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Table of contents:

Effectiveness of gamification to improve eye-hand coordination in children with cerebral palsy: an interventional study

Shivani Vyas [1], Priyanshu V. Rathod[2]

Abstract

Background: Gamification is the use of game elements to engage and invoke desired behavior in users. Children with cerebral palsy (CP) have compromised eye hand coordination and gamification may be one of the advanced therapeutics to improve the sensory motor coordination.

Objectives: To evaluate the effectiveness of gamification to improve eye – hand coordination and to find the impact of gamification on cognition improvement.

Methodology: 30 Children with CP were selected based on their ability to clear the first stage of bubble shooting and hill climb racing car games, Gross motor functional classifications (GMFCS) grade between 1 to 4, Mini Mental State Examination Scale (MMSE) score greater than 9, Manual Ability Classification System (MACS) grade between 2 to 4. Children were assessed pre- and post-performance with outcome measures such as Alternate Hand Wall Toss Test (AHWTT), Encephal Smartphone Stroop Test Application (ESSTA), and MMSE.

Result: Outcome measures AHWTT, ESSTA, MMSE were assessed every week for 4 weeks of duration of Gamification and statistically analyzed with repeated measure ANOVA where Wilk's lambda test saw highly significant as compared to p= 0.01 for ESSTA. Competitive gaming to achieve higher scores or stages with constant feedback ease sensory motor association. Bubble shooting games have vertical eye movement which gets hastened via pyramidal system and hill climb racing car games have horizontal eye movement via extrapyramidal system.

Conclusion: Gamification improves eye hand coordination along with cognition in children with cerebral palsy must be taken into consideration for neurodevelopmental training.

Key words: Gamification, Eye -Hand coordination, Cerebral palsy

INTRODUCTION

Gamification is one of the facilitation tools to hasten Neurodevelopmental development among children with cerebral palsy. Movement facilitation stays the major area of interest for every researcher. Appropriate sensory stimulation has a significant role in achieving motor output in Neurodevelopmental techniques (NDT). Eye-hand coordination movement is the skill whereby visual information from the eyes and motor information from the hands are efficiently applied to work together as an essential part of self-help activities, play, perception, and schoolwork. Coordination is the ability to execute smooth, correct, controlled movements. Coordinated movements are characterized by proper speed, distance, direction, timing, and muscular tension. Cerebral palsy is the most common motor disability in childhood. Its Prevalence range in India is from 1.5 to 4 per 1000 live births or children [1]. Preterm birth is a major risk factor for cerebral palsy. [2] Preterm born children have 6.4% chances of coordination disorder and very preterm born have 18.3% chances of coordination disorder.80% of children with Cerebral palsy have some abnormal neurological findings with the white matter being the most common. [2,4] White matter subserves coordination. [3] Information and communication technology has an increasing influence on the way we interact, learn, and live. The gamification where sensory-motor integration occurs at multiple levels & synchronization of sensory (visual) and motor (hands) stays essential components in the entire process. Regardless of the involvement of hemisphere eye-hand coordination is affected. If any damage in the hemisphere i.e., right hemisphere damage then the difficulty in the role of processing, difficulty in visual feedback and movement if the left hemisphere is damaged motor programming and timing & sequencing affected. Despite body area affected or brain involvement all the cerebral palsy children have eye-hand coordination affected. [5]

Gamification supplies a wide customize range from beginner level to more superior level which enables to supply a competitive level for children. The vestibular system manages balance and coordination. During gamification frequent movement occurs between eyes due to the game element. Stimulation from the brain reaches the midbrain –pons-medulla-semicircular canal. The semicircular canal is a part of the vestibular system. Continuous feed-forward and feed backward improve pathways between vestibulo-ocular reflex pathways. [5] Gamification is insightful when face to face rehabilitation is not possible and in absence of costly motion specific tools.

Materials and methods:

Study design: This study was an interventional study, an online mode where participants can take part in their comfortable environment. The study duration was one month starting from 6th January 2021 to 28th February 2021 was approved by the ethical committee of School of Physiotherapy, RK University, and Recognized by Central drug standard control organization and trial registered under clinical trials registry –INDIA. Telephonic verbal consent was taken from parents.

Data Collection

A flyer was distributed among special educators, special schools, and physiotherapists for voluntary participation in the study.39 parents agree to take part among them 7 are excluded because of not fulfilling inclusion criteria .32 children with cerebral palsy who have difficulty in eye-hand coordination were taken between the ages 10-16 years.

The participant was taken based on the following criteria:1) Children and parents who are willing to take part in the study.

2) Children with cerebral palsy who can play bubble shooting games (Bubble shooter 13.0.5 version) and hill climb racing games (finger soft 1.48.1 version) and clear first level.

3) Gross motor functional classifications (GMFCS) level between 1to 3[6].

4) Manual ability classification system between (MACS) level ii to IV [7].

5) Participants who complete 32 sessions or more than that out of 40 Sessions in a 4 week. Exclusion criteria.

4) Children with severe cognitive impairment who score Mini-mental state examination less than 9.

Intervention

39 Parents responded to a flyer, their children were assessed and among them, 32 children were selected who fully fill inclusion and exclusion criteria. Pre & Post Assessment was done for the following outcome measure

1. Alternate hand wall toss test
2. Encephal smartphone Stroop app test 3. Minimental state examination for children was taken.

Video games were played by children for 20 minutes a day for 5 Days a week for 4 weeks by mobile/computer/laptop According to the American Academy of Pediatrics.

Total 12 sessions were supervised by video conferences 28 sessions were non-supervised. One session is 10 minutes. A total of 2 games were chosen for vertical and horizontal eye movement. Bubble shooting game for vertical eye movement in which Aim was match and smash all the balls of the same color.

This is one of the best shooter games that are simple and easy to learn at more than 1500 + levels. **Hill climb racing game – horizontal eye movement** Face the challenges of unique hill climbing environments with many different cars.

Bubble shooting game

hill climb racing game

Detailed description of outcome measure

Outcome measures taken were for eye-hand coordination and cognition.

1) Alternate –hand wall toss test 2) Encephal smartphone Stroop app test 3) Mini Mental state examination scale.

Alternate hand wall toss test

The alternate hand wall toss is a test of upper limb coordination which consists of standing one meter away from a wall and tossing a tennis ball with one hand against the wall in an underarm maneuver and then catching it with the opposite hand. The ball was then thrown back against the wall with the hand that caught it, and then, it was caught again with the first throwing hand. The test continued for 30 seconds, and we normally distributed data. Pre- and post-change significantly conformed by paired t-test. Repeated measure analysis was done to see weekly changes for four weeks.

recorded the number of successful catches. [8,9]

Encephal smartphone Stroop app test

Stroop Test is a test of a user's mental speed. A series of runs will be presented to evaluate the user's response rate in finding the color of printed text. Lesser seconds suggest good eye-hand coordination. [10]

Mini Mental state examination scale Mini Mental state examination scale is a scale of cognition.it includes orientation, attention and concentration, registration & sensory perception, recall, language (name body parts, command, repeat sentence, reading, writing, and copy design. (11)

Sample size calculation

Considering the pilot study, a small sample size 30 has been taken for the study. (12)

Statistical analysis

Demographic and baseline data were examined for normality using the skewness and kurtosis, normally distributed bell-shaped histogram and Shapiro wilk test which suggest normal distribution of data. Pre- and post-change significantly conformed by paired t-test. Repeated measure analysis was done to see weekly changes for four weeks.

Encephal smartphone Stroop app test

Result:

Out of 32 children (20 boys) participated in the study, 2 children (1 boy) dropped out due to parents' observation about misuse of mobile phones.

	Grade 1	Grade 2	Grade 3	Grade 4
GMFCS grade	8	11	10	1
MACS grade	not included	12	10	8

Table: 1 Demographic details of children as per the different grades of GMFCS and MACS

- **AHWTT, ESSTA, MMSE outcomes mean value and standard deviation prove in table 2**

Outcome measure	Value and description	Pre means	Post means	P value
AHWTT	Numbers of catches in 30 seconds	7.93±1.76	10.00±2.00	0.00
ESSTA	Seconds to complete one round of the test	30.46±1.126	27.96±0.955	0.00
MMSE	Score	20±1.086	23.33±1.090	0.00

Table: 2: Pre and Post mean difference changes in outcomes

Table suggests pre-mean and post-mean of outcome measures and it suggests significant improvement (P=0.00) in AHWTT, ESSTA, and MMSE.

Outcome measures	Repeated measure analysis from Day 1 with 8th, 15th, 21st and 28th day				
	Day 1	Day 8	Day15	Day21	Day 28
AHWTT		1.00	0.65	0.11	0.00
ESSTA		1.00	0.10	0.02	0.01
MMSE		0.00	0.00	0.00	0.00

- **Repeated measure analysis was done to know significant improvement every week. Which is proved in table 3.**

Table: 3: Repeated measure analysis of variance of outcomes

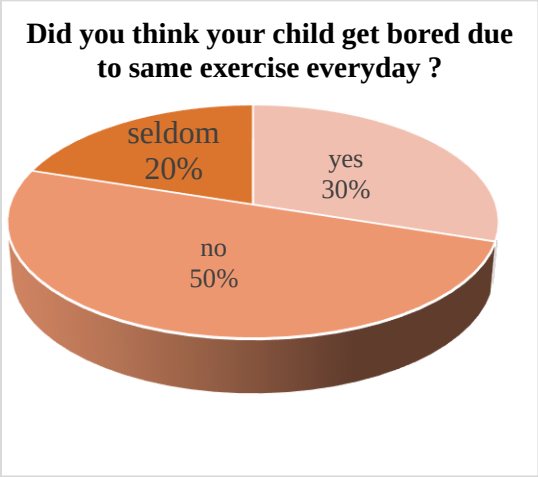
Significant improvement was noted in the alternate hand wall toss test from day21 Significant improvement was noted in the Encephal smartphone Stroop app test from day 15 onward. Significant improvement was noted in the Mini mental state examination scale after day 7. (Table 3)

Discussion

The current study assesses the effectiveness of gamification to improve eye-hand coordination in children with cerebral palsy. In the alternate hand wall toss test, the child throws a ball in the underarm manual and must catch with other hands. Child must move hand and eye in context to the ball. In this procedure gaze and vertical eye movement are needed. By playing a bubble shooting game vertical eye movement improves and leads to a better score in the alternate hand wall toss test. By playing vertical eye movement game rostral intestinal medial longitudinal fasciculus activated which are in pons. Pons is a connection between cerebellum and cerebrum so by playing video game activation of cerebellum and cerebrum occurs which manage balance and coordination. [9] Vertical eye movement directly correlates with the pyramidal system. As in hill climb, racing game movement involves horizontal eye movement. When doing horizontal eye movement neurons activated are para pontine reticular formation which is a part of the reticular formation system that makes a reticulospinal tract. The reticulospinal tract is a part of **Extrapyramidal tract pathway** which manages keeping coordination. [10] Gamification is based on **implicit learning** where a child fails and

learns it leads to more automaticity which improves eye-hand coordination. Mini Mental state examination scale has components like recall, attention, copy a design, reading sentence, writing which requires cognition and eye-hand coordination [12]. Mini Mental state examination scale suggests improvement in a score as a child has to focus on games and avoid external stimulation from the environment, so it improves concentration. During video games, if a child is unable to clear the stage, they still are which hurdles are difficult and memorize it, by that process memory improves. [8,10]. Gamification also works on augmented feedback where knowledge of result and knowledge of performance are applicable which overtime develops muscle memory to perform the task independently. [4]

As its mention in graph 1 & 2 that 30% children get bored due to same exercise every day and 40% parents think that gamification is insightful this data must take into consideration for future research.



Graph 2

Conclusion:

Gamification is useful to improve eye-hand coordination along with improvement in cognition. In context to statistical significance and clinical reasoning, we do see that gamification is one of the effective tools to improve eye–hand coordination in children with cerebral palsy. The selection of computed games must remain an essential fragment of the study. Hand movements in association with vertical and horizontal tracking of eye movements must be taken into consideration to improve eye–hand coordination [13]. Moreover, improvement in cognition level by game-specific interest and concentration may add to physical and functional activities related to eye-hand coordination in children with cerebral palsy.

Limitation and future recommendation

Limitation The size of the screen to play the computed games was varied. Future recommendation: The choice of games must have inclusion of simulation and includes hand – arm and trunk movements with eye coordination.

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Ethical Approval: Ethics Committee (EC), School of Physiotherapy, RK University, Rajkot approved by The Central Drugs Standard Control Organization.

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Conflict of Interest: Nil

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Table of contents:

Balance score assessment in menstrual phase vs late follicular phase of reproductive cycle.

Rai Richa H [1], Narang K[2], Himanshu Walia[3]

Abstract:

Background: The Menstrual Cycle, a vital biological rhythm, after circadian rhythm can affect various functions of body systems and activity, secondary to the differential effects of sex steroid hormones. It has been suggested that musculoskeletal and neurological functions may get affected due to it during this biological rhythm. Thus, the overall aim of this study was to assess if balance score gets affected in Menstrual Phase Vs Late Follicular Phase of the reproductive cycle.

Objectives: To Compare the effect of Menstrual phase vs late follicular phase of reproductive cycle on balance.

Methods: 30 Normal females from a reputed institution were recruited for the study according to the inclusion criteria. The subjects' parameters for balance (GBS) were collected at two instances i.e., Menstrual Phase and Late Follicular Phase. Global Balance Score of subjects was noted using Phyaction Balance Master, after having obtained informed consent and giving a trial session. Statistical analysis was performed using the statistical package SPSS.

Results: The effects of menstrual phases on balance, as measured via Global Balance Score, was assessed using paired t-test and level of significance was set at $p<0.05$. P-value was found to be 0.59 which is non-significant i.e., there is no change in Global Balance Score in Menstrual Phase vs Late Follicular Phase of reproductive cycle.

Conclusions: The study had shown non-significant results of Global Balance score in Menstrual Phase vs Late Follicular Phase.

Keywords: Menstrual Cycle, Balance, Global Balance Score

Introduction:

The Menstrual Cycle is the second most important biological rhythm, next to the circadian one. [1] It is a series of physiological changes that occur in the ovaries and lining of the uterus beginning with the onset of menstrual flow on Day1. It consists of three phases: Menstrual Phase, Follicular Phase and Secretory/Luteal Phase. Menstrual Phase, lasting for a variable of 4 to 6 days in individuals, is defined as "shedding of the thickened endometrium, a process known as menstrual bleeding. The Follicular or Proliferative phase continues until ovulation, lasting for about 7 to 14 days and is the period when follicles are grown under the influence of hormones. The Luteal Phase begins at ovulation and continues until the onset of menstrual flow, typically day 15 through 28". [2, 3]

Balance, as an "essential neuromuscular function in human daily life and sports activities, can be defined as central nervous system input from proprioceptive, vestibular, and visual afferent nerve signals, with analysis of signal integration" [4]. "It involves a combination of stability and postural orientation, being necessary for keeping a position in space, moving in a controlled and coordinated fashion, and conducting functional activities of daily living".[5]

Henkin RI in 1974 reported changes in somatic sensory processes during the menstrual cycle suggesting that hormones which regulate the menstrual cycle, may influence sensory acuity during the phases of the menstrual cycle. Their study showed changes in taste, smell, hearing, light touch, and 2-point discrimination in the follicular phase of the cycle and suggested that estrogen may enhance sensory acuity during the follicular phase while progesterone release in luteal phase may lessen acuity. [6]

It is therefore imperative to gain a better understanding of the effect of the menstrual cycle on balance. The aim of this study was to assess if balance score gets affected in Menstrual Phase Vs Late Follicular Phase of the reproductive cycle.

Methods

2.1: Participants: Thirty normal and healthy females from a reputed institution/setup were recruited for the study according to the inclusion criteria. Females with a regular menstrual cycle from the last three months, of age between 18-25 years and a normal BMI of 19-25 kg/m2, with no smoking history as it can affect the outcome of the study were included with informed consent. [7–11]. Females with any history of gynecological/reproductive disease (e.g., PCOD), treatment or surgical procedures, or irregular menstrual cycle, taking any medications/drugs/painkiller intake or hormonal treatment during menstrual phase or otherwise, at least 3 months before study initiation were excluded from the study. [10,11]. Pregnant women and females with history of visual or vestibular system disorder, having any type of neurological /cognitive impairment/musculoskeletal disorders/injury that can affect the outcome of the study were also excluded. [11,12]

2.2: Procedure and design: After explaining the procedure of this study and taking informed consent, they were asked to complete a data collection form. Subjects were asked history (date) of their last

menstrual cycle and date of next expected menstrual cycle/reproductive cycle. The subjects' parameters for balance (GBS) were collected two times, in two different phases of menstrual cycle i.e., they were assessed at two instances i.e., Menstrual Phase: When the data was collected on Day1 or Day 2 of menstrual phase/cycle and Follicular Phase: When the data was collected between Day10 to Day 12 of Reproductive cycle. (i.e., 10th -12th day after day one of Menstrual cycle).

On Day 1-2 of the menstrual cycle, the Global Balance Score was taken. On the Phyaction software, the Exercise program was set up for standing position with bilateral feet, at 40 cm diameter, straight board heading with Line profile done at Level 5. After Trial of 30 seconds, balance was again evaluated for one minute, which was used for results. During the test, they were asked to try maintaining the natural standing center of gravity without moving while keeping eyes open and instructed to keep themselves balanced using the indicator in the center of the target on the screen [3] Global Balance Score was noted and its significance was explained to the subject i.e. the lower the Global Balance Score, the better the ability of the subjects to maintain the center of gravity. The same procedure was followed on Day 11-12 of the Follicular Phase of the same subject.

VARIABLE	Mean	Standard Deviation
Age (yrs.)	21.043	0.9760
BMI	21.352	2.6108

Table 1 Mean Age and BMI of subjects

Figure 1 – Subject performing Balance Score Assessment Test

Statistical Analysis

The Statistical analysis was performed using the statistical package SPSS. Paired t-test and Shapiro-Wilk test were used for comparing the values of GBS between Menstrual phase and Late Follicular phase. Data were assessed by a Shapiro-Wilk test for normal distribution. The effects of menstrual phases on balance, as measured via Global Balance Score, was assessed using paired t-tests. Level of significance was set at $p<0.05$.

Results

3.1: Demographic characteristics of the subjects are provided in table 1. Mean and standard deviation of the subjects were calculated for age and BMI parameter and the Mean age was found to be in the range 18-25 years.

3.2: As shown in table 2, p-value was found to be 0.59 which is non-significant. i.e., there is no change in Global Balance Score in Menstrual Phase vs late Follicular Phase of reproductive cycle.

VARIABLE	Mean	Standard Deviation	t-value	P-value
Menstrual Phase	19.943	9.0472	1.992	0.59
Follicular Phase	16.483	8.3002		

Table 2 Comparison between Menstrual Phase and Follicular Phase

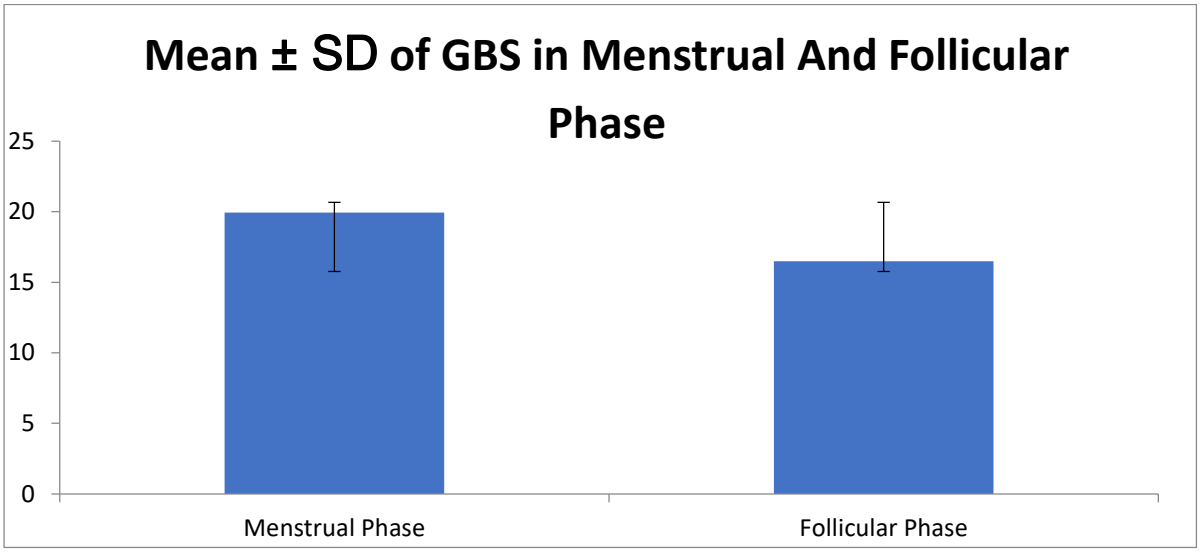

Figure 2 Comparison of Mean ± SD of Global Balance Score in Menstrual Phase vs Late Follicular Phase of reproductive cycle.

Discussion

Twenty-three subjects were included in this cross-sectional observational study to observe whether there is any significant difference in balance score in Menstrual Phase vs Late Follicular Phase of reproductive cycle. Computerized Balance Trainer (Phyaction Balance) assessed this via a software in computer that records Global Balance Score connected to Balance Board. The main finding of our study has shown non-significant results between Global Balance score in Menstrual Phase vs Late Follicular Phase. The effect of hormonal fluctuations during the menstrual cycle on postural control is less explored and there is dearth of literature depicting their relation. The results of present study show that Balance Score does not get affected in Menstrual Phase or Late Follicular Phase. These corroborate with Hayley Erickson et al., who also found that hormone fluctuations during the menstrual cycle did not affect ankle stability or posture. Dynamic postural control was assessed with the posteromedial reaching distance of the Star Excursion Balance Test. [13]

Christina Friden from Karolinska University, Sweden in 2004 studied "Neuromuscular performance and balance during the menstrual cycle and the influence of premenstrual symptoms". Subjects were studied during each phase within the menstrual cycle at three different instances by assessing their balance by an ankle disc placed on a Statometer and an AMTI Force Platform where visual feedback showed no significant difference in the two – legged stance. As seen in our study they too found no significant association between the variations in the hormones and parameters of postural control with respect to the phases of Menstrual Cycle. [14] A study by Bruce D. Beynnon et al. obtained the same results in which they demonstrated greater lower limb joint laxity in women as compared to

men, but there was no relation to alterations in the hormonal status i.e., there was no relationship between estradiol and progesterone fluctuation, ankle, and knee joint laxity. [15]

Jerrold Petrofsky et al. in 2015 studied balance control during the menstrual cycle. There was no difference in sway during menstrual phase, but impaired balance was seen at the day of ovulation due to increase in plantar fascia elasticity associated with increased levels of estrogen. However, there was no change in balance control during menstrual phase and late follicular phase and hence, results agree with our study. [16]

Evidence suggest that fluctuating levels of estrogen may result in changes in knee stability as it can affect the biochemical milieu of ACL that may affect its structure and function and increase the risk for an individual.[17]

Elisabeth Livingstone et al studied the effect of menstrual cycle on musculotendinous stiffness and knee joint laxity. The results of their study proved no statistically significant effect of the menstrual cycle on knee stability.[18] Similarly Karageanes and Blackburn reiterating the same also demonstrated no statistically significant effect of the phases of Menstrual cycle on knee stability even following exercise.[19]

However, there are few studies whose results do not corroborate with our results. Study by Darlington proved "the effects of menstrual cycle on postural stability but not on optokinetic function". It concluded that menstrual cycle significantly affects "Lateral sway but there was no significant effect on gaze-holding, optokinetic nystagmus slow phase velocity, amplitude, or frequency".[20]

Conclusions

Thus, looking at our results, one can presume that hormonal changes during different phases of the menstrual cycle do not cause significant alteration in balance scores thus accepting the null hypothesis.

Conflict of Interest

The authors declare there is no conflict of interest about publication of this article.

Author Contributions

All the authors have equally contributed for the study.

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Table of contents:

Effect of ankle rom on balance performance of elderly people residing in old age homes of Surat: a cross sectional study.

Rima Jani[1], Jahnvi Sardar[2], Shivani Patil[2], Pragati Bhanse[2]

Abstract

Background: It is a balance which enables an individual to maintain a steady state doing their activities. Also, with advancing age there is increasing risk of balance impairment. Various body systems are responsible for maintaining balance. These systems function together in coordination to maintain optimum balance.

Purpose: To study the relationship between balance impairment and changes in ankle range of motion (ROM) in elderly.

Method: Correlation study was conducted with sixty-five subjects aged between 60 - 80 years of elderly population who agreed to participate in this research. The study participants were categorized into high risk of fall, moderate risk of fall, low risk of fall. Balance / fear of fall was measured using Tinetti Performance Oriented Mobility Assessment (POMA) (balance and gait), multidirectional Reach Test (MDRT), and Dynamic Gait Index (DGI). Goniometer was used to measure the active range of motion of the ankle joint. Balance measures and ROM were correlated using Pearson's correlation coefficient.

Results: Frontal plane ROM has equal correlation with balance measures. However sagittal plane ROM has greater correlation with balance measures of DGI and MDRT (FR, BR) and mild correlation with POMA and MDRT (RR, LR). There exists a difference in ankle ROM between those who were at high risk and low risk of fall. And there was no significant difference between high and moderate risk groups.

Conclusion: Mild correlation exists between ankle ROM and balance measures in elderly. Improving ankle ROM with balance training in elderly may prevent risk of fall and its related injuries

Keywords: Ankle Range of motion (ROM), Balance in elderly, Multidirectional reach test, Tinetti performance-oriented mobility assessment, Dynamic gait index.

Introduction

Balance is a term by which the individual maintains their body position in equilibrium state. Maintaining balance is one of the major factors to prevent falls and consequent injuries in elderly people. It is an important ability to maintain upright posture during static standing [1]. It is required to maintain an equilibrium while moving from one place to another [2]. However, it is required to conduct daily living activities steadily as well as to move freely in the community. For this to be achieved it is important for the balance system to function properly in coordination, so it can help humans to have a clear vision during movement and can make postural adjustments according to the demand of activities of daily living [4].

For effective balance, individuals COG and COM should be maintained at BOS. COM is a point that refers to the center of total body mass [4].

COG is a point that refers to vertical projection of COM to the ground. It is located anterior to second sacral vertebrae. Position of COG varies; it depends on the anatomical structure of the individual. COG is higher in men and children than women because women carry greater weight in the upper half of the body [5]. Balance is greatest when the body's COM and COG is maintained over its BOS [4].

BOS refers to the contact area between the body and its support surface [4]. In stride standing, an area as wide as feet and distance between its outer border forms a base [5]. Foot placement may alter the BOS and change a person's stability. A wide stance is seen in many elderly individuals which increases stability [6], whereas a narrow BOS such as tandem stance or walking reduces it [4].

There are two types of balance:

1. Static balance
2. Dynamic balance

1. Static balance: it is term which describes that body position is maintained in steady state example: standing, sitting

2. Dynamic balance: it is a term which describes that body position is maintained in a dynamic state (individual's body is moving or surface is moving) example: walking, sit to stand, stair climbing, and turning around obstacles.

Balance control - balance is maintained by the nervous system, musculoskeletal system, and contextual factors.

Nervous system: it conducts sensory processes. Perception of the body is provided by visual, vestibular, somatosensory systems. This nervous system sends signals for motor response to maintain balance.

Musculoskeletal System: it includes ROM, joint integrity, and flexibility

Contextual factor - it includes environmental factors such as gravity, light, support surface [4].

Gravity- It places stress on structures that are responsible for maintaining the body upright and therefore provides a challenge for maintaining erect posture against gravity. So, there are forces which

Counteract the moment caused by gravity and these counterforces are provided by antigravity muscles to maintain erect position against gravity [5].

However, humans use hip, ankle, and step strategies to maintain upright position and equilibrium of the body to meet the demands of motor tasks to be done against gravity [7]. Flexion and extension of the hip is the component of hip strategy to maintain COM within BOS. In the forward sway of the body muscles are activated from proximal to distal sequence, in the beginning abdominal muscles activate first followed by quadriceps muscle. And in the backward sway of the body, paraspinal muscles are activated first followed by hamstrings [4]. To maintain balance in antigravity position muscles that activate are gluteus Medius, tensor fascia late, iliopsoas to prevent hyperextension of the hip [4].

The foot is able to sustain large weight bearing forces and able to accommodate on variety of surfaces and while walking on different surfaces The structural design of ankle and foot complex is such that it promotes stability as well as mobility to fulfill the goal of balance body's COM should be kept within the BOS and for that ankle strategy is used. However, the foot has multiple functions like providing BOS, working as a rigid lever to enhance pushing off during walking, running, and jumping and shock absorption thus preventing undue joint stresses. It also responds to GRF and imposed forces from spine, pelvis, hip, and knee [4].

To fulfill the goal of balance, the body's COM should be kept within the BOS and for this ankle strategy is used. In ankle strategy, muscles surrounding the ankle joint that are plantar flexors, dorsiflexors, investors and evertors are automatically activated against body sway in different directions. These muscles are activated in the opposite direction of body sway or to the perturbation [7]. During forward motion of the body, muscles are activated in distal to proximal direction. In beginning gastrocnemius muscle activates followed by hamstrings muscle. During backward motion of the body, the first tibialis anterior is activated followed by quadriceps muscle [4].

Further when balance is challenged with large perturbation the step strategy is utilized to maintain balance. In the incidence of perturbations by taking steps in the direction of perturbations [7]. However, in certain cases when COM displaces beyond limits of stability, forward or backward step is used and this allows maintaining COM within the BOS and counteracting the external forces that disturb balance [4,7].

Aging is a process in which there is a slow and progressive decline in multiple body systems [6]. Balance impairment is a major health issue in elderly people that can lead to fall and its related injuries [3]. Impairment in the postural control system can lead to instability and falls in elderly people [6]. Falls are common with aging. Instability and falls in elderly people [17,18] are associated with many risk factors. Common risk factors are muscle weakness, balance deficit, gait deficit, visual and vestibular deficit, use of assistive devices, fear of fall [3].

Fear of fall is a major negative consequence of balance impairment [1]. Fear of fall leads to loss of confidence in an ability to perform tasks and activities [3].

To utilize explained strategies of maintaining COM within BOS optimum ROM seems necessary. Optimum ROM needed for normal walking pattern and a certain amount of ankle ROM is needed for functional activities [9]. In the sagittal plane, during beginning of gait cycle in initial contact or in heel strike 20 degree of ankle dorsiflexion is required. And during foot flat, the hip requires 15 degree of flexion, 15 degree of knee flexion and 5 degree of plantar flexion and in the midst, knee requires 5 degree of flexion and 5 degree of ankle dorsiflexion [4].

In heel off and toe off ankle dorsiflexion needed minimum plantar flexion and that is 0 degree and 20 degrees of plantar flexion respectively [4].

Also, joint range of motion tends to decline with age related changes and changes might occur in joint structure [10,20].

With aging range of motion in lower extremity such as hip, knee and ankle may get reduced or altered. These altered range of motion may change movement patterns and these altered movement patterns may compromise balance and thus limit functional activities like ambulation and postural control and increase the risk of fall [6].

In view of this ankle ROM was taken along with balance and functional outcome measures. And to find if there is any relationship between ankle ROM and balance in elderly this study was done. Further, if any correlation gets established between ankle ROM and balance then we can aim for a future study to find treatment and intervention strategies to prevent incidences of loss of balance and frequent falls; thereby reducing functional impairments in elderly population.

However, there is a lack of enough data and research done to find correlation between ankle ROM and balance in elderly population of our region. Considering that with elderly population and the risk of frequent falls in them. This study is done to find if there is correlation among ankle ROM and balance.

Aims

This study aimed to assess correlation between ankle ROM and dynamic balance in elderly.

Objective

To assess mobility of ankle joints in elderly.
To assess scores of MDRT, POMA, DGI in elderly.

Methodology

Source of data: Two Old age homes
Study design: Cross-sectional study
Sampling technique: Convenient sampling
Study Duration: 6 months

Selection Criteria:

Inclusion criteria:

Age: 60 to 80 years
Subject who was able to walk with or without assistive devices.

Exclusion criteria:

History of stroke or any other neurological problem, malignancy. Any recent history of fracture or surgery in lower extremity Subject with Psychological disorder, Uncooperative subject.

Materials

Consent form, Measure-tap fifteen' walkway, Pen, Goniometer, twenty' walkway, Pencil, Chair, Micropore Shoebox, Sketch-pen, Measuring Scale.

Intervention

Correlation study was conducted with subjects between the ages of 60 to 80 years. Goniometry was used for ankle range of motion [11, 15]. Balance abilities were measured with multidirectional reach test (MDRT), Dynamic gait index (DGI), Performance oriented mobility assessment (POMA). The source of data collected for study were elderly individuals from two old age homes in Surat who fulfilled inclusion criteria.

Prior to examination the purpose and procedure of the study were explained to the subjects. Consent was taken from the subjects. Administration of various scales were conducted with subjects being barefoot. MDRT was first administered.

Next to a wall to avoid but not to touch a wall and to keep feet with normal stand MDRT was used to evaluate the maximum distance that the person can reach with outstretched arm forward (FR), backward (BR), right (RR), left (LR) with fixed base of support. It measures the postural control of a person in antero-posterior and medio-lateral direction [6].

In this test a 60 - inch measure-tape was mounted to a wall at a height of the subject's acromion. The subject was instructed to stand next to a wall to avoid but not to touch a wall and to keep feet with normal stance width and weight should be equally distributed on both feet. The subject was instructed to flex shoulder at 90 degrees with elbow extended and with a closed fist. Then the first measurement was recorded from the starting position at the third metacarpal on the measure-tape [12].

Then for the forward reach, the subject was instructed to reach forward as far as possible without taking a step. A second measurement was recorded at the third metacarpal on the measure-tape. And then this measurement was subtracted from the first one. Thus, the scores were assessed by the difference between starting and end position in inches.

For Backward Reach: In this subject was instructed to stand in the reverse direction of mounted measure-tape. This subject was instructed to reach backward as far as possible without taking a step and the rest of the instructions were the same as FR.

For Lateral Reach: This subject was instructed to face away from the wall and to reach sideways (to the right or to the left) and the rest were the same as FR. In all the components of MDRT, differences between the first and the second measurement were recorded in inches and three trials were done and an average of three trials were recorded at the end. And before the start of three trials, one practice trial was allowed.

Next POMA (balance and gait subsets) and DGI were administered. POMA was used to measure the balance. POMA has two subsets.

The Balance subset requires an individual to perform balance maneuvers such as sitting, moving from sitting position to standing position, standing with eyes closed and turning 360 degrees.

The Gait subset requires an individual to ambulate at a "usual" pace and at a "rapid, but safe pace. Scores on this assessment categorizes individuals as having a "low risk for falling," or "high risk of falling".

DGI Assesses the likelihood of falling in older subjects and this scale tests eight components of Gait Ankle ROM were assessed to prevent any bias [6].

Measurements for Dorsiflexion, Plantarflexion, Eversion, and Inversion were obtained using 180-degree stainless steel Goniometer.

Active ankle ROM was assessed in knee extended position [6]. Subject is in supine position with knee extended and feet over the edge of supporting surface. Prior to examination ankle ROM was proved to the subject. Then Goniometer was placed to examine the ankle range.

For DF and PF: Fulcrum was placed over lateral malleolus and stationary arm was aligned with fibular shaft and moving arm was parallel to the fifth metatarsal [11].

For IV and EV: Fulcrum was placed between two malleoli and stationary arm was aligned with midline of leg and moving arm was aligned with midline of the calcaneus. [11]

Statistical Analysis

The whole statistical analysis was done by using the JASP version 0.16. All statistical analysis was calculated using p value <0.05Pearson correlation test was applied to check correlation between ankle ROM & MDRT, Ankle ROM & DGI & POMA respectively

RESULTS

Pearson correlation coefficient study was used to calculate correlation. Ankle ROM data includes right and left side of dorsiflexion, plantar flexion, inversion, eversion motions. The mean scores and standard deviation for each motion are summarized in below Table

Ankle Range	Mean		SD	
	Rt	Lt	Rt	Lt
Dorsiflexion	10.76	10.76	3.97	3.97
Plantarflexion	38.69	38.30	3.77	3.22
Eversion	17.15	15.69	7.12	5.92
Inversion	9.5	9.6	2.75	2.91

Table 1: The mean scores and standard deviation for each motion

Since there were no significant differences between the right and left side ankle range of motion, therefore only the right side of ankle ranges were taken into consideration for data analysis. Right side of ranges were correlated with the balance measurement data which includes MDRT, DGI, POMA. Pearson correlation coefficient was used to calculate correlation. Subject were categorized based on their scores of MDRT, DGI, POMA scale measurement. Multidirectional reach test:

The mean scores and standard deviation are summarized in below table

MDRT	Mean	SD
FR	7.83	1.51
BR	3.83	0.53
RR	6.81	0.68
LR	6.80	0.71

Table 2: MDRT mean scores and standard deviation

There was no significant difference between RR and LR values, therefore only RR was taken into consideration. According to the scores of MDRT subjects were grouped as: High risk of fall (0-6 inches), Moderate risk of fall (6-10 inches), Low risk of fall (>10 inches) One subject had a score below 6 inches, which is a sign for risk of fall.

Dynamic Gait Index:

The mean scores for DGI were 21.06 (SD 2.42). According to the DGI balance measurement scores subjects were grouped as: Predictive of falls (<19), Safe ambulators (>22).12 subjects were scored below 19 showing predictive of fall.

Tinetti Performance Oriented Mobility Assessment: The mean scores for POMA were 24.06 (SD 1.77). According to the scores of POMA measurement scale subjects were grouped as: High risk for fall (<19/28), Moderate risk for fall (19-24/28), Low risk for fall (25-28/28)

One subject had a score below 19 showing high risk of fall.

"r" values ($p<0.05$)

Range	MDRT				DGI	POMA
	FR	BR	RR	LR		
DF	0.28	0.19	0.14	0.15	0.25	0.23
PF	0.29	0.18	0.13	0.11	0.47	0.23
IV	0.25	0.09	0.28	0.32	0.30	0.31
EV	0.32	0.32	0.26	0.18	0.4	0.38

Table 3: Correlation between ROM and MDRT

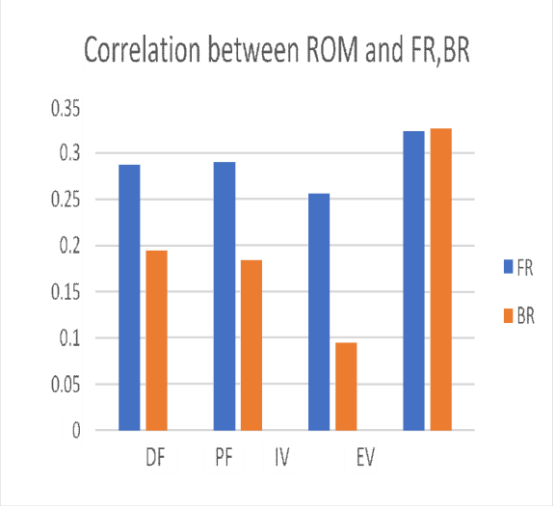


Figure 1: correlation between ROM and FR, BR

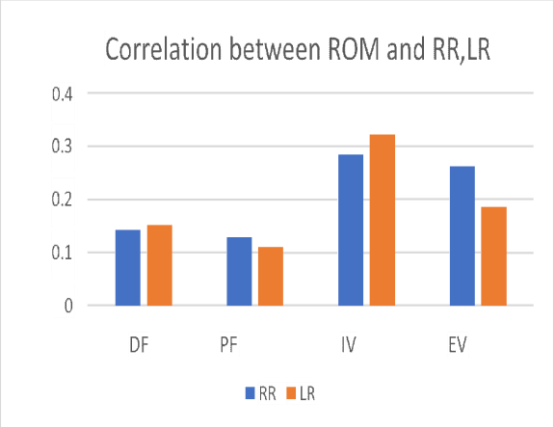
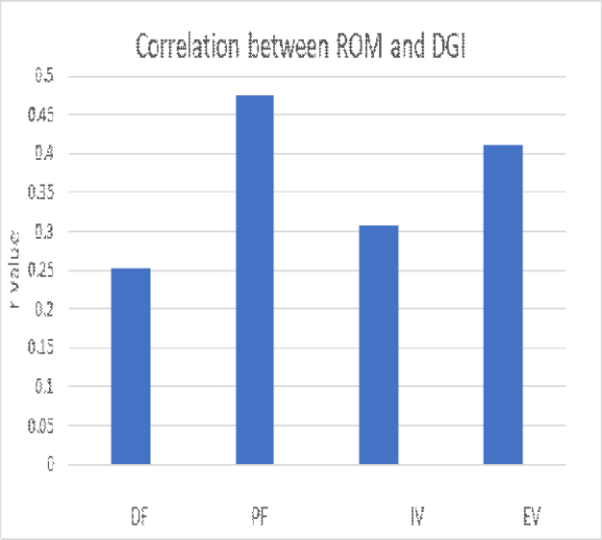


Figure 2: Correlation between Rom &RR, LR

Range	DGI
DF	0.25
PF	0.47
IV	0.30
EV	0.41

Table 4: Correlation between ROM and DGI



"r" values ($p < 0.05$)

Figure 3: Correlation between ROM and DGI

Range	POMA
DF	0.23
PF	0.23
IV	0.31
EV	0.38

Table 5: Correlation between ROM and POMA

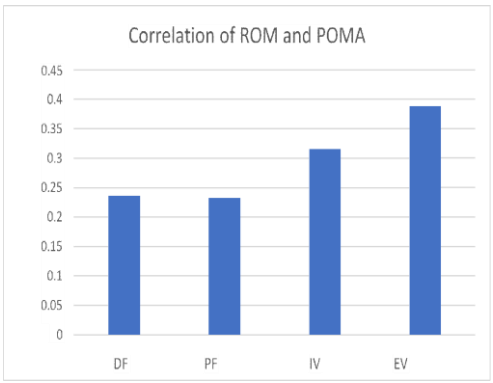


Figure 4: Correlation between ROM and POMA

Discussion

As there is no normative data for active ROM goniometric measurements for subjects in these age groups, we cannot make comparisons. This may show the fact that our measurements were active and not active assisted or passive which is maximal range. Where active motion is dependent on the subject's force generating ability [1,6].

In this study ankle ROM was examined in knee extended position and balance ability of subjects were assessed through balance measurement scales in sixty-five elderlies out of seventy-two aged 60-80 years. It has been proved in the study by Mecagni and O'Sullivan, (two thousand) that restricted ankle ROM in knee extended position is due to non-contractile tissue such as capsule, ligament and bone rather than short gastrocnemius muscle length [1].

In our study two subjects used assistive devices and their ankle ROM were less compared to others. Our study proves positive but lesser correlation between the ankle ROM as a whole and balance measures (table 3,4,5). However, there is more correlation between plantar flexion and eversion ROM with DGI compared to other scores.

In MDRT FR ($r = 0.32$, $p < 0.05$) and BR ($r = 0.32$, $p < 0.05$) have greater correlation with EV. RR ($r = 0.28$, $p < 0.05$) and LR ($r = 032$, $p < 0.05$) have greater correlation with IV. DGI has greater correlation with PF ($r = 0.47$, $p < 0.05$) and EV ($r=0.41$, $p < 0.05$). POMA has greater correlation with IV ($r = 0.31$, $p < 0.05$) and EV ($r=0.38$, p

< 0.05).

Sagittal plane:
Sagittal plane ROM has greater correlation with DGI and MDRT (FR, BR) and mild correlation with MDRT (RR, LR) and POMA (graph 1,2,3,4). This may show that sagittal plane motion correlates with balance measures during ambulation (gait) or in other activities (ADLs).

Frontal plane:
Frontal plane ROM has greater correlation with POMA, MDRT, DGI (graph 1,2,3,4). This shows that frontal plane ROM correlates with balance measures.

Therefore, both sagittal and frontal plane motions are important. Both have some correlation with balance measures during ambulation (gait) and other activities (ADLs). All ankle ROMs contribute to keeping balance during ambulation and other daily living activities where there is a change in BOS and in activities where there is fixed BOS. Thus, all motions of the ankle joint are important to keep balance during walking and they make the interaction between the feet and the ground. They are essential for walking and balance.

On comparison between high, moderate, minimal risk groups based on their scores on MDRT, POMA, there was found a difference in ankle ROM between high and low risk groups and there was no significant difference between high and moderate risk groups.

According to the scores on DGI there was a difference in the ankle ROM between those who were safe ambulators and those at risk. If ankle ROM decreases, then it may lead to instability and risk of fall thus limiting functional activities [16].

However, a further study is needed to establish correlation among ankle ROM in various body positions. Also, the study can be done to set up correlation between balance and ankle ROM based on gender.

Conclusion

In this study we found that a very mild relationship exists between the ankle ROM and balance in elderly subjects. The study suggests that age-related decline in ankle ROM is very less so it may result in decline of functional activities and balance abilities to a lesser extent.

The study does suggest mild correlation between ankle ROM and balance. Thereby, improving ankle ROM with balance training strategies in the elderly may help to improve balance and functional activities in elderly and may reduce risk of fall and its related injuries. And keeping length of gastroc-soleus muscle and other non-contractile structure should also be taken into consideration to ensure optimum ankle ROM. We also find future scope is there to undertake measurement of muscle strength of the same group and set up relationship with balance [19,20].

Limitation & Future Recommendations

Limitation:

1. Subjects were only taken from two old, aged homes of Surat.
2. Only ankle complex i.e., talocrural and subtalar ROM was taken into consideration [6].

Future recommendations

A further study is needed to establish correlation among ankle ROM in various body positions. Also, the study can be done to set up correlation between balance and ankle ROM based on gender. We also find future scope is there to undertake measurement of gastroc-soleus muscle strength and set up a relationship with balance.

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Table of content

Neurological autoimmune disease: retrospective analysis of nerve conduction studies to observe the pattern of axonal and demyelinating sensorimotor polyradiculoneuropathy among people with post covid 19 infections.

Prof. (Dr.) Priyanshu V. Rathod[1], Dr. Tejas Mehta[2]

Abstract

Background: Coronavirus Disease 2019 (COVID-19) has shown numerous challenges to modern medicine in the 21st century. Several systemic signs and symptoms have been observed during and post COVID 19 Infection including post viral (COVID-19) fatigue syndrome (PVFS) among 10% of people as well as autoimmune neurological disease with ascending sensory motor weakness.

Objectives: To analyze nerve conduction study to observe the pattern of axonal and demyelinating sensory motor polyradiculopathy retrospectively after the subject has covid -19.

Method: 42 retrospective electrodiagnosis report was studied who have had covid -19 with predominant bilateral progressive weakness in lower extremities. The tested nerves are median, ulnar in upper limb and peroneal, sural, tibia in lower limb. In the peroneal nerve f-wave velocity and latency are considered. **Result:** Prevalence of GBS has increased after covid -19 outbreak. Retrospective study shows Reduce Amplitude of compound muscles action potential (except tibial and sural nerve), Normal Latency in both lower and upper limb nerve, Reduction in NCV all the reported nerve except sural nerve, F- wave observers prolonged and absent in several cases.

Conclusion: To reduce morbidity and mortality after covid -19 electrodiagnostic study of the nerves are one of the helpful methods to rule out autoimmune neurological disease like Guillain-Barre syndrome

Key words: Neurological Autoimmune Disease, COVID-19, Axonal and Demyelinating sensorimotor Polyradiculoneuropathy

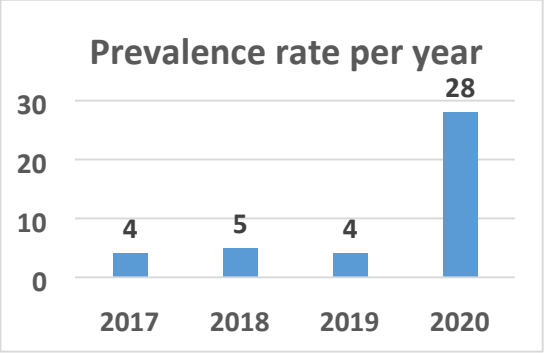
Introduction

Rajkot is one of the leading cities of western part of India with 18 lakh population usually observing 4-5 cases of polyneuropathy per year at one of the electrodiagnostic centers in 12 months of span. The city has observed 35+ cases from March 2020 to December 2020 has alerted medical science to face possible autoimmune neurological disease among people with post COVID 19 statuses. Early symptoms mimicked with Post-viral fatigue syndrome may begin suddenly, sometimes after an acute viral infection, and commonly include incapacitating and persistent fatigue, muscle aches, joint pains, weakness after exercise, headaches, swollen glands, digestive disorders, inability to concentrate, memory loss, recurring minor infections or low-grade fevers, depression, an increasing sense of being unable to function, sleep disturbance, light sensitivity, food intolerance and environmental allergies. [1,2]

Post viral - autoimmune Neurological diseases

It has been documented that certain microorganisms participate in the development of axonal and demyelinating subtypes of Gallium Barre Syndrome (GBS) include Epstein–Barr virus, Campylobacter jejuni, cytomegalovirus, influenza A virus, Haemophilus influenzae, and Mycoplasma pneumoniae.

Previously discovered types of coronaviruses (SARS-CoV and MERS) and Zika virus have been associated with demyelinating polyneuropathy (GBS) as well. The mechanism of the GBS incidence is based on molecular impression and anti-ganglioside antibodies after an infection in genetically predisposed patients. These antibodies show the highest association with certain forms of GBS. A mechanism is an autoimmune reaction in which the antibodies on the pathogen, which are like the protein structures of the peripheral nerve components, lead to the damage of the nervous system. This likeness has been termed "molecular mimicry" which is defined as the theoretical possibility that sequence similarities between foreign and self-peptides are enough to lead to the cross activation of autoreactive B cell or T cell by pathogen-derived peptides [3].



Graph 1 – Prevalence Rate of GBS per year at Electrodiagnostic center at Rajkot

Prevalence of sensorimotor polyradiculoneuropathy

The electrodiagnostic center at Rajkot usually observes (Graph 1) 4-5 patients per year but during March 2020 December 2020 noted 42 cases mild to moderate axonal and demyelinating sensorimotor polyradiculoneuropathy among people with post COVID-19 Infection was alert for medical fertility about Autoimmune Neurological Disease or GBS.

Statistical analysis

Means and standard deviations were calculated using Statistical analysis software

SPSS 20.0 version for Microsoft window

RETROSPECTIVE DATA ANALYSIS, INTERPRETATION

Neurodiagnostic Center has observed 42 cases (Male 30, Mean Age 39 years) of post COVID-19 patients during March 2020 to December 2020 with predominant bilateral progressive weakness in lower extremities for electrodiagnostic studies. Electrodiagnostic studies of 42 cases observed following features suggesting the prevalence of sensorimotor polyradiculoneuropathy.

1. Significant reduction of Compound Muscle Action Potential (CMAP) for bilateral peroneal, mean amplitude reduced to 2.9 mV from normal 5.37 mV (reduced by 36%) and Conduction Velocity (CV) reduced 38 m/s from normal 49 m/s (reduced by 22%).

2. Bilateral tibial nerve mean amplitude has no significant change however, Conduction Velocity (CV) reduced by mean 34.5 m/s from normal 46 m/s (reduced by 23%).

3. Bilateral ulnar nerves, mean value of amplitude reduced to 5.0 mV from normal 11.38 (reduced by 56%), Conduction Velocity (CV) reduced 44 m/s from normal 56 m/s (reduced by 21%).

4. Bilateral median nerves – mean value of Amplitude reduced to 6.95 mV from normal 11.82 (reduced by 41%), and Conduction Velocity (CV) reduced 46 m/s from normal 54 m/s (reduced by 14%).

5. Bilateral Sural nerves, Amplitude (18.00 mV) and Conduction Velocity (54.00) m/s remain within normal limits.

6. Amplitude of compound muscles action potential showed significant involvement in both upper and lower extremities.

7. Distal Latency and CV showed insignificant involvement in both upper and lower extremities.

8. 12-15 NCV Studies observed with early demyelinating Pure motor peripheral polyneuropathy affecting both the lower extremities.

9. F wave observers are prolonged and absent in several cases.

10. Onset of involvement of both upper and lower extremities with sensorimotor Poly Radiculoneuropathy was noted after 2025 days of COVID19 infection.

Nerves	Mean	Std. deviation	Indian Normal Values [5]
Rt Peroneal LAT	3.7879	3.07344	04.14 ± 0.36
Rt Peroneal AMP	**3.064**	**3.7869**	**05.37 ± 0.97**
Rt Peroneal NCV	**37.95**	**6.897**	**49.03 ± 9.01**
Lt Peroneal LAT	3.8374	3.42068	04.14 ± 0.36
Lt Peroneal AMP	**2.695**	**2.6148**	**05.37 ± 0.97**
Lt Peroneal NCV	**38.27**	**7.873**	**49.03 ± 9.01**
Rt Tibial LAT	4.2838	2.64628	04.77 ± 0.36
Rt Tibial AMP	6.360	6.9193	06.22 ± 0.48
Rt Tibial NCV	**36.61**	**8.589**	**45.52 ± 3.04**
Lt Tibial LAT	4.9071	4.63443	04.77 ± 0.36
Lt Tibial AMP	7.586	9.1557	06.22 ± 0.48
Lt Tibial NCV	**33.86**	**8.979**	**45.52 ± 3.04**
Rt Sural LAT	1.9760	1.07190	2.47+0.50
Rt Sural AMP	17.745	13.3175	15.63+3.57
Rt Sural NCV	53.57	19.049	50.02+3.45
Lt Sural LAT	1.9076	1.02690	2.47+0.50
Lt Sural AMP	18.850	13.9370	15.63+3.57
Lt Sural NCV	55.4	18.419	50.02+3.45
Rt Peroneal F Wave LAT	23.64	25.390	
Rt Peroneal F Wave Velo	25.37	23.810	
Lt Peroneal F Wave LAT	23.340	25.1800	
Lt Peroneal F Wave Velo	25.58	23.365	
Rt Ulnar LAT	2.77	1.466	02.44 ± 0.36
Rt Ulnar AMP	**5.04**	**4.118**	**11.38 ± 0.87**
Rt Ulnar NCV	**44.03**	**12.446**	**55.58 ± 3.33**
Lt Ulnar LAT	2.59	1.483	02.44 ± 0.36
Lt Ulnar AMP	**5.06**	**4.251**	**11.38 ± 0.87**
Lt Ulnar NCV	**43.77**	**11.479**	**55.58 ± 3.33**
Rt Median LAT	3.85	2.001	03.53 ± 0.51
Rt median AMP	**7.35**	**5.214**	**11.82 ± 0.48**
Rt Median NCV	**45.63**	**10.577**	**53.62 ± 0.49**
Lt Median LAT	3.73	2.144	03.53 ± 0.51
Lt Median AMP	**6.54**	**4.801**	**11.82 ± 0.48**
Lt Median NCV	**45.51**	**9.316**	**53.62 ± 0.49**

Table 1: Descriptive Analysis (mean values) of 42 electrodiagnostic studies of people with post COVID-19 status. Values are compared with Indian Motor NCV parameters. Note: Rt = Right Limb LAT = latency in ms, AMP= Amplitude in mV, NCV = Nerve Conduction Velocity in m/s - bold rows are showing abnormal pattern

Conclusion

Analysis of post COVID 19 Infection Cases (after 20-25 days) with ascending type motor weakness reported at neuro diagnostic center Rajkot, Gujarat, India, observing axonal and demyelinating type of sensorimotor polyradiculoneuropathy affecting both upper and lower extremities, indicative of showing presence of autoimmune neurological disease associated with GBS. [4,6] Moreover, for suspected cases and early detection of such disease, NCV studies must be taken into consideration. Early detection and medical attention may reduce the rate of morbidity and mortality.

Compliance with ethical standards

Conflict of interest

the author declares no conflicts of interest.

Ethical Approval

Ethical approval not applicable

Literature search strategy

In this study, a literature search was done on PubMed, SCOPUS, Embase, Cochrane database, Ovid, and Google Scholar according to preferred reporting items for Nerve Conduction study (NCV) and Autoimmune Neurological Disorders related to COVID-19 infection. The keywords used were “COVID 19 infection” “autoimmune neurological disorders,” “Nerve Conduction study (NCV)”, “post viral fatigue syndrome”, “Guillain-Barré syndrome.”

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Table of contents:

The impact of physiotherapy intervention in patients with peripheral arterial disease (PAD): an experimental clinical trial

Jigna Pansuriya[1], Priyanshu Rathod[2]

Abstract:

Background: The peripheral arterial disease affects more than 202 million people worldwide. It happens when the arteries in the legs and feet become clogged with fatty Plaque. This can lead to pain, Ischemia, intermittent claudication and many other symptoms.

Objectives: 1. To evaluate the impact of physiotherapy intervention on ABI and walking performance in patients with mild and moderate peripheral arterial disease. 2. To analyses the effect of patient's specific and severity-based exercise protocol in peripheral arterial disease.

Methodology: In this experimental clinical trial 30 patients with PAD distributed according to the severity of PAD based on ABI in Group A (n=15): Mild PAD (ABI-0.94 to 0.75) and Group B (n=15): Moderate PAD (ABI-0.74 to 0.50). Exercises were prescribed under the category of supervised and home-based exercises. Supervised exercise- treadmill walking was given 3 days a week for 4 weeks. Home Exercise- calf raising exercise was given 3 times a day, every day for 6 weeks. Patient's specific and severity-based protocol was given. Outcomes ABI and WIQ were taken on day 1, end of 2nd, 4th and 6th week.

Results: The data was analyzed using SPSS version 21. The result shows significant improvement ($p < 0.05$) in intragroup comparison in ABI and WIQ after 2nd, 4th and 6th week for both group A-mild PAD and group B-moderate PAD.

Conclusions: severity based, and patient's specific physiotherapy intervention are beneficial for improving the physical and functional performance of patients with mild and moderate PAD.

Keywords: Peripheral Arterial Disease (PAD), Ankle Brachial Index (ABI), Walking performance, intermittent claudication (IC), Physiotherapy intervention, Exercise

Introduction:

The peripheral arterial disease affects more than 202 million people worldwide which is a condition of partial or complete occlusion of one or more non-coronary arteries i.e., superficial femoral artery, popliteal artery etc. In PAD peripheral arteries blood flow is reduced which leads to ischemia due to atherosclerosis and endothelial dysfunction. [1-3] In general Indian population > 45 years of age is 18% and it increases with age and > 70 years of age is 29%. [16] The symptoms depend on the degree of vascular stenosis/ occlusion, obstruction and location of the lesion. Clinical manifestation varies from a complete absence of symptoms to atypical symptoms, pain in the lower extremity with exertion, and most severe form-critical limb ischemia (rest pain, ulceration and gangrene). [5, 6] According to severity, there is mild, moderate and severe PAD. In which ankle brachial index is reduced <0.94. [2] In patients with mild and moderate PAD, primary symptom reported is intermittent claudication. [4,7] In IC cramping and aching pain in the lower extremity in calf, thigh and buttocks while walking due to increased oxygen demand in working muscles secondary to physical activity. Which forces the patient to interrupt the exertion which subsides with rest. [4] Pain most commonly develops to distally from site of occlusion and atherosclerotic changes of arteries. Which affects walking performance and compromise functional activities of Daily Living (ADLs) which further affects the quality of life. [1-3,15] Risk factors include age, diabetes, smoking and hypertension.[3] Ankle-brachial index (ABI) is a non-invasive assessment of the degree of occlusion and sensitive, specific and cost-effective diagnostic as well as a prognostic tool for predicting PAD compared to another diagnostic tool. An abnormal ABI below 0.9 is an independent marker of cardiovascular risk. [6,7,20] Walking impairment questionnaire is a PAD-specific measure which includes walking distance, speed and severity of symptoms and used for evaluating walking impairment in patients with PAD. [12,13,14] Structural exercise may have a role in micro capillarization and increase oxygen-carrying ability to enhance ADLs, which further improve QOL. [1, 9] Some studies suggest that exercise in patients with PAD manages the improvement in the walking performance. Supervised treadmill walking and home-based calf raise exercise are efficient, effective and responsible for the improvement in physical and functional performance. Which is easily manageable and possible for the patients and have a role in increased vasodilatation for better improvement in walking ability. [8, 26] So aim of the study is to evaluate the impact of physiotherapy intervention in patients with peripheral arterial disease.

Materials and Methods:

In this experimental clinical trial total 30 patients were selected through purposive sampling from Dekiwadia institute of vascular science, Rajkot. Patients were first evaluated and diagnosed by physician or surgeon then patient's consent and assessment were taken. In this study age 25-75 years, male and female, ABI 0.94 to 0.50 in either leg and patients having intermittent claudication and pain in lower extremity and who was willing to participate included.[1,8,27,28] Patients

having ulcer in the lower limb and critical limb ischemia and history of hospitalization in last 6 months were excluded[29]. 30 patients allocated according to severity of PAD according to Ankle Brachial Index in to two groups in group A 15 patients having mild PAD- ABI 0.94 to 0.75 and in group B 15 patients having moderate PAD- ABI 0.74 to 0.50. Then counselling of patients was done, and exercise was monitored by a logbook. And exercise protocol was given along with medication.

Group A and B received supervised exercise treadmill walking 3 days/ week for 4 weeks and home-based exercise calf raising exercise 3 times a day: every day for 6 weeks. However, an intervention was given according to severity. Within-group patient's specific exercise was given in which frequency, intensity and duration were selected according to the patient's need. Intervention was given in Group A- Mild PAD: Supervised exercise: 3 days/ week for 4 weeks [1] :Warm-up exercise include marching on a place and walking (2-3 minute), treadmill walking at speed produce claudication pain grade- 3 (which was intense pain) within 5 to 10 minute with grade 0% followed by rest (30 minutes) Cool-down exercise include stretching of major muscle group (2 minutes), Every week speed was increased 0.3 km/m or grade by 1%. Home-based exercise was given 3 times a day; every day for 6 weeks [8]includes Calf raising exercise – repeated until the pain in calf following initiation of pain perform extra five repetitions for secured ischemia. Intervention was given in group B- Moderate PAD: Supervised exercise: 3 days/ week for 4 weeks [1,19] Warm-up exercise including marching on a place and walking (3-4 minute), treadmill walking at a speed produce claudication pain grade- 2 (which was moderate pain- patient can be distracted) within 5 to 6 minute with grade 0% followed by rest (40 minute), Cool-down exercise including stretching of major muscle group (2 minute), Every week speed was increased 0.3 km/m or grade by 1%. Progressive relaxation exercise involved tensing the specific muscle groups for 7 to 10 second followed by relaxing for 15 to 20 second as per Jacobson's protocol (2-3 minute) Home-based exercise were 3 times a day; every day for 6 weeks [8]. Exercise included was Calf raising exercise – repeated until the pain in calf following initiation of pain perform extra five repetitions for secured ischemia.

Outcome measures:

Ankle Brachial Index: [6,21,24]: The ankle-brachial index is defined as a ratio of highest systolic pressure of 2 ankles and highest systolic pressure of upper limb it was measured by highest systolic pressure of lower limb arteries (either anterior tibial artery, posterior tibial artery or dorsalis pedis artery) and higher 2 systolic pressure of upper limb. ABI is a non-invasive, easily performed, cost effectiveness and clinically valid assessment method used as a diagnostic tool for predicting lower extremity PAD. ABI < 0.9 interpreted as a PAD in which ABI 0.94 to 0.75 predicted as mild PAD, 0.74 to 0.50 predicted as moderate PAD and < 0.5 predicted severe PAD.

Walking Impairment Questionnaire [13,14,22]: WIQ is used to measure walking performance in PAD patients. It is a scoring of 0 – 100 and two part which measure walking distance and walking speed. In which 100 is the maximal physical ability

and greater walking performance and 0 is extreme limitation and lower walking performance. Higher the score suggests greater walking performance. It is a dependable (sensitivity 0.90 and specificity 0.73) and valid clinical tool which is used to check the effectiveness of intervention given to the patients.

Result:

Data was Analyzed using statistical software SPSS version 21. Descriptive statistics included computation of means and standard deviations. Intragroup analysis for both group A and group B were done using Repeated measures ANOVA test. Confidence interval (CI) was 95%, and the level of significance was considered < 0.05.

As the table 2 and 3 shows p value < 0.05 suggests significant improving in ABI and WIQ after the 2^{nd}, 4^{th} and 6^{th} week of intervention in group A and B.

Discussion:

The aim of the study was to evaluate the impact of physiotherapy intervention on physical and functional performance of mild and moderate peripheral arterial disease patients.

In this study total 30 patients allocated according to severity of PAD into two groups in which group A was mild PAD and group B was moderate PAD and in both groups total 6 weeks of exercise protocol was given. The changes in physical and functional performance were seen with ABI and WIQ before and after 2^{nd}, 4^{th} and 6^{th} week of the intervention in both mild and moderate PAD group.

To evaluate the impact of physiotherapy intervention on ABI and walking performance in patients with mild and moderate peripheral arterial disease The within-group comparison of both outcome measures ABI and WIQ Were done using statistical test Repeated Measures ANOVA. Result shows statistically significant improvement ($p < 0.05$) in ABI and WIQ score from day 1 to end of 2^{nd}, 4^{th} and 6^{th} week in group A and B and mean difference suggests that between 2^{nd} to 4^{th} week there is more improvement. In patients with PAD due to atherosclerosis and endothelial dysfunction vasomotor tone is disturbed, it causes the hemodynamic changes in the leg that affects ABI therefore walking performance is also affects.

Due to exercise causes changes in muscle metabolism and it improves intramuscular vasodilatation because of muscle cannot keep contraction without oxygen and because of oxygen deficit causes release of vasodilators substance include adenosine, potassium, ions, ATP etc. that improves vasomotor tone and leads to local arteriolar vasodilatation. And during exercise all the capillaries opens and this opening of dormant capillaries diffuse oxygen and other nutrients from capillaries to muscle fibers and improve micronutrients supply to the muscle through the plasma protein by microcapillaries. All the changes improve the arterial pressure therefore improvement in ABI occurs that also improve walking performance. [11]

In mild and moderate PAD Treadmill walking increases exercise tolerance and it shows the improvement in walking performance. Calf raising exercise also improves walking performance. [1, 25]

Table 1: Demographic distribution of group A and group B

Demographic data		Group A	Group B
Age (years)	**Mean ± SD**	58.93 ± 7.00	61 ± 7.16
No. Of patients in each age level	**Age 25- 41**	0 (0%)	0 (0%)
	AGE 42- 58	9 (60%)	5 (33.33%)
	AGE 59-75	6 (40%)	10 (66.66%)
Gender (**male: female)**		14: 1	12: 3
Smoking status	**Smoker**	9 (60%)	11(73.33%)
	NON-SMOKER	6 (40%)	4 (26.66%)
Onset of claudication (In **months)**	**Mean ± SD**	6.86 ± 3.33	9.06 ± 2.34

Interpretation: The above table shows that mean value and standard deviation of age, smoking status, the onset of claudication (in months) and gender distribution of group A and B.

Table 2: Intragroup pairwise comparison of ABI and WIQ in group A

		ABI		WIQ	
TIME (I)	**TIME(J)**	**MEAN (I-J) DIFFERENCE**	**p VALUE**	**MEAN (I-J) DIFFERENCE**	**p VALUE**
DAY 1	**6th WEEK**	0.242	0.000	30.56	0.000
DAY 1	**2nd WEEK**	0.014	0.021	4.06	0.000
2nd WEEK	**4th WEEK**	0.123	0.000	15.39	0.000
4th WEEK	**6th WEEK**	0.105	0.000	11.10	0.000

Interpretation: p value < 0.05 suggests significant improvement in ABI and WIQ score after 2nd, 4th and 6th week of intervention in group A and between 2nd to 4th weeks there is more improvement.

Table 3: Intragroup pairwise comparison of ABI and WIQ in group B

		ABI		WIQ	
TIME (I)	**TIME(J)**	**MEAN (I-J) DIFFERENCE**	**p VALUE**	**MEAN (I-J) DIFFERENCE**	**p VALUE**
DAY 1	**6thWEEK**	0.353	0.000	31.93	0.000
DAY 1	**2ndWEEK**	0.065	0.001	6.197	0.000
2ndWEEK	**4thWEEK**	0.151	0.000	14.50	0.000
4thWEEK	**6thWEEK**	0.137	0.000	11.22	0.000

Interpretation: p value < 0.05 suggests significant improvement in ABI and WIQ score after 2nd 4th and 6th week of intervention in group B and between 2nd to 4th weeks there is more improvement.

Treadmill training causes changes in the metabolism of the muscles because of increase muscle blood flow during exercise because of intramuscular vasodilatation caused by direct effects of improving muscle metabolism. In the working muscle, it reduces the anaerobic muscle activity that reduces the level of lactate. These cause an increase in the formation of ATP that rises the exercise capabilities. Treadmill training also helps in reducing blood viscosity and increases the flexibility of erythrocytes. And improve walking performance. [2, 10, 11]

Calf raising exercise increases mitochondrial activity and perfusion of blood flow to the calf muscle. During the calf muscle contraction vasodilators released and citrate synthesis activity improve. Muscle work output increases oxygen consumption and dilate muscle blood vessels. So, muscle mitochondrial respiration improves and may be exercise causes stretch of capillaries that activates stretch receptors and stimulus the stretch reflex and releases the vasodilators that dilate the blood vessels and blood perfusion improves so it improves the arterial pressure and improves the ABI. Hence it reduces intermittent claudication and improves walking ability. [8, 11]

Progressive muscle relaxation exercise works by stimulating the activity of the sympathetic nervous system. In muscles of the body, there is β1 receptors of the sympathetic nervous system, which causes vasodilation of blood vessels and increase the blood flow and oxygen to the muscles. [23]

In the result mean difference suggests in first 2 weeks there is less improvement in both the groups. It may be due to initially body is not adapted to exercise and human body takes time to get adapted with any physical or structural changes. And duration of exercise plays an important role to influence physical and functional performance. Initially may be anaerobic threshold extends due to accumulation of lactic acid in the tissue and anaerobic process become more dominant. That affects the vasomotor tone that is not keep sufficient pressure in arteries and ABI have a less improvement in first 2 week hence, there is also less improvement in walking performance. And there may have insufficient duration to lowering the anaerobic threshold level thereby keeping normal vasomotor tone and these hemodynamic changes may take more than 2 weeks of time to improve physical and functional performance.

To analyses the effect of patient's specific and severity-based exercise protocol in peripheral arterial disease we studied within-group, there is severity so the entire group may not perform the same exercise protocol, so it was given according to the severity of the disease. However, there are number of factors like individual's perception of pain which could differ from patient to patient, and it was based upon the severity of PAD and could not be under control and affect the claudication distance though to reduce this effect in the study claudication pain rating scale and individual's supervision were taken to standardized exercise protocol. According to scale intensity was differ with each patient. So within-group patient's specific exercise was given in which intensity and duration were selected according to the patient's need. And the result suggests it is effective for both mild and moderate PAD group.

The result of this research is incoherent with the result observed by Chaitsi Kirit Jani et al. they compared upper body strength training exercise vs treadmill walking on patients with intermittent claudication in which they concluded that treadmill walking exercise is effective for improving PFWD, HR and WIQ in intermittent claudication. While no significant improvement noted in ABI. [1]

The result of this study is also consentient with the result observed by Michel Van Schaardenburgh et al. they compared calf raising exercise vs traditional walking exercise in patients with intermittent claudication in which they concluded that calf raise exercise improves walking performance and increases biomarker of mitochondrial- volume density and mitochondrial respiration.[8] Maria Szymczak et al. compared walking exercise- treadmill walking and resistance exercise in the patient with chronic limb ischemia and suggested that treadmill walking is effective in the treatment of improving the claudication distance in PAD patients, which supports the result of this study.[5] Additional finding of the study- Demographically mean value of age in group A was 58.93 and in the group B was 61 and there was no any patients in 25 to 41 age in both groups, between 42 to 58 in group A- 60% and in group B- 33.33% patients and between 59 to 75 in group A- 40% and in group B- 66.66% patients. There was in group A – 93.33% male and 6.67% - female and in group B- 80% male and 20% female. There was 60% smoker in group A and 73.33% in group B. hence it can be evaluated that prevalence is higher in male as well as a smoker and above the age of 50 years. Because as the age increase many risk factors are responsible for PAD like decrease vascular reactivity, endothelial dysfunction, vascular wall abnormalities, reduce compliance and loss of elasticity of arterial wall.[17] And components of cigarette smoke, including carbon monoxide and nicotine, affect the endothelial cell's function, increase reactivity and adhesion of platelets causes vasoconstriction. [18]

As both physical and functional parameters affected in both mild and moderate PAD groups. And the result of the study suggests that according to severity based and patient's specific protocol at least 6 weeks of supervised and home-based both form intervention combined, and home exercise alone improves the physical and functional performance of the patients which further improves health status and QOL. So, according to the feasibility of patients, home-based exercise also prescribed. The result shows the similarity between both physical and functional ability. So, it can be evaluated that physiotherapy intervention protocol designed for both mild and moderate PAD groups can be used clinically to improve walking performance.

Further recommendation:

In future advance, the study can be done with different outcome measure like muscle biopsy and cardiac function measurements to know the local and systemic effect of treatment.

Conclusions:

The study concluded that severity based, and patient's specific physiotherapy intervention are beneficial for improving the physical and functional performance of patients with mild and moderate PAD. It may further improve health status and quality of life. Designed patient's specific

exercise programme should be taken into consideration for mild and moderate PAD patients to open new era of physiotherapy practice. Thus, physical and functional exercise which should be based on intensity, frequency and duration remain key factors for exercise to have an impact on mild and moderate PAD.

Ethical approval: Ethical approval was taken from ethics committee, school of physiotherapy, RK University, Rajkot.

CTRI Number registration: (CTRI/2019/09/021144)

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Rehabilitative needs in COVID19 recovered persons: A cross-sectional survey

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ABSTRACT

Background: Coronavirus disease (COVID-19) has caused a global pandemic since 2019, creating a burden on the medical industry. Recent studies have showed that even after recovering from the disease, the affected person can have persisting symptoms suggested as Long-COVID.

Objective: The aim of the survey was to understand the long-term sequelae of COVID-19 recovered people of different parts of India, and hence to assess the need of rehabilitation in them.

Method: It was a cross-sectional survey design. The survey was conducted via Google Forms on a convenient sample of COVID recovered participants (minimum 2 months post- recovered). Those with active disease or re-infections were excluded.

Results: 50 participants completed the survey. Difficulty in breathing was reported as the symptom persisting even after recovering by 44% of the participants. 58% of the participants reported difficulty in returning to work. 62% had shortness of breath after using the stairs and 48% of them got tired after doing daily tasks.

Conclusion: The long-term complications prevail in people who have recovered from COVID-19 which can potentially be addressed with a structured rehabilitation program.

Key words – Coronavirus disease, Long COVID, Pandemic, COVID recovered, Rehabilitation.

Introduction

Coronavirus disease is an infectious disease that is caused by SARS-CoV2. It originated from Wuhan, China. Symptoms of the disease can range from asymptomatic to mild, moderate or severe. Viral invasion may be acquired by several routes, such as blood-brain barrier spread, trans-synaptic spread, infection of the vascular epithelium, or entry via the olfactory nerve. [1] The National Institute for Health and Care Excellence (NICE) reported that the symptoms may last for more than eight or twelve weeks. It can devastate people's lives and make them fatigued even after a short walk. [2] Recent studies have shown that even after recovering from the disease, the affected people have difficulty returning to their earlier lives and have persistent symptoms of the disease, commonly fatigue and shortness of breath, which compromise their overall quality of life. This condition of long-term effects of the disease is referred to as Long COVID, Chronic COVID Syndrome or Long Haul COVID. Treatment of persons affected with long COVID requires a multi-disciplinary approach encompassing assessment, treatment based on symptoms, occupational therapy, psychological support and physiotherapy. [3] Activity restrictions, difficulty in returning to work or socializing or reduced participation, in general, suggest the need for rehabilitation for those affected. The World Health Organization has urged nations over the globe to prioritize rehabilitation for the complications resulting from COVID. [4] Several studies have asserted that it is imperative to begin rehabilitation for a person as soon as his/ her health is stabilized. Rehabilitation aims to reduce fatigue, dyspnea, and anxiety, prevent complications and improve function and quality of life. Prolonged stay in the intensive care unit (ICU) and prolonged use of ventilators can put the person at risk of developing post-ICU syndrome, the effects of which can remain even after years of discharge. Considering the cognitive, pulmonary, neuromuscular, neurological and debility complications, early rehabilitation in the ICU is crucial to prevent the development of Long COVID. The survey aimed to understand the long-term sequelae of COVID-19 in COVID recovered people in different parts of India and assess the need for rehabilitation in them.

Materials and Methods

It was a cross-sectional survey design. A semi-structured questionnaire was constructed after analyzing and understanding the existing research on long COVID. The survey was conducted via Google Forms and circulated to the participants in India via social media platforms viz WhatsApp and Instagram, through convenient sampling. People who had recovered from coronavirus disease at least two months prior were included for the study, while those who had active disease or re-infections were excluded. There was no restriction on the age range.

Statistical analysis

Descriptive statistics was used, and data were analyzed in terms of means, percentages and frequencies. The data was analyzed using SPSS version 16.

Result

Demographic Data

The survey included 50 participants who had recovered from the disease. The participants' age ranged from 8 to 66 years. 60% of the participants were females (n=30), and 40% were males (n=20). The participants were all Indians and belonged to Delhi, Chennai and Pune regions. The participants had the following pre-existing comorbidities: Hypertension (10%), Asthma (4%), Heart Disease (2%), Obesity (6%), Hypothyroidism (6%), Post-Polio Residual Paralysis (2%), Migraine (2%), Cold and cough (2%), and Anxiety (2%). The reported range of symptoms during the course of COVID has been summarized in Table 1. 2% of the participants were asymptomatic.

Symptom	Percentage distribution	Symptom	Percentage distribution
Cough	66%	Diarrhea	36%
Sore Throat	58%	Fatigue	20%
Fever	52%	Rashes	16%
Difficulty in Breathing	50%	Anxiety	16%
Loss of Taste	48%	Abdominal Pain	14%
Loss of Smell	42%	Nausea and Vomiting	8%
Myalgia	40%	Headache	6%
Difficulty in Sleeping	40%	Conjunctivitis	6%
Loss of Appetite	4%	Loss of hearing	2%
Inability to wake up or difficulty in staying awake	4%	Weakness	2%
Repeated shaking with chills	2%	Leg pain	2%

Table 1. Distribution of symptoms reported during COVID19

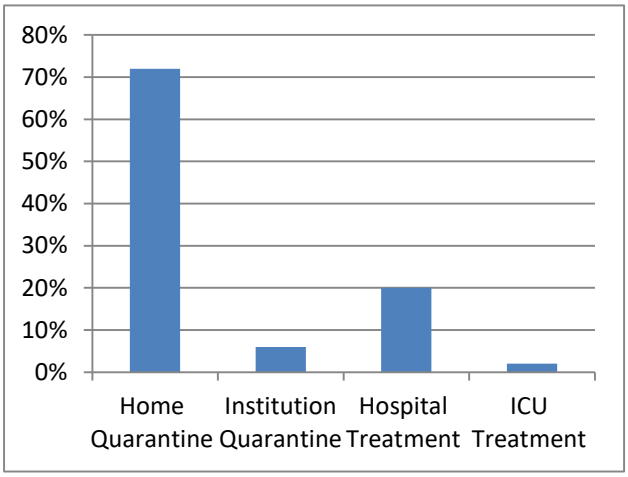
When asked about added complications, the following were the responses received along with the percentage of participants mentioned in parenthesis:

- Generalized weakness (8%)
- Tiredness and Difficulty in Breathing (2%)
- Eye weakness (2%)
- Continuous burnt smell feeling (2%)
- Poor immunity (2%)
- High fever (2%)

Most of the participants were treated under home quarantine (72%), and 2% were admitted to ICU, while the rest were either quarantined in designated institutions (6%) or treated in stable areas of the hospital (20%), (Graph 1).

Graph1: Distribution of the location where the participants were treated.

Around 26% of the participants took 1-10 days to recover, 46% recovered in 10-20 days, 24% took less than a month, and 4% took ≥ 2 months to recover from COVID.



The participants reported a range of symptoms that persisted even after two months of recovery, as summarized in Table 2.

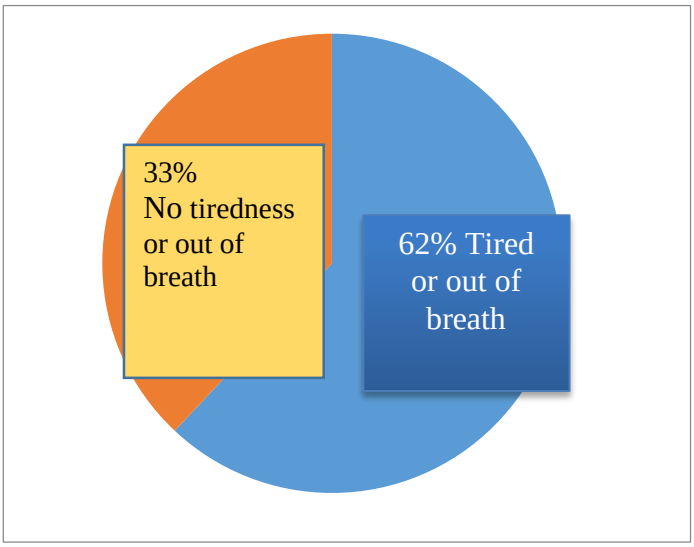
The following were the relieving factors of their symptoms, as reported by the participants.

- Rest (12%)
- Medication (22%)
- Yoga (4%)
- Hot water gargles (8%)
- Consuming healthy food (6%)
- Vitamin C (2%)
- Relaxation – Breathing exercises (14%)
- Homeopathy medicines and Ayurveda medicines (4%)
- Avoiding activities which can aggravate the symptoms (2%)
- Being occupied (4%)
- Sleep (6%)
- Nebulization with the help of an oxygen mask (2%)
- Maintaining a daily routine (2%)
- Honey and ginger (2%)
- Home remedies – kadha (4%).

On being asked whether they felt tired or out of breath after walking or climbing stairs, 33% of the participants responded negatively, while 62%reported walking for a short distance or climbing stairs made them tired (Graph 2).

Symptoms	Percentage distribution	Symptoms	Percentage distribution
Difficulty in breathing	44%	Headache	8%
Cough	18%	Fever	8%
Difficulty in Sleeping	14%	Tachycardia	6%
Fatigue	12%	Skin Rashes	6%
Myalgia	12%	Short-Term Memory Issues	6%
Loss of Smell	12%	Low mood	4%
Difficulty with Thinking and Concentration	10%	Anxiety	4%
Chest Pain	8%	Changes in Mood	4%
Runny or Congested Nose	2%	Hair loss	2%
Complete or partial loss of sense of taste	2%	Diarrhoea	2%
Abdominal pain	2%	Blurred Vision	2%

Table No 2 Symptoms persisting after recovery from COVID19



Graph 2: Percentage of participants reporting tiredness or out of breath while walking or climbing stairs

58% of the people felt that COVID affected their ability to be efficient at work, while 42% reported no such issues.

48% found it difficult to do daily tasks due to tiredness, while 52% reported no such difficulty.

The majorities of the participants (48%) said that the symptoms had not hindered their ability to socialize, while 16% said that it did. 36% of the participants reported confusion about this response. Most participants reported being satisfied with their health, while a small part (24%) responded that they were not at all satisfied with their health.

When asked to rate their tiredness on a scale of 1 to 10, 52% of the participants gave a rating between 1 to 5, and 48% gave a rating between 6 and 10.

When the participants were asked to rate their difficulty in breathing on a scale of 1 to 10, 86% gave a rating between 1 and 5, while 14% gave a rating between 6 and 10.

When the participants were asked to rate their quality of life after COVID, 34% gave a rating between 1 and 5, while 64% gave a rating between 6 and 10, which shows little to no disruption in the overall quality of life. The higher the score, the better the quality of life.

Discussion

This survey examined the long-term consequences of coronavirus disease and how it had affected the lives of recovered persons. A total of 50 participants from Delhi, Chennai, and Pune, who had recovered from COVID19, completed the survey.

Though not an accurate representation, the survey from multiple regio ns helped us to understand how COVID has affected different regions. To the best of our knowledge, it is the first attempt to study the long-term sequelae of COVID in persons living in India. Most participants (72%) studied were home quarantined during their acute illness. One of the asymptomatic subjects during acute illness reported a late onset difficulty in breathing with activity after two months of recovery. [5]

The present study reported that shortness of breath, cough, insomnia, fatigue and anosmia the most commonly reported symptoms in individual 2-month post-recovery. This observation is consistent with a review by Malkova et al [6]. Lemhofer et al. found that 84.1% participants had limited participation and activity restrictions and 61.9% had long-COVID symptoms more than 3 months post infection. However, they reported that those symptoms were not severe and did not lead to a reduced quality of life, which is consistent with our findings. [7] The majority of our participants also reported a better QOL. Chen (2020) reported a poor health-related QOL amongst COVID persons. That was understandable as, during the COVID infection, the person suffers from multiple ailments and emotional stresses. Hence the status of health-related QOL would be expected to be poorer than our participants, where the status of QOL was being understood after a recovery period of a minimum of two months. [8]

44% of the participants reported having dyspnea and tiredness while walking or after climbing stairs. This was in line with the findings of the survey conducted by Orru, G et al (2021), where shortness of breath was reported by 40% of the participants two months after recovery. They also found that the long COVID

symptoms recede over time, which could explain the better quality of life. [9]

Lemhofer, C et al (2021) found that 61.9% of the participants reported at least one symptom persisting more than 3 months of recovery and 49% had participation limitations and activity restrictions. However, the impacts on quality of life were low, which is consistent with our findings. [10]

While several studies assessed the persistence of long-covid symptoms, little investigated the impact of long COVID on return to work. In our study, we found that long COVID significantly impacted the said area. 58% of the participants had difficulties being as efficient at work as before and 48% of the participants faced difficulties socializing. Additionally, 48% of the participants reported activities related to restrictions.

Among the reported long-term sequelae, a structured, tailor-made rehabilitation has shown promising results in overcoming fatigue, difficulty breathing, mood disorders, difficulty concentrating, reduced functional ability and generalized myalgia.

Among the reported long-term sequelae, a structured, tailor-made rehabilitation has shown promising results in overcoming fatigue, difficulty breathing, mood disorders, difficulty concentrating, reduced functional ability and generalized myalgia.

Rehabilitation should focus on graded aerobic exercises, stress management techniques, easing safe return to work, energy conservation techniques and strategies to prevent ICU or hospital-related complications. Several rehabilitation protocols have also been laid down to address the complications resulting from this syndrome. [11 -14]

Lemhofer, C et al (2021) developed a comprehensive screening tool to evaluate the need of rehabilitation during and after the end of the active phase of the disease. [15]

The results of the study may be generalized given certain limitations. The sample size was small and diverse regarding geographical location and age. It was limited to people who could understand English and had access to social media. The responses were limited to the self-understanding of the participants. Nevertheless, our study managed to capture the main long- term effects of COVID 19 recovered persons in a diversified population.

Conclusion

The long-term complications prevail in people who have recovered from COVID-19, which can potentially be addressed with a structured rehabilitation program.

Conflict of interest

The authors declare no conflict-of-interest

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