Effect of Respiratory Muscle Training with Device for Pulmonary Physiotherapy in Community Dwelling Elderly of New Delhi, India



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There is a need to highlight the medical problems that are being faced by the elderly people in India, and explore the strategies for bringing about an improvement in their quality of life.

Objective: To evaluate effect of Device for Pulmonary Physiotherapy (DPP) (Smart Breathe) on mobility status and community life of elders.

Design: Pre test post test design

Setting: Chattarpur Extension, New Delhi, India.

Subject: 37 elders were recruited using convenient sampling from members belonging to local senior citizen organization at Chattarpur Extension, New Delhi (n_37).

Method: Six physical therapists were trained on protocol of breathing exercises with device for pulmonary physiotherapy (DPP). Demographic profiles of older people were documented on the ICF Checklist Version 1A before starting the intervention. After correction of breathing pattern, breathing exercises started using DPP with increasing duration from day 2 to week 20. Components of Geriatric ICF core set reassessed at the end of week 8 and week 20.

Result: The study illustrates significant improvement in sensations associated with cardiovascular and respiratory functions, mobility status and community life of elderly.

CONCLUSION

Using the pulmonary physical therapy and training device helped older people with sensations associated with cardiovascular and respiratory functions. The study showed improved mobility of subjects around their house and community life.

KEYWORDS

Respiratory muscle training, Device for pulmonary physiotherapy, Community dwelling elderly, India is in a phase of demographic transition. As per the 1991 census, the population of the elderly in India was 57 million as compared with 20 million in 1951. India has acquired the label of "an ageing nation" with 7.7% of its population being more than 60 years old.

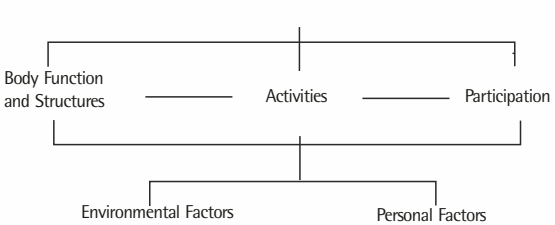
In India, the elderly people suffer from dual medical problems, i.e., both communicable as well as non–communicable diseases. In the population over 70 years of age, more than 50% suffer from one or more chronic conditions[1]. According to Government of India statistics on elderly mortality, respiratory disorders account for about 10% of total mortality[2].

A cross sectional study conducted in Chandigarh, India by Malhotra G ET. AL (2014), reported activity limitation was significantly more prevalent in the elderly aged over 70 years and performance restriction was significantly more prevalent in the elderly staying with family compared than those who stayed alone. This has been the major cause of social isolation and mental diseases in elderly in India[3].

Breathing is a major function of the body, which has an impact on state of health. Breathing exercises can influence the involuntary (sympathetic nervous system) that regulate blood pressure, heart rate, circulation, digestion and many other bodily functions therefore can be an effective ways to normalize different health parameters, and also increase the level of physical performance capacity and therefore better participation in activities of daily life. As older people who are more susceptible to chronic diseases, age related associated diseases (co morbidity), decline/loss of social support, atypical clinical presentations and special diagnostic problems make the elderly patient with respiratory disease, a complex client for a physician[4]. Much of the disease burden in rural India is due to respiratory disease, namely asthma, bronchitis, tuberculosis and pneumonia[5].

The respiratory mechanics of an elderly is different in that energy is not drawn as effectively from breathing as in young. Therefore, during exertion a tachypnoeic shift may result, which is defined as increased rate of breathing at the expense of maintaining tidal volume[6,7,8]. A subsequent increased work of breathing may cause blood stealing (blood diverted from working peripheral muscles to the respiratory muscles to meet increased demand) as well as respiratory muscle fatigue and increased dyspnoea which affects performance[9,10,11,12]. This explains early fatigue and dyspnoea in elders as compare to their younger counterparts, which require appropriate intervention Resistance breathing exercises has long been known to medicine. The concept of resistance breathing exercise with a breathing device has been utilized in this study. This Device for Pulmonary Physiotherapy (DPP), Smart Breathe works on the concept of improving expiratory muscle strength by incorporating a pressure threshold valve that provides resistance during expiration. The study has focused on monitoring effect of DPP on mobility status and community life of elders.

International Classification of Functioning, Disability and Health (ICF) is a multipurpose classification, which belongs to the WHO family of international classifications. The classification is organized in a hierarchical structure comprising of two main parts, each with separate components. The first part consists functioning and disability with 3 components: Body Functions (coded b) and Body Structures (s), and Activities and Participation (d). The second part of ICF encompasses contextual factors, and has two components: Environmental Factors (e) and Personal Factors (not coded)[13]



The Geriatric ICF Core Set is a selection of categories out of the entire classification that can serve as the minimal standard of the assessment and reporting of functioning and health. Since we were interested in the modifiable physical condition as potential determinant of self-efficacy, categories of the ICF components body functions, activity, participation, and environment of the Geriatric ICF Core Set were used for assessment.

METHODS

Six physical therapists were trained (12 hours in 2 days) on breathing exercises protocol with the Device for Pulmonary Physiotherapy (DPP). The therapists underwent training (20 hours in 3 days) on International Classification of Functioning. 37 elders were recruited using convenient sampling from members belonging to local senior citizen organization, according to the inclusion criteria i.e. male or female >60 years of age with cognitive level, MMSE >23. Elderly having cardiac arrhythmias or cardiac pacemakers were excluded from the study. All participants provided written informed consent for the study. Seven subjects were excluded from the study due inability to adhere to the protocol. Duration of the study was 20 weeks. Institutional review board approval was obtained at Max Super Speciality Hospital.

Demographic profile of age sex marital status, employment status, and prevalence of disease, was documented on the ICF Checklist Version 1A. Information of subjects on selected items codes (Table 1) from activity and participation and body functions from ICF Geriatric Core Set was recorded. Each subject was given a Device for Pulmonary Physiotherapy (DPP). Before using device for Pulmonary Physiotherapy (DPP) subjects were taught diaphragmatic breathing to correct their breathing pattern. Subjects then instructed to inhale to normal depth through nose and breath out against resistance for as long comfortable, maintaining diaphragmatic breathing pattern. At the start of study breathing exercise was done using Device for Pulmonary Physiotherapy (DPP) for duration of 15 minute from day two to end week two. The duration of use of Device for Pulmonary Physiotherapy (DPP) was increased from 15 to 30 minutes each day from end of week two to end of week four. Exercises of two sessions of 15 minutes each was done under supervision of therapist. The duration of use of DPP was progressed to 60 min each day with 3 sessions of 20 minutes each, under supervision of therapist, from end week four to end week six. The duration of breathing with DPP progressed to 90 minutes. From end week six to end week eight, subjects used the DPP with 4 sessions of 20 min each, out of which 3 sessions were under supervision of therapist, and the subject at home did 1 session. The minimum resistance at start of the study for each subject was three subjected to tolerance of the participant and was further progressed accordingly. At the end of week eight and at the end of 20 weeks, the baseline assessment was repeated.

Usage of Device for Pulmonary Physiotherapy (Smart Breathe) by elders.

Outcome measure of effect of DPP was done by five categories of the component Body Functions from the ICF Geriatric Core Set [25]. We used the first qualifiers, which describe the extent of a problem in functioning – more precisely, it denotes the range from full functioning '0' (no problem) to complete disability '4' (complete problem). If a category was not specified it was coded with '8' and if a category was inapplicable then it was coded with '9'. Because the properties of all qualifiers are not sufficiently evaluated, we used, similar to Grill et al, a simplified qualifier: each category of the components Body Functions and was graded with the qualifiers '0' for 'no impairment / restriction' and '1' for 'impairment / restriction'. The response option '9' was set to '0', because an inapplicable ICF category cannot be a problem and the qualifier '8' was set to missing. Five categories from body function and three categories from the component activity and participation were selected as shown in Table 1.

Table 1. ICF code and description

Item code	Description
b440	Respiration functions
b445	Respiratory muscle functions
b450	Additional respiratory functions
b455	Exercise tolerance functions
b460	Sensations associated with cardiovascular and respiratory functions
d455	Moving around
d460	Moving around in different locations
d910	Community life

RESULTS

The data was analyzed using Microsoft excel-07 and SPSS-17. Out of 37 subjects, 68% fall in to age group 60-69 and 32%, subjects were from age group 60-69 years. 70% of the subjects were male and 30% were female. 86% subjects were married and 14% widowed. 43% of the participants had completed 11-15 years of the education, 35% subjects completed 6-10 years of formal education and 8% were illiterate. 65% of the subjects were retired and 5% were self-employed.

Table. 2: Demographic Profile

SUBJECT DEMOGRAPHICS:		
Characteristics	Number	%
Age groups		
60-69	25	67.57
70-79	12	32.43
Sex		
Male	26	70.27
Female	11	29.73
Marital status		
Married	32	86.49
Unmarried	0	0
Widowed	5	13.51
Education (in years)		
0	3	8.11
1-5	4	10.81
6-10	13	35.14
11-15	16	43.24
16-20	1	2.70

Employment status		
Self employed	2	5.40
House wife	11	29.72
Retired	24	64.86
Prevalence of disease		
Hypertension	16	43.24
Diabetes	15	40.54
Asthma	7	18.91
Hospitalization in past 1 year	8	21.62

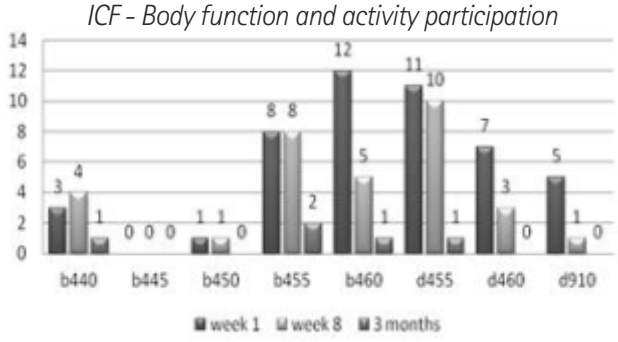
43% of the participants reported to have hypertension, 41% reported diabetes, 19% asthma and 22% of the participants reported history of hospitalization in last one year. 35% subjects were taking medication for hypertension, 24% were taking anti diabetic medications, 11% were using medicines for asthma and 8% were taking painkillers. 8% subjects gave history of alcohol intake and 11% of participants reported smoking. 89% of all the participants were using spectacles and 5% reported use of hearing aid.

Table. 3: Item codes from ICF Geriatric Core Set

ICF	N	disability count		Healthy %
		count	%	
ICFb440 (1st week)	30	3	10	90
ICFb440 (8th week)	30	4	13.3	86.7
ICFb440 (20th week)	30	1	3.3	96.7
ICFb445 (1st week)	30	0	0	100
ICFb445 (8th week)	30	0	0	100
ICFb445 (20th week)	30	0	0	100
ICFb450 (1st week)	30	1	3.333	96.666
ICFb450 (8th week)	30	1	3.333	96.666
ICFb450 (20th week)	30	0	0	100
ICFb455 (1st week)	30	8	26.666	73.333
ICFb455 (8th week)	30	8	26.666	73.333
ICFb455 (20th week)	30	2	6.6666	93.333
ICFb460 (1st week)	30	12	40	60
ICFb460 (8th week)	30	5	16.666	83.333
ICFb460 (20th week)	30	1	3.333	96.666
ICFd455 (1st week)	30	11	36.666	63.333
ICFd455 (8th week)	30	10	33.333	66.666
ICFd455 (20th week)	30	1	3.333	96.666
ICFd460(1st week)	30	7	23.333	76.666
ICFd460 (8th week)	30	3	10	90
ICFd460 (20th week)	30	0	0	100
ICFd910 (1st week)	30	5	16.666	83.333
ICFd910 (8th week)	30	1	3.333	96.666
ICFd910 (20th week)	30	0	0	100

Paired t-test was used for comparing the components of ICF. Paired t-test was applied between 1st week to 8th week and 1st week to 20th week.

Graph. 1: Disability count in body function & activity participation



The study group reported there was no significant difference in respiratory functions between visit 1 and at 8th week but significant improvement between visit 1 and at 20th week ($p > 0.001$ at 95% CI). No changes were reported in additional respiratory function and exercise tolerance function as there was no/minimum disability counted. Statistically significant difference was reported in sensations associated with cardiovascular and respiratory functions between visit 1 and 8th week (p value 0.002 at 95% confidence interval) and between week 1 and week 20th. There was statistically significant difference in moving around function between visit 1 and at 20th week. No statistically significant difference was noticed in the domain of moving around in different locations.

There was statistically significant difference in community life between visit 1 and at 8th week (p value 0.02 at 95% confidence interval) (Table 4. Paired t-test of ICF component).

DISCUSSION

The study illustrates significant improvement in sensations associated with cardiovascular and respiratory functions that includes sensations of tightness of chest, feelings of irregular beat, dyspnoea, air hunger, choking, gagging and wheezing[14]. It was noticed that mobility status, and community life of elderly also showed significant improvement.

Earlier studies have shown that respiratory muscle strength training may prevent a certain degree of muscle wasting[15,16,17,18]; Improvement in respiratory muscle strength reduces the competition for blood flow between the respiratory system and peripheral body segments[20,21,22,23]. It restores balance between respiratory system and peripheral body segments, and reduces the oxygen cost of respiration. Thus, there is a reduction in the requirement of motor-unit recruitment for respiratory muscles, which affect the intensity of dyspnoea [25]. This further improves participation in activities of daily living. This could be partially explained with Campbell's length-tension inappropriateness paradigm (1966).

In a study done by Watsford ET. AL (2008), elderly female subjects who underwent inspiratory and expiratory muscle strengthening training obtained significant improvement in respiratory functions. Elderly reported an improved ability of climbing stairs reduced fatigue while walking briskly uphill and improved quality of life and life satisfaction among the elderly participants[25].

Another study conducted by Matsumoto ET. AL (2011), designed to clarify the effects of breathing with prolonged expiration on cardiopulmonary responses and autonomic nervous system activity during incremental exercise, resulted in improvement in ventilation efficiency, the suppression of sympathetic nervous system activity, and the activation of parasympathetic activity. Moreover, prolonged expiration breathing may have suppressed the exercise – induced increase in myocardial oxygen uptake[23] thus, improving the sensation of dyspnoea during exercises.

In our study, we have devised a respiratory muscle-strengthening program using a simple Device for Pulmonary Physiotherapy (DPP). DPP reinforces expiratory muscle strength training by incorporating a pressure threshold valve. Performing diaphragmatic breathing during the training helped subjects to correct their breathing pattern. Improvement in feeling of dyspnoea during various indoor and outdoor activities, improved walking ability in different locations and different kind of surfaces and community life such as social gathering, visit to markets and temples etc.

This respiratory muscle training helps in reduction in dyspnoea and improvement in cardio-vascular and respiratory function. This further leads to improved mobility and participation in activity living that facilitates increase participation in community life and reduction in social isolation. The Improved social gathering thereby helps in healthy ageing.

S.F. HO ET AL (2001) supported our study that dyspnoea had significant negative effects on going out socially, managing the garden and driving the car[26].

The limitation of current study was small sample size hence results of this study cannot be generalized. There were 5 drops outs from the study due to various reasons like difficulty in using the device thereby causing headache, personal health issues and problem at home. Simple Technology like the Device for Pulmonary Physiotherapy (DPP) may help elders to develop physical and emotional wellbeing. Innovative technologies which involve elder participation can be a future study to promote participation of elders in community.

CONCLUSION

The Device for Pulmonary Physiotherapy (DPP) helped elders to improve sensations associated with cardiovascular and respiratory functions, mobility social life. The study showed improved mobility of subjects around their house and community participation.

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Table. 4: Paired t-test of ICF component

	Paired Differences				P- value			
	Mean	Std. Deviation	(-) 95% CI	(+) 95% CI	Correlation	Sig.	t	Sig. (2-tailed)
ICFb440 (1 wk – 8wk)	-.03333	.41384	-.18786	.12120	.196	.299	-.441	.662
ICFb440 (8wk -20wk)	.10000	.30513	-.01394	.21394	.473	.008	1.795	.083
ICFb440 (1wk – 20wk)	.06667	.25371	-.02807	.16140	.557	.001	1.439	.161
ICFb450 (1 wk – 8wk)	.00000	.26261	-.09806	.09806	-.034	.856	.000	1.000
ICFb450 (8wk -20wk)	.03333	.18257	-.03484	.10151	.	.	1.000	.326
ICFb450 (1wk – 20wk)	.03333	.18257	-.03484	.10151	.	.	1.000	.326
ICFb455 (1 wk – 8wk)	.00000	.45486	-.16985	.16985	.489	.006	.000	1.000
ICFb455 (8wk -20wk)	.20000	.48423	.01918	.38082	.141	.457	2.262	.031
ICFb455 (1wk – 20wk)	.20000	.48423	.01918	.38082	.141	.457	2.262	.031
ICFb460 (1 wk – 8wk)	.23333	.43018	.07270	.39397	.548	.002	2.971	.006
ICFb460 (8wk -20wk)	.16667	.53067	-.03149	.36482	-.346	.0611	1.720	.096
ICFb460 (1wk – 20wk)	.40000	.56324	.18968	.61032	.000	.000	3.890	.001
ICFd455 (1 wk – 8wk)	.03333	.61495	-.19629	.26296	.196	.300	.297	.769
ICFd455 (8wk -20wk)	.30000	.53498	.10023	.49977	-.131	.489	3.071	.005
ICFd455 (1wk – 20wk)	.33333	.47946	.15430	.51237	.244	.194	3.808	.001
ICFd460 (1 wk – 8wk)	.20000	.61026	-.02787	.42787	-.045	.813	1.795	.083
ICFd460 (8wk -20wk)	.03333	.41384	-.12120	.18786	.	.	.441	.662
ICFd460 (1wk – 20wk)	.23333	.43018	.07270	.39397	.	.	2.971	.006
ICFd910 (1 wk – 8wk)	.13333	.34575	.00423	.26244	.415	.023	2.112	.043
ICFd910 (8wk -20wk)	.03333	.18257	-.03484	.10151	.	.	1.000	.326
ICFd910 (1wk – 20wk)	.16667	.37905	.02513	.30821	.	.	2.408	.023

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Funny Bone

*Source - Social Media