ORIGINAL ARTICLE

Effects of Circuit Class Versus Individual Task Specific Training on Balance in Post-Stroke Patients

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ABSTRACT

Objective: To compare the efficacy of circuit class versus individual, task specific training on balance, in post stroke patients.
Methods: From a total of 64 participants, 32 participants were treated in circuit based workstations, while 32 participants were treated individually for 4 weeks. Importantly, both groups were treated with standard balance physiotherapy protocols. The treatment was delivered for 5 days per week with 1.5 hours daily. The patients were evaluated for three outcome measures i.e. berg balance scale, time up and go test and for motor assessment scale at baseline and after treatment.
Results: Patients in both groups reported significant improvement after 4 weeks of training program compared to baseline on all outcome measures, except time up and go test that did not significantly improve in individual group. Compared to individual group, circuit group reported more improvement on berg balance scale scores (31.33 versus 37.80), time up and go test (23.13sec versus 16.67sec) and on motor assessment scale scores (18.77 versus 20.63) respectively.
Conclusion: Circuit class training is more efficacious in improving balance in stroke patients as compared to individual task specific training.

Key words: Balance dysfunctions, Circuit class training, Physiotherapy.

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INTRODUCTION

Stroke is a major public health concern and is the second leading cause of death worldwide . It accounts for 11% of overall deaths[2]. According to World Health Organization (WHO) approximately 85% of deaths occur, worldwide due to stroke in middle and low income countries[1]. Although there is no well-designed, population based published survey, on stroke prevalence in Pakistan and other developing countries[3], the estimated average incidence rates of stroke in Pakistan is reported to be 250 deaths per 100,000 population which is higher than western countries[4]. Older adults, especially those suffering from stroke are additionally at high risk of un-intentional injuries due to high risk for fall. As reported, falls constitutes two-thirds of these deaths[5]. The broad category of gait problems and balance impairments are precipitating causes for falls among elderly population suffering from stroke[5-6]. The main goal of stroke rehabilitation is to help patients in regaining possible and highest degree of physical and psychological performances with the goal to regain functional independence. Physiotherapy is one of the proven element of stroke rehabilitation[7]. According to physiotherapy approaches, the stroke treatment should be intensive with more time to be involved in treatment practice in a task specific pattern[8]. The concept of task specific training is based on motor re-learning theory which emphasizes on repetition of whole sequence of task rather that practicing individual treatment component[9]. The better functional recovery

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with task specific training was

supposed to be due to positive cortical reorganizations that usually occur with repetitive practice of new tasks and associated neuro-plasticity (motor re-learning theory)[10]. A number of studies reported that stroke patients receiving in-patient rehabilitation or community based rehabilitation, spend most of the day time inactive and depend on therapist skills for functional recovery[11]. Providing task specific training to stroke patients in groups was proposed as a method for increasing active amount of time in task practice[12]. The other potential benefits of group trainings include peer support and social interactions, therapist time saving and cost-saving to health system by reducing staff to patients ratio[12]. According to Car and Shepherd, the functional activities can be trained within group or circuit classes. The circuit or the group trainings consist of different work stations and these workstations provide the opportunity for maximum repetition of task[13]. Circuit class trainings can be defined as treatment provided to more than 2 patients involving the tailored intervention program, with main focus on repetition or practice of functional tasks assigned to them by the therapist within a group setting[12]. The patients with similar or different degree of functional limitations physically move from one to another workstations under the therapist's supervision[14]. Usually, the staff to patient's ratio in these circuits is 1:3, depending upon the functional capabilities of patients[15]. The interventions can be designed to gait training, range of movement activities and upper limb etc.[14]. The definition of circuit trainings is distinct from the group trainings that usually involve patients with similar degree of functional abilities)[13].

Previously, the number of parameters studied in circuit class training programs included gait training, upper and lower limb strength training and cost effectiveness of circuit training programs. It thus established the overall effectiveness on individual task specific training[12]. A limited number of studies have been conducted on training balance dysfunctions in circuit group after stroke[13,16-17]. Furthermore, the literature is unclear in this particular area on the basis of these studies[12]. Potential reasons could be a very small sample size[13], lack of proper randomization[16], recruiting patients with wide neurological disorders[17] and the use of different scales for balance measurement and their sensitivity issues[12]. Moreover, most of the published articles on circuit training focused on circuits related to gait training[12].

Thus, we designed the current study with the most standard tools for balance assessment on stroke patients with comparatively large sample size to evaluate the efficacy of circuit training program on balance in stroke patients. Moreover, there is an unmet research need on balance training in circuit for effective management of balance training after stroke.

The patient to therapist ratio is high in the majority set-ups of Peshawar (Pakistan), therefore, it is imperative to introduce the concept of circuit training in Peshawar stroke setups due to the afore-mentioned benefits.

METHODS

The total sample size was calculated to be 64 using OpenEpi software with 95% confidence interval and 80% power[16]. A total of 64 patients were enrolled in this study after inclusion and exclusion criteria and informed consent. The main study centers were Fauji Foundation Hospital Peshawar, Rafsan Paraplegic Center Peshawar and Institute of Physical Medicine and Rehabilitation (IPMR) clinic Khyber Medical University (KMU). The participants were enrolled for this study on the basis of following inclusion and exclusion criteria. Inclusion criteria were: 1) stroke patients diagnosed with cerebrovascular accident resulting in unilateral motor deficits; 2) patients between 3-8 months of stroke; 3) both male and female patients; 4) age 45-65 years; 5) individuals with well cognitive status; 6) patients able to sit independently. The exclusion criteria were: 1) patients who had previously received physiotherapy; 2) patients with associated co-morbidities e.g. severe arthritis and sever angina; 3) patients requiring moderate assistance in functional activities even prior stroke.

(Ethical approval was provided by the Ethics Board Committee of Khyber Medical University Peshawar, Pakistan (REFERNCE NO.DIR/KMU/AS&RB/EC/000520).

All the participants were evaluated for outcome measures at baseline and then randomly allocated to two groups after informed consents. The informed consent was based on Helsinki ethical consideration. The randomization was carried out by simple random sampling (Figure 1) through a lottery based sequence method. Participants from both groups participated in 1.5-hour task specific training program for 5 days a week, for a total 4 weeks. However, the circuit group received physiotherapy in circuit based workstations and individual group received physiotherapy individually. The participants were allocated to workstations according to their functional balance level and the time required for completion of one circuit was about 15-20 minutes. The participants were

excluded from the study if they failed to attend =2 sessions per week. The patient to staff ratio in circuit group was ~4:1 while it was 1:1 in individual group. The study staff was trained for training balance dysfunction by the approach called Task Specific Training (TST). The participants of the study were randomized into either circuit class or individual task specific training. It was a single blind study where the participants did not know which treatment they were receiving but the physiotherapists did know the offered treatment.

The overall aim of the treatment program was to improve patient's balance. There were 10 work stations incorporated into this study (1) sitting on a table and reaching out in different directions, (2) sit/stand from different chair heights (3) lower limb strengthening exercises in weight bearing position (4) stepping in forward, side and side directions (5) postural training in standing 6) heel lifts (7) standing up from a chair and walk for short distances (8) walk on treadmill (9) gait training over various surfaces and obstacles (10) walking over slopes and stairs with variant environment. The patient's compliances were recorded high at Fauji Foundation Hospital and Rafsan Paraplegic Center Peshawar because the patients were admitted in these institutes. The records were taken from the registers that marked patients' attendance daily in all of three study setups. Three main therapists were involved in this study at each center.

Four patients withdrew from the study shortly after getting in physiotherapy sessions. They mentioned domestic problem as a reason for not continuing the treatment sessions.

Three outcome measures were used for this study. The Modified Motor Assessment Scale (MAS), Berg Balance Scale (BBS), and Time Up and Go Test (TUGT). These outcome measures were recorded at two occasions initially at baseline and later after 4-week training program. The BBS consists of 14 functional tasks using a 5-point ordinal scale ranging from 0-4 scores. It examines unsupported sitting, standing, transfers, functional reach, picking objects from floor, turning, single leg stance, and stepping. Both intra-rater and inter-rater reliability for BBS are high (r=0.95) . The TUGT is used for evaluating balance during walk and it is used to assess participant's mobility. Participants were asked to stand up from a chair (back supported) walk on 3-meter line turn around and sit back on the chair. The normal young individual takes 10 seconds on this test, while 10-20 seconds is considered normal for elderly population while >20 second is pathology associated walk that needs to be addressed. It's a valid and reliable instrument for assessing a functional mobility . The MAS is a categorical 9-point ordinal sub-scale, which can evaluate functional activities post stroke at any stage. This research utilized only component of MAS related to balance including balance sitting, sitting to standing and walking. It has revealed high test-retest consistency (r = 0.98) and inter-rater consistency (r = 0.95) . Mean ± Standard Deviation of clinical characteristics including age, 1st physiotherapy visit after stroke, length of hospital stay, and baseline and post treatment BBS, TUGT and MAS was calculated for both groups in this study. The within group analysis was done by paired sample t-test. To test the overall effect of treatment and to minimize the probability of type 1 error due to comparison of multiple variables between 2 groups, one-way analysis of variance (ANOVA) was carried out as data was normally distributed. The data was analyzed using SPSS version 21. A P-value <0.05 was considered statistically significant.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study.

RESULTS

Table 1 shows the means and standard deviations for all characteristics including participants' age, 1st physiotherapy visit after stroke and the mean length of hospital stay (LOHT) at time of acute onset of stroke.

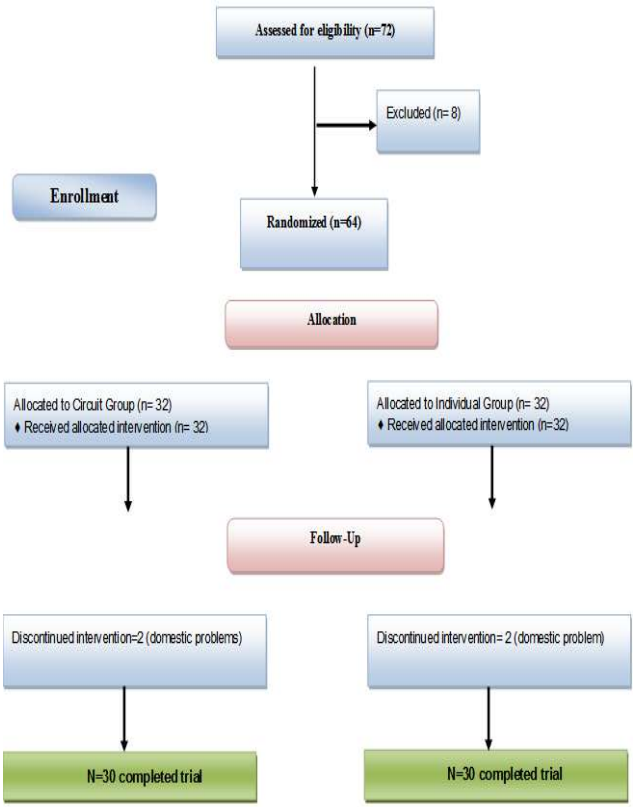

Table 2 shows the genders of participants and involved hemi paretic sides in numbers. At baseline assessment, the mean BBS in the circuit and individual groups was 26.37 scores and 25.40 scores respectively. The patients significantly improved in both groups on BBS after 1 month task specific training (P<0.05, paired sample t-test) (Table 3). After treatment, the mean BBS significantly improved in the circuit group, compared to individual training group, as they scored 37.80 scores versus 31.33 scores respectively. (P=0.01, ANOVA) (Table 3). At baseline, the mean TUGT for both circuit training group and individual training group was 23.17 seconds and 23.87 seconds respectively. Within group analysis by paired sample t-test showed significant improvement on TUGT in circuit group (P=0.001) (Table 3) while non-significant results on TUGT in individual training group was observed (P=0.65) (Table 3). After treatment the mean TUGT significantly improved in the circuit group, compared to individual training group (16.67 seconds and 23.13 seconds respectively) (P=0.02, ANOVA) (Table 3). At baseline the mean MAS for both circuit training group and individual training group was 14.40 scores and 14.63 scores respectively. The patients significantly improved in both groups on MAS after 1 month task specific training (P<0.05, paired sample t-test). After treatment the mean MAS significantly increased in the circuit group, compared to individual training group, as their scores were 20.63 nd 18.77 respectively (P<0.05 ANOVA) (Table 3).

Table 1: Demographic characteristics of participants

Variables	Circuit group (Mean ± SD)	Individual group (Mean ± SD)
Age of participants	58.01±3.7	59.83±2.76
1st PT visit after stroke (in months)	4.57±1.45	4.63±1.35
Length of hospital stay (days)	14.00±2.15	14.13±2.22

SD=standard deviations,

Table 2: Gender and side of hemiparesis of participants

Variables	Circuit group	Individual group
Gender of the participants	16=male, 14=female	14=male, 16=females
Side of the hemiparesis	22 LHP and 8 RHP	18 LHP and 12 RHP

LHP= left hemi-parses, RHP= right hemi=paresis

Table 3: Paired sample t-test and ANOVA for both groups

Variables	Individual group (n=30)		P-value1	Circuit group (n=30)		P-value1	P –value2
	(Baseline Mean ± SD	After Mean ± SD		Baseline Mean ± SD	After Mean ± SD		
BBS	25.40 ±5.24	31.33±5.14	0.00*	26.37 ±5.39	37.80±6.71	0.03	0.01*
TUGT	23.87 ±12.48	23.13±4.19	0.65	23.27±11.06	16.67±5.08	0.00	0.02*
MAS	14.63 ±1.84	18.77 ±1.94	0.00*	14.40±1.99	20.63±2.22	0.02	0.01*

Significant P-values are presented with*. P-value1 =Paired sample t-test, P-value2= ANOVA, SD=standard deviation

DISCUSSION

The results of this study indicated that circuit group had more gains in balance recovery on BBS, TUGT and on MAS than the individual group. This study also favored task specific training to be carried out for balance training post stroke at an early stage after stroke. However, the non-significant results for TUGT in individual group by task specific training suggests that the functional mobility could be improved by treating patients individually with task specific training either extensively or would require more follow-up[13, 16, 17]. Previously Dean et al ,. Sherrington et al ., and English et al ., investigated the area of similar research as compared to the effects of circuit training with individual trainings on balance in post stroke patients. The sample size of Dean et al[13]., was only 9 patients (a pilot study) and their outcome measure were 6-minute walk test (6 MWT), step test and time up and go test (TUGT). They investigated more dynamic balance in circuits.

Previous literature showed clinical results, but they lacked significant results on statistical analysis. Our study reported both clinically and statistically significant results on balance measures. It might be due to comparatively large sample size of this study. Another reason could be the post stroke acute patients in this study as compared to more chronic stroke patients that were recruited by Dean et al [13]., and it is evident from the literature that the chances of recovery are more in early post stroke rehabilitation than in chronic phase . The Sherrington et al. [17], evaluated functional balance in circuits by using functional parameters like stepping, sit/stand and by gait parameters, they however reported for significant results for functional balance, but their baseline populations were not similar. The outcome measures used by English et al [16]., were five-meter walk test (5 MWT), 2-minute walk test (2 MWT) and BBS, to evaluate the functional balance in circuit class. They reported significant improvement in both groups for pre and post treatment values but not significant difference between groups for all primary outcome measures. The patients reported to be more satisfied with circuit training and were comparatively more independent on gait related test over individual training program. The major limitation of the above study [16] was the lack of random allocation and there was lack of a more homogenous sample size.

The circuits for balance training, the staff to patient's ratio, the study duration and treatment time, the exclusion and inclusion criteria used in our study were like previous studies with some modification .

Several different outcome measures were used previously for balance evaluation to determine the

patient's ability to perform activities of daily life. However, the results from these studies regarding balance training in circuits post stroke were somewhat unclear. BBS, TUGT, step test, Activities Balance Confidence Scale (ABCS) and functional reach test were frequently used by researchers to evaluate balance recovery post stroke in circuit groups.

The Meta-analysis by English & Hillier and of Wevers et al ., reported no significant differences on BBS between the control and experimental group whereas the later meta-analysis showed significant difference on TUGT for patients who received circuit based training. The English & Hillier and 2 other studies (not included in this Mata-analysis) showed significant improvement in activities balance confidence scale in area of similar research. This study in contrast to previous research added MAS for evaluating functional balance and revised the same scenario of balance training post stroke in circuit groups as compared to previous studies. The positive effects on TUGT by the previous studies might be in conjunction with improved walking ability which is related to improvement in perceived health status . The step up test has a ceiling effect when it is used with community ambulant stroke survivors, which may explain why some trial found no balance improvement on this scale .

This study addressed most of the methodological flaws as mentioned in the previous studies and used the most standard scales including BBS, MAS and TUGT for balance measurement. However, future large scale studies are required to generalize the results of this study.

The task specific training is efficacious for balance training post stroke, including static and dynamic balance especially when carried out between 3rd to 8th months of stroke whether done in circuits or individually, however, circuit training is more efficacious to individual training on improving balance after stroke.

The limitations of the study are that it was a single blind study and that the duration of the treatment was short. In addition, the patients could have been further followed for assessing other parameters but due to lack of funding this was not possible.

CONCLUSION

Circuit class training is more efficacious in improving balance in stroke patients as compared to individual task specific training, but large scale double blind randomized controlled trials are required to validate the assertions made in this article.

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