Effect of slow deep breathing exercise on blood pressure and heart rate among newly diagnosed patients with essential hypertension

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Abstract:

Background: Essential hypertension is the most prevalent type, affecting most of hypertensive patients. It increases progressively with age. **The aim of this study** is to examine the effect of slow deep breathing exercise on blood pressure and heart rate among newly diagnosed patients with essential hypertension. **Research hypotheses** were H_1-There will be a statistical significant difference in blood pressure before and after breathing exercises. H_2- There will be a statistical significant difference in heart rate before and after breathing exercises. **Design**: A quasi-experimental. **Setting:** The study was conducted in medical and surgical departments at a general governmental Hospital in Cairo, Egypt. **Sample:** A convenient sample of 120 adult patients. **Tools:** (a) the Structured Interview Questionnaire. It covers personal and Medical background data (b) Assessment data sheet: designed by the researchers, to record BP and heart rate measurements, (c) Automated digital Sphygmomanometer. **Results:** A total of 120 adult patients; Most of them was males, their age ranged from 51-60 years and married. There is no statistical significant differences were found in socio-demographic variables in relation to systolic and diastolic BP as well as heart rate before and after intervention . High statistical significant difference was found in systolic and diastolic BP as well as in heart rate between before and after intervention. **Conclusion:** practicing slow deep breathing exercise decreased the systolic and diastolic BP as well as heart rate of patients with essential hypertension. **Recommendation** Replicate this study on a larger population with different medical diagnosis to ensure generalization of results.

Key words: slow deep breathing exercise, systolic blood pressure, diastolic blood pressure, heart rate, newly diagnosed patients, essential hypertension.

1-   Introduction:

Hypertension is a widespread health problem and is called the "silent killer" because it often has no warning signs or symptoms, and many people don't realize they have it (Centers for Disease Control and Prevention, 2013). It is a major risk factor for cardiovascular disease, as well as other maladies including renal disease, stroke, heart failure, and peripheral artery disease. Also, it increases the risk of blindness and dementia, and the number one cause of death in America (Madhur, 2014, Roger, et al. 2012 and Kochanek, et al., 2011).

People of all ages and backgrounds can develop high blood pressure. The prevalence of hypertension increases progressively with age (Mohammed 2013 and Kochanek, et al., 2011). It affects approximately 75 million adults in the United States (Madhur, 2014). Globally, the overall prevalence of raised blood pressure in adults aged 25 and over was around 40% in 2008. However, because of population growth and ageing, the number of people with uncontrolled hypertension rose from 600 million in 1980 to nearly 1 billion in 2008 (WHO, 2014). According to the WHO (World Health Organization), one in three people world over suffers from high blood pressure (Sampath, 2013).

Classification of hypertension for adults ages 18 and older has been provided by the Seventh Report of the Joint National Committee of High Blood Pressure (JNC 7 Classification, 2013), patients with sustained hypertension are further divided into stage 1hypertension (systolic BP 140-159 or diastolic BP 90-99 mmHg), and stage 2 hypertension (systolic BP ≥160 or diastolic BP ≥100 mmHg) (Mohammed, 2013).

There are two main types of hypertension, "Primary" hypertension, also known as essential or idiopathic hypertension and "secondary" hypertension and other four less common types of hypertension include malignant

hypertension, isolated systolic hypertension, white coat hypertension, and resistant hypertension (Symptomfind, 2013).

Essential hypertension is the most prevalent type, affecting 90-95% of hypertensive patients (Madhur, 2014), with this type of hypertension, there is no single identifiable cause; it's pathogenesis is multifactorial can trigger risk as genetic factors which play an important role. Environmental factors such as sedentary lifestyle, stress, high salt (sodium) intake, smoking and high alcohol intake. Obesity, insulin resistance and ageing, also are significant (Adhana, et al., 2013, Madhur & Maron, 2013 and Sawicka, et al., 2011). Secondary hypertension is a less common, affects about 5 to 10 percent of hypertension cases, results from various conditions and medications (Wikipedia, 2014 and Onusko, 2013).

Many pharmacological and non-pharmachological interventions effective in treating essential hypertension, Pharmacological therapy depends on antihypertensive drugs, while non - pharmacological therapy involved five lifestyle modifications are recommended by JNC 7 for reducing blood pressure: reducing sodium intake, increasing exercise, limiting alcohol consumption, dietary changes, losing weight in addition to; other lifestyle interventions as smoking cessation, dietary supplements and meditation. The last one includes careful attention to the process of breathing, to achieve a state of inner calm, detachment, and focus (Mancia et al., 2013, McElroy, et al., 2012, and Ribeiro, et al., 2011).

Breathing exercises is one of the non-pharmacological modalities. It is known that regular practice of breathing exercises increases parasympathetic tone, decreases sympathetic activity, improves cardiovascular and respiratory functions, decreases the effect of stress and strain on the body and improves physical and mental health (Adhana et al., 2013, Kulur et al., 2009 and Mourya et al.,2009). Hence, breathing is considered to be a regulator of the autonomic nervous system and consequently of mental processes. Controlling the breath and thus calming the nerves is a prerequisite to controlling the mind and the body. By voluntarily changing the rate, depth, and pattern of breathing, the messages being sent from the body's respiratory system to the brain can be changed. In this way, breathing techniques provide a gateway to the autonomic communication network through which the individual can, by changing the breathing patterns, specific messages send to the brain using the body language, and the body responds to it. Messages from the respiratory system have rapid, powerful effects on major brain centers involved in thought, emotion, and behavior (Adhana et al., 2013 and Matayan, Singh, and Jain, 2009).

Slow breathing increases baroreflex sensitivity and reduces sympathetic activity and chemoreflex activation, it suggest a potentially beneficial effect in hypertension; where, baroreflex is the system in the body that regulates blood pressure by controlling heart rate, strength of heart contractions, and diameter of blood vessels. Slow breathing reduces blood pressure and enhances baroreflex sensitivity in hypertensive patients. These effects appear potentially beneficial in the management of hypertension (Oneda, et al., 2010 and Joseph, et al., 2009).

Slow breathing improves vagal activity and therefore decreases baseline heart rate and blood pressure. This is associated by improving vagal tone and by decreasing sympathetic discharge. Improvement in both sympathetic and parasympathetic reactivity may be the mechanism that is associated in those practicing the slow breathing exercises (Matayan , Singh,& Jain, 2009). Heart rate increases during inspiration and decreases during expiration. Recordings from cardiac autonomic nerves reveal that neural activity increase in sympathetic fibers during inspiration and increases in vagal fibers during expiration (Adhana et al., 2013 and Berne and Levy, 2009).

Deep breathing increases blood and oxygen flow to the brain to function in its optimal state. It creates a connection between mind and body that can lead to greater self-awareness, mindfulness and clear thinking, improves circulation, which improves heart health, energy levels and helps the body eliminate toxins, as well as reduces stress (Shakeshaft, 2012). Hence, practicing deep breathing exercise influence autonomic functions and has therapeutic benefit to hypertensive patients (Almahrezi, et al., 2008), and despite the important relationships between heart rate and hypertension there is a lack of evidence supporting heart rate lowering as a therapeutic

strategy in hypertension (Reule & Drawz, 2012). Therefore this study was undertaken to find a non-pharmacological method for managing essential hypertension by using slow-deep breathing exercises.

Significance of the study:

Hypertension is a common disease with significant morbidity and mortality. It is ranked as third cause of disability and anticipated to increase to almost 30% by 2025 (Williams, 2013). In Egypt, it has been estimated to be responsible for 9% of the years of life lost. The overall prevalence rate of pre-hypertension and hypertension in Egypt were 57.2% and 17.6% respectively. Only 25.2% of the population had normal blood pressure levels of <120/80 mmHg. (Arafa and Ez-Elarab, 2011).

Despite the significance of the problem with respect to overall health; and its undesirable health consequences, high blood pressure still is not adequately controlled and far from being optimal. From researchers' experiences with hypertensive patients, it was observed that there is no other treatment modalities were tried for those patients, hence ends to try other method to be safer and economical, complementary treatment measure is therefore needed. There appear to be few studies that have demonstrated the effect of non-pharmacological complementary modality.

Slow-deep breathing is an easy exercise, non-invasive and painless. It can be done at any place, less time consuming, and cost effective. Therefore, this study was conducted to examine the efficacy of slow deep breathing exercises on hypertension and heart rate as a non-pharmacological complementary approach to treat newly diagnosed essential hypertensive patients; make these gentle practices a worthwhile activity to incorporate into a healthy lifestyle. Hopefully this study could add an important evidence based practice to the concerned patients and health care providers.

2- Aim of the Study:

The aim of this study is to examine the effect of slow deep breathing exercise on blood pressure and heart rate among newly diagnosed patients with essential hypertension.

3- Research hypotheses:

The following research hypotheses were formulated to achieve the aim of the current study:

H1 - There will be a statistical significant difference in blood pressure before and after slow deep breathing exercises intervention.

H 2- There will be a statistical significant difference in heart rate before and after slow deep breathing exercises intervention.

4- Subjects and Methods:

4.1. Design: A quasi-experimental study design was utilized.

4.2. Setting: The study was conducted in medical and surgical departments at a general governmental Hospital in Cairo, Egypt.

4.3. Sample: A convenient sample of 120 male and female adult patients with the criteria of: (a) age between 30 to 60 years, (b) newly diagnosed with essential hypertension in stage 1 (BP= 140 – 159 / 90 - 99) and stage 2 (BP= greater than 160 /100) according to Joint National Committee Classification of Hypertension 7 (JNC 7 Classification 2013), taking anti-hypertensive medication, (c) No past history of any chronic illness like chronic renal failure, liver disease, angina, diabetes..…etc, (d) agree to participate in the study, (e) excluded smokers, and women taking oral contraceptives and women during menstrual and premenstrual phases.

4.4. Tools: Data of this study was collected using the following tools:

4.4.1. The Structured Interview Questionnaire (SIQ) was designed by the researchers based on literature review, it included Sociodemographic data; namely; age, sex, marital status, etc... and Medical background data as diagnosis, medication…etc.

4.4.2. Assessment data sheet: designed by the researchers, in order to record systolic and diastolic blood pressure and heart rate measurements of the concerned patients.

4.4.3. Automated digital Sphygmomanometer: it is an apparatus measure blood pressure and heart rate automatically. It was used by the researchers to measure blood pressure and heart rate from patients' upper extremity**.**

4.5. Ethical Consideration: Permission to conduct the study was obtained from the hospital authorities. Prior to the initial interview, the researchers introduced themselves to patients who met the inclusion criteria; each potential patient was fully informed with the purpose and nature of the study, and informed consent was taken from participants who accept to share in the study. The researchers emphasized that participation in the study is entirely voluntary and withdrawal from the study would not affect the care provided; anonymity and confidentiality were assured through coding the data.

4.6. Procedure:

An official permission was obtained from the concerned departments to conduct the proposed study. Once permission was granted to proceed with the proposed study, the researchers met the patients who fulfilled the inclusion criteria two basic times (1st time was initial meeting in the departments between 9.00 AM to 10.00 AM., and the 2nd time was one week after the first assessment).

At the first visit, the purpose, nature of the study, and tools were explained and written consent was taken from educated participants and oral consent from illiterates who accept to share in the study .The Structured Interview Questionnaire (SIQ) was read, explained and the choices of answers from patients were recorded by the researchers. For more validation of information, patients' files were revised to complete the needed information. Systolic and diastolic blood pressure and heart rate were measured from participant' upper extremity after a rest in a comfortable sitting position as a base line parameters using automated digital Sphygmomanometer. The baseline readings were recorded using the assessment data sheet.

In a comfortable setting position, in the morning after taking light breakfast not in empty stomach(because it increases digestion); and after taking medication; the patient was asked to perform slow deep breathing exercise (less than 10 breath) for one minute, followed by 2 minutes rest ; used for10-minutes and inspiration should be from nose and expiration from mouth. The breathing was controlled by visual instructions and under continuous monitoring of breathing rate. Blood pressure and heart rate were measured by the researchers within 30 seconds after the procedure using automated digital Sphygmomanometer. Instructions were given to repeat the same slow deep breathing exercises four times daily for one successful week; and try to schedule the last session just before bedtime to help maximize oxygenation while sleeping. Throughout the intervention week, the researchers follow up and encourage participants to perform breathing exercises training.

During the second assessment (after one week) in the morning time after light breakfast and in a comfortable sitting position, the participant perform the trained breathing exercise procedure; then within 30 seconds post procedure, systolic and diastolic blood pressure and heart rate were measured using automated digital Sphygmomanometer and recorded in the assessment data sheet.

5- Results:

The data obtained by the designed tools were tabulated, analyzed and presented as follow:

Figure (1) shows that more than two thirds of the study sample their age ranged from 51-60 years and married 70.7% & 72.5% respectively. Most of the study sample 85.8% was males and more than half residing in urban areas and had a university education 60% & 50.8% respectively. While only 40.8% their monthly income more than 1000 Egyptian pounds.

As seen in table (1) it was obvious that there is no statistical significant differences were found in socio-demographic variables in relation to systolic BP, diastolic BP as well as heart rate before and after intervention of deep breathing exercise with p-value more than 0.05 (p-value < 0.05).

Table (2) showed that the highest mean scores were observed in systolic BP. 146.89±20.16 and diastolic BP. 83.49± 11.87as well as in heart rate 79.75± 10.65 is before intervention of slow deep breathing exercise. There was an observable decrement in mean scores of systolic BP. 138.17± 19.01, diastolic BP.77.96± 12.37 and heart rate 75.68±10.72 in the second assessment (After 2) after intervention of deep breathing exercise than in the first assessment (After 1) before intervention 144.74 ±20.01, 82.56± 11.46 and 76.01± 7.70 respectively. Indicating that there were significant improvement occurred post intervention of deep breathing exercise.

Table (3) illustrates high statistical significant difference between before and after intervention of breathing exercise concerning systolic and diastolic blood pressure as well as in heart rate with a (p-value 0.000). While no statistical significant difference was found in heart rate between after 1&2 with a p value = 0.575.

6 - Discussion:

The discussion of this study is presented in the following sequence**:** *part I*, related to description of subjects' characteristic, *part II*, is devoted to highlighting variables related to socio-demographic and hypertension; *part III*, presents findings related to the differences between pre and post breathing exercises intervention with hypertension and heart rate.

Part I: Subject Characteristics:

The current study findings showed that more than two thirds of the study sample their age ranged between 51 to 60 years, and more than one fourth their age ranged between 41 to 50 years, which indicates that essential hypertension is increases with age. This result is supported by studies done by Madhur (2014), Wikipedia (2014) and Mohammed (2013) that the prevalence of essential hypertension was found to increase with age. Moreover, Basu & Millett (2013) reported that hypertension significantly increased with age. Most of the study sample was males. This coincides with James, Oparil & Carter (2014) and Bani (2011) that male subjects had a higher prevalence of hypertension than female. More than half of subjects residing in urban areas, that could explain that urban areas are more stressful than rural areas as a result of urbanization and rapid rhythm of life style; this correspond with Bani (2011) that hypertension might be more prevalent in urban communities. Also, the result matched with Carretero & Oparil (2013) and Sever and Messerli (2011) that geographic patterns, is indicator of lifestyle attributes and sedentary lifestyle and stress cause high BP. More than half of this study subjects had a university education; this dissimilar with Bani (2011) study finding that hypertension was more prevalent among illiterate subjects than those with school and higher education. Most of subjects in the current study their monthly income less than 1000 Egyptian pounds, this could be interpreted as a low income and explained that might be a source of stress and cause elevation of blood pressure. This result is matched with Sabri et al., (2005) study entitled "correlation between hypertension and income distribution among United Arab Emirates population"; they found hypertension was significantly higher among the low income group. Moreover, Babyak et al., (2011) concluded that, "Those with low education and income tended to be more overweight and exercised less, and in turn had higher blood pressure."

Part II: Socio-demographic and hypertension and heart rate:

The present study demonstrates socio-demographic variables in relation to Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP). Surprisingly, the results represent no significant differences between systolic BP as well as diastolic BP measurement in relation to all selected socio-demographic variables in the form of age,

sex, residence, marital status, education, and income; before and after intervention of breathing exercises. These results were correspond Balci & Nuran (2010) who conclude that there was no significant differences were found between SBP as well as DBP with age, gender, education, and employment status.

The current study also, revealed no significant difference in heart rate, before and after intervention of breathing exercises with all selected demographic variables; this supported in a study for patients with ischemic heart disease with diabetes conducted by Kulur et al.,(2009) that heart rate is not significant with age ; while, the current study result is not match with a study on patients with coronary artery disease conducted by D'silva, Vinay & Muninarayanappa (2014) who revealed a significant association between heart rate and age as well as gender.

Part III: pre and post breathing exercises intervention with hypertension and heart rate:

The present study illustrates a significant difference in systolic as well as diastolic blood pressure before and after one week demonstrating breathing exercise; this could highlight the effect of slow deep breathing exercises intervention among newly diagnosed essential hypertensive patients. So, study hypothesis can be accepted; furthermore mean scores of systolic and diastolic BP was decreased after breathing exercises intervention, as the maximum systolic BP before starting intervention was 190 mmHg, decreased to 165 mmHg after one successful week of intervention. Moreover, mean systolic BP before breathing exercise decreased from 146.89 mmHg to 138.491mmHg after intervention. In addition, the mean score of diastolic BP was decreased from 83.49 mmHg to 77.96 mmHg after intervention which is supported by another study on healthy people conducted by Tharion et al., (2012) which revealed mean SBP and DBP in volunteers decreased from 91.51 mmHg to 85.51mmHg and 85.40 mmHg to 81.46 mmHg respectively. Other studies Adhana, et al., (2013), McElroy et al., (2013), Shakeshaft (2012), and Lee et al., (2008) are supported the current study results.

The study also revealed a significant difference in heart rate before and after breathing exercise intervention, in view of that study hypothesis can be accepted. Moreover, mean score of heart rate before intervention was decreased from 79.06 to 75.68 after intervention which is supported by another study on healthy people conducted by Tharion et al., (2012) and coincides with Oneda,et al., (2010). Similar findings was supported by study among patients with coronary artery disease conducted by D'silva, Vinay & Muninarayanappa (2014) reveals a significant effectiveness of deep breathing exercise on reducing heart rate. Kulur et al., (2009) explained that the observed improvement in heart rate with the modified breathing technique could be due to the direct effect of breathing on the autonomic nervous system controlling the heart. Kaushik et al., (2006) added that slow breathing is modality increase the parasympathetic tone resulted in a fall in systolic blood pressure, diastolic blood pressure, and heart rate. Finally, Whitmore (2013) conclude that breathing exercises can help calm the fight-or-flight response and return heart rates to normal without the use of drugs.

7 - Conclusion

Based on findings of the current study, it can be concluded that, This study has proven that practicing slow deep breathing exercise daily for one weeks 4 times a day for 10 min has significantly decreased the systolic and diastolic blood pressure as well as heart rate of patients newly diagnosed with essential hypertension. Hence it can be considered as a complementary modality and cost-effective strategy to help in treating newly diagnosed essential hypertensive patients.

8 - Recommendation

Slow deep breathing exercises are recommended as a relaxation technique and to reduce the arterial blood pressure in essential hypertensive patients. Further studies on a large number of individuals for a long duration are required to confirm the findings. Replicate the study on population with different medical diagnosis to ensure generalization of the results.

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11- Figures and tables:

Figure (1): Distribution of Socio-demographic Characteristics among the Study Sample (N= 120):
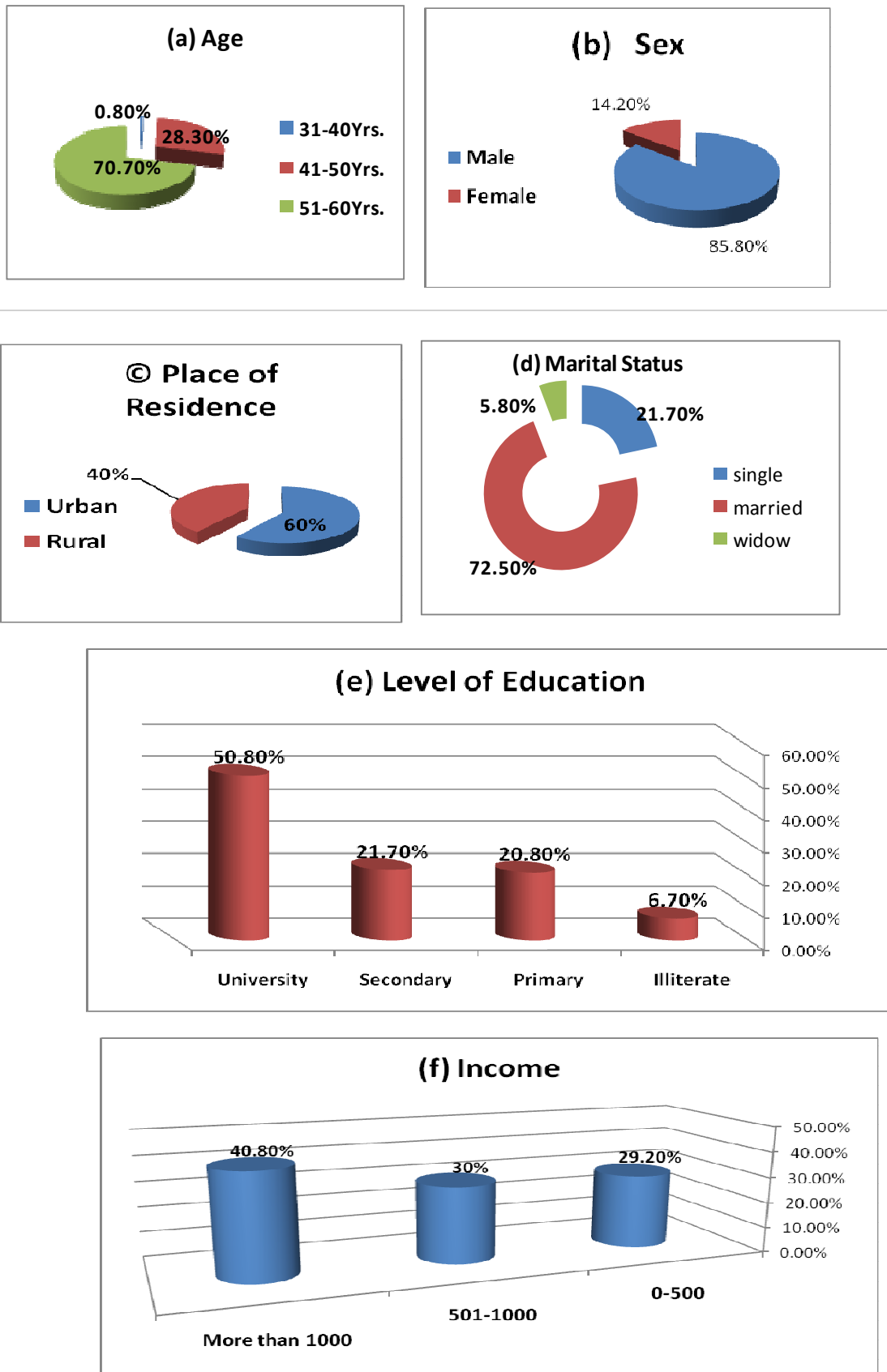
Table (1): Socio-demographic variables in relation to systolic and diastolic blood pressure as well as heart rate before and after intervention among the study sample (N= 120).

Variable	Systolic Blood Pressure			Diastolic Blood Pressure			Heart Rate /min		
	Before	After (1)	After (2)	Before	After (1)	After (2)	Before	After (1)	After (2)
- Age: T-test	0.596	0.554	0.556	1.201	1.136	3.542	1.441	1.741	0.921
p-value	0.416	0.581	0.680	0.242	0.260	0.062	0.164	0.086	0.367
- Sex: T-test	0.425	0.318	0.316	1.113	1.112	1.371	1.484	0.688	0.967
p-value	0.672	0.751	0.753	0.257	0.268	0.173	0.140	0.493	0.336
Residence: T-test	0.988	1.027	0.971	0.251	0.578	0.264	0.499	0.654	0.112
p-value	0.435	0.307	0.334	0.803	0.564	0.793	0.619	0.513	0.911
Marital status: T-test	0.180	0.299	0.427	0.316	0.512	0.820	0.371	1.199	0.479
p-value	0.858	0.766	0.670	0.753	0.610	0.414	0.711	0.233	0.633
Education: T-test	1.294	1.136	1.384	0.664	0.554	0.144	0.409	0.049	0.418
p-value	0.200	0.260	0.171	0.509	0.581	0.886	0.684	0.961	0.677
Income: T-test	0.384	1.741	0.978	0.635	0.904	0.553	0.038	0.134	0.671
p-value	0.702	0.086	0.331	0.527	0.369	0.582	0.969	0.894	0.504

Table (2): pre and post breathing exercises intervention among the Study Sample (N= 120).

Variable	Systolic BP. mmHg			Diastolic BP. mmHg			Heart Rate /min		
	Before	After* (1)	After** (2)	Before	After (1)	After (2)	Before	After (1)	After (2)
Mean	146.89	144.74	138.17	83.49	82.56	77.96	79.06	76.01	75.68
±SD	20.16	20.01	19.01	11.87	11.46	12.37	10.65	7.70	10.72
Minimum	100	99	100	60	55	65	53	55	53
Maximum	190	189	165	100	100	100	99	96	98

*After (1) = first time after breathing exercise   **After (2) = after one week of training

Table (3) Relationship between Systolic Blood Pressure, Diastolic Blood Pressure, and Heart Rate Before and After Intervention among the Study Sample (N=120).

Variable	mean	±SD	T-test	P- value
Systolic Blood Pressure				
-Before & After(1)	2.150	2.019	11.663	0.000*
-After(1) & After(2)	6.041	7.385	8.961	0.000*
-Before & After(2)	8.191	7.813	11.485	0.000*
Diastolic Blood Pressure				
-Before & After(1)	1.008	1.732	6.377	0.000*
-After(1) & After(2)	3.716	7.998	5.090	0.000*
-Before & After(2)	4.725	8.312	6.227	0.000*
Heart Rate				
- Before & After(1)	3.050	5.196	6.429	0.000*
-After(1) & After(2)	0.333	6.494	0.562	0.575
-Before & After(2)	3.383	7.464	4.965	0.000*

 * Significant *After (1) = first time after breathing exercise   **After (2) = after one week of training