಮತಿ ನಗೀನಾ ನಿಖತ್ ಎಂ . ಎಂ.ಪಿ.ಟಿ ಸಹಾಯಕ ಪ್ರಾಧ್ಯಾಪಕರು, ಜೆ.ಎಸ್.ಎಸ್ ಫಿಸಿಯೊಥೆರಪಿ ಕಾಲೇಜು ಮೈಸೂರು ಅವರನ್ನು ಸಂಪರ್ಕಿಸಿ.

ದೂರವಾಣಿ ಸಂಖ್ಯೆ:+91-9986729786

Appendix D. Level of Evidence

Canadian Medical Association Journal (CMA) 1998

Level I: Evidence is based on RCTs (or meta- analyses of such trials) of adequate size to ensure a low risk of incorporating false- positive or false- negative results.

Level II: Evidence is based on RCTs that are too small to provide level I evidence.

Level III: Evidence is based on non- randomized, controlled, or cohort studies, case series, case- controlled studies, or cross- sectional studies.

Level IV: Evidence is based on the opinion of respected authorities or those expert committees as published consensus conferences or guidelines.

Level V: Evidence expresses the opinion of those individuals who have written and reviewed guidelines, based on their experience, knowledge of the relevant literature, and discussion with their peers.

Appendix E. Critical Appraisal Skills Programs (CASP).

E1. CASP for systematic review

Questions	Answer
Did the review address a clearly focused question?	Yes/No/Can't tell
Did the authors look for the right type of papers?	Yes/No/Can't tell
Do you think all the important, relevant studies were included?	Yes/No/Can't tell
Did the review's authors do enough to assess the quality of the included studies?	Yes/No/Can't tell
If the results of the review have been combined, was it reasonable to do so?	Yes/No/Can't tell
What are the overall results of the review?	
How precise are the results?	
Can the results be applied to the local population?	Yes/No/Can't tell
Were all important outcomes considered?	Yes/No/Can't tell
Are the benefits worth the harms and costs?	Yes/No/Can't tell

E2. CASP for Cross sectional study

Question	Yes	No	Don't know
Were the aims/objectives of the study clear?			
Was the study design appropriate for the stated aim(s)?			
Was the sample size justified?			
Was the target/reference population clearly defined? (Is it clear who the research was about?)			
Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?			
Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?			
Were measures undertaken to address and categories non-responders?			
Were the risk factor and outcome variables measured appropriate to the aims of the study?			
Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?			
Is it clear what was used to determined statistical			

significance and/or precision estimates? (e.g. p-values, confidence intervals)			
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?			
Were the basic data adequately described?			
Does the response rate raise concerns about non-response bias?			
If appropriate, was information about non-responders described?			
Were the results internally consistent?			
Were the results presented for all the analyses described in the methods?			
Were the authors' discussions and conclusions justified by the results?			
Were the limitations of the study discussed?			
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?			
Was ethical approval or consent of participants attained?			

E3.Critical appraisal tool for case control study (center for evidence based management)

Questions	Yes	Can't tell	No
Did the study address a clearly focused question / issue?			
Is the research method (study design) appropriate for Answering the research question?			
Are both the setting and the subject's representative with Regard to the population to which the findings will be referred?			
Is the researcher's perspective clearly described and taken into account?			
Are the methods for collecting data clearly described?			
Are the methods for analyzing the data likely to be valid and reliable? Are quality control measures used?			
Was the analysis repeated by more than one researcher to ensure reliability?			

Are the results credible, and if so, are they relevant for Practice?			
Are the conclusions drawn justified by the results?			
Are the findings of the study transferable to other settings?			

E4. CASP for RCT

Questions	Answer
Did the trial address a clearly focused issue?	Yes/No/Can't tell
Was the assignment of patients to treatment randomized?	Yes/No/Can't tell
Were all of the patients who entered the trial properly accounted for at its Conclusion?	Yes/No/Can't tell
Were patients, health workers and study personnel 'blind' to treatment?	Yes/No/Can't tell
Were the groups similar at the start of the trial?	Yes/No/Can't tell
Aside from the experimental intervention, were the groups treated equally?	Yes/No/Can't tell
How large was the treatment effect?	
How precise was the estimate of the treatment effect?	Yes/No/Can't tell
Can the results be applied in your context? (or to the local population?)	Yes/No/Can't tell
Were all clinically important outcomes Considered?	Yes/No/Can't tell
Were all clinically important outcomes Considered?	Yes/No/Can't tell

E5.JBI Critical appraisal tool for case series study

Questions	Yes	No	Unclear	Not applicable
Were there clear criteria for inclusion in the case series?				
Was the condition measured in a standard, reliable way for all participants included in the case series?				
Were valid methods used for identification of the condition for all participants included in the case series?				
Did the case series have consecutive inclusion of participants?				
Did the case series have complete inclusion of participants?				
Was there clear reporting of the demographics of the participants in the study?				
Was there clear reporting of clinical information of the participants?				
Were the outcomes or follow up results of cases clearly reported?				
Was there clear reporting of the presenting site(s)/clinic(s) demographic information?				
Was statistical analysis appropriate?				

E6. JBI critical appraisal tool for quasi experimental studies

Question	Yes	No	Unclear	Not applicable
Is it clear in the study what is the cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?				
Were the participants included in any comparisons similar?				
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?				
Was there a control group?				
Were there multiple measurements of the outcome both pre and post the intervention/exposure?				

Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?				
Were the outcomes of participants included in any comparisons measured in the same way?				
Were outcomes measured in a reliable way?				
Was appropriate statistical analysis used?				

Appendix F. ARAT scale

Activity	Score
Grasp	
1. Block, wood, 10 cm cube (If score = 3, total = 18 and to Grip) Pick up a 10 cm block	_____
2. Block, wood, 2.5 cm cube (If score = 0, total = 0 and go to Grip) Pick up 2.5 cm block	_____
3. Block, wood, 5 cm cube	_____
4. Block, wood, 7.5 cm cube	_____
5. Ball (Cricket), 7.5 cm diameter	_____
6. Stone 10 x 2.5 x 1 cm	_____
Coefficient of reproducibility = 0.98	
Coefficient of scalability = 0.94	
Grip	
1. Pour water from glass to glass (If score = 3, total = 12, and go to Pinch)	_____
2. Tube 2.25 cm (If score = 0, total = 0 and go to Pinch)	_____
3. Tube 1 x 16 cm	_____
4. Washer (3.5 cm diameter) over bolt	_____
Coefficient of reproducibility = 0.99	
Coefficient of scalability = 0.98	
Pinch	
1. Ball bearing, 6 mm, 3 rd finger and thumb (If score = 3, total = 18 and go to Grossmt)	_____
2. Marble, 1.5 cm, index finger and thumb (If score = 0, total = 0 and go to Grossmt)	_____
3. Ball bearing 2 nd finger and thumb	_____
4. Ball bearing 1 st finger and thumb	_____
5. Marble 3 rd finger and thumb	_____
6. Marble 2 nd finger and thumb	_____
Coefficient of reproducibility = 0.99	
Coefficient of scalability = 0.98	

Grossmt (Gross Movement)

1. Place hand behind head (If score = 3, total = 9 and finish) _____
2. (If score = 0, total = 0 and finish) _____
3. Place hand on top of head _____
4. Hand to mouth _____

Coefficient of reproducibility = 0.98

Coefficient of scalability = 0.97

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Appendix G. Extreme 3D Pro Joystick and Lenovo laptop and Mirror box



Extreme 3D Pro Joystick, Lenovo laptop, mirror box

The Logitech extreme 3d pro gaming joystick will be used for this video game based therapy. The features are precision twist rudder control, programmable buttons, and way hat switch rapid-fire trigger, comfortable hand grip, stable, weighted base and it is compatible with the laptops and desktop computer systems which is easily portable and accessible for the gaming. The Logitech Extreme 3D Pro Joystick features 12 programmable buttons and an 8-way rubber hat switch to give user optimum control, customized as per user needs and Use these to dominate your enemy whether you're dropping bombs or firing guns – machine gun style, thanks to the rapid-fire trigger. The twist handle will allow user to home in on target for deadly precision. Smooth and accurate throttle settings will also be of major advantage in-game playing along with that 12 programmable buttons are there in joystick.

The game features a realistic world with dozens of aircraft. "Flight Simulator X"& Ace Combate is a game that contains more than 80 missions around the globe. A realistic weather cycle allows user to witness the day change from dawn, to the afternoon

to the evening within a flight. The simulator allows users to experience what it's like to fly 32,000 feet in the air. It is enjoyable to the user with pleasant experience of gaming.

Ace combate game had 3 levels and it's very interesting to play as well as challenging to face the enemies in the game. Website: www.logitech.com

Lenovo Laptop features: Lenovo G50 is a budget laptop for everyday use. It runs on Windows 10, 64 bit OS, and Intel Core i3 (4th generation), 1.7 GHz processor and has Intel HD Graphics 4400 processor. The laptop has a 15.6 inch HD LED Glare Flat Display and 1366 x 768pixels resolution.

Mirror box: It is a rectangular shape one and half feet width and one and half feet height box. Which is foldable portable and less weight to carry.

Appendix H: Similarity index certificate

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