Kufa Journal for Nursing Sciences
Open Access Full Text Article

Publisher
University of Kufa, Faculty of Nursing

Received: 22 December, 2023
Accepted: 03 March, 2024
Published: 21 March, 2024
Vol. 14(1), 2024: 53 – 61

https://doi.org/10.36321/kjns.vi202401.14525

ORIGINAL RESEARCH

Impact of Slow Deep Breathing Exercises using Incentive Spirometry on Functional Capacity among Patients with Coronary Artery Disease

Zahra Abdulmunem Ahmed [1], Hussam abbas Dawood [2].

[1] *Registered Nurse, Kerbala Health Directorate, Ministry of Health, Karbala, Iraq.*
[2] *Adult Health nursing, College of Nursing, University of Kerbala, Kerbala, Iraq.*

CORRESPONDING AUTHOR: Zahra Abdulmunem Ahmed, Registered Nurse, Kerbala Health Directorate, Ministry of Health, Karbala, Iraq. Email: zahraa.a.m.ahmed@gmail.com

ABSTRACT

Background: A condition known as coronary artery disease occurs when the myocardium does not receive enough blood or oxygen. It is caused by blockage of the coronary arteries and is characterized by an imbalance in the supply and demand of oxygen. Usually, it involves blood flow obstruction caused by plaques that form in the coronary artery lumen. It is the leading global cause of death.

Objectives: this study aims to measure the impact of slow deep breathing exercises using incentive spirometry on functional capacity of patients with coronary artery disease.

Methodology: Participants in this quasi-experimental research design included patients with coronary artery diseases. Patients with severe respiratory conditions, a history of coughing, difficulty breathing deeply, non-pulmonary status at first examination, and inability to complete the study were among the exclusion criteria. the participants in the study were 50 samples (25 research groups and 25 control groups), the research groups were given an incentive spirometer in addition to hands-on instruction on how to use it and collect accurate measurements. Patients were told to lie down or sit in order to breathe in and out through the tube 10 times. Patients were instructed to do this exercise three times every eight hours for a duration of three weeks.

Results: Three weeks following the intervention, a re-assessment of the functional capacity, revealed an improvement in factional capacity solely in the study groups relative to the pre-test.

Conclusion: Using an innovative spirometer, the study demonstrated the impact of various deep breaths on the functional capacity of patients with CAD. Nearly all patients demonstrated a significant short-term improvement in their functional capacity, and no significant side effects were found. Consequently, this methodology can be applied in subsequent research to examine long-term impacts for weeks or months. Because it is simple to use and the measurement is non-intrusive, this method is perfect for self-monitoring at home.

Keywords: incentive spirometer, coronary artery disease (CVDs), function capacity.

INTRODUCTION

Globally, coronary heart disease (CHD) is the primary cause of heart surgery as the burden of cardiovascular diseases and CVD increases. It is the primary cause of death worldwide, accounting for a growing number of deaths in emerging as well as high-income nations. The number of fatalities from CVD reached 17.9 million in 2019, accounting for 32% of all deaths worldwide. CVDs are on the rise. Heart attacks and strokes were the cause of 85% of these fatalities. Cardiovascular mortality and

How to Cite: Ahmed, Z. A., & Dawood, H. A. (2024). Impact of slow deep breathing exercises using incentive spirometry on functional capacity among patients with coronary artery disease. *Kufa Journal for Nursing Sciences, 14*(01), 53–61. https://doi.org/10.36321/kjns.vi202401.14525

morbidity are related to an increased risk of autonomic dysfunction, such as a decrease in heart rate variability. (Roth, et.al., (2020); Benjamin, et al., (2019)).

Deep breathing exercises are beneficial to health. Clinical uses of slow breathing have included the treatment of heart failure, hypertension, anxiety, depression, and pulmonary ailments such as asthma and chronic obstructive lung disease. It has also been used to treat cardiovascular and stress-related problems. An essential component of many mind-body techniques is slow breathing. A respiratory rate of less than 10 breaths per minute has been used to characterize sluggish breathing in study. An established technique for determining sympathetic and parasympathetic tone is heart rate variability (HRV) analysis, which can be performed using the HRV power spectrum. It is necessary to carry out these spectral measurements of autonomic modulation under controlled circumstances. It is crucial to take into account how varying respiratory rates may affect heart rate variability (HRV). (Hamasaki, et al., (2020); Birdee, et al., (2023); Russo, et al., (2017))

The incentive spirometer assesses a patient's inspiratory effort by monitoring inhalation volume. The incentive spirometer can be utilized as a helpful tool in rehabilitation because it is inexpensive, simple to use, and has no known negative effects. It is simple to teach and does not require assistance after a patient has learnt how to use it correctly. Furthermore, the visual input promotes patient compliance. (Franklin, E., & Anjum, F. (2023).

METHODOLOGY

Study design:

This study used a quasi-experimental design with pre- and post-testing for both the study and control groups in order to accomplish their objectives. An application for this study was made to the Karbala Center for Cardiology, Surgery, and Cardiac Consultation.

Instrument Construction

A two-part administered questionnaire (Part: I: The Demographic and Medical Characteristics, this section focuses on gathering demographic information from patients via interview questionnaires, including questions about age, gender, marital status, place of residence, smoking status, smoking habit type, daily cigarette/hookah consumption rate, years of smoking history, weight, height, body mass index (BMI), and other chronic diseases. and Part II: Function Capacity the Physical Functional Ability Questionnaire (FAQ5), a performance-based instrument that focuses on each individual's ability to A self-care ability assessment, Family and social ability assessment Movement ability assessment Lifting ability assessment ability assessment) was used to evaluate the impact of the program on the patient by assessing the importance and advantages of slow, deep breathing when using an incentive spirometer on patients with CAD.

Study Sample

For this study, the Karbala Center for Cardiology, Surgery, and Cardiac Consultation provided a total of (50) patients with coronary artery disease. In both the study and the control groups, there were 25 participants in total. Using the Purposive Sample, which was divided into two groups with 25 patients each, the sample was chosen as being Non-Probability Sampling.

In contrast to the control group, which continued to only receive medical management of CAD, the study group underwent IS procedures that included slow, deep breathing and medical management of CAD. The written informed consent for each participant to take part in this investigation. On the following criteria, participants were chosen for participation

1. An official CAD medical diagnosis
2. The patient's condition is stable.
3. Adults above the age of 18 who could participate in study procedures and follow instructions

4. Patient Not participating in a systematic aerobic exercise program in the six months before
5. Mindful, goal-oriented, and cooperative.

Instruments Research:

1. Incentives spirometer,
2. Pulse oximeter,
3. Electronic sphygmomanometer,
4. Weighing scale,
5. Length measuring tape,
6. Stadiometer ECG, and
7. Other tools were utilized in this investigation.

Statistical Analysis:

The statistical analysis system SPSS (Statistical Package for Social Sciences) version 26 and the Excel program are used to analyze data. The outcomes of the study were analyzed and evaluated using the following statistical data analysis techniques

1. Descriptive data analysis
2. Inferential data analysis the Paired-Samples T Test-technique compares the two variables' means for a single group.

Procedure

Purposeful grouping of the participants who met the inclusion criteria resulted in two groups, each with 25 participants.

Group 1: The study group got medical treatment for CAD along with slow, deep breathing exercises that the patient used ten times a day, every eight hours, for three weeks. A researcher demonstrated how to utilize IS to the patients.

Group 2: The control group, which received just medical treatment for CAD management.

RESULTS

Table (1): Participants' sociodemographic characteristics

sociodemographic characteristics		Study Group (n = 25)		Control Group (n = 25)	
		Frequency	Percent	Frequency	Percent
Age (Years)	42 – 48	1	4.0	2	8.0
	49 – 54	6	24.0	9	36.0
	55 – 60	8	32.0	3	12.0
	61- 66	5	20.0	8	32.0
	67 - 72	5	20.0	3	12.0
Mean (SD)		study: 60.0 ± 7.59		control: 57 .6 ± 8.38	
Sex	Male	15	60.0	13	52.0
	Female	10	40.0	12	48.0
Marital Status	Married	25	100.0	25	100.0
	Single	0	0.0	0	0.0
Residency	Urban	19	76.0	21	84.0
	Rural	6	24.0	4	16.0

The participants of the study group are 60.0 ± 7.59 years old on average; this means that fewer than a third are between the ages of 55 and 60 (n = 8; 32.0%), 49 and 54 (n = 6; 24.0%), 61 and 67 and 72 (n = 5; 20.0%) for each, and one is 42 (n = 1; 4.0%). The control group's average age is 57.6 ± 8.38; the age categories comprising the bulk of the group (n = 9; 36.0%) are 42–48 (n = 2; 8.0%), 61–66 (n = 8; 32.0%), and 55–60 and 67–72 (n = 3; 12.0%). In terms of sex, there are more men in the study group than women (n = 15; 60.0% vs. n = 10; 40.0%). Males make up more than half of the control group (n = 13; 52.0%) as opposed to females (n = 12; 48.0%). The marital status of every one of the 25 research participants (n = 25; 100.0%) is married.

In terms of residence, more research participants (n = 19; 76.0%) reported living in urban regions, whereas fewer individuals (n = 6; 24.0%) said they were living in rural areas. While a minority (n = 4; 16.0%) of the control group claimed living in rural areas, the majority (n = 21; 84.0%) reported dwelling in urban areas.

Table (2): Smoking status of participants

Smoking status		Study Group (n = 25)		Control Group (n = 25)	
		Frequency	Percent	Frequency	Percent
Smoking	Never	13	52.0	13	52.0
	Before	7	28.0	8	32.0
	Currently	5	20.0	4	16.0
Smoking Type	Cigarette	7	58.3	7	58.3
	Cigarettes and hookah	2	16.7	5	41.7
	Electronic cigarettes and cigarettes	3	25.0	0	0.0
	Total	**12**	**100.0**	**12**	**100.0**
Number of cigarettes	< 10	3	25.0	6	50.0
	10-20	9	75.0	6	50.0
	Total	**12**	**100.0**	**12**	**100.0**
Duration of smoking (Years)*	< 10	1	8.3	1	8.3
	10-20	8	66.7	4	33.3
	> 20	3	25.0	7	58.3
	Total	**12**	**100.0**	**12**	**99.9**

* Percent is not exactly 100.0 %.

The study's findings show that the majority of participants in the study group—n = 13; 52.0%—reported never having smoked. This was followed by those who had smoked before they were declared to be "ex-smokers" (n = 7; 28.0%) and those who now smoke (n = 5; 20.0%). In the control group, the majority (n = 13; 52.0%) said they had never smoked, followed by "ex-smokers" (n = 8; 32.0%) who had smoked in the past and smokers (n = 4; 16.0%). Regarding the type of smoking, the majority of participants in the survey (n = 7; 58.3%) reported having smoked cigarettes. This was followed by people who smoke both cigarettes and electronic cigarettes (n = 3; 25.0%) and those who smoke both cigarettes and hookah (n = 2; 16.7%). More than half of the smokers in the control group (n = 7; 58.3%) reported having smoked cigarettes, with those who smoke both cigarettes and hookahs (n = 52; 41.7%) coming in second.

In terms of daily cigarette consumption, the majority of smokers in the research group (n = 9; 75.0%) reported smoking between 10 and 20 cigarettes, with those who smoke fewer than 10 cigarettes per day (n = 3; 25.0%) coming in second. In the control group, the number of smokers who smoke between 10 and 20 cigarettes a day (n = 6; 50.0%) is equal for each smoker who smokes fewer than 10 cigarettes. Regarding the length of time, they have been smokers, the majority of study participants (n = 8; 66.7%) stated that they have been smoking for 10–20 years. This was followed by those who have been smoking for more than 20 years (n = 3; 25.0%) and one who has been smoking for less than 10 years (n = 1; 8.3%). In the control group, the majority (n = 7; 58.3%)

reported smoking for 10–20 years, followed by those who reported smoking for 20 years or longer (n = 7; 58.3%) and one who reported smoking for less than ten years (n = 1; 8.3%).

Table (3): Comparison of self-care ability for study and control groups

Paired Samples Test								
Self-care ability	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Study Pretest – Posttest	-1.60000	2.78388	.55678	-2.74913	-.45087	-2.874	24	.008
Control Pretest – Posttest	.60000	2.19848	.43970	-.30749	1.50749	1.365	24	.185

df: Degree of freedom; Sig. Significance; Std. Deviation: Standard Deviation; Std. Error Mean: Standard Error Mean t: T-Test.

The study results reveal that there is a statistically significant difference in the self-care ability for participants in the study group (p-value = .008).

Table (4): Comparison of family and social ability for study and control groups

Paired Samples Test								
Family and social ability	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Study Pretest – Posttest	-2.60000	2.92973	.58595	-3.80933	-1.39067	-4.437	24	.000
Control Pretest – Posttest	.20000	3.05505	.61101	-1.06106	1.46106	.327	24	.746

The study results reveal that there is a statistically significant difference in the family and social ability for participants in the study group (p-value = .000).

Table (5): Comparison of movement ability for study and control groups

Paired Samples Test								
Movement ability	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Study Pretest – Posttest	-.80000	1.87083	.37417	-1.57224	-.02776	-2.138	24	.043
Control Pretest – Posttest	.20000	1.75594	.35119	-.52482	.92482	.569	24	.574

The study results reveal that there is a statistically significant difference in the movement ability for participants in the study group (p-value = .043).

Table (6): Comparison of lifting ability for study and control groups

Lifting ability	Paired Samples Test					t	df	Sig. (2-tailed)
	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Study Pretest – Posttest	-1.00000	2.04124	.40825	-1.84258	-.15742	-2.449	24	.022
Control Pretest – Posttest	.40000	1.38444	.27689	-.17147	.97147	1.445	24	.161

The study results reveal that there is a statistically significant difference in the lifting ability for participants in the study group (p-value = .022).

Table (7): Comparison of work ability for study and control groups

Work ability	Paired Samples Test					t	df	Sig. (2-tailed)
	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Study Pretest – Posttest	-3.60000	2.29129	.45826	-4.54580	-2.65420	-7.856	24	.000
Control Pretest – Posttest	1.80000	2.84312	.56862	.62642	2.97358	3.166	24	.004

The study results reveal that there are statistically significant differences in the work ability for participants in the study and control groups (p-value = .000, .004) respectively.

Table (8): Comparison of physical functional ability for study and control groups

Physical Functional Ability	Paired Samples Test					t	df	Sig. (2-tailed)
	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Study Pretest – Posttest	-9.60000	6.75771	1.35154	-12.38945	-6.81055	-7.103	24	.000
Control Pretest – Posttest	3.20000	7.05337	1.41067	.28851	6.11149	2.268	24	.033

The study results reveal that there are statistically significant differences in the physical functional ability for participants in the study and control groups (p-value = .000, .033) respectively.

DISCUSSION:

Considering the sociodemographic traits shown in Table 1 that are the mean age for participants in the study group is 60.0 ± 7.59; less than a third age 55–6 years (n = 8; 32.0%); for the control group, the mean age is 57.6 ± 8.38; more than a third age 49–54 years (n = 9; 36.0%).

This result supports the result of a randomized control trial that was conducted by Aweto, et al., (2020). The mean age of the participants in the IS was 54.47±9.77 years, while the control groups were 55.76±14.56 years.

Qiu, et al., (2022) mention in the study group age n= 15.66 ± 8.28, while in the control group n=15.66 ± 8.28.

The opinion about old age the structure and function of the heart change with age. Heart rate slows down when there is a lack of cell function throughout the conduction system.

Regarding sex, Table (1) indicates that there are significantly more males (n = 15; 60.0%) than females (n = 10; 40.0%) in the study group. Males make up more than half of the control group (n = 13; 52.0%) as opposed to females (n = 12; 48.0%).

Sweaty, et al., (2021) mention in the study the sex of males than females in the study group n=22(55.0%) compared with female n=18 (45.0%). For control the male n=21 (52.5%) while the female n=19 (47.5%).

The frequency and percentage distribution of demographic factors in patients with AR. Bharathi, (2021) show that, in terms of sex, 16 (53.33%) of the participants were male and 14 (46.67%) were female.

The opinion about gender and the structural variations in men's and women's hearts have important consequences. Women typically have smaller hearts than men do. Women's coronary arteries are likewise smaller in diameter than those of men. Due to the cardioprotective properties of the female hormone estrogen, women usually acquire CAD 10 years later than males.

The results mentioned in the table 1 Regarding marital status, all participants in the study and control groups are married (n = 25; 100.0%) for each of them

According to research by Zerang, et al., (2022) all patients in both groups were married (p = 1) when cardiac surgery was performed at Razi Hospital in Birjand, Iran in 2020.

The result in Table 2 mention study results displays that more than half of the participants in the study group reported that they never smoked (n = 13; 52.0%), For the control group, more than half reported that they never smoked (n = 13; 52.0%).

In Sweaty, et al., (2021) In the study group (IS group), the average smoker was n = 14 (35.0%), while the average non-smoker was n = 26 (65.0%). The control group's smoking rate was 16 (40.0%), but the non-smoking rate was 24 (60.0%), with a p-value of 0.644.

Regarding smoking cigarettes, there are main ways that smoking cigarettes affects the onset and severity of CAD: Catecholamines are released when tobacco products include nicotine. This causes an increase in blood pressure and heart rate. Another factor that might narrow the coronary arteries is nicotine acid. An elevated risk of CAD and unexpected cardiac death results from these impacts.

The result shown in Tables 3-8 appears to enhance the function capacity in the study group compared control group. whereas the self-care ability for the study sig(2-trailed)= .008 and control group sig(2-trailed)=.185, family and social ability for the study sig(2-trailed)=000 and control group sig(2-trailed)=.746, movement ability for study Sig. (2-tailed)=.043 and control groups Sig. (2-tailed)=.574, lifting ability for study Sig. (2-tailed)=.022and control groups Sig. (2-tailed)=.161, workability for study Sig. (2-tailed)=000 and control groups Sig. (2-tailed)=.004, and Comparison of physical functional ability for study Sig. (2-tailed)=.000 and control groups Sig. (2-tailed)=.033.

The study includes Sheraz, et al., (2022). 64 individuals (71.9%) said they had "improved" and 25

(28.1%) thought they had "not improved" following phase I cardiac rehabilitation. Participants who reported their own improvement as having improved on average had a mean change in functional capacity of 71.9 ($p < 0.01$), while those who rated their own improvement as having not improved on average had a mean change in functional capacity of 28.1 ($p < 0.01$).

When ARAZI, et al., (2021) evaluated the two groups at baseline, they discovered no discernible difference between them in terms of functional capacity (p =.68). On the 2-month posttest, however, there was no discernible intergroup difference in functional capacity (p =.43;).

Studies by Naik, et al., (2018) demonstrate There was no discernible change in the baseline stress, cardiovascular, and anthropometric scores between the study and control groups. Body mass index (BMI) and waist-hip ratio showed statistically significant changes after 12 weeks of slow breathing exercise; however, the mean values' reduction (0.16 kg/m2, 0.003) did not seem to have a clinically relevant impact on day-to-day functioning.

Frequent, moderate exercise lowers triglyceride levels and raises HDL levels, which lowers the risk of coronary events. Most adults want to do aerobic exercise at a moderate intensity. vigorous-intensity aerobic activity of at least 75 minutes per week, or an equivalent combination, or at least 150 minutes per week of physical activity.

CONCLUSIONS:

The conclusion obtained from this study is that in patients who have coronary artery disease, there is a decrease in the functioning capacity result shown in the pretest. The present study concluded that flow-oriented Incentive Spirometry proved to be beneficial in improving functional capacity when compared to the study group that used flow-oriented incentive spirometry and the control group in the post-test.

REFERENCES:

AR. Bharathi, Assess The Effectiveness of Deep Breathing Exercise with Incentive Spirometer on the Respiratory status of Cardio Thoracic and Vascular Patients, *J Res Med Dent Sc*i, 2021, 9(11): 165-179.

ARAZI, Tajmohammad; ALIASGHARPOUR, Mansooreh; MOHAMMADI, Sepideh∗; MOHAMMADI, Nooredin; KAZEMNEJAD, Anoushirvan. Effect of a Breathing Exercise on Respiratory Function and 6-Minute Walking Distance in Patients Under Hemodialysis: A Randomized Controlled Trial: [RETRACTED]. *Journal of Nursing Research* 29(2):p e146, April 2021. | DOI: 10.1097/JNR.0000000000000423.

Aweto, H. A., Obikeh, E. O., & Tella, B. A. (2020). Effects of incentive spirometry on cardiopulmonary parameters, functional capacity and glycemic control in patients with Type 2 diabetes. *Hong Kong physiotherapy journal*: official publication of the Hong Kong Physiotherapy Association Limited = Wu li chih liao, 40(2), 121–132. https://doi.org/10.1142/S1013702520500110.

Benjamin, E. J., Muntner, P., Alonso, A., Bittencourt, M. S., Callaway, C. W., Carson, A. P., Chamberlain, A. M., Chang, A. R., Cheng, S., Das, S. R., Delling, F. N., Djousse, L., Elkind, M. S. V., Ferguson, J. F., Fornage, M., Jordan, L. C., Khan, S. S., Kissela, B. M., Knutson, K. L., Kwan, T. W., … American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee (2019). Heart Disease and Stroke Statistics-2019 Update: A Report From the American Heart Association. *Circulation*, 139(10), e56–e528. https://doi.org/10.1161/CIR.0000000000000659.

Birdee, G., Nelson, K., Wallston, K., Nian, H., Diedrich, A., Paranjape, S., Abraham, R., & Gamboa, A. (2023). Slow breathing for reducing stress: The effect of extending exhale. *Complementary therapies in medicine*, 73, 102937. https://doi.org/10.1016/j.ctim.2023.102937

Franklin, E., & Anjum, F. (2023). Incentive Spirometer and Inspiratory Muscle Training. In StatPearls. StatPearls Publishing.

Hamasaki, H. (2020). Effects of Diaphragmatic Breathing on Health: A Narrative Review. *Medicines*, 7(10), 65. *MDPI AG*. Retrieved from http://dx.doi.org/10.3390/medicines7100065

Naik, G. S., Gaur, G. S., & Pal, G. K. (2018). Effect of Modified Slow Breathing Exercise on Perceived Stress and Basal Cardiovascular Parameters. *International journal of yoga*, 11(1), 53–58. https://doi.org/10.4103/ijoy.IJOY_41_16.

Qiu, T., Li, Y., Zhang, J., Hou, X., Wu, Y., Xu, Y., Chen, W., Rui, J., Yang, J., & Qian, J. (2022). A Cross-Sectional Study on the Application of IS in Perioperative Pulmonary Function Training in Spine and Orthopedics. Computational intelligence and neuroscience, 2022, 4546549. https://doi.org/10.1155/2022/4546549.

Roth, G. A., Mensah, G. A., Johnson, C. O., Addolorato, G., Ammirati, E., Baddour, L. M., Barengo, N. C., Beaton, A. Z., Benjamin, E. J., Benziger, C. P., Bonny, A., Brauer, M., Brodmann, M., Cahill, T. J., Carapetis, J., Catapano, A. L., Chugh, S. S., Cooper, L. T., Coresh, J., Criqui, M., … GBD-NHLBI-JACC Global Burden of Cardiovascular Diseases Writing Group (2020). Global Burden of Cardiovascular Diseases and Risk Factors, 1990-2019: Update From the GBD 2019 Study. *Journal of the American College of Cardiology*, 76(25), 2982–3021. https://doi.org/10.1016/j.jacc.2020.11.010.

Russo, M. A., Santarelli, D. M., & O'Rourke, D. (2017). The physiological effects of slow breathing in the healthy human. *Breathe (Sheffield, England)*, 13(4), 298–309. https://doi.org/10.1183/20734735.009817.

Sheraz, S., Ayub, H., Ferraro, F. V., Razzaq, A., & Malik, A. N. (2022). Clinically Meaningful Change in 6 Minute Walking Test and the Incremental Shuttle Walking Test following Coronary Artery Bypass Graft Surgery. *International journal of environmental research and public health*, 19(21), 14270. https://doi.org/10.3390/ijerph192114270.

Sweity, E. M., Alkaissi, A. A., Othman, W., & Salahat, A. (2021). Preoperative incentive spirometry for preventing postoperative pulmonary complications in patients undergoing coronary artery bypass graft surgery: a prospective, randomized controlled trial. *Journal of cardiothoracic surgery*, 16(1), 241. https://doi.org/10.1186/s13019-021-01628-2.

Zerang, F., Amouzeshi, A., & Barkhordari-Sharifabad, M. (2022). Comparison of the effect of incentive spirometry and deep breathing exercises on hemodynamic parameters of patients undergoing coronary artery bypass graft surgery: A Clinical Trial. *Journal of vascular nursing: official publication of the Society for Peripheral Vascular Nursing*, 40(3), 134–139. https://doi.org/10.1016/j.jvn.2022.08.002.