

Effect of respiratory proprioceptive neuromuscular facilitation technique with chest physiotherapy in mechanically ventilated Organophosphorus poisoning patients

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Abstract

Background: Organophosphorus (OP) compounds were first synthesized about one and half century back in France. Consumption of OP compounds for suicidal attempts are particularly high in agricultural families all over the world. OP toxicity occurs, soon after exposure but may be delayed, depending on the agent and route of entry.

Objective: To determine the Effect of Respiratory PNF technique with Chest Physiotherapy in mechanically ventilated Organophosphorus poisoning patients.

Materials and Methods: A Experimental comparative study was done. A total of 30 participants with OP poisoning in the age group of 15-85 years were included in the study. On 1st, 2nd and 3rd day static compliance, dynamic compliance, Minute ventilation, Heart Rate, Systolic Blood Pressure and Diastolic Blood Pressure were assessed. Group A received Chest Physiotherapy and Group B received Chest Physiotherapy and PNF technique. Intervention was given twice in a day, 3days and each session lasts for 15-30 minutes. Data was analyzed by Paired' test and Mann Whitney u test.

Results: There was highly significant difference in Static compliance ($p=0.02$), Dynamic compliance ($p=0.01$) and minute ventilation ($p=0.01$) while there was no significant difference in SPO₂ ($p=0.61$), Heart Rate ($p=0.94$), Systolic Blood pressure ($p=0.19$) and Diastolic Blood pressure ($p=0.41$) values after 3 days of intervention. Conclusion: The study concluded that Chest Physiotherapy along with PNF technique in the management of mechanically ventilated patients with pulmonary complication proved efficient for preventing pulmonary complications, clearing the mucous secretions and better prognosis in patients with OP poisoning.

Keywords: organophosphorus poisoning, chest physiotherapy, PNF, mechanical ventilation

Introduction

In this rapidly developing, capitalist world, people are continually exposed to numerous environmental pollutants such as industrial waste, polluted air and pesticides these invariably comprise complex mixtures of chemicals. The effects of these mixtures and their mode of action in humans are not thoroughly studied. The majority of pollutants are potentially toxic for organisms, some being connected to disease development^[1].

Pesticide poisoning from occupational, accidental and intentional exposure is a leading public health problem of the developing world^[2]. Millions of people are exposed to danger by hazardous occupational practices and unsafe storage^[3]. In developed countries, the rate of mortality from poisoning is 1% to 2% but in India it varies between 15 to 30%^[4]. Poisoning is the fourth most common cause of mortality in rural India^[5]. The nature of poisoning varies from one region to another depending upon the poison availability and the knowledge of local population regarding poisonous properties. Organophosphorus (OP) insecticides are used extensively in

horticulture and agriculture. According to World Health Organization, 3 million people consume these compounds resulting in 40,000 deaths annually, these sounds like cold statistics but there is a huge human tragedy of national proportions behind them.

Organophosphorus compounds produce clinical manifestations by depression of the enzyme cholinesterase resulting in the accumulation of acetylcholine at various receptors which has three types of effects

(1) Muscarinic (2) Nicotinic and (3) Central

Muscarinic effects are due to actions on bronchi, salivary, lacrimal, sweat glands, etc; and give rise to pulmonary oedema, sweating and bradycardia. Nicotinic effects are motor and sympathetic and lead to fasciculation, muscular weakness and tachycardia. The central effects lead to giddiness, anxiety, emotional lability, ataxia, confusion, and apathy. Organophosphorus compounds have many toxicological effects on respiratory and cardiovascular system, due to this overstimulation of muscuranic acetylcholine receptors in the parasympathetic system causes respiratory disorders such as

central failure of breathing. In the sympathetic system due to overstimulation of nicotinic acetylcholine receptors myocardial necrosis occurs^[6]. Cardiac manifestations includes Sinus tachycardia, sinus bradycardia, hypertension, impaired heart rate and force contraction while ECG changes are ST segment elevation, low amplitude T waves, extra systole and prolonged PR interval. The acute cholinergic crisis creates a toxidrome of muscarinic (miosis, hypersalivation, nausea, emesis, bronchospasm, bronchorrhea, alveolar edema, bradycardia, and hypotension) and nicotinic (sweating, muscle weakness, fasciculation, and paralysis, occasionally with hypertension and tachycardia) features. Clinical presentation of OP exposure depends on the specific agents, the quantity and the route of entry. Initial symptoms may range from mild as flu like syndrome, to immediately life threatening respiratory arrest. Toxicity occurs soon after exposure but may be delayed, depending on the agent and route of entry. The most rapid onset of symptoms occurs with consumption, inhalation and the slowest with dermal exposure. Respiratory arrest can occur within 50 minutes of inhalation^[7, 8].

Immediate attention to airway and adequate oxygenation is essential for which atropine is administered until secretions dry. Frequent suctioning of the airway along with chest physiotherapy is usually necessary until the patient is adequately atropinized. Endotracheal intubation is often necessary in severe poisoning because of secretions, decreased level of consciousness, or weakness of the respiratory muscles^[9].

A study was conducted to Determine the significance of Proprioceptive Neuromuscular Facilitation (PNF) technique with conventional chest physiotherapy in mechanically ventilated organophosphorus poisoning patient and they found that PNF is not an adjunct to improve hemodynamic as well as pulmonary parameter values, in OP poisoning acute management period^[10]. Another study conducted on Effect of Intercostal Stretch Technique and Anterior Basal Lift Technique on Respiratory Rate, Saturation of Peripheral Oxygen and Heart Rate among ICU Patients in which 30 patients were included in the study were given intervention according to their allocated group for 3 days and effects of these techniques on RR, SpO₂ and HR parameters were observed and after 3 days of intervention they concluded that Intercostal stretch more effective in reduction of respiratory rate and heart rate and improving oxygen saturation over anterior basal lift technique^[14]. Chest physical therapy goal is to improve mucus clearance, to decrease the risk of pulmonary

infection and improve quality of life. Mucociliary activity and an effective cough are needed for normal airway clearance. Viscous secretions, the presence of a cuffed tracheal tube, dehydration, hypoxemia, immobility and poor humidification of gases impede mucociliary clearance, causing secretion retention. Routinely CPT is advocated to bring improvement in pulmonary and hemodynamic parameters. Facilitator stimulus in the form of Proprioceptive Neuromuscular Facilitation (PNF) respiration is adopted to produce reflex respiratory movement responses. It alters the rate and depth of breathing, improving the compliance and hemodynamic parameters. PNF techniques are externally applied proprioceptive and tactile stimuli that produce reflex respiratory movement responses that appear to alter the rate and depth of breathing. There is limited evidence available in OPP Patients who are mechanically ventilated with use of chest physiotherapy along with Respiratory PNF. Therefore the present study has been undertaken to determine the Effect of Respiratory PNF technique with Chest Physiotherapy in mechanically ventilated organophosphorus poisoning patients.

Materials and Methods

An experimental prospective comparative study was conducted on thirty participant (n=30, 21 Male and 9 Female) using simple random sampling. The study received approval from Institutional Ethical Committee Ref.no. PIMS/CPT/IEC/2016/16556 of Pravara Institute of Medical Sciences, Loni. Participants who were mechanically ventilated with organophosphorus poisoning with the age group of 20-85 years were included according to inclusion and exclusion criteria. The intervention was given twice in a day for 3 days for 15-30 min per session. Control group had Conventional CPT which includes Vibrations, percussions, postural drainage and suctioning if indicated while experimental group had conventional CPT along with PNF techniques of Intercostal Stretch and Anterior Basal lift. Each technique was repeated 10-12 times with 2-3 sets in supine lying position with 10 seconds of stimulus pressure and 10 seconds of rest for 3 days. The inclusion criteria for this study were both male and female participants, age between 20 to 85 years, those willing to participate in the study and were mechanically ventilated after organophosphorus poisoning. Exclusion criteria for the study were participants with Rib fractures, Chest Trauma and Thoracic vertebral fracture and who underwent cardiac or abdominal surgery recently. Participants with unknown compound poisoning and any other systemic illness.

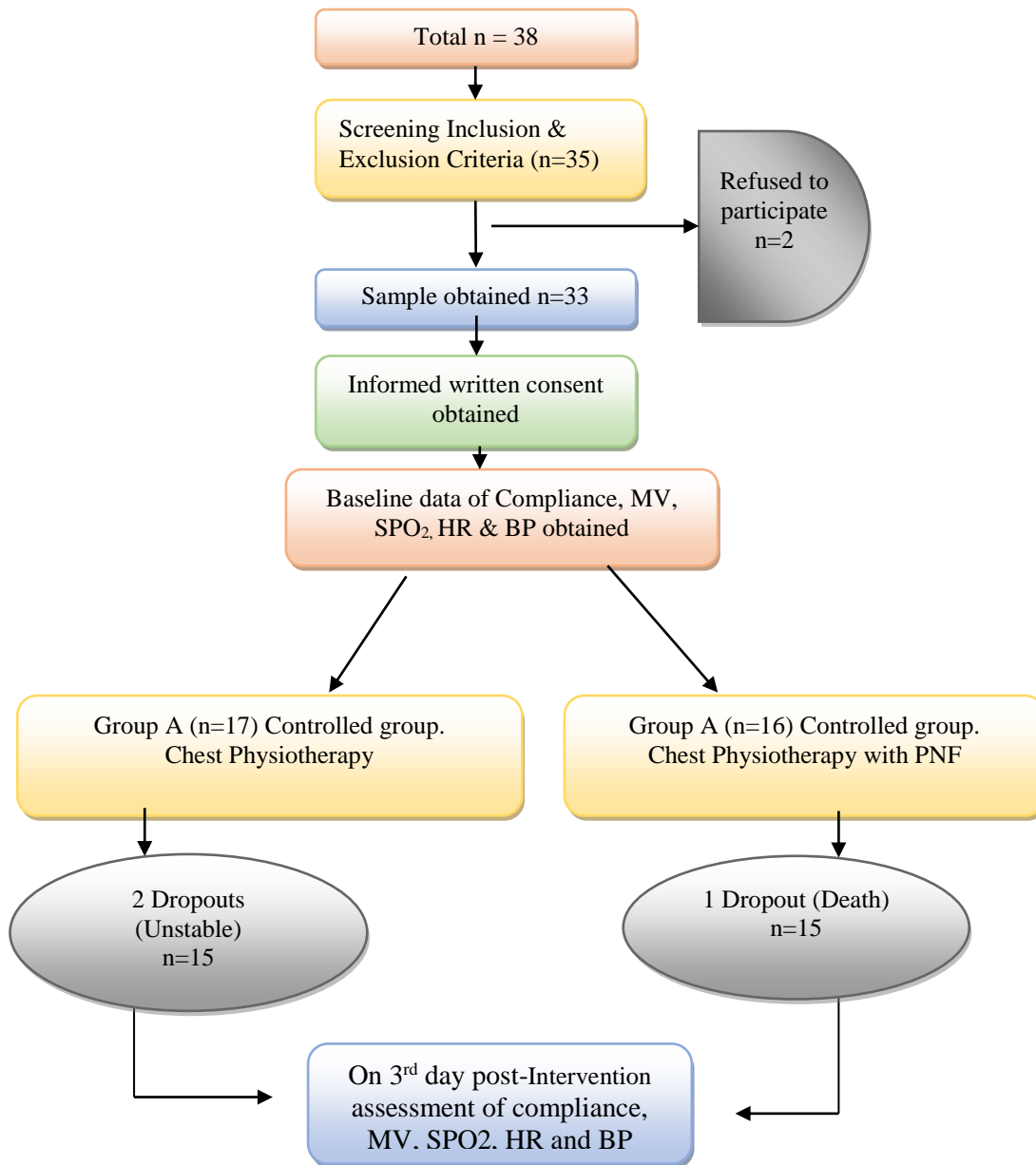


Fig 1: Flow Chart representing the procedure of selection of participants

Outcome Measures

1. Compliance (mL/cm H₂O)

Static compliance: Normal static compliance is 50-100 mL/cm H₂O

$$C_{stat} = \frac{V_T}{P_{plat} - PEEP}$$

Dynamic lung compliance: Normal Dynamic compliance is 35-45 mL/cm H₂O

$$C_{dyn} = \frac{V_T}{PIP - PEEP}$$

1. Minute ventilation (MV) (L/min)
2. Saturation of oxygen (SpO₂) %
3. Heart rate (HR) (beats/min)
4. Blood pressure (BP) (mm/Hg)

Data Analysis and Results

Statistical analysis was carried out utilizing SPSS software. Paired ‘t’ test and mann whitney u test were utilized to analyze the data. The results were concluded to be statistically significant with p<0.05, very significant p<0.001 and highly significant p<0.0001

Compliance were calculated using post intervention data in both the groups (Table & Graph no.1). The mean value of Static Compliance in Group A was 47.93 ±8.63 & in Group B was 56.87±11.91. The mean value of Dynamic Compliance in Group A was 35.20±12.52 & in Group B was 45.73±7.17.

Minute ventilation was calculated using post intervention data in both the groups. The mean value of Minute Ventilation in Group A was 9.66 ±2.00 & in Group B was 10.73±1.75.

Saturation of oxygen was calculated using post intervention data in both the groups. The mean value of SPO₂ in Group A was 98.60 ±1.76 & in Group B was 98.33±1.04

Heart rate was calculated using post intervention data in both the groups. The mean value of Heart Rate in Group A was 100.20 ± 15.24 & in Group B was 100.53 ± 1

Blood pressure was calculated using post intervention data in both the groups. The mean value of Systolic Blood Pressure in Group A was 119.47 ± 10.76 & in Group B was 114.53 ± 9.53 . The mean value of diastolic Blood Pressure in Group A was 75 ± 7.17 & in Group B was 72.73 ± 7.76 .

Discussion

The results obtained in the present study indicates that, there was highly significant difference in Static compliance ($p=0.02$), Dynamic compliance ($p=0.01$) and minute ventilation ($p=0.01$) while there was no significant difference in SPO₂ ($p=0.61$), Heart Rate ($p=0.94$), Systolic Blood pressure($p=0.19$) and Diastolic Blood pressure($p=0.41$) values after 3 days of intervention.

Pulmonary Compliance

Static Compliance had very significant difference between the groups while Dynamic Compliance also had very significant difference between the groups. It states that the static and dynamic compliance improved in group B as compared to group A.

Minute Ventilation

There was very significant difference between the groups. It states that the Minute ventilation improved in group B as compared to group A.

Saturation of Oxygen

There is no significant difference between the groups. Comparing the mean difference of these two groups after the intervention confirmed that there is no significant difference between the groups.

Heart Rate

There is no significant difference between the groups. Comparing the mean difference of these two groups after the intervention confirmed that there is no significant difference between the groups.

Blood Pressure

Systolic Blood Pressure had no significant difference between the groups while Diastolic Blood Pressure also had no significant difference between the groups. Comparing the mean difference of these two groups after the intervention confirmed that there is no significant difference between the groups.

Dr. Shivananda venkata reddy *et al* conducted study to determine the significance of proprioceptive neuromuscular facilitation technique with conventional chest physiotherapy in

mechanically ventilated organophosphorus poisoning patients in which they included 30 patients with history of OP poisoning & within 48 hours of ventilation. Values of pulmonary and hemodynamic parameters were compared on post conventional CPT and further after post PNF³² they suggested that PNF did not significantly enhance values of post CPT pulmonary & hemodynamic parameters in mechanically ventilated OP poisoning patients during acute management period. The present study shows that there was significant improvement in pulmonary compliance and minute ventilation after 3 days of intervention in OP poisoning patients. The present study contradicted with this study as there experimental group did not receive Chest physiotherapy and the intervention was given just once but in the present study experimental group received Chest Physiotherapy along with PNF for 3 days two times per day so they showed significant improvement in post-post value of compliance and minute ventilation^[10, 11].

P. Gupta *et al* conducted study on Effect of Intercostal Stretch Technique and Anterior Basal Lift Technique on Respiratory Rate, Saturation of Peripheral Oxygen and Heart Rate among ICU Patients. 30 patients were included in the study were given intervention according to their allocated group for 3 days and effects of these techniques on RR, SpO₂ and HR parameters were observed. Data were taken at baseline and after 3 days of intervention and they concluded that Intercostal stretch more effective in reduction of respiratory rate and heart rate and improving oxygen saturation over anterior basal lift technique. The present study shows that there was significant improvement in pulmonary compliance and minute ventilation after 3 days of intervention in OP poisoning patients while there was no significant improvement on SPO₂, Heart Rate and Blood pressure^[12, 13].

Conclusion

The present study concludes that there was more significant improvement in static, dynamic compliance, minute ventilation, Spo₂ and HR parameters after giving Chest Physiotherapy along with PNF than Chest Physiotherapy alone.

Limitation of Study

At times, it was difficult to manage the timing for intervention due to workload in ICU therefore some patients received intervention in the morning, some in the afternoon and some in the evening

Suggestion for future research

Future research should be done with more focus on mechanically ventilated pulmonary complications patients and by increasing the period of intervention.

Table 1: Comparison of post-procedure parameter of the study among groups

	Groups	Mean	Std. Deviation	Mean differences	P value	t value
Static (MI/H2O)	Group A	47.93	8.639	8.93	0.02 (S)	2.352
	Group B	56.87	11.91			
Dynamic (MI/H2O)	Group A	35.20	12.525	10.53	0.01 (S)	2.826
	Group B	45.73	7.17			
MV (L/min)	Group A	9.66	2.002	2.74	0.01 (S)	1.556
	Group B	10.73	1.75			
SPO ₂ %	Group A	98.60	1.765	0.26	0.61	

	Group B	98.33	1.047			0.5034
HR (beats/min)	Group A	100.20	15.247	0.333	0.94	0.5736
	Group B	100.53	16.557			
SBP (mmHg)	Group A	119.47	10.769	4.93	0.19	1.328
	Group B	114.53	9.538			
DBP (mmHg)	Group A	75.00	7.171	2.26	0.41	0.8303
	Group B	72.73	7.769			

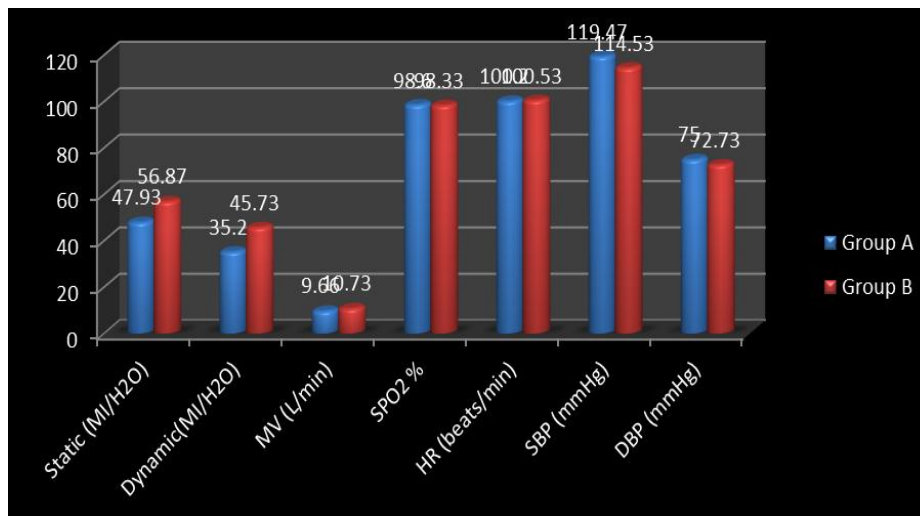


Fig 1: Comparison of post-procedure parameter of the study among groups.

Table 2: Comparison of mean difference of clinical parameter of the study among groups

	Groups	Mean	Std. Deviation	Mean differences	p value	t value
Static (MI/H2O)	Group A	2.8	0.77	10.93	0.001 (S)	3.67
	Group B	13.73	11.49			
Dynamic (MI/H2O)	Group A	4.46	1.68	6.06	0.02 (OS)	2.68
	Group B	10.53	8.59			
MV (L/min)	Group A	0.76	1.17	1.50	0.005(S)	4.14
	Group B	2.74	1.275			
SPO2 %	Group A	2.2	2.704	0.4	0.65	0.447
	Group B	2.6	2.16			
HR (beats/min)	Group A	3.73	4.63	0.8	0.60	0.4948
	Group B	4.23	5.76			
SBP (mmHg)	Group A	0.4	8.05	1.93	0.57	0.029
	Group B	1.5	10.33			
DBP (mmHg)	Group A	1.66	5.77	0.26	0.91	1.08
	Group B	1.4	7.89			

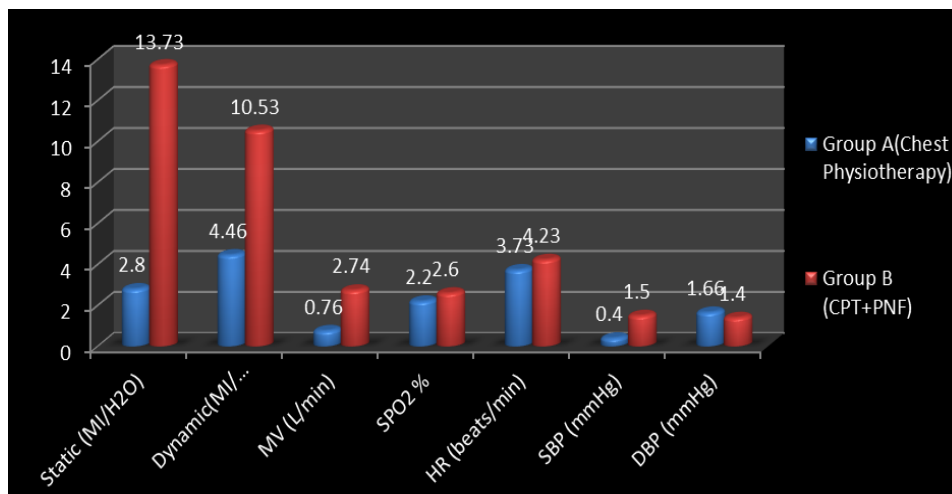


Fig 2: Comparison of mean difference score of clinical parameter of the study among groups

References

1. Jayaratnam J. Acute pesticide poisoning. A major global health problem World Health Statistics Quarterly. 1990; 43:139-144.
2. Gupta RC. *Toxicology of Organophosphate & Carbamate Compound*. Elsevier Academic Press, 2006.
3. Karalliedde L. Epidemiology of organophosphate insecticide poisoning in: organophosphate pesticides and human health. London : Imperial College; in press
4. Pillay V. Hand book of Forensic Medicine and Toxicology. 12th Ed. Paras Publication. Hyderabad. 2001, 276-299.
5. Taruni NG. A profile of poisoning cases admitted to RIMS Hospital, Imphal, Journ Forensic Med. Toxicology. 2001, 18:31-33.
6. Povoia R, Cardoso SH, Luna-Filho B. Arq Bras Cardiol. 1997; 68:377-380.
7. Juliana MT, Nathan DM, Diana AM, Francisco TR, Ana LK. Ecotoxicology and Environmental Safety. 2009; 72:1413-1424.
8. Yusuf Y, Yucel Y, Hayrettin S, Polat D, Seda O. A Okhan, *et al*. J Emerg Med. 2009; 36:39-42.
9. Polhuijs M, Langenberg JP, Benschop HP. New method for retrospective detection of exposure to OP anticholinesterases; application to alleged sarin victims of Japanese terrorists. Toxicology and applied pharmacology. 1997, 15661.
10. Dr. Shivananda venkata reddy. Determine the significance of proprioceptive neuromuscular facilitation technique with conventional chest physiotherapy in mechanically ventilated organophosphorus poisoning patients Indian Journal of Basic and Applied Medical Research. 2014: 3(2):461-466.
11. Pryor J. Mucociliary clearance. In: Ellis E, Alison J, editors. Key issues in cardiorespiratory physiotherapy. Oxford, UK: 1992. Butterworth-Heinemann. 1992, 105-30.
12. Judson MA, Sahn SA. Mobilization of secretions in ICU patients. Respir Care. 1994; 39:213-26.
13. Walsh J, Vanderwarf D, Hoscheit C, *et al*. Unsuspected hemodynamic alterations during endotracheal suctioning. *Chest*. 1989; 95:162-165.
14. Gupta P. Effect of Intercostal Stretch Technique and Anterior Basal Lift Technique on Respiratory Rate, Saturation of Peripheral Oxygen and Heart Rate among ICU Patients International Journal of Health Sciences and Research www.ijhsr.org ISSN: 2249-9571 Received: 05/12//2013 Revised: 09/01/2014 Accepted: 16/01/2014