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Guest Editorial

Responsibilities of physiotherapist

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The profession of physiotherapy is one of the most sought after professions in the present times. It can be seen right from the time the students give this as one of the top most choices while choosing their careers soon after schooling, with the lists soaring with the top rankers struggling to get into the few colleges offering the seats. Besides, the demand of the profession in our country and outside has also made it very popular. With the increasing demand, the number of colleges offering such courses has also mushroomed. With the mushrooming of the colleges, the demand for the post-graduate teachers has also risen many folds.

If we go back a few years, we had a handful of colleges offering a handful of students the chance to become physiotherapists. I must say that the course was wholesome with lots of practical inputs and shorter duration making each one qualifying able to get into serving patients and earning soon after qualifying. The times have changed a lot. Basically, trying to fulfill the requirements of the foreign employers, more number of years were added to the curriculum, more emphasis was put on theory and management of the newer colleges never tried to inculcate the facilities for the practical training. They were relying on other hospitals and nursing homes to provide the practical training. It has also been seen that at some places, the conditions are so deplorable that colleges are running in a single temporary room in a nursing home or in the residential accommodation turned into classrooms and small rooms labeled as labs. The question is: "is physiotherapy only classroom teaching?" No way. It is wound round the patients, more of practical than just theory. The students coming out of such unfortunate colleges without their own hospital facilities keep wandering from pillar to post to look for attachments in other hospitals which keep on refusing to accommodate them, while other hospitals wish to make a quick buck out of them at the same time exploiting the 'free labor' given to them at periodic intervals. Is there adequate supervision available at such hospitals giving practical training to the students or are the students left alone to fend for themselves. High time someone gave a deep thought to such institutions. Are we producing the right kinds of therapists in such institutions sans practical training, students sweating out with patients not knowing what to do or having a false sense of 'know all' on the outside. Should we allow such institutions to come up and should we allow students continue to be admitted to such institutions with the hope that someone would ultimately give them the hospital exposure some day.

I would like all the managers of such institutions to introspect and see if they are just offering the courses to fill their coffers or enriching the students with only false promises of wholesome training. I know, opening such an institution is not easy but should we play with the lives of the naïve students falling for such colleges thinking everything would be taken care of. How long would such institutions keep on evading their responsibilities? The students while enrolling into such colleges must ensure that adequate facilities of a teaching hospital with a good staff of teachers are available at the respective institutions offering such courses.

The responsibility does not just rest over there with the students and the managers. What about the teachers. Are the teachers keeping abreast with the latest? Are they continuing

to study further and also contributing to research. If the norms of the universities were to be explored, the teachers are supposed to partake in research and also contribute to the research publications. Do we have adequate facilities for research? We have such a large number of patients in this vast country, therefore no dearth of material. Do we have adequate platform to present our research, why not. We have scientific meetings and now this journal to fulfill the requirements of the community of physiotherapists striving to come forward to augment the knowledge and standards of the teaching and research in the field. We must utilize every opportunity to partake in research and publication that would be how the standards of physiotherapy would rise. Let us take this profession responsibly.

Effect of Backpack Loading on Cervical and Shoulder Posture in Indian School Children

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Study Design - An experimental study with same subject design, examining the effects of backpack loading on adolescent posture.

Aims & Objective - To investigate the response of cervical and shoulder posture to backpack load. The aims of this study were to determine whether the weight of backpack or time carried affected the adolescents cervical and shoulder posture.

Summary of Background data - The majority of children use a backpack to transport their belonging to and from school on a daily basis; however, controversy exists over the safety of backpack use. There is widely held belief that repeated carrying of loads, such as school backpacks, places additional stress on rapidly growing adolescent spinal structures, making them prone to postural change.

Methods-A total of 60 school children aged 10-15 years randomly selected from CBSE affiliated school in Delhi, participated in this study. Each child's body weight, height, and school bag weight were measured. Standing posture measured from the sagittal plane and recorded photographically under 3 loading conditions, 1) without bag 0% bodyweight, 2) static loading 10% BW, 3) after dynamic activities 10% BW.

Data Analysis- Comparison of postural angles after dynamic activities is done with static loading with 10 % body weight and with 0% body weight. The significance of changes in data was estimated using repeated measure analysis of variance on each angle with which planned contrast were made of the unloaded condition with each of two other loaded condition. Statistical test were considered significant if p=0.05.

Results- A significant change in craniovertebral angle was found in 2 loading conditions, static loading (10% BW) and dynamic loading (10% BW) when comparing standing posture with no backpack. Results revealed that both backpack weight and time carried influenced cervical and shoulder posture.

Conclusion - Carrying a backpack weighing 10% of body weight appeared to be too heavy to maintain standing posture for adolescents. These findings have implications for future load carrying studies in adolescents.

Key Words - Load carriage, backpacks, posture, children

The Backpack is one of the several from of manual load carriage that provides versatility and is often used by hikers, backpackers and soldiers, as well as school children, (Knapit et al 1996)[1]. The backpack is an appropriate way to load the spine closely and symmetrically, while maintaining stability (Voll & Klimt 1977)[2]. However musculoskeletal problems associated with backpack use have become increasing concern with school children [3,4,5,6,8,9]. Recent studies confirmed high prevalence rate (10% to 40% depending on back pain definition and age) of back pain among adolescent in many countries like New Zealand [8], United Kingdom [10], India [5], Italy [6], America [5], Finland [4] and Switzerland. There are also few reports of other problems associated with backpack i.e. functional scoliosis, rucksack palsy [11,12] and reduced lung functions [33, 34, 35].

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Musculoskeletal symptoms in school children are multifactorial in origin; the carriage of heavy school bag is clearly a suspected factor [8]. The combined effects of heavy load, position of the load on body, size and shape of the load, and load distribution, time spent carrying, physical characteristics and physical condition of the individual were hypothesized as factors which were associated with these problems. A recent study has shown a significant association between spinal pain and heavy weight. Past research has shown numerous attempts to study the effects of these factors on health safety of adult carriers. Many authors in the past have studied the effect of carrying load on different biomechanical and physiological parameters in adults. The effects of carrying load on posture, gait[13, 14,15.16]; muscle activity, lung function[17,18] and energy expenditure have been studied in adults and children.

Most of the studies on the effect of load carriage have focused on soldiers and hikers with the purposes of improving the techniques of load carriage. Information derived from these studies might not apply to schoolchildren [19]. School children are adolescent who experience a period of accelerated growth and development of skeletal and soft tissue. Their spinal structures are thus markedly different from those of adults. As growth of the spinal structures extends over a longer period of time than the other skeletal tissues , incongruities in rate of tissue development can pose a threat to postural integrity .Moreover , external forces such as load carrying may also influence the growth , development and maintenance of alignment of the human body (Leveace and Bernhardt 1984) .Consequently , posture in adolescent can be affected by both internal and external influences , which may make adolescent more susceptible to injury. Studying postural responses to loads will help us to understanding the impact of carrying school bags on children. When load is positioned posterior to the body in the form of backpack it changes posture because of changes to center of gravity. The body tries to keep the center of gravity between feet, so with a backpack, the trunk is in a more forward position, placing abnormal forces on the spine. Load carried in a backpack shift the center of gravity behind the body in order to compensate, the center of the gravity of the body plus the load is moved back over the base of the support; the feet. This is accomplished by either leaning forward at the ankle or hip or inclining the head; the rigidity of postural muscles controlling these adjustments increases to support the load. These alterations can lead to back pain and injury by stressing ligaments or muscles in the back or by changing the forces applied to the intervertebral discs .As the individuals fatigue and these changes become more pronounced, there is potential for the risk of injury to the load carrier. The studies have done by other researchers proved that carrying backpack lead to "forward head position" [19]. These changes in alignment of the neck can produce strain of cervical joints and soft tissue as well as imbalanced muscle performances. This can cause pain in cervical, upper thoracic and shoulder region [2].

The restriction of the maximum weight to 15% of the body weight is one of the main controls. However some other authors have recommended that bag weight should not exceed 10% of the body weight. It is only very recently that two researchers [19, 20] done in Australia have attempted to find out appropriateness of these recommendations by studying postural responses to different loads. In this study we are trying to determine whether the weight of the backpack (10% of body weight), its position on the spine or time carried affected adolescents cervical and shoulder posture. None of the researchers till date have studied responses of cervical and shoulder posture after static loading and after post dynamic activities with 10% of body weight. Moreover owing to anthropometrical differences [5] between western and Indian children of similar study done there are not directly applicable to Indian children.

Need of the study

There is need of this study, which can provide us with information about the average weight a child has to carry to school. Therefore if preventive measures can be introduce now with the regard to safe load carriage in school students, it will not only help to protect young

people while they are still developing, but will also ensure, that the principles they learn now are carried through to work place as adults.

Statement of question

What is the effect of carrying double straps school bag on cervical and shoulder posture of Indian school children aged 10-15 years with static loading and following dynamic activities?

Hypothesis

Dynamic loading the students with 10 % body weight leads to significant changes in cervical and shoulder posture as compared to static loading with 10% body weight and with unloaded or 0% body weight.

Operational Definition (Figure 1)

Cranio Horizontal Angle (CHA)

The angle formed at the intersection of horizontal line through the tragus of the ear and the line joining the tragus of the ear and external canthus of the eye. It is believed to provide and estimation of head on neck angle or position of upper cervical spine.

Craniovertebral Angle(CVA)

It is the angle formed at the intersection of a horizontal line through the spinous process of C7 and line of the tragus of the ear. This believed to provide an estimation of neck on upper trunk positioning .A small angle indicates forward head posture.

Sagittal Shoulder Posture (SSP)

The angle formed by intersection of a horizontal line through C7and line between the mid point of the greater tuberosity of the humerus and posterior aspect of acromian process. This provides measurement of forward shoulder position.

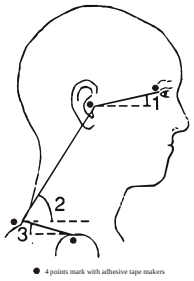


Figure 1. The craniohrizontal angle (1) and carniovertebral angle (2), and sagittal shoulder posture (3).

Limitation of study

The small sample size makes it necessary to reduce the scope of study and limit it to single load placement site i.e. low back.

1- The methodology used in the study fails to study the effect of postural sway on body response to backpack load. It seems likely that postural sway in child would affect postural response to load. Due to limited resources and understanding of the concept it could not be integrated in the study.

2- The postural responses to load are best studied by observing changes in trunk forward lean (TFL), craniovertebral angle (CVA) and spinal curvature. However, this study only examines cervical and shoulder posture.

3- Postural response to load has studied only in static condition and following post dynamic activities and not during dynamic conditions, like walking. The static condition does not perfectly resemble a realistic environment for students during normal daytime school bag carriage.

Recent worldwide attention has focused on the role of backpacks in the development of adolescent non- specific low back pain. Researcher have explored whether there is a critical backpack weight to body ratio that if exceeded affects health. Studies indicate the incidence of backpack use by school children in the developed countries is at least 90% [6-8,36,26,37] .The average loads vary greatly between studies; the majority of reports indicate that the loads carried by students are greater than the recommended limits [6,7,36,26]. Negrini Carobalona [6] found that the average daily loads of Italian students over a week ranged from 22% body weight to 27.5% body weight with one student who carried46.2%. In this group (n=237), 34.8% carried more than 30% of their body weight. Other studies report more modest load ranging from 10.3%body weight to20%body weight [6, 7, 26, 37]. Voll and Klimt [2] conducted a study strain in children caused by school bags. They found that the relative weight of the school bags for the 1st graders was one ninth of the body weight, for the 2nd graders it was one eighth, for the 3rd and 4th graders between one eighth and one seventh. More than 50% of the children considered their schoolbags to be very heavy or quite heavy. They also found that the

average traveling time between home and school was 28.5 minutes, which is relatively short in comparison with the results of investigations conducted by other researchers.

Children are at a higher risk of overuse injuries for two reasons. First, a child's skeleton has great amounts of cartilage, especially in areas where growth occurs, as it is predecessors to bone ossification[21,22]. These cartilaginous regions include the articular cartilage, the epiphyses, and the apophyses. Each form of cartilage is susceptible to different types of injury. Articular cartilage is vulnerable to sheer stress as seen in osteochondritis dissecans, where the epiphysis and apophysis are more susceptible to repetitive micro trauma. In addition to the weakness of these cartilaginous areas, decreases in soft tissue flexibility or muscle imbalances can also lead to injury. Soft tissues elongation occurs as a response to longitudinal bone growth, resulting in a period during growth where muscles and tendons are taut and subsequently lose flexibility[21]. The highest rate of growth for school-aged children occurs during puberty (10-12) years of age for girls and 13-15 years of age for boys) [23]; therefore, proper backpack use should be emphasized during these years. Growth of the appendicular skeletal system ceases around 16 yeas of age for females and 18 years for male; however, secondary ossification of vertebrae is not completed until the mid-20s[24]. Therefore, the spine may be susceptible to injury for a greater length of time.

The types of backpack injuries reported in children include back pain, rucksack palsy, shoulder pain, and muscle soreness. Numerous authors have documented a correlation between backpack use and back pain with children ranging from 9 to 18 years of age [5-7, 36, 26]. Although this correlation exists, the association between the actual load and back pain is not consistent. The Italian Backpack Study [6] found that backpack load was not a good predictor of back pain; however, reports of fatigue were highly correlated with back pain reports. The odds ratio calculated for back pain when reporting fatigue while carrying a backpack was 3.8 when wearing the backpack and 5.6 for previous back pain. Because fatigue, not weight, was found to be the predicting factor in this study, limiting only weight may not decrease the prevalence of injury, as fatigue is associated with physical fitness, pack design, time of carriage, and the load. Some cross-sectional studies link backpack weight with back plain[6, 26]. However, because of the cross-sectional nature of these studies, a selection bias may be confounding the results. To further investigate the association between backpack weight and back pain, a prospective study is required.

Methods and Materials

Subjects

50 males and 15 females' student aged between 10-15 years were included in the first phase of the study. The children were students of the 5th, 6th, 7th and 8th classes of CBSE affiliated School in Delhi. The school follows CBSE prescribed syllabus for all the classes and has no locker facility. Informed consent was obtained from the school Principal for the first phase. The height, body weight and weight of school bag were measured (Table 1).

In the second phase, parents of students were contacted and informed consent was sought. The parents of 5 students refused the consent. So a total of 48 males and 12 females participated in the second phase of study. Students were excluded if recent injury, fever, systemic illness or congenital deformity were reported. Further screening was undertaken prior to testing in order to eliminate students who had scoliosis or kyphosis. The students were asked to report if there was any pain while the testing procedure. A stopping rule (stopping the procedure if there was complaint of pain) was followed during the testing procedure. No student left the sample either by exclusion for scoliosis or kyphosis or by application of the stopping rule.

Table 1. Characteristics of Subjects

Variable	Mean(SD)	Max.	Min
Age(yrs)	11.42 (1.55)	14	11
Height (cms.)	145.5 (11.43)	172	105
Body weight(kg)	34.82 (8.68)	69	21
Weight of School bag(kg)	6.1 (1.6)	10	3

Design

Experimental, same subject design was used for the study. 2 experimental load conditions (static and dynamic loading with 10% body weight) were tested. The subjects were their own controls where baseline or unloaded posture is compared with posture under two different experimental loading conditions.

Instrumentation

Subjects were weighed with and without their school bags on the one set of calibrated electronic scale (Beurer scale, accurate to be within 0.1 kg to 120 kg). Standing height was measured against a measuring tape secured to wall. One school bag was used for all the experimental conditions. The school bag had two adjustable padded shoulder straps, two compartments and no waist or chest compression straps. Ranges of weights of 2 kg, 1 kg, 500 gm, 100gm, and 50 gm were used for the experimental load conditions. The dimension of weights replicated typical education material. One Sony 3.2 Mega pixels digital camera was used to take still photographs of subject's sagittal posture. Tripod stand with a spirit meter level was used for mounting the camera. Measures of cervical and shoulder posture were calculated from digital photographs using the digitizing software (Image Tool UTHCSA version 3.0 University of Texas Health Service Center, San Antonio, TX).

Protocol

Informed consent was obtained from the school principal for the first phase of study. All the students who were in age group of 10-14 years were selected. Students were weighed with and without their school bags using Beurer scale and standing height were measured against a scale secured to wall. The bared foot student stood tall with chin retracted and eyes looking straight ahead. A scale was placed on the topmost aspect of skull and height was measured. For the 2 nd phase of study informed consent was obtained from the parents. Prior to commencement of the procedure, physical examination was carried out to rule out scoliosis and kyphosis. The photographic measurement was obtained in the morning to minimize the effect of fatigue and diurnal variation. Subjects were photographed in specific order. Subjects were 1st photographed without backpack then with static loading with 10%body weight followed by after dynamic activities with 10% body weight.

Procedure

Clothing was rearranged so that shoulders were exposed. With the subjects in standing posture adhesive markers were placed on four anatomical landmarks.

- external canthus of the right eye
- right tragus
- spinous process of the 7th cervical vertebrae
- Midpoint between greater tuberosity of humerus and posterior aspect of acromian of the scapula.

Subjects were asked to stand comfortably with their arms by their side in normal standing posture. They were asked to place their weight evenly on both feet. The lateral malleoli were placed between parallel lines, which are perpendicular to the frontal planes. The subjects looked directly ahead. Camera was placed two meters from the subject's right side. Photograph was taken within 5 second of assuming the position.

The photographs of the subjects were taken in specific order. The length of the straps of the school was adjusted prior to loading, to place the center of bag approximately at mid back level. Subjects were encouraged to relax and move about after each photograph.

- Without school bag (unloaded, 0% body weight)
- Static loading (with 10% body weight)
- After dynamic activities (with 10% body weight).

In this student perform two activities with 10% body weight school bag prior to be photographed.

- 3 min - walking
- 2 min - stair climbing

Photographs were analyzed by digital software Image Tool UTHCSA version 3.0, University of Texas Service Center, San Antonio.

Data Analysis

Comparison were made of postural angles with no school bag, and postural angles produced by carrying school bag over two shoulders equivalent to 10% body weight with static loading and after dynamic activities.

Comparison of postural angles after dynamic activities is done with static loading with 10 % body weight and with 0% body weight. The significance of changes in data was estimated using repeated measure analysis of variance on each angle with which planned contrast were made of the unloaded condition with each of two other loaded condition. Statistical test were considered significant if p=0.05.

Table .2 : Mean (SD) degrees values from postural Assessment

Conditions	Craniovertebral Angle (CVA) Mean (SD)	Craniohorizontal Angle (CHA) Mean (SD)	Sagittal Shoulder Posture (SSP) Mean (SD)
Unloaded condition (0% of body weight)	45.311 (7.201)	15.258 (8.039)	53.793 (10.152)
Static loading(10% of the body weight)	42.093 (7.793)	17.796 (7.586)	58.042 (11.990)
Dynamic loading (10% of the body weight)	41.867 (7.139)	17.986 (9.211)	62.052 (12.950)

Results

60 subjects in the age group of 10-15 (mean age 11.42 ± 1.55) were enrolled for the study. The mean height and mean weight of the subjects enrolled were 145.5cms, ±11.43cms and 34.82 kg ± 8.68kg respectively. The mean weight of the bag child carried to school was found to be 6.1kg ± 1.62kg which was 17.5% of their body weight .

Baseline values were obtained by measuring craniovertebral angle, craniohori-zontal angle and sagittal shoulder posture on the unloaded condition with 0% of their body weight (Graph 1).

The mean values of craniovertebral angle reduced in all two experimental loaded conditions in comparison with unloaded condition (Table 2). The mean value of CVA in the unloaded state was 45.311 ±7.201, whereas the mean values of CVA while static loading with 10% of body weight and after dynamic activities with 10% of body weight were 42.093 ± 7.793 and 41.867 ± 7.139 respectively.

Significant difference was found by repeated measure of variance (ANOVA) in the CVA between unloaded state, static loading and after dynamic activities with p value 0.018 which is less than 0.05.

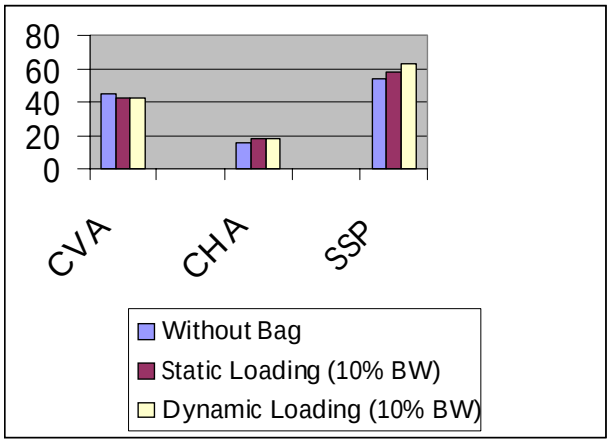
Pair wise comparison between unloaded state and static loading with 10% body weight shows that there is significant difference with p value 0.05 and also significant difference between unloaded state and after dynamic activities posture with p value 0.034. There was no significant difference was found between static loading states and after dynamic loading activities posture with 10% body weight load for CVA as p value is greater than 0.05.

The mean values of craniohorizontal angle increased in all two experimental load conditions in comparison with unloaded state (Table 2). The mean value of CHA in the unloaded state was 15.258 ± 8.039, whereas the mean values of CHA while static loading and after dynamic activities with 10% body weight were 17.796 ± 7,586 and 17.986 ± 9.211 respectively. No significant difference was found in CHA between the unloaded condition and carrying school bags weighing 10% body weight while static loading and after dynamic activities posture.

The mean value of sagittal shoulder posture increases in all the two experimental loads conditions in comparison with unloaded state (Table 2). The mean value of sagittal shoulder posture in the unloaded state was 53.793 ±10.151, whereas the mean values of sagittal shoulder posture while static loading and after dynamic activities with 10% body weight were 58.042 ±11.990 and 62.052 ±12.950 respectively.

Pair wise comparison shows that there was significant difference between unloaded state and after dynamic loading activities posture

with 10% body weight with p value .000. No significant difference was found between unloaded state and static loading posture with 10 % BW and between static loading posture and after dynamic loading posture with 10% BW as p value is greater than 0.05.



Graph 1: Pattern of postural change under different load conditions

Discussion

The result of this study revealed that most of the Indian children in the age group of 10-15 years carried school bag weighing between 10%-18% of their body weight. The mean value of weight of the school bag carried by children was found to be 6.1kg, which is found to be 17.5% of their body weight. The weight of the school bag expressed in percentage of body weight was found to be consistent with studies done by Shruti.R .Iyer[5] and Pascoe et al[7]. Shruti. R Iyer[5] in their study found that Indian children carry school bags weighing 18.5% of their body weight. Pascoe et al [7] in their study done in America found that mean weight of school bag carried by school children in the age group of 11-13 years was 17% of their body weight. Also Negrini et al[6] in their study done in Italy found that average load carried by school children aged 11.29 ±0.33 was 9.3 kg, which was calculated to 22% of their body weight. In contrast the weight of school bag expressed in percentage of body weight in this study was found to be heavier than reported by Forjuoh SN et al in their study done in Texas (6.2% among kindergarteners and 12% among fifth graders). Also J.K Whitefield et al[8] in their study done in New Zealand school reported 13.2% of body weight for third grade and 10.2% for sixth grade.

The effect of weight of backpack on posture

Craniovertebral angle provides an estimation of head on upper back. A small angle indicates more forward head position. It has been found that smaller the CVA angle is associated with headaches in females [38]. Also change in alignment of neck can produce strain of cervical joints and soft tissues as well as imbalanced muscle performance [2, 27]. This can cause pain in cervical, thoracic and shoulder. Muscle imbalance caused due to forward head posture can lead to increase in thoracic kyphosis[28]. This may precipitate impingement syndrome. Head posture has an immediate effect on the position of mandible and can lead to temporomandibular joint dysfunction, and swallowing difficulties[29]. The incidence of pain in the cervical region in school going children is high. Altered cervical and shoulder posture associated with carrying heavy school bags is clearly a suspected factor. Also repeated micro traumatic events such as carrying backpack may lead to postural anomaly of forward head posture in children[7]. Therefore it is important to limit postural changes with backpack loading. Good carrying habits, better backpack designs and limiting the weight of backpack have been recommended to reduce the immediate and chronic postural changes .The recommendation and limits are based on paucity of research related to students carrying these backpack loads. Wunpen Chansirinukor et al [19] found that children are unable to maintain their cervical and shoulder postural alignment while carrying 15% of body weight. Hence they rationalized children must be carrying lesser weight and they arbitrarily suggested carrying 10% body weight. The possibility of fatigue (caused by different loading conditions) affecting the results cannot be ruled out in his study. This study attempts to refine on the previous attempts to study postural responses to 10% of body weight load in children.

We found that child assumes a forward head posture (indicated by decrease in CVA) when loaded with 10% of body weight and following dynamic activities with 10% body weight.

There was significant difference was found between different load conditions. Thus it can be said that carrying school bags weighing 10% body weight would alter the head position and may result in pain and other anomalies associated with altered posture. The results of this study are supported by the findings of Pascoe et al[7] (1997) who reported a forward head posture when carrying 17% of body weight. Also Wunpen Chansirinukor et al[19] reported a significant decrease in CVA when carrying 15% of body weight.

The effect of time of carrying a backpack on changes in posture

In this study we also recorded altered cervical posture following dynamic activities with 10% of body weight load. These results are consistent with the study done by Wunpen Chansirinukor et al[19] who found similar changes in cervical posture (decrease in CVA) after 5 minutes walk with 15% body weight. This indicates that time carrying a load influences neck on upper trunk position.

Rounded shoulder posture is associated with imbalanced muscle performance and has been linked to impingement syndrome, neck pain, head ache and craniomandibular disorders[32, 30, 31]. In this study we found that sagittal shoulder posture increases while static loading with 10% of body weight and after dynamic activities with 10% of body weight as compared to unloaded condition.

Raine and Twomey et al[27] (1994) commented that a more rounded shoulder is represented by smaller sagittal shoulder angle, provided the position of C7 remains fixed. However, the study done by Wunpen et al argue that a smaller sagittal shoulder angle does not necessarily indicate a more rounded shoulder posture as it is difficult to know if C7 has remained in the same place under different postural conditions. For instance, a larger sagittal shoulder angle may also represent a more rounded shoulder if the forward head posture is increased- for example the marker at C7 is displaced anteriorly. The closer the points at the shoulder and C7 are, the bigger the sagittal shoulder angle is. Therefore, the more anterior head position observed in most subjects in this study when carrying a backpack may contribute to an enlarged sagittal shoulder angle. However, it can be concluded that loading with 10% of load leads to altered shoulder alignment. While it is still debatable whether it leads to rounded shoulder or not. Craniohorizontal angle indicates the position of upper cervical segment. We found a non significant change in CHA with 10% body weight.

In this study we have found that there are significant changes in craniovertebral angle and sagittal shoulder posture when comparison is done between unloaded state and static loading with 10% body weight and between unloaded state and after post dynamic activities with 10% body weight. There was no significant difference was found for craniovertebral and sagittal posture between static loading posture and after dynamic activities. This can be explained on the basis that subjects might have good cervical muscles endurance or five minutes activities might be not enough to change cervical and shoulder posture.

A study done by Grimmer et al[20] found that as student matures, they acquire different postural response to load carrying, such as adaptive or compensatory involvement of other aspects of spine (such as lumbar spine or hip), which influence head on neck placement. Also anthropometric of the subjects taken in study might also contribute to different postural response of upper cervical spine and shoulders to loads. The result of this study suggest that carrying school bag weighing 10% of body weight would be too heavy for students aged 10-14 years to be able to maintain their normal postural alignment. In other words carrying a load of less than 10% of body weight school bag is recommended to maintain good postural alignment. However, this recommendation is only applicable for double strap school bag placed fastened on both shoulder and placed on low back. This might not be true for other type of backpacks and other load placements.

Relevance to Clinical Practice

Physical therapy is concerned with health promotion, prevention, treatment or rehabilitation (as defined by world confederation for physical therapy).

Physiotherapist can play an important role in preventing musculoskeletal pain associated with carrying heavy school bags in children. The finding of this study will helps us in planning more effective preventive strategies for school children. The students, parents, and teachers should be advised to restrict the school bag weight to less than 10% of body weight.

Imparting back care education program to school children is a professional avenue, which has been explored by physiotherapist and occupational therapist in different countries across the world. It has been taken as social responsibilities by some professional organization like American Occupational Therapist Association, Professional Physiotherapist Association and Physiotherapist of our country can also take an active part in increasing awareness about possible musculoskeletal problems associated with carrying school bags heavier than 10% of body weight. As studies in past shown that an effective back care program given to student by Physiotherapist with the collaboration of school teachers can potentially reduce the incidence of spinal pain in children.

Conclusion

The result of the study supports the experimental hypothesis that dynamic loading the student with 10% of body weight leads to significant change in cervical and shoulder posture as compared to static loading with 10% of body weight and unloaded condition. Significant change in cervical and shoulder indicated by decrease in craniovertebral angle and increase in sagittal shoulder posture was found in dynamic loading and static loading as compared to unloaded posture. This implies that loading with 10% of body weight would be too heavy for the child to maintain normal cervical and shoulder posture alignment. We have also found that 5 minutes of dynamic activities with 10 % of body weight produce significant change in craniovertebral and sagittal shoulder posture as compared to unloaded posture. It can be say that duration of time spent in carrying school bag has an effect on shoulder and cervical posture. Thus implying that school bag weighing 10% of body weight would be too heavy for the Indian school children aged 10-15 to be able to maintain their normal cervical and shoulder posture alignment. Thus carrying a load of less than 10% of body weight is recommended.

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Lower extremity muscle strength and balance performance in indian community dwelling elderly men aged 50 years and above

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Background and purpose.

Age related changes in posture and gradual decrease in lower extremity muscle strength increase risk of falls in elderly.

Subjects

43 community-dwelling voluntary males between 50-80 participated.

Methods

Cross sectional observational study included the measurements of Berg Balance Scale (BBS), Functional Reach Test (FRT) and the Timed Get-up and Go-Test (GUG). The force generated by 4 lower limb muscle groups was measured using strain gauge.

Result

Age is negatively correlated with balance performance and with muscle force production. The toque production of hip extensors (predict FRT and GUG scores) and knee extensors (predict BBS score) can serve to predict balance performance on certain scales, and have an important contribution in the maintenance of balance in older adults. Conclusion: - marked deficits in strength and balance performance found among senior citizens which need to be rule out in advance through various measures, as the present study emphasized the importance of predicting the score of FRT and GUG by hip extensors and BBS by knee extensors and hence suggesting the muscle involved in prediction differ depending on the measure of balance.

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Age and lack of physical activity may both be responsible for a poor balance control. The risk of developing problems in one or more of the sensory, motor, or adaptive brain components of balance increases with age as the body is exposed to degenerative or infectious diseases, or the effects of injuries accumulated over a lifetime. Thus, balance problems among older adults are frequently caused by combinations of subtle degenerative, infectious, or injury processes that are individually not clinically significant. Contributing factors may include a history of injuries, such as concussions, ear infections, or serious sprains or fractures.

Some elderly individuals experiencing balance problems have obvious medical diagnosis such as diabetes, Parkinson's disease, or even a stroke that is the primary source of the problem. Whether balance disorders result from combinations of subtle problems or obvious disease, clinical studies indicate that elderly fallers are different from their healthy age-matched counterparts and require medical treatment to maintain their functional independence and quality of life.

It has been reported that physical characteristics of gait change after the age of 62 years. Singer (1984) found that single stance time declines with age and is a marker for poor balance. In fact, single stance tests have been used as a predictor of falls, since majority of falls occur during single leg stance activities. Wolfson, et al (1996) reported gait characteristics are affected with age and are correlated with balance. If gait characteristics change after the age 62, it is hypothesized that balance measures will decline after the age of 62 as well.

Impaired motor performance of an older individual is often characterized by a slowing of movements, a decline in muscle strength or maximal force production and a loss of fine coordination. Changes in muscle strength during growth and ageing have been a matter of sporadic scientific interest.

Physiological evidence indicates that there is a 30-40% decline in isometric forces and approximately 18% reduction muscle mass between 2nd and 7th decade of life. The proximal muscles of the lower limb have been reported to be especially affected by muscle fiber atrophy and decline in maximum strength during ageing. Studies noted changes in both isometric and dynamic strength with age i.e. a steep increase to 20-29 years group and a decline beginning in 50-59 years group. Maximum speed of movement followed the pattern seen for strength with increasing age, although the changes were less pronounced. Strength decline was also found to correlate significantly with the Type-II fiber atrophy in old age. Also, no significant differences have been observed in anthropometrics characteristics or muscular strength between 60-69 years group and randomly selected 70 years men. Simmonson et al. (1947) – found leg strength has been found to decline more rapidly with age than handgrip.

Maximum strength would be expected to depend on total no. of muscle fibers recruited. Consequently, the assumed age dependent decrease in the total no. of muscle fiber together with the muscle atrophy might be the primary causes of the decline in strength during ageing. Other mechanism such as change in endocrine activity, reduction of the intra-muscular blood flow in the neuromuscular system and in contractile protein and protein metabolism have been suggested as associated with decline in muscle strength with age and may cause the decrease in the total no. of muscle fibers.

Poor balance has repeatedly being shown to be a risk factor for falls in community-dwelling older adults. Line defined balance as function requiring the constant adjustment of muscle activity and joint position to retain body weight over the base of support. Balance has three basic dimensions-maintenance of a position, stabilization for voluntary movements and reaction to external disturbances. Most injurious falls occur during the performance of routine daily activities such as walking, transferring, stopping, bending or reaching.

In many countries like US, as the population over the age of 65 years continues to grow, there will be a corresponding rise in the level of functional disability. Physical therapist can play an important role in delay the onset of disability and prolonging health into old ages. It is therefore imperative that appropriate screening methods are developed to identify community-dwelling elderly individuals with functional impairment who should be referred for a detailed physical therapy evaluation. Thus, measure of postural control may be useful for determining fall risk in older people and for determining the outcomes of treatments aimed at improving balance.

The elderly are among those at greater risk for disequilibrium. Although the relationship between muscle weakness in old age and equilibrium maintenance would seem to be closely related, studies related to this topic are rare and incomplete. Like Margurerite et.al (1999), purpose of this study is to determine the degree to which one component of postural control (muscle force of lower limb) contributes to the scores on 3 functional balance measures and to determine how the muscle force values and balance performance differed with different decades of life (50-80).

There are many tests of balance function, but most of these depend on laboratory tests that are not available to average clinician. Although laboratory measures of balance offer greater precision and potential to detect subtle or sub clinical balance impairments, functional tests of balance share the advantages of ease of administration, low cost and more directly interpretable functional relevance. Three commonly used tools for measurement of balance impairment are Berg Balance Scale (BBS), Functional Reach Test (FRT) and the Timed Get-up and Go-Test (GUG).

Reliability of using strain–gauge, small numbers of subjects and physical activity level is not considered in this study, which probably

does not represent the current population of older adults in this country, these were few limitation of the study.

METHODS

Sample

The study is conducted in different residential areas of Delhi, Modi Hospital, Saket and subjects are taken from one Senior Citizen Welfare Association, Vasant Kunj. The data is collected in a time period of one year. The subjects in the study are male geriatric population aged between 50 to 80 years. A total of 55 elderly males volunteered to participate: 43 subjects were selected who fulfilled the inclusion criteria had undergone balance measurement and lower limb muscle force measurement.

Inclusion Criteria

1. Healthy elderly males of age 50-80 years.

2. All are able to walk without assistive devices.

3. Asymptomatic degenerative diseases like OA, RA etc.

Exclusion criteria

1. Presence of any neurological or musculoskeletal diagnosis that could account for possible in balance and falls such as CVA, Parkinson's disease, cardiac problem, TIA or lower limb joint replacements.

2. Persons undergoing balance training and strengthening exercise training for lower-limb.

Design of the study: - observational cross sectional design.

Protocol

Design with 3 groups corresponding to 3 different decades of elderly man 50-60 (Group-A), 60-70 (Group-B), and 70-80(Group-C). The independent variable is age group. The dependent variables are balance scales scores and muscle force measurement of the dominant leg.

Subjects who agreed to participate signed an informed consent.

Measurement

Berg Balance Scale[52, 54] Berg Balance Scale is a performance-based measure designed to monitor performance during balance activities, to screen for individuals who therapists perceive would benefit from a physical therapy referral,[53] and to predict multiple falls in community-dwelling and institutionalized older adults. The Berg Balance Scale consists of 14 common tasks, requires only a few props, and takes approximately 15 to 20 minutes to administer. The 14 items are scored on a 5-point ordinal scale (0=unable to perform, 4=independent) based on ability to complete the task and time for completion. The scores on the 14 items are combined for a total score, which can range from 0 to 56, with a higher score relating to better performance.

Each task was demonstrated first to each subject. Scoring was done by recording the lowest response category that applies for each item. In most items, the subject was asked to maintain a given position for specific time. Progressively more points were deducted if the time or distance requirements were not met, if the subject's performance warrants supervision, or if the subject touched an external support or receives assistance from the examiner. Subjects should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach were left to the subject.

Equipment used for testing was a stopwatch. Chairs used during testing were of reasonable height. A step (of average step height) was used for item #12.

Functional Reach Test. [52]

Test was developed as a measure of the margin of stability. The Functional Reach Test has been used to describe and monitor an individual's balance and to screen for or predict an individual who is at risk for falling.

Functional reach was measured using a leveled yardsticks secured at the height of the subjects's acromion on the dominant arm. Subjects were asked to stand comfortably to make a fist, and to raise their both the arms until it was parallel to the yardstick (position 1). The placement of the end of the third metacarpal along the yardstick was recorded. Subjects were then asked to reach as far as forward as they could without losing their

balance (position 2), and the position of the end of the third metacarpal along the yardstick was again recorded. No attempt was made to control the subject's method of reach, but if he touched the wall or took a step during the maneuver, that trail was considered invalid and repeated. Each subject was given three trials. Functional reach was defined as the mean difference between position 1 and position 2 over the three trails. All subjects were guarded by a research during the reach task.

Timed Get Up and Go[50] measures the time it takes a subject to stand up from an armchair, walk a distance of 3 m, turn, walk back to the chair, and sit down. It was developed originally as a clinical measure of balance in elderly people and was scored on an ordinal scale of 1 to 5 based on an observer's perception of the performer's risk of falling during the test.[45] Podsiadlo and Richardson[55] modified the original test by timing the task (rather than scoring it qualitatively) and proposed its use as a short test of basic mobility skills for frail community-dwelling elderly.

A 3-m distance was marked off on the floor in front of a firm chair with arms (seat height of 46.5 cm). The test began with each subject sitting, back against the chair, arms resting on the lap, and feet just behind the distance-marker on the floor. Subjects were instructed as follows: "On the word 'go,' stand up, walk comfortably and safely to the cone on the floor, walk around the cone, come back, and sit all the way back in your chair." They were informed that the trial would be timed. Timing began on the word "go" and ended when the subject's back rested against the chair upon returning. A practice trial was performed and then followed by 2-recorded trials. Data obtained during the 2-recorded trials were averaged for use in data analysis.

After balance scales, measurement of muscle power was done on dominant leg.

Lower-extremity muscle force was evaluated using a strain gauge. Studies have shown the strain gauge to be a reliable tool for clinical measure testing.[29,44]

All muscle groups were tested in midrange of joint motion. The idea behind this was to get maximum force production. The strain gauge was always held perpendicular to the limb segment. After the subject was positioned and stabilization (manual stabilization of position) was achieved, the subject was asked to flex and extend his knee and hip and dorsiflex and plantar flex the ankle actively as a warm-up. One practice trial was given prior to testing for each movement. Best of the three trials was recorded for each muscle group and average of these scores for the dominant leg was recorded and used for data analysis. Each trial lasted 4 to 5 seconds so the subjects could be instructed to increase their force to maximum over a few seconds' time. Rest period of 60 seconds was given between each trial. Instructions were standardized for each test.

The force of the hip extensor muscles was tested with each subject positioned prone and his knee flexed to 90 degrees.[57] The subject was asked to grasp the edges of the testing plinth. For extension, the strap of stain gauge was applied around the posterior surface of the thigh (along with the soft padding) just proximal to the knee, superior to the popliteal fossa.

Knee extensor muscle forces were tested with the subject positioned high sitting with the hip flexed to 90 degrees and the knee flexed to 90 degrees.[21] The strap of strain gauge placed around the distal tibia for extension.

Ankle plantar-flexor muscle force was tested with the subject positioned supine with the hip and knee extended and the ankle in neutral dorsiflexion. Ankle dorsiflexor force was tested with the subject in a long-sitting position with the hip flexed between 70 and 80 degrees and the knee extended.[51] The subject was asked to grasp the edges of the testing plinth. A pillow was placed under the non-testing extremity. The strap of strain gauge was applied proximal to the metatarsophalangeal joints, for measurement of plantar-flexor muscle force and the same for the measurement of dorsiflexor muscle force.

DATA ANALYSIS

Data were analyzed using the statistical analysis system (SBSS) computer program. All lower-extremity muscle force measurements

were divided by body weight (kilograms/ kilograms of body weight) in order to normalize the force data. Descriptive statistics (mean, median, and standard deviation) were calculated for all variables. Each subject's age was correlated with each of torque values to determine the relationship between age and torque. The Pearson product – moment method of correlation was also used to determine the relationship between age and torque production. The same statistical procedure was used to test the relationship between the subject's age and balance scores. Two one-way analysis of variance (ANOVA) were performed to test the effect of activity level on torque and on balance. Significant F ratios were tested using least-squares means for the post hoc analysis. A forward stepwise multiple regression analysis was applied to the force measurements to determine which measurements were important predictors of the BBS, FRT, and GUG results and of fall status.

Non-Parametric tests (Kruskal-Wallis Test and Mann-Whitney Test) were applied for BBS scale. . Parametric tests (independent t tests with Bonferroni correction) were applied to the transformed force data to determine differences in force measurements between subjects of different age groups and the same tests were applied to the other two balance scales (FRT and GUG). Tables, charts and graphs were constructed for all of the raw data to determine the distribution of the values for each variable.

RESULTS

Descriptive statistic on the anthropometrics data and all the variables of the study subjects is shown in table 1 and 2. Balance scales scores were found to be negatively correlated with age. BBS (C.C* = -.513, P = 0), FRT (C.C = -.740, P = 0), and positive correlation with GUG (C.C = .565, P = 0); which means time taken to complete GUG is increasing with the increase in age. On the other hand the muscle forces also showed similar negative correlation with age. HE (C.C = -.706, P = 0), PF (C.C = -.648, P = 0), DF (C.C = -.673, P = 0), KE (C.C = -.716, P = 0).

Comparing the balance scores and muscle force production, BBS (HE – C.C=0.459, PF – C.C= 0.375, DF –C.C= 0.519, KE –C.C= 0.557) and FRT (HE –C.C= 0.632, PF – C.C= 0.590, DF - C.C= 0.576, KE – C.C= 0.618) have positive correlations with all muscle group chosen in this study except GUG (HE - C.C=-0.595, PF - C.C=-0.449, DF - C.C=-0.594, KE - C.C=-0.544), which is negatively correlated with muscle torque values. It means with the increase in muscle torque is directly proportional to decrease in scores of BBS and FRT test value, and also increase in the time of TGUG test.

Inter Group Comparison

Significant difference was found between the group 1 and 3 (p=. 000), 2 and 3 (p=. 000) but not between 1 and 2 (p=. 119) in FRT.

Significant difference was found between the group 1 and 3 (p=. 001), 2 and 3 (p=. 013) but not between 1 and 2 (p=1.00) in GUG.

Significant difference was found between the group 1 and 3 (p=. 019), 2 and 3 (p=. 047) but not between 1 and 2 (p=1.00) in BBS.

Hip extension muscle force significantly differ red between group between 1 and 2 (.000), 1 and 3 (.000) and not between 2 and 3 (.690)

Knee extension muscle force significantly differ red between group between 1 and 2 (.000), 1 and 3 (.000) and not between 2 and 3 (.369).

Plantar flexor muscle force significantly differ red between group between 1 and 2 (.000), 1 and 3 (.000) and not between 2 and 3 (.971)

Dorsi flexor muscle force significantly differ red between group between 1 and 2 (.002), 1 and 3 (.000) and not between 2 and 3 (.233)

Result of regression analysis shows (as in above table), out of all the 4 muscle in my study the force of knee extensor muscle (R^2 = 31.0%, P = .000) and hip extensor muscle (R^2 = 39.9%, P = .000) was predictive of the score on BBS and FRT. Force of hip extensor muscle was also (R^2 = 35.4%, P = .000) predictive of the score on GUG.

Note :- C.C* = Correlation Coefficient.

Descriptive statistic on the anthropometrics data and all the variables of the study subjects is shown in Table 1.

Descriptive Statistics

Table 2

Variables	N	Minimum	Maximum	Mean	Std. Deviation
AGE	43	51	80	64.58	8.67
HEIGHT	43	157	185	171.00	7.12
WEIGHT	43	50	90	68.00	8.31
BBS	43	46	56	54.84	2.28
FRT	43	16	38	31.35	4.78
GUG	43	8.18	15.15	11.1233	1.6999
HP Normalized HP	43	8.06 0.12	40.05 0.64	22.8951 0.3331	9.9952 0.13417
PF Normalized PF	43	6.80 0.11	27.20 0.43	13.9726 0.2046	5.7135 0.07957
DF Normalized DF	43	7 0.10	29 0.44	16.39 0.2410	5.72 0.07894
KE Normalized KE	43	9 .16	47 .66	27.28 .3989	10.23 0.13736

Table 2

VARIABLES	A (MEAN ± SD)	B (MEAN ± SD)	C (MEAN ± SD)
BBS	55.6667 ± .8997	55.4615 ± 1.1266	53.4667 ± 3.2484
FRT	35.0667 ± 2.0517	32.5385 ± 1.6132	26.6000 ± 4.6568
GUG	10.2240 ± 1.0085	10.7200 ± .9407	12.3720 ± 2.0506
HIP	33.5420 ± 4.7564	18.4954 ± 7.6462	16.0613 ± 6.1246
PF	20.0713 ± 4.4739	11.4446 ± 3.2884	10.0647 ± 2.5495
DF	21.9587 ± 3.6333	14.9831 ± 4.7159	12.0540 ± 3.2488
KE	37.9913 ± 6.5340	23.6677 ± 7.4087	19.7113 ± 5.2536

Key words: - BBS berg balance scale FRT functional reach test
GUG get up and go test
HIP Hip extensors PF plantar flexors
DF Dorsi flexors KE Knee extensors

MEASURE	PREDICTOR VARIABLE	R^2	P
BBS	KE	.310	.000
FRT	HE	.399	.000
GUG	HE	.354	.000

DISCUSSION

It is generally believed, and supported by cross sectional and longitudinal studies, that aging is associated with the reduction in muscle strength. [59,60,61] The results of this study are also in accordance with these previous studies depicting the loss of strength with increasing age. Significant difference in the torque production of an elderly healthy person belonging to group A and B, A and C in this study group population shows that the males of Indian community between the ages of 50-60 years have more muscle strength than people 60 years and above. Physiological basis for this decrease have been discussed already in many studies.[31, 32, 38]

Rather than selecting participants who were free from pathologies, I chose to study older people who functioned independently without assistive devices in the community. The study anticipated that the range of performance on the tests by our participants would show substantial variation. The characteristics of our subjects should be kept in mind when interpreting our findings. The participants in our study included men of age between 50-80. Based on the descriptive data, as well as our perception, I believe that the study participants represent elderly people who have little medical co morbidity, are self-reliant in daily activities, and are mobile in the community. Thus, they represent a range of older adults who are fairly active and have fairly good health, in spite of the presence of some pathology.

In the present study no significant difference was found between muscle force production of age group B and C. One factor could be that the study examined the current activity level and did not look at the previous occupation. There is a possibility that the people in 70-80 years age group (Group C) could have been more active previously. Also, since the subjects were recruited from a recreation center, I could be assumed that people of this age group who were coming to this center represented the more active subset of people in 70-80. While significant difference was found between group A and B, A and C, which can be explained as people in group A were still indulging in some kind of occupation or activity which meant that their activity levels were definitely higher than retied subjects of age between 60-80. Also sedentary men are less likely to venture outside of their home and are therefore difficult to recruit.

Lin SI, Woollacott M et al. [58] found that the difference in muscle strength was significant in young and functionally unstable older adults, but not between young and stable older adults. In spite of consistent trend of weaker strength in the stable older adult then young adults, the age difference was not significant except for the hip and knee flexors. The small sample size (n=16 in each group) might contribute to the lack of age effect. The same explanation could be given for lack of significance between the torque values in-group B and C.

Previous studies have shown that balance scores decreases with increasing age.[62, 63,64] The results from this study concur with these results and showed a significant negative relationship between age and balance scores. Balance scores showed a significant decrease ($p < 0.05$) with age for the testing conditions BBS, FRT and a significant increase in the time taken to complete the task of TGUG. However, inter group comparison of this study says that balance scores have a significant decrement between age group A and C, B and C and not between A and B.

In contrast to this Bogle – thorbalum and Newton did not find a relationship between age and BBS data in 66 elderly people. Their result suggests that age related norms might be needed for the BBS. Controversy still exist as to weather increasing age is associated with decline in BBS performance.[50, 65] However Lin SI, Woollacott M et al.[58] said although age was a significant factor in contributing BBS, only 25% of the variance in BBS could be explained by it.

Lois K Boulgarides et al[66] used 5 balance tests (including BBS and TGUG) to predict the falls in the community dwelling adults 65-90 years and concluded that multiple fallers and non multiple fallers both scored very well on many of the balance tests. The small sample size, the large number of subjects who were physically active, and the high level of subject

performance may have affected the results of the statistical tests. Multiple falls did occur in this population, but these falls could not be predicted by the tests. Because many subjects scored very high on the BBS, the DGI, and TUGT, a ceiling effect may have occurred, indicating that these performance-based tests are not suitable for older adults who are high functioning, even when they are at risk for falls. Different, possibly more challenging, performance-based tests might reveal balance deficits that could cause falls in people who are high functioning. The development of new tests for this population is indicated.

Hagemen PA et al[10] studied age and gender effects on six relatively new postural control measures (including FRT) and found that age had a significant effect on all. FRT in men who were taller showed larger values of FRT than the shorter women, however when FRT was normalized to body height no significant gender differenced was observed.

Maraharu ossital et al.[25] examined the relationship between falls and physical performance measures among 402 community dwelling Japanese elderly women aged 60 years and over. They concluded that FRT score decreases with age but FRT was not associated with falls.

In the present study balance scores (BBS and FRT) and torque measures of (ankle plantar-flexors, knee hip extensors and ankle dorsiflexors) muscle forces have significant correlation but GUG have negative correlation with muscle power. This means that with the increase in muscle strength the time taken to perform an activity reduces. However, consideration of other factors such as physiological (visual and sensory propriocetion) and psychological factors (code the articles) apart from muscle strength is also necessary while studying balance.

Also in response to externally impose postural disturbances, the timing and the amplitude of postural muscle response need to be scaled to the size of the perceived imbalance.[67,68] This process involves reception and integration of sensory inputs, selection of response synergies and execution of postural responses. Muscle strength, which is related to response execution, would become a limiting factor only when the required strength exceeds the person's capacity. When the perturbation used are medium in size and all subjects are able to recover balance without difficulty. It is probable that when large threats are used, the role of muscle strength could be more prominent. A functional balance test results such as BBS does not necessary coincides with the external balance threats. Physical impairment may not be sufficient to predict the changes in this ability either. The level of ability of reactive balance control in the elderly thus needs to be specifically assessed before the intervention can be developed.

On examination of the extent to which lower-extremity muscle force measurements were predictive of scores on 3 commonly used measures of balance. The force-generating capacity of only the knee extensors (KE) muscles accounted for 31% of the score on the BBS, hip extensors (HE) 39.9% on FRT and 34.5% of the score on the GUG. So only KE and HE muscles was found to be predictive of scores on all 3 measures.

In contrast to this Elsie G Culham et al [51] determined ankle dorsiflexor and evertor muscle was force to be predictive for 58% of the score on the BBS. Ankle plantar-flexor force contributed to prediction of the score on the FRT. Ankle plantar-flexor and subtalar invertor force also contributed to the score on the GUG. The only differences in lower-extremity muscle force between the fallers and nonfallers were found in the ankle dorsiflexor and hip extensor muscles.

According to Brian D Iverson et al [57] torque production of the hip flexors, abductors and extensors (in noninstitutionalized men 60-90 years of age) is a predictor of balance performance on the OLST (one leg stance), suggesting importance of maintaining hip muscle force capabilities in the elderly.

When large external perturbations are applied in stance, the control of the body is thought to be primarily the responsibility of the hip muscles (hip strategy) as opposed to the ankle muscles when perturbations are smaller.

The hip flexor and extensor muscles act during the single-limb support portion of the stance phase of gait to control the angular acceleration of the head, arms, and trunk. Thus, weakness of these muscles may contribute to instability during gait and dynamic activities. Human subjects respond to postural disturbances through movement primarily at the ankles and hips (ankle and hip strategy). The ankle strategy requires sufficient ankle range of motion and force in the ankle muscles and is most effective when perturbations to equilibrium are slow and small and the support surface is firm and wide.

Previous researchers[69, 70,71,72] have also identified the ankle muscles as being the most important predictor in postural control. While findings of this study does not match with these studies. So further studies on this aspect needs to be considered.

Future research

Future studies should be aimed at developing a valid and reliable balance scale as none of the currently available tests like BBS, FRT, TUG etc can discriminate between fallers and non fallers. Use of CDP (Computerized dynamic posturography) would be more reliable as it gives a quantitative measure of balance performance. More research into the fall prevalence, fall prevention and etiology of falls needs to be done in Indian population.

Relevance to clinical practice

This study may be useful for determining fall risk in older people and for determining the outcomes of treatments aimed at improving balance. By identifying the determinants of balance in elderly men of Indian community, important new data can be provided from which fall prevention strategies may be designed and tested. The present study reports the predictor of balance scores, correlation of balance, muscle and age in Indian dwelling men. This provides a rationale for maintaining balance and muscle strength in elderly population. However, because of the previous evidence[73] that maintenance of strength alone does not substantially improve balance, balance training separately should be included in such interventions also.

CONCLUSION

Balance performance and force production have a positive relationship (i.e. as force production increases balance performance improves). The toque production of hip extensors and knee extensors can serve to predict balance performance on certain scales, and have an important contribution in the maintenance of balance in older adults. Age is correlated negatively with balance performance and with muscle force production. Studies of correlating the role of muscle strength of lower extremity in predicting balance dysfunction on Indian population are needed.

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BOOK REVIEWS

Textbook of Physiotherapy for Obstetric and Gynecological Conditions by G.B. Madhuri published by Jaypee Brothers Medical Publishers (P) Ltd, Delhi. ISBN 81-8061-813-7, pp 191, 1st Edition 2007, Price Rs.295/-.

This is a very good book not only for physiotherapists who are practicing but for students too. Various breathing techniques and exercises, which are described in the book, can be used to encourage natural birth. This book named is quite useful for practitioners who wish to establish ante-natal and post-natal clinics. The book has covered all the important aspects of physiotherapy needed for obstetric and gynecological practice.

The format of the book is quite good. The language is simple and easy to understand and follow. The book is well designed. The printing and paper is quite good.

In nutshell, this is a good book for physiotherapists intend to do obstetric and gynecological practice. The book is reasonable priced.

Dr. Archna Sharma
Editor-in-Chief

A comparison of autogenic drainage and the active cycle of breathing techniques in patients with acute exacerbation of chronic obstructive pulmonary disease

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ABSTRACT

Purpose: The effect of a short term treatment of autogenic drainage (AD) and active cycle of breathing techniques (ACBT) were evaluated in patients with acute exacerbation of chronic obstructive pulmonary disease (COPD)

Methods: Thirty male COPD patients with acute exacerbation were trained and randomly assigned into two groups and they performed each technique on successive days in a within subject randomized two day cross over design. The experiment was conducted in ward / IMCU in Escorts hospital, Faridabad. Following dependent variables were measured before treatment, during treatment, immediately after treatment and 30 minutes after treatment, sputum volume, SpO2, heart rate, PEFR, respiratory rate, VAS and patients preference.

Results: Data was analyzed using SPSS 11.5 for window version. Between the treatment means analyzed for difference using paired t-test. General linear model repeated measure of variance (ANOVA) was used to examine the changes in dependent variables; level of significance was set at $p < 0.05$. There was statistically significant difference SpO2, HR, and VAS between the treatments however none of these changes was clinically significant. Within treatment analysis showed both the treatments were equally effective in removing secretion, improving oxygenation and thereby decreasing dyspnea.

Conclusion: The results of this study indicates that AD is as effective as the ACBT in acutely clearing secretions and improving oxygen saturation without causing any undesirable effects on heart rate respiratory rate and breathlessness in patient with acute exacerbation of COPD. These techniques can be used in COPD exacerbations according to patients' and the physiotherapists' preferences.

Key words: Autogenic drainage, active cycle of breathing techniques, acute exacerbation of COPD, airway clearance techniques

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality. It affects about 4-10% of the global population[1]. The World Health Organization estimates that COPD causes 4.7 million deaths annually, making condition the fifth leading cause of global mortility.[2] About 18 million Indians 5 percent men and 2.75 percent women above the 30 years of age are already suffering from this disease.[3] Cigarette smoking is the most important factor for COPD: 15-20% of smoker develop clinically important airway obstruction.[4]

Global initiative of chronic obstructive lung disease (GOLD)[5] defined COPD as "a disease state characterized by air flow limitation that is not fully reversible. Airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lung to the noxious particles or gases". In addition to their chronic disease patients with COPD often experience regular acute exacerbation (typically around 2-3 per year).[10,11] Anthonisen et al.[12] in1987, defined acute exacerbation of

COPD (AECOPD). This definition is based on the presence of specific symptoms in patient with COPD, namely increased dyspnea, sputum volume and sputum purulence. Airway mucus hyper secretion is a cardinal feature of COPD. Mucus hyper secretion, implicit in term chronic bronchitis, is one of the physiological entities comprising COPD. The increased mucus is associated with goblet cell hyperplasia and submucosal gland hypertrophy. The number of ciliated cells and ciliary length is decreased in patient with chronic bronchitis[6]. These abnormalities coupled with mucus hyper secretions are associated with reduce mucus clearance and airway obstruction. Retained airway secretions can form mucous plugs and bronchial casts that cannot be expelled by coughing. Airway plugging causes impaired ventilation, resulting in lower ventilation – to-perfusion ratios. Increased airway resistance to airflow and air trapping result in hyperinflation of the chest and inspiratory loading of the respiratory muscles, leading to fatigue.[7]

Chest physiotherapy (CPT) is effective in clearing secretions from the lung of the patients with copious secretion. The conventional treatment for many years was postural drainage (PD) with percussion. Deleterious effects have been associated with manual techniques including arterial desaturation, bronchospasm, atelectasis, increased oxygen consumption and metabolic and hemodynamic disturbances.[8] In recent years new method have been adopted among which are Autogenic drainage (AD) and Active cycle of breathing technique (ACBT). The AD has been compared with postural drainage and chest clapping and it was concluded that the AD was less likely to produce oxygen desaturation may be better tolerated by patients while producing similar benefits.[9]Short term effect of postural drainage (PD), FLUTTER and expiration with glottis open in the lateral posture (ELTGOL) compared in acute exacerbation of chronic bronchitis and concluded that all the treatments were safe and effective in removing secretion causing undesirable effect on oxygen saturation but FLUTTER and ELTGOL techniques were more effective in prolonging secretion removal than PD method.[10] Savci et al. studied the effect of long term treatment of AD and ACBT in 30 male stable COPD patient and concluded that AD is as effective as ACBT in clearing secretion and improve lung function[11]

The literature is confusing with comparison between and among regimens making the interpretation difficult. No studies to date have determine the efficacy & which of these two techniques is superior for improving oxygen saturation, sputum production, pulmonary function, patient tolerance & patient choice of treatment in acute exacerbation of COPD. This study was designed to compare the short-term effect of AD &ACBT in acute exacerbation of COPD. Based on the findings, appropriate airway clearance techniques could be used in these patients.

Methods

Patients : Thirty male COPD patients age group of 41-65 years with mean ±SD age 54.46 ± 7.69 yrs, height of 1.68 ± 6.45 m, and weight of 63 ± 7.07 kg. All were admitted in the hospital for treatment of there acute exacerbations were included in the study.

The acute exacerbation of COPD was defined as "1 of 3 symptoms i.e. worsening of dyspnea; increase in sputum purulence; increase in sputum volume[12] as well as 1 of the following: upper respiratory tract infection in past 5 days; fever without apparent cause; increased wheezing; increased cough; or increase respiratory rate or heart rate by 20% above base line."[13] subjects with coexistent medical problem like angina, neurological deficit, orthopedic abnormality, uncontrolled diabetes or hypertension, TB, asthma, bronchiectasis, indication for ventilatory support, hemodynamic instability, cor pulmonale, GOLD stage iv, pulmonary embolism, previous abdominal surgery, hernia, pneumothorax, polycythemia, CHF, were excluded from the study.

Interventions : On the day autogenic drainage was performed patient was advised to sit and relax with neck slightly extended. He was also asked to clear the upper airways (nose or throat) by huffing or blowing nose the patient began by performing the diaphragmatic breathing at low lung volume inspiration was

slow with a pause of three seconds, and expiration was done as a sigh with an open glottis and with high velocity as possible but no forced expiration. During this low lung volume breathing, expiration was encouraged down to the expiratory reserve volume. When the patient felt secretions to be moving, the volume of inspiration became deeper and expiration did not go down as far as expiratory reserve volume. As the secretions moved up the bronchial tree to the large airways the patient performed higher lung volume breathing, tidal volume to inspiratory reserve volume. Only when the secretions were felt to be as high as possible did expectoration occur. The patients were taught to suppress the cough to allow this the cycle of breathing exercise was repeated through out the 30-minute treatment session

On the day ACBT was performed, the patients' position was sitting with back supported. ACBT was performed several times, commencing with tidal volume breathing with the lower chest (breathing control) for approximately six breaths, followed by 3-4 deep inspirations of full capacity, and then another period of breathing control. Finally, the patient performed one or two forced expirations (huffs) from mid to low lung volume. If secretions were felt to be high enough in the proximal airways a huff was performed at higher lung volume. Patients were encouraged to cough and expectorate only if secretions were high enough. After the huff and or cough a further period of gentle lower chest breathing control was performed, and the cycle repeated through out the 30-minute treatment session

Data acquisition and measurements:

Subjects meeting inclusion / exclusion criteria received proper training of AD and ACBT. Training was one to two initial one- hour sessions with or without one to three 30-40 minute follow-up sessions. As the subject trained, was randomly assigned to a group. Subjects in 'Group A' treated with AD on the first test day and ACBT on the second test day. Subjects in 'Group B' treated with ACBT on first test day and AD on the second test day. All the treatment sessions were performed under supervision and at the same time of the day. All the usual medications were administered during the study days; the inhaled and / or nebulised treatments were standardized and administered before the study interventions and were the same on all study days.

Following dependent variables were collected before treatment, 15 minutes after treatment, immediately after treatment and 30 minutes after treatment.

Expectorated sputum

Any sputum produced during and following either the treatment was collected into the same plastic beaker (labeled mL scale) and volume measured in milliliters.

Arterial oxygen saturation and heart rate

The content of oxygen combined with hemoglobin in the arterial blood and hart rate were measured with a standard pulse oximeter (NANOX 2).

Peak expiratory flow rate (PEFR)

A Mini Writ's Peak Flow Meter was used .All the subjects were encouraged to produce maximal effort and the procedure was demonstrated. The meter was made to zero. Subjects were asked to inhale completely, quickly place the peak flow meter into the mouth and to make a seal around the mouthpiece with the lips. It was made sure that the mouthpiece was past through the patients teeth and not occluded by the tongue. Immediately then the subjects exhaled completely with maximal force the reading was taken as shown in the Peak Flow Meter. This measurement was repeated for two more times. The best one was taken for the record.

Respiratory Rate (RR)

Respiratory rate was recorded as observation of number of thoracic excursion for one minute.

Visual Analog Score (VAS)

Immediately prior to treatment the subject received the same instructions in the use of a 10 cm horizontal visual analog scale with anchor descriptors of 'Not at all breathless' and 'Severely breathless'. The subject was then requested to rate the intensity of their breathlessness by marking a point on the line. This was repeated immediately following

treatment without the subject viewing the initial recording

Patient preference

At the end of the second treatment day subjects were asked which treatment they preferred and recorded.

Data analysis

Data analysis was performed using the software package SPSS for windows version 11.5 (SPSS Inc., Chicago, U.S.A) and STATA 7.0. STATA was used to find mean and standard deviation of Age, Height, and BMI of all patients and of the variables. Paired t- test was used to compare Sputum Volume, Heart Rate, PEFR, Respiratory Rate, VAS between the two treatments (AD& ACBT) at Before Treatment, During Treatment, Immediately After Treatment, 30 Minutes After Treatment (same subject design). Paired t- test was used to compare VAS scores before and after treatment for both the techniques.

The general linear model, repeated measure analysis of variance (ANOVA) was used to examine changes in all dependent variables; the within subject factor was time which was measured at four intervals: before treatment, during treatment, Immediately after treatment and 30 min. after treatment. The significant level set for this study was 95% ($p< 0.05$).

Results

Sputum Volume : The mean volume of sputum expectorated during AD was greater than of the ACBT and was not affected by the order in which the treatment were given (Figure 1) but this difference was very small and found statistically non significant ($p >0.05$). However, intra- treatment multiple pairwise comparisons were made i.e. post hoc analysis was done that revealed that both the treatments were equally effective in removal of secretion the significance level was same for AD ($p = 0.00$) as well as ACBT ($p= 0.00$).

Arterial Oxygen Saturation (SpO2) : The men SpO2 gradually increases during treatments. Immediately after treatment the mean Spo2 for AD and ACBT were 94.2 and 92.7 respectively. This difference between two treatments was statistically significant with $p = 0.043$ (Fig. 2) Within treatment analysis shows significant increase in SpO2 in both the treatments when compared to their base line values ($p<0.05$).

Heart Rate (HR) : The mean heart rate increases gradually during the treatments. (Fig.3) However, the increase in HR was more in AD than in ACBT mean 83.7and 82.2 respectively. This difference was very small but found statistically significant ($p=0.043$). Heart rate tends to decrease gradually after treatment and at 30min after treatment it reaches nearly to its baseline.

Peak Expiratory Flow Rate (PEFR) : There were no significant differences in PEFR comparing both the treatments. (Fig.4) Within treatment analysis shows significant increase in PEFR during ACBT ($p=0.000$) however, it was non significant during AD treatment ($p>0.05$).

Respiratory Rate (RR) : There was no significant difference between the treatments for the respiratory rate with $p >0.05$ (Fig.5), intra treatment analysis multiple pairwise comparison made that is post hoc analysis was done that revealed non significant change in respiratory rate in both the treatments immediately following treatment. Respiratory rate significantly decrease 30 min after treatment when compared to their baseline values, in AD and ACBT significance level was $p = 0.001$ and $p = 0.016$ respectively.

Visual Analog Scale (VAS) : Paired t-test was used to compare resting VAS scores with immediately after treatment VAS scores for both the treatments. (Fig.6) In AD and ACBT after treatment VAS scores decreased significantly with significance level $p = 0.000$ and $p =0.008$ respectively. In AD the mean VAS score decrease more than ACBT this difference was statistically significant with $p = 0.007$.

Patient Preference : Twelve patients preferred autogenic drainage, fourteen patients preferred ACBT, three patients preferred both, and one patient had no preference.(Fig.7)

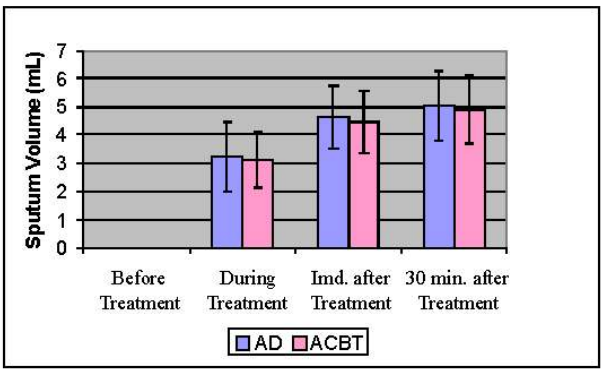

Fig. 1 Comparison Of Sputum Volume Between Two Treatments

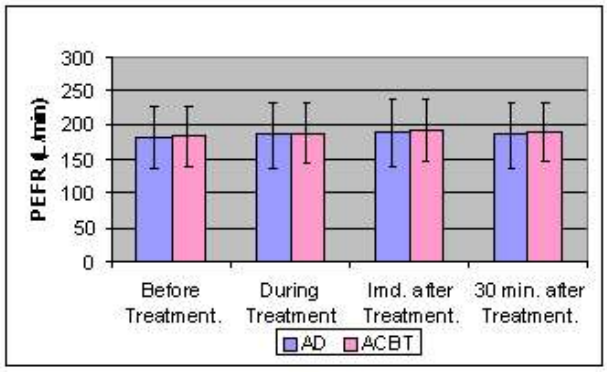

Fig. 4 Comparison Of Peak Expiratory Flow Rate Between Two Treatments

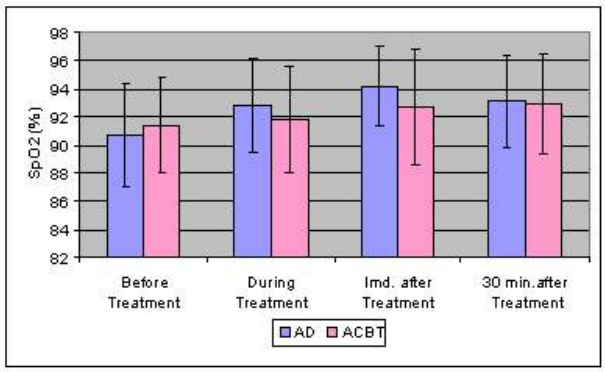

Fig. 2 Comparison Of Arterial Oxygen Saturation Between Two Treatments

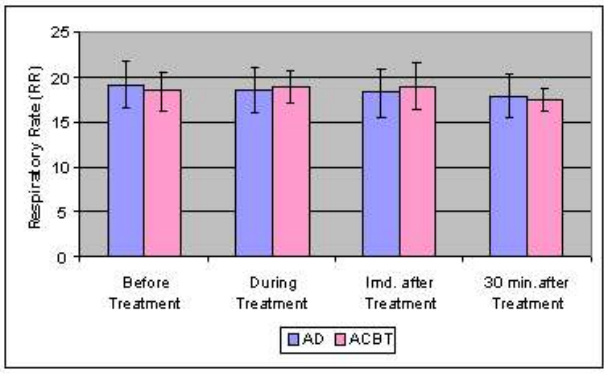

Fig. 5 Comparison Of Respiratory Rate Between Two Treatments

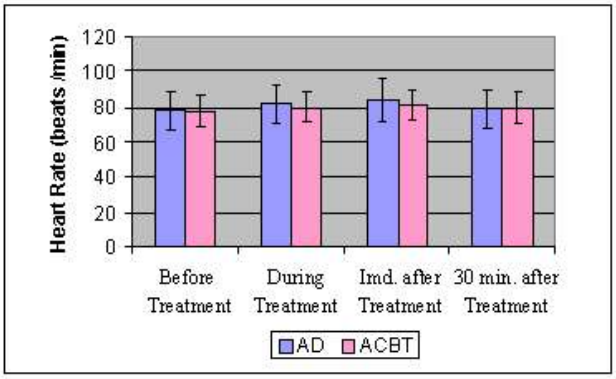

Fig. 3 Comparison Of Heart Rate Between Two Treatments

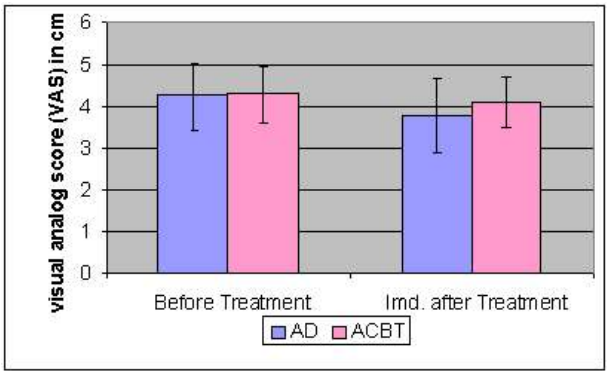

Fig.6 Comparison Of Visual Analog Score Between Two Treatments

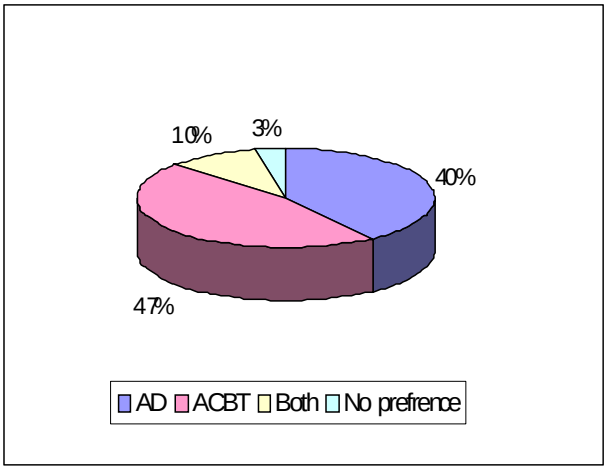

Fig. 7 Patients' Preference For The Treatments

Discussion

This study was designed to compare the effectiveness of two airway clearance techniques in acute exacerbation of COPD. It was a randomized crossover study .The results clearly demonstrated that there was no over all difference between the two treatments. In this study both the treatments found equally effective in sputum clearance however, no significant difference was found in sputum volume between the treatments. Similar observations have been reported by Millar et al[14] comparing AD with ACBT in cystic fibrosis patients, observed no significant difference in sputum weight between the two methods.

In this study sputum volume is measured because it is a simple non- invasive short-term clinical outcome measures of the effectiveness of airway clearance technique. It has been suggested that sputum volume or weight is misleading, as unknown quantity of saliva may be included.[15] Radio aerosol tracer[16] method has been suggested to evaluate the secretion clearance, but it raises serious ethical concerns and is therefore, being used in very few centers. It is further suggested that sputum volume is misleading as it may be swallowed or individual have difficulty in expectorating. [17] The subjects in this study were accustomed to expectorating sputum and treatment sessions were supervised by physiotherapist who discouraged subjects from swallowing sputum.

We cannot say whether the changes found in our study were independent of treatment, although we are looking for definite improvement in airway clearance rather than simply changes.

In this study subjects were demonstrated a significant improvement in oxygen saturation in both the treatments. However, the tendency towards higher oxygen saturation was with AD than ACBT and therefore, the difference found statistically significant. This was very much in accordance to finding of Savci et al[11] who found that in AD treatment, the increase in oxygen saturation was significantly higher than in ACBT. In contrast Miller et al[14] found no significance difference in oxygen saturation between the treatments in cystic fibrosis patients. However, no patients dropped saturation in either method. Increase in oxygen saturation might have been the results of removal of retained mucus plugs from the airways, lead to improved alveolar ventilation, optimized ventilation- perfusion mismatch, and finally improved oxygen transport to the tissue. Elizabeth Dean.[18]

Furthermore, the reason of comparatively increased oxygen saturation during AD is not well known. However, it can be suggested diaphragmatic breathing at different lung volumes might have been the result of increased alveolar oxygen tension due to carbon dioxide washout from overall hyperventilation

As per the results, the heart rate increased in both the treatments significantly. This increase had no clinically significant impact and soon showed a trend back towards baseline, as seen by continuous monitoring of heart rate. Comparison of heart rate between two treatments yielded small but significant difference ($p = 0.043$) but this difference had no clinical relevance because immediately after treatment means of AD and ACBT were 83.70 bpm and 81.26 bpm respectively. It indicates that both the treatments were not stressful enough to cause a considerable increase in heart rate. The reason of this increase in heart rate can be explained by this theory which says that 'at low level of exercise, heart rate increases almost exclusively via vagal withdrawal, with little evidence for systemic increases in

sympathetic nerve activity until the intensity of exercise is at or above the maximal steady state'[17,19].

In airway clearance techniques PEFR is a useful outcome measure of any change in airway obstruction following short-term intervention. Both FEV_1 and PEFR are most widely used and reproducible measures of force expiration. The FEV_1 and PEFR are well correlated but FEV_1 does not measure average flow rate over the large volume than PEFR.[20]

There was seen a substantial increase in PEFR in both the treatments. In AD, this increase in PEFR was found non significant. However, ACBT showed greater improvement in PEFR than AD. No significant difference was found comparing both the treatments. Similar findings have been reported by Savci et al[11] comparing AD with ACBT in a stable COPD patient they found increased PEFR in both the treatments, and PEFR increased more in AD than in ACBT.

There is still much controversy on correlation of sputum clearance and pulmonary function. Mucus hypersecretion can be an important contributing factor to airway obstruction. There is little doubt that copious sputum in the airways increase resistance to airflow and by blocking bronchial secretion can impair gas exchange within the lung. In patients with copious sputum, various measures of airflow resistance can be improved by airway clearance Clarke et al. [21]

Our subjects were found to have no significant change in respiratory rate during the treatments. However, both the treatments showed there is a small but significant decrease in respiratory rate 30 minutes after the treatment, reflect that both the treatments does not cause increase in respiratory rate and therefore may be safe in acute exacerbation.

Breathlessness significantly decreased in both the treatments after removal of secretion. However, this decrease was more in AD than in ACBT. Although, the difference was less but found statistically significant. This difference had no clinically significant impact because the mean difference was very less.

Future research

To give these treatments a more grounded base of practice future research need to be carried out by taking a large sample including both male and female patients.

Due to unavailability of resource this study could not included radio- aerosol tracing, continuous blood pressure monitoring, ECG during treatment, and complete PFT, future research can be embark upon with documentation of these readings.

Conclusion

The results of this study indicates that AD is as effective as the ACBT in acutely clearing secretions and improving oxygen saturation without causing any undesirable effects on heart rate respiratory rate and breathlessness in patient with acute exacerbation of COPD. These techniques can be used in COPD exacerbations according to patients' and the physiotherapists' preferences.

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Event Calendar

6th International Myotonic Dystrophy Consortium Meeting
September 12-15, 2007, University of Milan, Milan, Italy
This is the first announcement for the 6th international myotonic dystrophy meeting, organized by Dr. Giovanni Meola.
http://www.idmc-6.com/

12th International Congress of the World Muscle Society
17-20 October 2007, Giardini Naxos, Taormina Mare (Messina), Sicily, Italy
The symposium will be in the traditional WMS format with 3 selected topics: 1. New developments in metabolic disorders of muscle (including disorders of glycogen, lipid metabolism and mitochondria), 2. Update on congenital muscular dystrophies and congenital myopathies, 3. What's new in therapy of neuromuscular disorders?
http://www.worldmusclesociety.org

Moving and Handling People 2007
Business Design Centre, London N1
January 31 - February 2
http://www.movingandhandlingpeople.co.uk

27th Annual Scientific Meeting of the Australian Pain Society
1 - 4 April 2007
Adelaide Convention Centre
http://www.dcconferences.com.au/aps2007/posters.php

23rd International Seating Symposium
Orlando, Florida, USA
March 8-10, 2007
WEBSITE: www.iss.pitt.edu

The 23rd Annual Pacific Rim Conference on Disabilities
Honolulu, Hawaii, USA
March 12-14, 2007
WEBSITE: www.pacrim.hawaii.edu

87th American Occupational Therapy Association Annual Conference & Expo
St. Louis, MO
April 20-23, 2007
WEBSITE: http://www.aota.org/nonmembers/area29/links/link02.asp

International Society for Magnetic Resonance in Medicine
Barcelona, Spain
May 12-18, 2007
WEBSITE: http://www.ismrm.org/meetings/index.html

World Physical Therapy Conference 2007
Vancouver, BC
June 2-6, 2007
WEBSITE: http://www.physiotherapy.ca/congress20042007.htm

Canadian Association of Physical Medicine and Rehabilitation Annual Scientific Meeting
London, ON
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WEBSITE: http://www.capmr.medical.org/agm2007.htm
Festival of International Conferences on Disabiltity,Aging & Technology
Growing Older with a Disability Technology and Aging Advances in Neurorehabilitation Caregivers: Essential Partners in Care Toronto, Ontario, CANADA

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TRANSED 2007
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June 18-21, 2007
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International Spinal Cord Society
Reykjavik, Iceland

June 27-July 1, 2007
WEBSITE: www.sci-reykjavik2007.org
Deadline for abstract submission: November 27, 2006

12th World Congress of the International Society for Prosthetics and Orthotics
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July 29 - August 3, 2007
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CORRIGENDUM

In our last issue Vol. 1 no 1 on page number 31 the title of article was published as follows

“Effects of Repeated Sauna Bathing on ECG”

Gaurav Shori, J S Sandhu

It may be read as follows

“Effects of Repeated Sauna Bathing on ECG”

Shori Gaurav, Sinha A G K, Sandhu J S

The error is regretted -------- Editor.
