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Belly Breathing Effectiveness on Sleep and Life Quality among Patients with Non-Erosive Gastroesophageal Reflux

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Abstract: Belly breathing recently has an important role in managing GERD symptoms, improving quality of life, medication adherence and sleep quality. **Study purpose:** to evaluate the belly breathing effectiveness on sleep and life quality among patients with non-erosive gastro esophageal reflux. **Design:** Quasi-experimental design. Setting: Medical out-patients' clinics of Menoufia University hospital and The National Liver Institute outpatient's clinics at Menoufia Governorate, Egypt. **Sample:** A purposive sample of 100 patients. **Instruments**: Five instruments: Structured interview questionnaire, Belly breathing exercises performance checklist & self-reported compliance sheet, GERD clinical symptoms severity and frequency assessment, Pittsburgh Sleep Quality Index and GERD Health-Related Quality of Life Scale. **Results:** GERD symptoms frequencies were reduced from 26.64 pre-intervention to 17.61 & 9.58 respectively post intervention by 2& 4 months. Also antacid consumption among 34 % of patients preintervention was 7 days / week but reduced to 2% and 0 % postintervention by 2 and 4 months respectively. Moreover good sleeper was 24% preintervention then elevated to 62% and 90% postintervention by 2 and 4 months respectively. Regarding, GERD related quality of life, only 1% were satisfied preintervention but post intervention by 2 and 4 months percent reach 32 and 72 respectively. **Conclusion:** Belly breathing presenting better therapeutic improvements in all patients' out comes as reduction of GERD symptoms severity and frequencies, little anti acid consumption, better sleep quality and more satisfaction with health-related quality of life. **Recommendations:** Encourage health care professionals, especially nurses to integrate belly breathing with the treatment protocols of patients with non-erosive GERD.

Keywords: *Belly breathing, Non-erosive gastroesophageal reflux, Sleep and life quality.*

Introduction

Gastroesophageal reflux disease (GERD) indicating backflow of stomach and duodenal contents into the esophagus, resulting in gastrointestinal discomfort with esophageal mucosa damage. Causes include an imbalance between factors harming stomach lining as gastric acidity, volume and duodenal contents and factors defending the esophagus as anti-reflux barriers, esophageal acid clearance and tissue resistance (De Bortoli et al., 2018).

Obesity, pregnancy, drinking alcohol, smoking and Non-Steroidal Anti-Inflammatory Drug (NSAID) are the main risk factors. Although the disease related provoking symptoms its self is rarely life threatening, it devastating all health- domains as physical, mental, social and psychological as a result of pain, heartburn, regurgitation, belching, persistent cough, hoarseness, teeth erosion, emotional distress, eating and drinking problems and bad general overall health. Additionally, the nocturnal symptoms which are significant contributors to a variety of sleep disorders as poor sleep quality, sleep apnea, lack of sleep, insomnia, snoring, and nightmares. Therefore, GERD is a significant strain on the economic and healthcare systems due to increased work absenteeism, decreased work productivity, higher health-care consumption and greater healthcare resources consumption (Taraszewska, 2021).

GERD symptoms usually identified, treated and relieved through proton pump inhibitors (PPIs). Calculating antacids intake or quitting percent of intaking is a measure of condition severity. Although pharmaceutical drugs may reduce the disease symptoms, it also run the risk of those symptoms recurrence. Long-term maintenance also may lead to negative side effects as myocardial infarction, lower bone mineral density and bone fractures. Surgery which advised for serious cases, can considerably lower the likelihood of recurrence, but it is still troubling to wonder about it consequences of bleeding, dyspepsia or even death (Roman et al., 2018).

Traditionally, modifying triggering factors is the non-pharmacological method overcome this disease through changing diet component, abstaining from alcohol, quitting smoking and decreasing weight, stop eating at least three hours before bedtime, elevating bed head, using a different position in bed instead of the right decubitus, turning off the lights when getting into bed, minimizing the awake time before falling asleep and not interrupting sleep time. Recently, belly breathing exercises have shown to be the more effective technique in managing GERD-related symptoms, enhance quality of life, medication adherence and sleep pattern among non-surgical / non-pharmacological modalities (Fass, Ronnie et al., 2021).

Diaphragm is the primary inspiratory muscle, contracts and relaxes in dome shape with respiration. It’s capacity to elevate and expand the lower rib cage usually compromised by GERD leading to pathological alterations resulting in reduction of lower ribs' transverse diameter during inspiration,

tension within the fascia can cause diaphragmatic dysfunctions with related biomechanical problems, which may affect various bodily functions and musculoskeletal regions. Therefore, belly breathing (manual diaphragm release and stretch) is the aim to release tension in a particular area of the diaphragm and attachments within and around the diaphragm (Nair et al., 2019).

Also belly breathing increases the cholinergic anti-inflammatory pathways in the parasympathetic nervous system, which mediate an antihyperalgesic action. It can strengthen the crural diaphragm (CD) tone, raise lower esophageal sphincter (LES) pressure and enhance diaphragm motor function, all of which will increase the antireflux barrier effect and lessen reflux. Patients with GERD may find that deep inhalation exercises greatly reduce their sensations of stomach pain caused by esophageal hyperalgesia (Yu, Yue et al., 2019).

The crural diaphragm is a skeletal muscle that, like other striated muscles, can be strengthened by training. Overall objective is always to strengthen these muscles and improve their anti-reflux defenses. Exercises that focus on breathing have been demonstrated to strengthen the gastro esophageal junction (Qiu et al., 2020).

Significance

Annually GERD symptoms are increasing by about 4%, in comparable with rising in obesity frequency. Weekly from 10% to 20% adults in western countries and nearly 5% of those in Asia experience have been diagnosed with GERD symptoms. The prevalence of GERD was reported to be as high as 20% in Western world with much lower rate in Asia. Each year, it accounts for more than 5.6 million doctor visits (Boulton and Peter 2022).

While much research has been done on managing GERD patients medically, little is known about breathing exercises effectiveness on patients with GERD. Coaching patients on belly breathing become the main nursing focus to avoid the recurrent attacks of reflux episode. To date, patient's belly breathing demonstrations are required for effective prevention, decrease disease aggressiveness, proper management and prevention of its complication on sleep and life quality.

Purpose of the study:

To evaluate the belly breathing effectiveness on sleep and life quality among patients with non-erosive gastroesophageal reflux.

Hypotheses:

- ❖ Patients who apply belly breathing exercise will exhibit more identification of GERD triggering factors.
- ❖ Patients who apply belly breathing exercise will exhibit reduction of GERD symptoms severity and frequencies than pre application.
- ❖ Patients who apply belly breathing exercise will exhibit less anti acid consumption than pre application.
- ❖ Patients who apply belly breathing exercise will exhibit better sleep quality than pre application.
- ❖ Patients who apply belly breathing exercise will exhibit more

satisfaction with their health-related quality of life than pre application.

Method

Design:

Quasi-experimental design.

Setting:

Medical out-patients' clinics at Menoufia University hospital and The National Liver Institute outpatient's clinics at Menoufia Governorate, Egypt.

Sample

A purposive sample of 100 patients.

Inclusion criteria

Male and female patients ≥18 years, meeting the diagnostic criteria of GERD (typical heartburn, acid regurgitation, which can be combined with atypical symptoms of chest pain, belching or extra-esophageal symptoms as cough and asthma, should have been experienced for at least 6 months). The diagnosis was confirmed by endoscopy or a 24 hour esophageal pH-value test. The patients treated by PPI or acid suppressant with symptoms recurrence.

Exclusion criteria

Contraindication of performance of physical exercise or handicap, Having metabolic or endocrine disorders, The patients with secondary GERD as (surgery, pregnancy, drugs as glucocorticoid), Patients having serious chronic diseases as upper gastrointestinal ulcer, or hiatus dysfunction, Having metabolic or endocrine disorders, Follow weight reduction program (medications /diet) to prevent conflict with the current intervention.

Instruments

Five instruments were used.

Instrument one: Structured interview questionnaire:

Developed by researchers after extensive recent literature review to assess patients' socio-demographic data, patients knowledge about GERD triggering factors and number of anti-acid consumed per week .It divided into three parts:

- **Part one: Socio-demographic data:** Includes seven questions about age, sex, educational level, occupation, residence, associated chronic diseases, unprescribed NSADs consumption and telephone number.
- **Part two: GERD triggering factors assessment questionnaire:** Includes 11 questions regarding tea and coffee intake, diet type, eating to bedtime hours, physical activity, tight-fitting clothing, triggering foods and drinks, eat smaller meals and slow down, elevate bed head, smoked cigarettes /day and BMI (kg/m2). Mean and standard deviations of all items was obtained throughout the study phases.
- **Part three: Days of antacid consumption /week:** A question about number of days of antacid consumption /week. It divided into: nothing/ day all over the week, 1-3 days /week, 4 -6 days/ week and 7 days / week.

Instrument two: Belly breathing exercises performance checklist & self-reported compliance sheet:

Developed by researchers after extensive recent related literature review (Ali et al., 2017) to evaluate patient's performance and compliance with belly breathing exercise. Includes two parts

- **Part one: Belly breathing exercises performance checklist:** Include researchers' demonstration and patient's redemonstration of planned exercise procedure steps. The researcher instructs patients perform the following 4 steps:
  - Place one from both hands on the belly just below the ribs and the other hand on the chest. Patients can perform this while standing or lying with knees bent as it may be more comfortable .
  - Inhale deeply from nose. Allow patient's tummy to push their hands out as they inhale, but keep the chest motionless.
  - Breathe out through pursed lips to force all air out of lungs, feel the hand on the belly descend and softly press on the area. Breathe out slowly.
  - Three to ten times, repeat these steps per day, allowing each breath to be deliberate.

Scoring system:

It was comprised of three-points Likert scale as follows; zero for not done or Fault, one for accurate incomplete performance and two for accurate completely performance. The total score ranged from 0-8 score.

- **Part two: Self-reported compliance sheet:** A question about patient's compliance with belly breathing exercise

Scoring system:

It was comprised of three-point Likert scale: Zero for not comply at all, one for comply with some extent and two for completely comply with the learned exercise performance.

Instrument three: GERD clinical symptoms severity and frequency assessment:

Adopted from velanovich, 2007 to assess the severity and frequency of GERD symptoms. Include 16 of heartburn, regurgitation, dysphagia, bad breath, nausea, vomiting, epigastric pain, dyspnea, sore throat, belching, chest pain, chronic cough, hoarseness, globus, tooth erosions and bloating / flatulence.

Scoring system:

- **For symptoms severity:** It was comprised of four-points Likert scale : graded 0 = none, 1 = mild, 2 = moderate, and 3 = severe. The total score ranged from 0 to 48. Then divided into (0- 16) Mild, (17-33) moderate and (34-48) severe symptoms.
- **For symptoms frequency:** It was comprised of three-point Likert scale: graded 0 = absent, 1 = occasional (symptoms appear in < 2 days /week), 2 = frequency (symptoms appear in 2 to 4 days /week, and 3 = very frequent (symptoms appear in > 4 days / week). Mean and standard deviations of all items was obtained throughout the study phases.

Instrument four: Pittsburgh Sleep Quality Index (PSQI):

Developed by Buysse et al., (1989) to measure the quality and patterns of sleep in the older adult. It having seven subscales; sleep time, latency, disturbances, subjective sleep quality, the efficiency of habitual sleep, sleeping pills use and the dysfunction of daytime over the last month. The score of sleep quality is obtained via summarizing seven elements.

Scoring system:

Each score ranged from zero to three points in which, three reflect the negative extreme on the Liker Scale. The total PSQI ranging from 0 (no trouble) to 3 (sever trouble). The worldwide score is ranging of (0 to 21). A PSQI total score from (0-7) indicate good sleep quality; from (8-14) average sleep quality and (15-21) indicate poor sleep quality.

Instrument five: GERD Health-Related Quality of Life (GERD-HRQL) Scale:

Developed by Velanovich (2007), containing two parts , the first is heartburn which include 10 question and the second is regurgitation which include 6 question each question has a Likert scale from (0 to 5) which zero indicate no symptoms, 1=noticeable (but not bothersome), 2=noticeable & bothersome(but not every day), 3=bothersome daily, 4=bothersome and affects daily activities and 5=incapacitating to do daily activities. Final question about satisfaction level with current health related quality of life. Its answer has three points scale, 2 for satisfied, 1 for neutral and zero for dissatisfied.

Scoring system:

- For heartburn section: Ten question ranged from (0-50) score, for regurgitation section: six questions ranged from (0-30), finally mean and standard deviations of all items was obtained throughout the study phases.
- Final question was categorized as satisfied, neutral and dissatisfied (number & percent of studied patients).

Sampling

The calculated sample size was 109 as the target population with these inclusion and exclusion criteria at the free inpatient units was 150 patients, 95% level of confidence, 5% acceptable error and 50% expected outcome. Only 100 (response rate=91.74%) patients who completed follow–up and their results were used in statistical analysis.

Validity and Reliability

Experts in the fields of medicine, surgery and family and community health nursing evaluated each tool's content validity. They were asked to assess the items' clarity and completeness. The tool was modified to include suggestions. All changes that were suggested were carried out.

In order to determine the dependability of the created tools, test-retest was utilized. Cronbach's alpha reliability was 0.94, according to instrument one's dependability report. Instruments 2, 3 and 4 had coefficient alpha reliability of 0.92 and Instrument 5 had Cronbach's alpha reliability of 0.94, all

of which point to the tool's generally acknowledged reliability.

Pilot study

Conducted on 10% of patients to test clarity and applicability of developed tools. The necessary modifications were done accordingly. Data obtained from those patients were not included in the final study.

Ethical considerations

Formal approval was taken from the Research Ethics Committee of the Faculty of Nursing at Menoufia University. All ethical rules were considered, patients were informed with their voluntary participation in the study and their liberty to reject. Their privacy and confidentiality were preserved. Patients were informed with investigation purpose and signed an agreement to participate in the study.

Procedure

- Patients who had agreed to participate in the trial received a brief description of the study purpose from the researchers before any data were collected .
- Between January 2023 and March 2023 (pre assessment phase period), one / two days a week from 9 am to 12 pm, the study researchers were present at the gastroenterology and internal medicine clinics to collect the study participants and involve them in belly breathing exercises .
- Pretest, implementation and posttest phases were used to collect data.

Pretest phase:

Researchers using all study instruments start gathering information to establish a baseline data about patient's biodemographic, disease related triggering factors, number of days of antacid consumption /week, disease related clinical symptoms severity and frequency, patient's sleep quality and the impact of the disease on health-related quality of life. These items of assessment took about 30-45 minutes to be completed.

Implementation phase:

- The researchers prepare the environment so that it is calm and quiet, well- ventilated, and well-lit before the starting exercise performance.
- In an appropriate well-prepared room; the researchers were giving a 20 minutes for patient's face-to-face education about disease nature, signs and symptoms, triggering factors, different management modalities and drugs adherence (30 to 45 minutes before a meal) / spreading of dose (morning and evening) to help patients in behavioral change.
- Each patient was interviewed at the gastroenterology outpatients' clinic via scheduling a meeting with them on the same day for his/her follow-up appointment.
- To make the technique and the key ideas of each phase clear, the researchers were giving each patient a specially created, colorful, illustrated booklet with photographs.
- For further explanation to ensure proper execution of each step, the researchers role-play and videotape for the belly exercise technique after researcher initial demonstration in front of the patients and before having them re-demonstrate it.
- For belly breathing, patients were instructed to :-

- Free their mind of anything that is straining it out and take a seat as far back on a chair as they can.
- Next, belly breathing exercises were performed (around 10–15 patients / day) under the direction of an internal medicine doctor .
- Inhale normally and slowly through nose while keeping mouth shut, as done with smelling a flower.
- Slowly exhale through pursed lips. Patient's one hand at the top of the chest and the other on the belly, just below the ribs. Slowly inhale through nose until the tummy has inflated as far as it can on the hand.
- Retain the other hand on the chest; try exercising at regular intervals throughout the day.
- The patient's daily breathing will incorporate this approach as it becomes more natural with repeated use.

- For four months, this exercise was performed 2-3 times daily for 15-20 minutes on an empty stomach or two hours after meals; the duration and intensity of the belly breathing exercises could be changed depending on the patient's stamina.
- Rather than meeting patients in outpatient's clinics during their follow-up, researchers were contact weekly by phone calls to follow their compliance the exercise.

Post-test phase:

The patients were reassessed after 2 and 4 months using the same data collection instruments (except part one in the first instrument) then comparisons were done to evaluate the belly breathing effectiveness on sleep and life quality among patients with non-erosive gastroesophageal reflux.

Statistical analysis

Collected data were described using Mean and Standard Deviation (SD) for numerical data and frequency and percentage for categorical data. The McNemar test, extended McNemar test, paired-t-test, and Wilcoxon signed-rank test were used to compare changes in studied parameters throughout the study phases, as appropriate. The Spearman correlation coefficient (Rho) was used to assess the correlation between studied variables. Statistical significance was considered at $P<0.05$. Data management was carried out using STATA/SE version 11.2 for Windows (STATA Corporation, College Station, Texas) (StataCorp, 2009) .

Results

Table 1: represents that Mean age of studied patients was 42.5 years with more than half of them (56%) were female and highly educated (university / above). Also more than half of them (58%) were physically work and live in urban but little less than half of them (48%) were consumed unprescribed NSADs.

Table 1: explains that post intervention most of subjects identified GERD triggering factors by 2 and 4 months compared with pre intervention in high statistically significant differences ($p = 0.001$). Furthermore, mean smoked cigarettes decreased from 7.73 in pre-intervention to 5.48 & 3.92 by 2 and 4 months with high statistically significant differences ($p <0.001$). Also Mean body mass index of subjects lowered throughout the study phases, from 27.99 pre intervention to 26.95& 25.89 respectively post

intervention, with high statistically significant differences (p value <0.001).

Table 3: reports that mean score of completely accurate performance of breathing exercises among studied patients raised from 2% in pre interventions to 40% & 78% by 2 & 4 months respectively, post-interventions with high statistically significant differences (p value <0.001). Regarding to patient's self-reported exercise compliance improvement was seen from 39% by 2 months to 74% by 4 months post intervention, with high statistically significant differences (p value <0.001).

Table 4: confirms that the total mean score of patients' GERD symptoms frequencies reduced from 26.64 pre-intervention to 17.61 & 9.58 respectively post intervention by 2& 4 months, with a high statistically significant differences (p <0.001). Besides the total mean score of GERD symptoms severity reduced from 26.49 to 19.13 & 12.19 by 2& 4 months postintervention, with a high statistically significant differences (p value <0.001).

Figure 1: illustrates that antacid consumption among patients taken it 7 days / week was 34 % preintervention but reduced to 2% and 0 % postintervention by 2 and 4 months respectively. Adversely, patients who don't take antacid daily increased from 4%preintervention to 34% and 39% postintervention by 2 and 4 months respectively.

Table 5: shows improvement in sleep quality among studied patients whereas patient's related sleep suffering decreased from 10.18 preintervention to 6.1 and 4.38 post interventions by 2 and 4 months respectively with a highly statistically significance difference. On other meaning, good sleeper was 24% preintervention then elevated to 62% and 90% postintervention by 2 and 4 months respectively with a highly statistically significance difference.

Table 6: reveals improvement in the heartburn total mean score whereas decreased from 26.94 preintervention to 17.38 & 12.42 respectively by 2&4 months post intervention with a high statistically significant differences (p <0.001). Additionally, there was a reduction in regurgitation total score from 18.06 preintervention to 12.04 & 8.90 respectively postintervention by 2&4 months, with a highly statistically significance difference. Regarding GERD patient's current health related quality of life, only 1% were satisfied preintervention but post intervention by 2 & 4 months percent reach 32 and 72 respectively, with a highly statistically significance difference (p <0.001).

Table 7:documents that there was a significant negative correlation between patient's belly breathing compliance and GERD symptoms severity, symptoms frequency and antacid consumption days /week post interventions by 2 & 4months respectively (0.0004, 0.001&0.041). While there was a significant positive correlation between patient's breathing exercise compliance and patients sleep quality, current health related quality of life, heartburn and Regurgitation post interventions by 2 & 4months.

Table (1): Distribution of the studied patients according to their socio-demographic characteristics: (No. =100)

Variable		(No. %)
Age/ year (Mean ±SD)	42.56±9.14	
Sex	Male	44
	Female	56
Educational level	Elementary / below	20
	Middle education	24
	University / above	56
Occupation	Physical work	58
	Mental work	14
	No occupation/ house wife	28
Residence	Rural	42
	Urban	58
Associated chronic diseases (N.=40)	Diabetes mellitus	18
	Hypertension	28
	Liver disease	10
Unprescribed NSADs consumption	Yes	48

NSADs: Non-steroidal anti-inflammatory drugs

Table (2): Distribution of the studied patients according to GERD triggering factors throughout the study phases (N. =100)

Variable (N.=100)		Pre intervention	Post-intervention by 2 months	Post-intervention by 4 months	P1	P2	P3
Tea intake (cups/day)	<5	56	72	82	<0.001	<0.001	0.002
	≥5 cups/day	44	28	18			
Coffee intake (cups/day)	≤2 cups/day	40	60	72	<0.001	<0.001	0.0005
	>2 cups/day	60	40	28			
Diet type	Vegetarian	16	16	16	1.00	1.00	1.00
	Non-vegetarian	84	84	84			
Eating to bedtime hours	<2	74	38	26	<0.001	<0.001	0.0005
	≥2	26	62	74			
Physical activity	Sedentary	72	24	16	<0.001	<0.001	0.008
	Non-sedentary	28	76	84			
Tight-fitting clothing	Usually used	56	14	6	<0.001	<0.001	0.008
	Avoided	44	86	94			
Triggering foods and drinks	Usually used	18	0	0	<0.001	<0.001	1.00
	Avoided	82	100	100			
Eat smaller meals and slow down	Yes	36	82	96	<0.001	<0.001	0.0001
	No	64	18	4			
Elevate head of bed	Yes	18	90	90	<0.001	<0.001	1.00
	No	82	10	10			
Smoked cigarettes /day (N.=48)	Mean ±SD	7.73±1.25	5.48±0.99	3.92±0.85	<0.001	<0.001	<0.001
BMI (kg/m2)	Mean ±SD	27.99±3.71	26.95±3.61	25.89±3.38	<0.001	<0.001	<0.001

BMI: Body Mass Index; Comparisons were carried out using the paired t-test for quantitative data and McNemar test for qualitative data. Significant differences were considered at P<0.05.

P1: For comparing preintervention data against postintervention by 2 months.

P2: For comparing preintervention data against postintervention by 4 months.

P3: For comparing postintervention by 2 months data against postintervention by 4 months.

Table (3): Means and Standard Deviations of studied patient's breathing exercise performance checklist and compliance throughout the study phases (No. =100*)*

Breathing Exercise (N.=100)	Pre-intervention	Post-intervention by 2 months	Post-intervention by 4 months	P1	P2	P3
Accurate complete performance	2	40	78	<0.001	<0.001	<0.001
Accurate incompletely performance	32	59	21			
Not done/ Fault	66	1	1			
Patient's self-reported exercise compliance	**Post intervention by 2 months**		**Post intervention by 4 months**	**P - Value**		
Noncompliance	0		0	<0.001		
Comply to some extent	61		26			
Completely compliance	39		74			

Comparisons were carried out using the Wilcoxon signed-rank test for quantitative data and the McNemar test and extended McNemar test for qualitative data. Significant differences were considered at P<0.05.

P1: For comparing preintervention data against postintervention by 2 months.

P2: For comparing preintervention data against postintervention by 4 months.

P3: For comparing postintervention by 2 months data against postintervention by 4 months.

Table (4): Means and standard deviations of studied patient's symptoms severity and frequencies throughout the study phases: (No=100)

GERD symptoms	Mean ±SD			P1	P2	P3
	Pre-intervention	Post-intervention by 2 months	Post-intervention by 4 months			
GERD symptoms frequencies						
Heartburn	2.39±0.55	1.67±0.68	1.09±0.69	<0.001	<0.001	<0.001
Regurgitation	2.32±0.75	1.57±0.65	108±0.60	<0.001	<0.001	<0.001
Bad breath	1.85±1.21	1.09±0.94	0.70±0.80	<0.001	<0.001	<0.001
Dysphagia	2.14±0.79	1.29±0.62	1.16±0.71	<0.001	<0.001	0.0008
Nausea	1.60±0.68	1.16±0.49	1.03±0.52	<0.001	<0.001	0.0003
Vomiting	1.24±0.77	0.83±0.68	0.66±0.70	<0.001	<0.001	<0.001
Epigastric pain	1.41±0.57	1.07±0.45	0.87±0.56	<0.001	<0.001	<0.001
Dyspnea	1.72±0.79	1.29±0.62	1.08±0.63	<0.001	<0.001	<0.001
Sore throat	1.30±0.93	0.77±0.55	0.40±0.49	<0.001	<0.001	<0.001
Belching	1.27±0.53	0.80±0.47	0.33±0.51	<0.001	<0.001	<0.001
Chest pain	1.89±0.76	1.23±0.58	0.79±0.61	<0.001	<0.001	<0.001
Chronic cough	1.83±0.70	1.22±0.46	0.94±0.55	<0.001	<0.001	<0.001
Hoarseness	1.42±0.65	0.88±0.43	0.59±0.55	<0.001	<0.001	<0.001
Globus	1.10±0.78	0.70±0.56	0.44±0.56	<0.001	<0.001	<0.001
Tooth erosions	0.97±0.85	0.58±0.57	0.30±0.48	<0.001	<0.001	<0.001
Bloating / Flatulence	2.19±0.61	1.46±0.67	0.99±0.73	<0.001	<0.001	<0.001
Total score	**26.64**±6.64	**17.61**±5.00	**9.58**±4.26	**<0.001**	**<0.001**	**<0.001**
GERD symptoms severity (No. %) total score (0-48)						
Total score	**26.49±7.47**	**19.13±5.56**	**12.19±4.73**	**<0.001**	**<0.001**	**<0.001**
• **Mild (0- 16)**	6	31	83	<0.001	<0.001	<0.001
• **Moderate (17-33)**	77	69	17			
• **Severe (34-48)**	17	0	0			

Comparisons were carried out using the Wilcoxon signed-rank test for quantitative data, as appropriate, and the extended McNemar test for qualitative data. Significant differences were considered at P<0.05.
P1: For comparing preintervention data against postintervention by 2 months.
P2: For comparing preintervention data against postintervention by 4 months.
P3: For comparing postintervention by 2 months data against postintervention by 4 months.

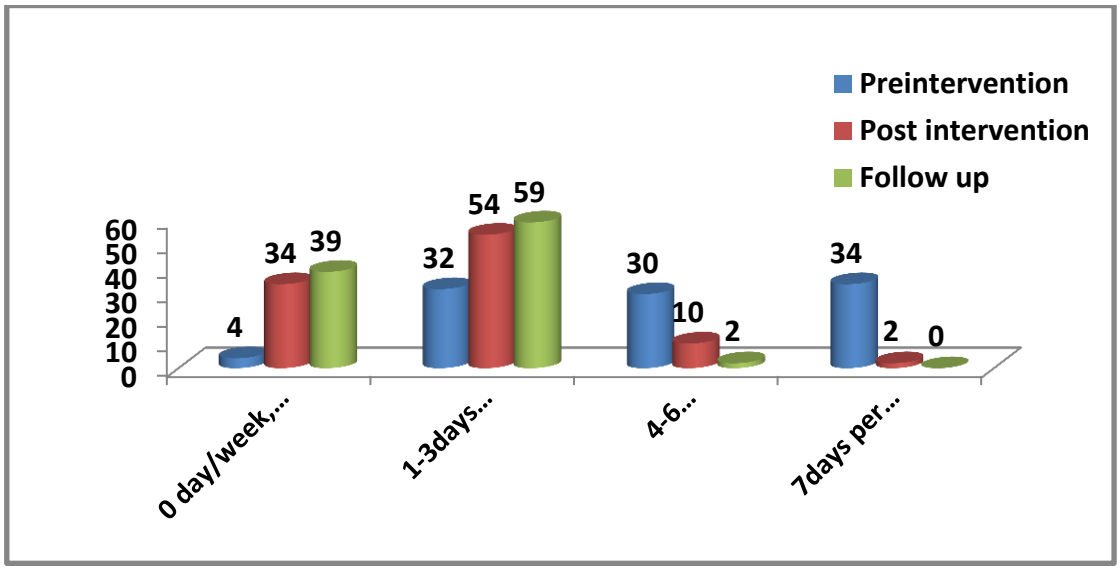

Figure (1): Distribution of studied patients according to antacid consumption days/ week throughout the study phases: (No=100)

Table (5): Means and standard deviations of studied patient's sleep quality throughout the study phases: (No=100)

Pittsburgh sleep quality items (N.=100)	Mean ±SD			P1	P2	P3
	Pre-intervention	Post-intervention by 2 months	Post-intervention by 4 months			
Subjective sleep quality	2.02±0.68	1.54±0.73	1.4±0.85	<0.001	<0.001	0.0002
Sleep latency	1.80±0.85	1.02±0.74	0.72±0.53	<0.001	<0.001	<0.001
Sleep duration	1.58±0.88	0.90±0.67	0.58±0.61	<0.001	<0.001	<0.001
Habitual sleep efficiency	1.84±0.86	0.94±0.74	0.84±0.73	<0.001	<0.001	0.002
Sleep disturbances	1.62±0.92	0.96±0.75	0.54±0.67	<0.001	<0.001	<0.001
Use of sleeping medication	0.24±0.43	0.16±0.37	0.04±0.20	0.005	<0.001	0.0005
Daytime dysfunction	1.08±1.00	0.58±0.78	0.26±0.52	<0.001	<0.001	<0.001
Total score	**10.18±4.40**	**6.1±3.53**	**4.38±2.60**	**<0.001**	**<0.001**	**<0.001**
Good sleep (0-7)	24	62	90	<0.001	<0.001	<0.001
Average sleep (8-14)	60	37	9			
Poor sleep (15-21)	16	1	1			

Comparisons were carried out using the paired t-test and Wilcoxon signed-rank test for quantitative data, as appropriate, and the extended McNemar test for qualitative data. Significant differences were considered at P<0.05.
P1: For comparing preintervention data against postintervention by 2 months.
P2: For comparing preintervention data against postintervention by 4 months.
P3: For comparing postintervention by 2 months data against postintervention by 4 months.

Table (6): Means and Standard Deviations of Studied patient's GERD health-related quality of life throughout the study phases: (No=100)

Studied patient's GERD health-related quality of life		Mean ±SD			P1	P2	P3
		Pre-intervention	Post-intervention by 2 months	Post-intervention by 4 months			
How bad is heartburn?		3.20±0.92	2.14±0.98	1.26±0.94	<0.001	<0.001	<0.001
Does heartburn present with lying down?		2.68±0.55	1.56±0.70	1.14±0.80	<0.001	<0.001	<0.001
Does heartburn present with standing?		2.26±0.69	1.46±0.73	1.00±0.63	<0.001	<0.001	<0.001
Does heartburn present with after meal?		3.28±0.70	2.70±0.67	2.10±0.61	<0.001	<0.001	<0.001
Does heartburn change your diet?		3.48±1.07	2.44±0.81	1.84±0.79	<0.001	<0.001	<0.001
Does heartburn wake you from sleep?		2.64±1.18	1.18±1.22	0.98±1.14	<0.001	<0.001	0.0004
Do you have difficulty in swallowing?		1.96±1.15	1.24±0.86	0.76±0.71	<0.001	<0.001	<0.001
Do you have pain while swallowing?		2.48±1.00	1.60±0.83	1.18±0.74	<0.001	<0.001	<0.001
Do you have gassy or bloating feeling?		2.66±0.87	1.44±0.88	0.92±0.63	<0.001	<0.001	<0.001
Affection of reflux medication on daily life?		2.30±0.54	1.62±0.60	1.24±0.55	<0.001	<0.001	<0.001
Heartburn total score		**26.94±6.26**	**17.38±5.12**	**12.42±4.44**	**<0.001**	**<0.001**	**<0.001**
How bad is the regurgitation?		3.30 ±0.95	2.28 ±0.83	1.70 ±0.70	<0.001	<0.001	<0.001
Does regurgitation present with lying down?		3.26±0.56	2.20±0.63	1.50±0.58	<0.001	<0.001	<0.001
Does regurgitation present with standing?		2.12±1.06	1.32±0.91	0.90±0.73	<0.001	<0.001	<0.001
Does regurgitation present with after meal?		3.44±0.86	2.46±0.81	1.86±0.72	<0.001	<0.001	<0.001
Does regurgitation change your diet?		3.38±1.08	2.44±0.90	2.04±0.78	<0.001	<0.001	<0.001
Does regurgitation wake you from sleep?		2.56±1.29	1.34±0.98	0.90±0.93	<0.001	<0.001	<0.001
Regurgitation total score		**18.06±4.34**	**12.04±3.50**	**8.90±2.88**	**<0.001**	**<0.001**	**<0.001**
GERD patient's current health related quality of life	• **Satisfied**	1	32	72	<0.001	<0.001	<0.001
	• **Neutral**	61	68	28			
	• **Dissatisfied**	38	0	0			

Comparisons were carried out using the Wilcoxon singed-rank test for quantitative data and McNemar, and extended McNemar test for qualitative data. Significant differences were considered at P<0.05.
P1: For comparing pre-intervention data against post-intervention by 2 months.
P2: For comparing pre-intervention data against post-intervention by 4 months.
P3: For comparing post-intervention by 2 months data against post-intervention by 4 months.

Table (7): Correlation between patient's belly breathing exercise compliance and symptoms severity and frequencies, Days number of antacid consumption /week, sleep and life quality throughout the study phases (No=100).

Patient's outcomes	Patient's compliance with belly breathing exercise					
	Pre intervention		Post intervention by 2 months		Post intervention by 4 months	
	Rho	P- Value	Rho	P- Value	Rho	P- Value
GERD symptoms severity	0.287	0.004**	-0.119	0.238	-0.344	0.0004***
GERD symptoms frequencies	0.290	0.003**	-0.381	0.0001***	-0.460	<0.001***
Antacid consumption days /week	0.335	0.0007***	-0.333	0.0007***	-0.205	0.041*
Sleep quality	0.126	0.212	0.269	0.007**	0.061	0.547*
GERD patient's current health related quality of life	0.283	0.004**	0.142	0.16	0.055	0.588
Heartburn total score	0.316	0.001**	0.392	0.0001***	0.072	0.476
Regurgitation total score	0.382	0.0001***	0.373	0.0001***	0.153	0.127

Rho: Spearman correlation coefficient; statistical significance was considered at P<0.05.
* P<0.05; ** P<0.01; *** P<0.001

Discussion

Attention has been gained for the devastating negative effect of GERD on all quality-of-life domains whether physical, social, psychological and spiritual of affected individuals. Meanwhile, belly breathing is an effective modality for GERD management could improve various aspects of the disease and could play an important role in the management of GERD-related symptoms (Halland et al., 2021). Therefore, the purpose of the present study was to evaluate the belly breathing effectiveness on sleep and life quality among patients with non-erosive gastro esophageal reflux.

The first hypothesis was accepted according to the present study which revealed that post-intervention, most of patients improved GERD triggering factor's identification by 2 and 4 months compared with pre intervention with high statistically significant differences. This finding was consistent with Yuan et al., (2019) who reported that patients who followed all recommended habitual changes experienced significant improvement in lifestyle factors (fast eating, spicy food, very hot foods, drinking tea and coffee and smoking) after 6-month follow-up.

Also, the present study illustrated that mean score of completely accurate performance of belly breathing exercises among studied patients raised from pre intervention to 2 & 4 months post-interventions. Moreover, patient's self-reported exercise compliance significantly increased by 4 months after intervention. This result was agreed with Xu et al., (2016) who reported that majority of patients in the intervention group demonstrated significantly higher self-efficacy and compliance for better performance of abdominal respiration after 3 months of intervention compared to non-intervention group. Also, they completed all breathing steps in a correct manner after training. This could be related to the provided patient's motivation and enthusiasm for self-management, better remission of symptoms and improvement in psychological distress by researchers.

Otherwise, the second hypothesis was accepted as the current study stated that total mean scores of GERD symptoms frequencies and severity were significantly reduced by 2 & 4 months post intervention compared with pre-intervention. This finding was congruent with Mahmoud, et al ., (2018) who reported a significant improvement in signs and symptoms of GERD as percentage decreased after practicing breathing exercise compared to pre intervention. Breathing exercise had significant effect on decreasing GERD manifestations after two months of practicing breathing exercise as heart burn, chest pain, bitter taste, presence of hoarseness and sore throat comparing to pre exercise.

Additionally, this result was aligned with Hosseini et al., (2022) who found that the mean scores of symptom frequency and severity decreased significantly after the intervention. This indicated that diaphragmatic breathing training could alleviate symptoms and improved quality of life among patients had GERD.

Moreover, the current study showed that the mean of patient's smoked cigarettes and BMI was significantly reduced by 2 and 4 months post intervention compared with pre intervention. These findings were congruent with Ahmed and Khalil, (2021) who found that there was an improvement in the patient knowledge and practices in all aspects of life style factors. Quit smoking was improved and body weight was also decreased with highly statically significant differences between pre/post and follow up program implementation. This could be related to patients' commitment to instructions in order to reduce GERD symptoms to feel better and work effectively.

The third hypothesis was accepted for antacid consumption, because the current study revealed that antacid consumption among patients taking it 7 days / week was 34 % preintervention but reduced to 2% and 0 % postintervention by 2 and 4 months respectively. This result was in accordance with Ong et al., (2018) they found that eighty percent of patients in the intervention group significantly reduced antacid consumption compared with pre intervention. This could be related to the positive effect of belly breathing on reducing regurgitation and heartburn sensation which resulted in patients decreased their usage of antacid medications.

Meanwhile, the fourth hypothesis was accepted as the present study showed that there was significant improvement in patient's sleep quality post intervention by 4 months compared to pre intervention with a highly statistically significance difference. This finding was consistent with Liu et al., (2022) who stated that at the end of 3rd month, patients reported that they felt much better with "falling sleep much easier". This was due to belly breathing that could relieve symptoms and promote relaxation which help patients to improve their sleep quality.

Additionally, this finding was in the same line with Hamasaki (2020) who found that diaphragmatic breathing had a positive effect on improving sleep quality and the QoL of patients with GERD post intervention with a statistically significant difference. This could be related to breathing exercise that alleviates GERD symptoms of heart burn and regurgitation so, patients could sleep and feel better.

Concerning patient's GERD health-related quality of life, **the fifth hypothesis was accepted** because the present study showed significant improvements in the total mean scores of both heartburn and regurgitation post intervention by 2&4 months compared with pre-intervention. This finding was in the same line with Demirtaş et al., (2019) who reported that after three months of intervention, the total mean scores of heart burn and regurgitation decreased at a significant level in patients performed breathing exercise.

Moreover this result was consistent with Moffa et al., (2020) who found that GERD health-related quality of life scores significantly improved whereas GERD common symptoms of both heartburn and regurgitation

significantly reduced after 4-weeks of intervention than before.

Additionally, this finding was agreed with Jallepalli et al., (2022) who reported that there was a significant decline in gastrointestinal symptoms rating scale & HRQL scores from baseline to follow up1 and 2. This indicated that patient belly breathing coaching can be effectively reduce symptoms and improve the quality of life of GERD patients.

From other point of view, the majority of studied patients were satisfied post intervention with their current health related quality of life compared to pre intervention with a highly statistically significance difference. This result was in accordance with Ahmadi et al., (2021) who reported that breathing exercise training significantly improved the quality of life of the patients and majority of them had greater satisfaction post intervention compared to before the study. This could be related to belly breathing that improved their exercise capacity, respiratory function and affected positively on GERD clinical symptoms.

This study confirmed a significant negative correlation between patient's breathing exercise compliance and GERD symptoms severity, frequencies and antacid consumption days number /week in both post interventions by 2 &4 months. This finding was congruent with Qiu et al., (2020) who reported that there was a negative correlation between breathing exercises and GERD symptoms, and acid suppression usage whereas patients performed breathing exercises had lower mean scores of GERD symptoms severity and frequencies. Moreover, number of acid suppression usage decreased post intervention with a statistically significant difference. This was due to belly breathing that can improve pressure generated by the lower esophageal sphincter. The possible mechanism behind this is the enhancement of the anti-regurgitation barrier especially crural diaphragm tension.

While there was a significant positive correlation between patient's breathing exercise compliance and sleep quality, GERD patient's current health related quality of life, heartburn total score and regurgitation total score post interventions by 2& 4 months. This result was in agreement with Hosseini et al., (2022) who found that there was a positive correlation between breathing exercise and health related quality of life as there was a reduction in reflux symptoms and increased quality of life in the experimental group after four weeks of practicing diaphragmatic breathing with a statistically significant difference.

Conclusion

As the study findings revealed, Belly breathing presenting better therapeutic improvements in all patients' out comes as reduction of GERD symptoms severity and frequencies, little anti acid consumption, more sleep quality and more satisfaction with health-related quality of life.

Recommendations

For nursing practice:

- Encourage health care professionals, especially nurses to integrate belly breathing with the treatment protocols of patients with non-erosive GERD.
- In-service continuous updated nursing led-training program pertaining to belly breathing exercise should be designated and presented in special training sessions to all patients with GERD.
- Study replication with large probability sample and different geographical area is recommended to confirm belly breathing exercise practice efficacy.

For nursing education:

- Awareness enhancement program regarding GERD triggering factor through mass media should be disseminated by authorized personnel.
- Manual pamphlet about belly breathing exercise should be accessible to nurses as a reference to be distributed among patients suffered GERD.

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