



## THE EFFECT OF SUPERFICIAL COLD APPLICATION THERAPY ON THE SEVERITY OF PAIN AMONG POST CARDIAC SURGERY PATIENTS

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### ABSTRACT

**Background:** Cold therapy is an effective, inexpensive, and simple intervention for pain management which is well documented in sport injuries, post-surgery and medically associated pain. **Aim of the study:** to evaluate the effect of superficial cold application therapy on the severity of pain among post cardiac surgery patients. **Design:** Quasi experiment pre and post test design was used in carrying out the study. **Setting:** The study was conducted at Al-Hayat Hospital, El-Fayoum in the Open Heart Surgery Intensive Care Unit. **Subjects:** A purposive sample consisting of 60 newly admitted adult post cardiac surgery patients. **Tools:** 1<sup>st</sup> tool (structured interview questionnaire), 2<sup>nd</sup> tool (Subjective and objective Pain Assessment Scale ). **Results:** there was a highly statistically significant decrease in pain severity post cold Gel pack application compared to pre intervention during coughing, mobility, breathing & use of spirometry among studied patients. **Conclusion:** pain was decreased post cold gel pack application compared to pre intervention during the procedural pain among studied patients. **Recommendation:** further studies are needed to confirm the impacts of the non-pharmacological therapy (cold therapy) on the severity of pain for post cardiac surgery patients.

**Keywords:** superficial Cold Application, severity of pain, post cardiac surgery patients.

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## 1. INTRODUCTION

Based on *Cani et al., (2019)* the leading cause of death worldwide is cardiovascular disease, according to the World Health Organization (WHO), predominating in elderly patients. The treatment for these diseases is through surgery, the vast majority being performed by the Unified Health System, medications, changes in eating habits and physical activity. Surgery is a safe procedure for the treatment of coronary artery disease (CAD), as it can be performed in elderly, diabetic patients with low left ventricular ejection fraction. This procedure controls persistent ischemia and the evolution of acute myocardial infarction, relieving symptoms and preventing ischemic complications.

According to *Beccaria et al., (2020)* in Brazil, the prevalence of cardiac surgeries has been increasing every year, the most common being myocardial revascularization and valve replacement, and several studies have shown that both are the best way to treat coronary insufficiency. In 2015 there were 91,738 deaths, an average of 7,645 deaths per month and in 2016 there were 45,900 deaths an average of 7,650 per month, an increase of 0.7%.

According to *Kang& Brennan (2022)* management of acute postoperative pain is an essential component of perioperative patient care. Good pain control after surgery is important to facilitate overall recovery, improve patient satisfaction, and reduce health care cost. Effective post-operative pain management is also likely to decrease morbidity and improve functional outcome. Moreover, severe acute post-operative pain is a risk factor for chronic post-surgical pain, raising more awareness regarding the importance of adequate perioperative pain management, despite heightened awareness and clinical advancements in pain management post-operative pain continues to be significant clinical problem.

Regarding to *Yazdkhasti et al. (2018)* cold therapy with different mechanisms may help to decrease pain. This effect varies from analgesic stimulation, inhibition of awareness of pain by stimulating peripheral nerve receptors, improving the flow of energy in acupuncture points, reducing muscle tension, changing velocity of nerve conduction and slowing down the transmission of pain to the central nervous system to the distraction of thought from pain. Reducing the levels of catecholamine and increasing the levels of endorphins are among other mechanisms of cold therapy. According to the gate theory of pain, the cold effectively blocks the conduction of sensory fibers, and reduces pain; and in this way the pain threshold is increased.

## Significance of the study

According to *Ali (2019)* the cardiovascular disease is responsible for 17.7 million people every year which constitutes 31% of all global deaths. Worldwide 80% of all CVD cases occur in developing countries. In Egypt (CVDs) mortality according to the latest WHO data published in 2017 reached 126.312 or 24.58% of total deaths. Post cardiac surgery acute pain which is not relieved can lead to physical and psychological distress that can leave negative effect on the prognosis and outcome of the disease and the surgery.

Based on *Timmis et al. (2020)* cardiovascular disease remains a public health problem worldwide which causes one third of all deaths by year 2030. More than one-third of these deaths occur in middle-aged adults. The incidence of cardiovascular diseases is increasing constantly due to the epidemiologic transition implicating atherosclerosis, hypertension and associated lifestyle risk factors diet, smoking and physical inactivity. Nearly 52% of However, deaths in the United States and 48% in Europe are related these diseases. According to data in Egypt, cardiovascular diseases have been the chief cause of premature death since the 1990s. In 2017, it accounted 46.2% of the overall mortality in Egypt.

According to *Keawnantawat et al. (2018)* patients still report poorly controlled pain in the immediate post-operative phase following cardiac surgery. Patients perceived high pain scores during the first 24-72 hours. The majority of patients (51%) experienced bad pain sensation in the chest wound area. Furthermore, responses of the patients included reports of tender (70.6%), sharp (58.8%) and aching (56.9%) pain. Cardiac surgery patients also expressed the interference of pain with their daily functions. Intensive pain from coughing was reported in 78% of patients and 62% experienced severe pain while moving. Uncontrolled acute pain after cardiac surgery has a major impact leading to prolonged intensive care unit time, extended cost, increased morbidity and mortality rates and poor recovery.

## Aim of the Study:

The aim of this study to evaluate the effect of superficial cold application therapy on the severity of pain among post cardiac surgery patients through:

- Assessment of patient's level of pain before application of cold therapy during coughing exercise, deep breathing exercise, incentive spirometer and mobility.
- Application of cold gel application therapy during coughing exercise, deep breathing exercise, incentive spirometer and mobility.

- Evaluating the effect of cold gel application on the severity of pain during coughing exercise, deep breathing exercise, incentive spirometer and mobility.

#### Research Hypotheses:

The severity of pain during the procedural pain for post cardiac surgery patients will be decreased after applying the cold gel application than before as measured by tool (II).

#### Subjects and Methods:

##### Research design:

A quasi experimental pre and post research design was used in carrying out the study to evaluate the effect of superficial cold application therapy on the severity of pain among post cardiac surgery patients.

##### Study design:

##### Setting:

The study was conducted Al-Hayat Hospital El- Fayoum in the Open Heart Surgery Intensive Care Unit, located in the third floor. The unit consists of three beds, one physician room, one bathroom and one sink, the total number of nurses is 13 nurse distributed as head nurse and three staff nurses every shift.

##### Subjects:

**Sample Size:** A purposive sample 60 of newly admitted adult post cardiac surgery patients to open heart surgery intensive care unit and accepted to participate in the study were included. The sample size was calculated by adjusting the power of the test to 80% and the confidence interval to 95% with margin of error accepted adjusted to 5% (Steven equation, 2012).

$$n = \frac{N \times p(1-p)}{[N-1 \times (d^2 \div z^2)] + p(1-p)}$$

- P= 0.5
- N= Total population
- Z= Z value "1.96"
- D= Standard Error
- n= sample size

##### Exclusive criteria:

- Hemodynamically unstable such as (hypotension, tachycardia and Bradycardia).
- Diabetic patient.
- Postoperative cardiac complications such as bleeding.

##### 3-Tools of data collection:

- **1<sup>st</sup> tool:** structured interview questionnaire was designed by the researcher to the following data.
  - **Part (1):** Demographic characteristics which contained: age, gender, level of education, marital status, occupation,

smoking history, physical activity and overweight.

- **Part (2):** Assess the past, surgical and medical history questionnaire and any psychological features e.g. depression and anxiety

- **2<sup>nd</sup> Tool:** Subjective and objective Pain Assessment Scale used to assess subjective and objective components of pain. This part consists of four parts:

##### Part one namely (pain intensity scale):

Pain intensity scale; it was adopted from **MaCaffery (1982)**. This scale consists of 10 points numerical scale with "0" representing no pain, "1-3" representing mild pain, "4-6" representing moderate pain, "7-9" representing severe pain and "10" representing unbearable pain. **Scoring system:** The scores were distributed as 0 for no pain, 1-3 for mild pain, 4-6 for moderate pain 7-9 for severe pain and 10 for unbearable pain.

< 50 was considered mild pain.

50 -70 was considered moderate pain.

> 70 was considered sever pain.

##### Part two namely (physiological indicators of pain):

It was developed by the researcher after reviewing the relevant literature (**Nesbitt et al., 2012**). It included heart rate (HR) in beats/min, pulse strength, mean arterial pressure (MAP) in mmHg, respiratory rate (RR) in breath/min, temperature in °C, pupils' assessment, perspiration and SPO2.

**Scoring system:** The scores were distributed as 0 for abnormal and (1) for normal.

##### Part three namely critical care pain observation tool (CPOT).

It was adopted from **Gelinas et al. (2006)** to assess behavioral indicators of pain. It is composed of four behavioral indicators of pain. **The first behavioral indicator** namely facial expression, a score of "0" was marked when there is no muscle tension, a score of "1" was marked when there is tense facial muscles and a score of "2" was marked when grimacing with tense facial muscles. **The second behavioral indicator** namely body movements, a score of "0" was marked when there is absence of movements, a score of "1" was marked when there is protective movements and a score of "2" was marked when there is restlessness or agitation. **The third behavioral indicator;** namely muscle tension in upper extremities, a score of "0" was marked when relaxed muscle, a score of "1" was marked when there is tense or rigid muscle and a score of "2" was marked when there is very tense muscle. **The fourth indicator;** namely vocalization, a score of "0" was marked when there is no sound or the patient talking in the normal voice tone, a score of

“1” was marked when there is sighing or moaning sound and a score of “2” was marked when there is crying out or sobbing sound. The total score of CPOT are eight points.

**Scoring system:** The scores were distributed as (0) for mild pain and (1) for moderate pain and (2) for severe pain.

< 50 was considered mild pain

50 – 70 was considered moderate pain

≥ 70 was considered severe pain

#### Part four namely (Self report of pain Scale).

It was developed by the researcher after reviewing the relevant literature (Elcokany, 2008) self-report of pain regarding **pain characteristics** such as onset, radiation, location, quality, frequency and duration.

#### Ethical and legal consideration:

- The research approval was obtained from the ethical committee before starting the study.
- The researcher clarified the objective and aim of the study to patients included in the study.
- The researcher assured maintaining anonymity and confidentiality of patients' data.
- Patients were informed that they were allowed to choose to participate and they had the right to withdraw from the study at any time without giving any reason.
- The patients (oral and written consent approval was obtained from them to participate in this study.

#### Validity and reliability:

**Validity** of tools was done by a group of experts to check the relevance, clarity, comprehensiveness and applicability of the questions. According to their opinions, modifications were done and the final form was developed. Face and content validation of the studied tools were according to opinions of the experts.

Tools of data collection were test to face validity of content, by five professions and experts, one assistant professor of Medical and Surgical Nursing Department in Faculty of Nursing at Al-Fayoum University, one assistant professor of Adult Health Nursing at Faculty of Nursing at Helwan University and three lectures in Critical and Emergency Nursing Department at Helwan University.

The **reliability** of developed tools was estimated using the Chronbach's alpha test to measure the internal consistency of the tools; it was found that the reliability questionnaire using

Chronbach's alpha equation as illustrated in the following table:

Tool	No	Chronbachs Alpha
Pain intensity scale	4	0,843
Critical pain observation tool	4	0,833
Physiological indicator of pain	8	0,843

#### Pilot study:

It was carried out on 10 % of the studied patients. A pilot study was conducted before performing the application on group (6) patients in order to test for clarity and applicability of the study tools. Required modifications were done in the form of adding or omission of some questions. Patients involved in the pilot study were excluded from the main study subjects and replaced by another patients.

#### Field work:

##### A-Assessment phase:

##### A-Demographic and health relevant sheet:

Orientation was done about the researcher name, job, purpose of the study and explanation of the procedure, demographic data and medical history was filled by the researcher before the application of cold gel pack for all patients with specific including criteria. It was used one time (pre the application). The sheet was administered to each patient individual using the personal interview method, the interview was carried out in the unit, the questions were directed in simple Arabic language and the answers were recorded immediately; sheet filling took about 10 minutes.

##### Subjective and objective Pain Assessment Scale sheet:

It was filled by the researcher at the end of first phase after asking the patient to make four procedural pains (without application of cold gel pack) and also used at the end of the second phase (with application of cold gel pack) after asking the patient to make four procedural pains.

##### B-Preparatory Phase:

It included reviewing of related literature, and theoretical knowledge of various aspects of the study using books, articles, internet periodicals and magazines to develop tools for data collection and the educational program.

Permission for data collection and implementation of the cold application obtained from dean of Helwan University, Faculty of Nursing, hospitals administrative personnel and the head of Cardiothorathic Department.

On the third day of operation, the researcher prepared the cold gel pack in the freezer

for one hour. After one hour, the gel pack wrapped in washcloth or towel and was applied over dressing site (sternum site) and at this time the researcher applied the first and second phase of data collection and educate the patient how to apply the four procedural pain, between each procedure 15 minute rest time.

**C-Planning phase:**

Through which the research design, sample size, inclusion and exclusion criteria, tools for data collection were selected and developed. Face and content validity of the study tools were tested by a panel of experts in the field of medical-surgical nursing and critical and emergency nursing. Developing a preliminary draft of the study intervention was done.

**D-Implementation phase:**

The implementation phase was divided into three phases on the third day of operation after the patient stopped intropic medication and ventilator connections and the patient became fully conscious, able to move, chest tube removal and hemodynamically stable, it was done during the period from **March to July 2020** and divided into three phases:-

**First phase:**

The researcher asked the patients about demographic characteristic and medical history then, educated the patient how to demonstrate the four procedural pains (coughing exercise, incentive spirometer, deep breathing exercise and mobilization).

**Second phase:**

The researcher asked the patient to make four procedural pains then, the researcher made pain assessment after each procedure by using tool number II then, gave the patient approximately 15 minutes as a rest time between each procedure (each procedure was done three times).

**Third phase:**

The researcher placed the cold gel pack over the dressing site to the same patient for 20 minutes, then, asked the patients to re demonstrate the four procedural pains (coughing exercise, incentive spirometer, deep breathing exercise and mobilization) then, the researcher make pain assessment after each procedure by using tool number II.

**E-Evaluation phase:**

This phase was used to evaluate the effect of superficial cold therapy on the severity of pain among post cardiac surgery patients by comparing results pre and post application of the cold gel pack on the third day of operation. It was done by using the same tool II to evaluate patients' pain.

**Statistical Analysis:**

Data were presented in the form of tables and figures using the Statistical Package for Social Sciences version 21.0 (SPSS). Qualitative variables were presented in the form of frequencies and percentages and quantitative variables were presented in the form mean and SD. Test of significance was used to find out associations between study variables. Chi-square ( $\chi^2$ ) test of significance was used in order to compare proportions between two qualitative parameters. Spearman's rank correlation coefficient (r) was used to assess the correlation between two variables. The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following:

- P value  $\leq 0.05^*$  was considered significant.
- P value  $\leq 0.001^{**}$  was considered as highly significant
- P value  $> 0.05$  was considered insignificant.

**RESULTS:**

**Table (1):** Percentage distribution of studied patients according to their demographic characteristics (n=60).

	No	%
<b>Age</b>		
<20	4	6.7
20<40	26	43.3
40<60	<b>30</b>	<b>50.0</b>
<b>Mean=39 SD=11.578</b>		
<b>Gender</b>		
Male	<b>34</b>	<b>56.7</b>
Female	26	43.3
<b>Occupation</b>		
Working	<b>52</b>	<b>86.7</b>
Not working	8	13.3
<b>Work Nature</b>		
Manual	32	53.3
Administrative	28	46.7
<b>Change of work nature after disease</b>		
Yes	<b>44</b>	<b>73.3</b>
No	16	26.7
<b>Educational level</b>		
Non educated	<b>30</b>	<b>50.0</b>
Educated	30	50.0

**Table (1):** illustrates that half of studied patients (50.0%) aged from 40 to <60 years with a mean age (39 ±11.578) years old and non educated respectively. Moreover more than half of them (56.7%) were male, regarding working condition the study shows that, the majority of them (86.7%) were working, nearly three quarters of them (73.3%) changed their work nature after disease.

**Table (2):** Percentage distribution of studied patients according to their operative history (n=60).

	No	%
<b>Pre-operative ejection fraction</b>		
>50%	35	58.4
≤50%	<b>25</b>	<b>41.6</b>
<b>Onset of signs and symptoms of cardiac problem</b>		
<3 years	<b>50</b>	<b>83.3</b>
3-5 years	8	13.3
5-7 years	0	0.0
>7years	2	3.3
<b>Signs and symptoms of cardiac problem (number not mutually exclusive)</b>		
Chest pain	18	30.0
Difficult breathing	20	33.3
Nauseas	8	13.3
Fatigue	50	83.3
<b>Type of present cardiac surgery</b>		
CAPG	40	66.6
Valve surgery	20	33.3
<b>Duration of chest tube</b>		
<48 hrs	60	100.0
<b>Duration of MV weaning</b>		
<6hrs	<b>50</b>	<b>83.3</b>

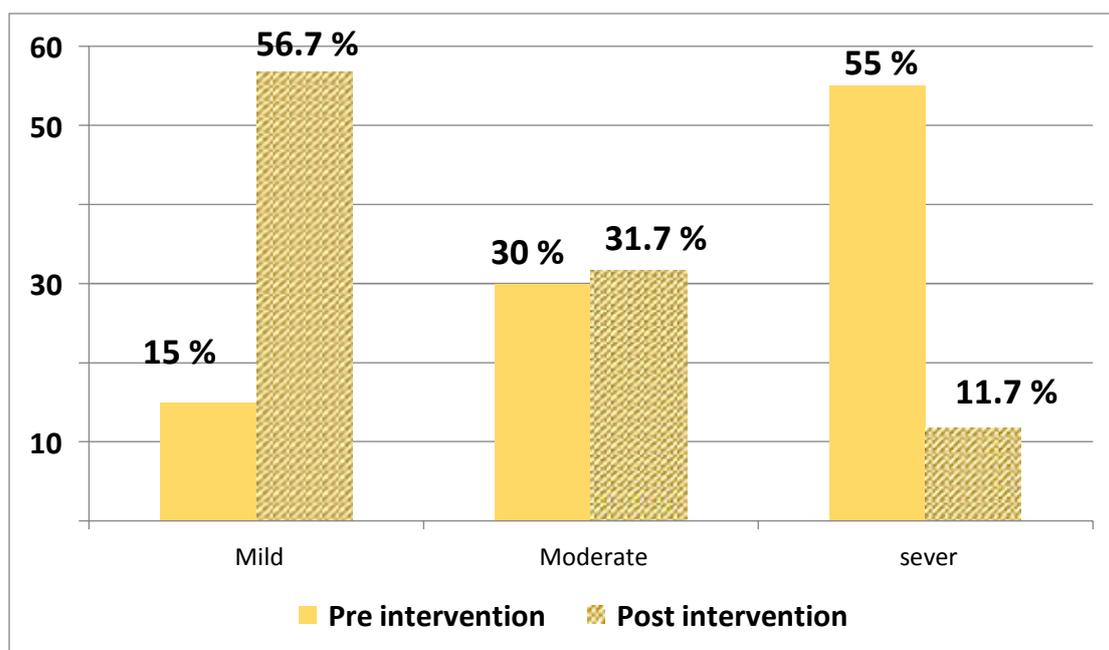
6-24 hrs	10	16.7
<b>Length of ICU stay</b>		
<72 hrs	60	100.0

**Table (2):** illustrates that more two fifth of studied patients (41,6%) had pre- operative ejection fraction <50.0%. This table also shows that the majority of patients (83.3%) had disease onset <3 years ago and weaned off mechanical ventilator < 6 hrs respectively, this table also illustrated the majority of them had fatigue as a sign of cardiac problem (83.3%), also illustrated two third of them had CABG (66.6%), all the study sample had chest tube <48 hrs and all the study sample had length of ICU stay <72 hrs.

**Table (3):** Percentage distribution of studied patients according to their pain intensity pre & post cold gel pack application during coughing, mobility, breathing & use of spirometry (n=60)

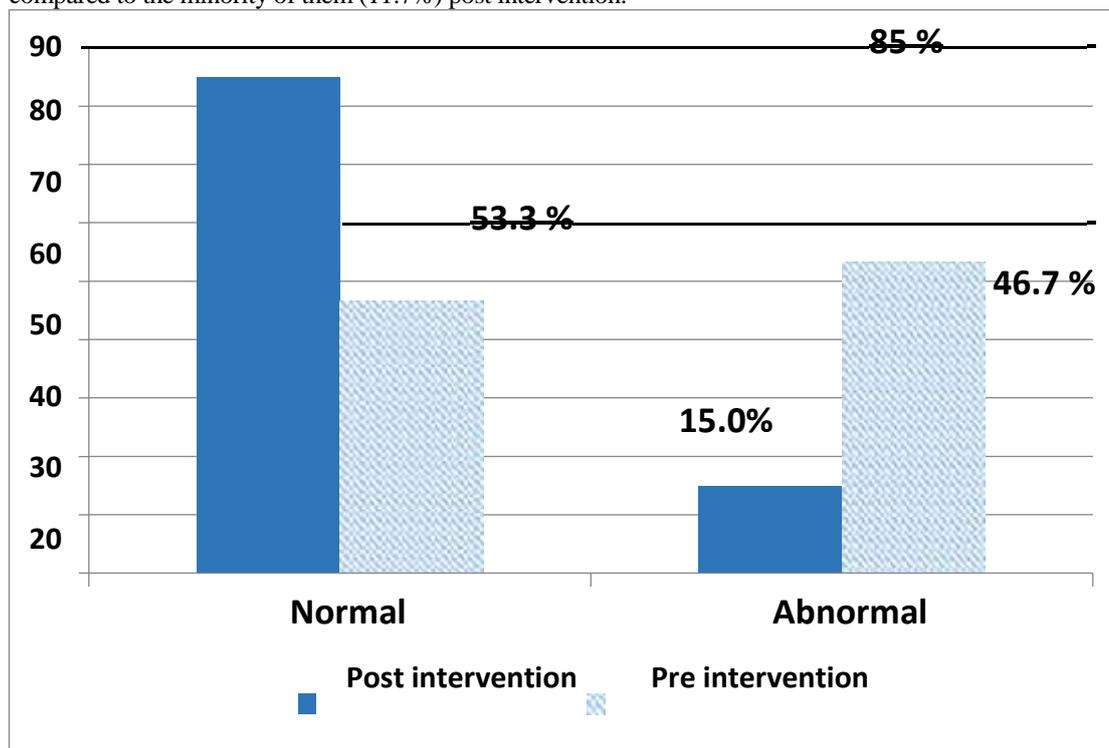
Pain intensity	Pre								Post								X <sup>2</sup>	P value
	No Pain		Mild		Moderate		Sever pain		No Pain		Mild		Moderate		Sever			
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%		
Coughing	10	16.7	8	13.3	18	30	24	40	24	40	16	6.7	12	20	8	13.3	49.097	0.000**
Mobility	4	6.7	10	16.7	26	43.3	20	33.3	20	33.3	22	36.7	12	20	6	10	35.116	0.000**
Breathing	8	13.3	10	16.7	20	33.3	22	36.7	22	36.7	18	30	12	20	8	13.3	52.526	0.000**
Spirometry	10	16.7	10	16.7	18	30	22	36.7	20	33.3	22	36.7	11	18.7	7	11.7	46.726	0.000**

**Table (3):** illustrates that there was a highly statistically significant decrease in pain intensity post cold Gel pack application compared to pre intervention during coughing, mobility, breathing & use of spirometry (p = 0.000\*\*).



**Figure (1):** Percentage distribution of studied patients according to their total critical pain manifestations level pre and post cold gel pack application (n=60).

**Figure (1):** illustrates that the minority of studied patients (15.0%) had a mild total critical pain manifestations pre-cold-gel pack application compared to nearly three fifth of them (56.7%) post intervention. In addition, more than half of them (55.0%) had severe critical pain manifestations pre-cold-gel pack application compared to the minority of them (11.7%) post intervention.



**Figure (2):** Percentage distribution of studied patients according to their total physiological pain indicator level pre and post cold gel pack application (n=60).

**Figure (2):** illustrates that the majority of studied patients (85.0%) had abnormal physiological indicators pre-cold-gel pack application compared to nearly half of them (46.7%) post intervention. However, the minority of them (15.0%) had normal physiological indicators pre-cold-gel pack application compared to more than half of them (53.3%) post intervention.

**Table (4):** Relation between patients’ demographic characteristics & their total pain intensity pre and post cold gel pack application (n=60).

	Pre						Post					
	Mild		Moderate		Sever		Mild		Moderate		Sever	
	No	%	No	%	No	%	No	%	No	%	No	%
<b>Age</b>												
<20	0	0.0	2	7.1	2	10.0	4	10.0	0	0.0	0	0.0
20<40	8	66.7	12	42.9	6	30.0	18	45.0	8	66.7	0	0.0
40<60	4	33.3	14	50.0	12	60.0	18	45.0	4	33.3	8	100.0
Chi & p value	4.539 0.338						11.867 0.018*					
<b>Gender</b>												
Male	6	50.0	14	50.0	14	70.0	20	50.0	8	66.7	6	75.0
Female	6	50.0	14	50.0	6	30.0	20	50.0	4	33.3	2	25.0
Chi & p value	2.172 0.338						2.308 0.315					
<b>Occupation</b>												
Working	10	83.3	24	85.7	18	90.0	34	85.0	12	100.0	6	75.0
Not working	2	16.7	4	14.3	2	10.0	6	15.0	0	0.0	2	25.0
Chi & p value	0.330 0.848						2.885 0.235					
<b>Work nature</b>												
Manual	0	0.0	20	71.4	12	60.0	20	50.0	10	83.3	2	25.0
Administrative	12	100.0	8	28.6	8	40.0	20	50.0	2	16.7	6	75.0

Chi & p value	17.755 0.000**						7.098 0.029*					
<b>Change in work nature</b>												
Yes	4	33.3	24	85.7	16	80.0	28	70.0	10	83.3	6	75.0
No	8	66.7	4	14.3	4	20.0	12	30.0	2	16.7	2	25.0
Chi & p value	12.468 0.001**						0.852 0.653					
<b>Education</b>												
Non educated	6	50.0	14	50.0	10	50.0	22	55.0	2	16.7	6	75.0
Educated	6	50.0	14	50.0	10	50.0	18	45.0	10	83.3	2	25.0
Chi & p value	0.00 1.000						7.733 0.021*					

**Table (4):** illustrates that there was no statistically significant relation between total pain intensity level and all items of patients’ demographic characteristics pre cold gel pack application except for items related to (working nature and change in work nature) there was a highly statistically significant relation( $p \leq 0.001^{**}$ ). This table also revealed that there was statistically significant relation between total pain intensity level and all items of patients’ demographic characteristics post cold gel pack application except for items related to (gender, occupation and change in work nature) there was no statistically significant relation ( $p > 0.05$ ).

**Table (5): Correlation between total pain intensity and (CPOT & physiological pain indicators)**

Variables	Total pain intensity pre-intervention		Total pain intensity post-intervention	
	R	P-value	r	p-value
Total CPOT pre-intervention	0.259*	0.045*	0.452**	0.000**
Total CPOT post- intervention	0.283*	0.039*	0.398**	0.000**
Total Physiological indicators pre-Intervention	0.720**	0.000**	0.393**	0.001**
Total Physiological indicators post-Intervention	0.232*	0.042*	0.517**	0.000**

**Table (5):** revealed that there was statistically significant correlation between total pain intensity pre- intervention and total CPOT pre and post intervention moreover, there was a highly statistically significant correlation between total pain intensity pre-intervention and total physiological indicators at ( $r = 0.720^{**}$  &  $p = 0.000^{**}$ ) pre-intervention whenever there was statistically significant correlation total pain intensity pre-intervention and total Physiological indicators post-intervention at ( $r = 0.232^*$  &  $p = 0.042^*$ ). This table also revealed that there was a highly statistically significant correlation between total pain intensity post intervention with (total CPOT and physiological indicators pre and post intervention ( $P \leq 0.001^{**}$ )).

**DISCUSSION:**

According to *Abdelhakim et al., (2020)* cardiovascular diseases have the greatest mortality rate in developing countries. They are responsible for nearly 31% of deaths according to the World Health Organization. Every year, 30,000–40,000 patients undergo cardiac surgery and coronary artery bypass graft (CABG) accounts for 50–60% of these surgeries.

Cardiac surgery is commonly accompanied by pre- and post-operative physical and psychological complications as anxiety, pain, severe stress, depression, and vital sign changes which have a great influence on prognosis .

Based on *Macaire et al., (2019)* open cardiac surgery may cause severe postoperative pain and promote a high risk of pain chronicisation if not treated adequately. Severe post-operative pain after

cardiac surgery originates from many causes including surgical incision, sternotomy, drain thoracic back pain and cost transvers and costovertebral joints distention. Furthermore, a painful post-operative period after cardiac surgery leads to increased morbidity, a longer hospital stay and higher overall costs .

**Regarding to patients Age**, the findings of the present study illustrated that half of studied patients aged from 40 to < 60 years with mean =39. **This may be due to that** age-related intrinsic changes in cardiac morphology and may be expected to worsen cardiac performance and lead to cardiac surgery. As evidenced by basic assessment and supported by *Heidari et al., (2022)* whose study is entitled (Patient-specific finite element analysis of heart failure and the impact of surgical intervention in pulmonary hypertension secondary to mitral valve disease) and *Riffel et al., (2021)* whose study is entitled (Age-and gender-related reference values of cardiac morphology and function in cardiovascular magnetic resonance), the stiffness of the left ventricle is known to increase with age and the cardiac morphology and physiology affected with the age.

**Regarding to patients gender**, the findings of the present study showed that more than half of them were male patients. **This may be due to that most of** males are smokers and lead to cardiac disease and can lead to cardiac surgery. As evidenced by basic assessment and supported by *Ma et al., (2020)* whose study is entitled (China cardiovascular diseases report 2018: an updated summary) and *Dziedzic et al., (2022)* whose study is entitled (Small Differences in Vitamin D Levels between Male Cardiac Patients in Different Stages of Coronary Artery Disease); they reported that the smoking was good risk factor between male patients for cardiac surgery.

**Regarding the working condition**, the present study showed that the majority of them were working. **This could be a result** of that minor stress can trigger heart problems like poor blood flow to the heart muscle. This is a condition in which the heart doesn't get enough blood or oxygen. As evidenced by basic assessment and supported by *Upadhyay (2022)* whose study is entitled (Chronic Non-communicable Diseases: Risk Factors, Disease Burden, Mortalities and Control) and *Challoob (2022)* whose study is entitled (Relationship between Omentin-1 and Oxidative Stress in Myocardial Infarction Patients) who showed that the minor working stress can lead to cardiac problems and affected on the oxygen and blood flow level.

**Regarding to changing of working nature after disease**, the present study showed the nearly three quarter of them changed their work nature after disease; **this may be due to that** These work stressors can produce chronic biologic arousal and promote unhealthy behaviors and thus, increased CVD risk. As evidence by basic assessment and supported by *Rudolph et al., (2022)* whose study is

entitled (Biological embedding of peer experiences: The contribution of peer adversity to stress regulation) and *Stoney et al., (2022)* whose study is entitled (Integration of implementation science in cardiovascular behavioral medicine) who reported that job stressors can produce chronic biologic arousal and increased CVD risk.

**Regarding the patients' education**, the present study that showed half of them were educated, **this may be due to that** improving knowledge and skills in order to influence the attitudes and behaviour are required to maintain or improve health or health style and improve the co-operation during implamention of the intervention. As evidence by basic assessment and supported by *Cestari et al., (2022)* whose study is entitled (Requirements for building educational and care technology on heart failure) who showed that the the education had positive influence on health condition for cardiac patients.

**Regarding pre- operative ejection fraction** the present study illustrated that more than two fifth had pre-operative ejection fraction <50%, **this may be due to that ejection fraction** can be a way of assessing the status and progression of heart failure over time, as well as a way to track the benefits of various heart failure treatments. As evidence by basic assessment and supported by *Das et al., (2022)* whose study is entitled (Heart Failure with Preserved Ejection Fraction in Children) and *Çamc & Yılmaz, (2022)* whose study is entitled (Effects of Sodium-Glucose Co-Transporter-2 Inhibition on Pulmonary Arterial Stiffness and Right Ventricular Function in Heart Failure with Reduced Ejection Fraction) who reported that the ejection fraction is away to assess stage of heart failure.

**Regarding the onset of signs and symptoms of cardiac problem**, the present study illustrated the majority of the signs and symptoms of cardiac disease occurs less than 3 years, **this may be due to that** it is related to different patients tolerance. As evidence by basic assessment and supported by *Chowdhury et al., (2022)* whose study is entitled (Return to activity after SARS-CoV-2 infection: cardiac clearance for children and adolescents) who reported that onset cardiac signs and symptoms, A more gradual approach may be necessary depending on patient tolerance.

**Regarding to the signs and symptoms of cardiac problem**,the present study showed the majority of them had fatigue; **this may be due to that** fatigue and psychophysiological reactions to mental stress are known to be problematic in coronary artery disease (CAD) patients. As evidence by basic assessment and supported by *Gecaite-Stonciene et al., (2021)* whose study is entitled (Fatigue is Associated with Diminished Cardiovascular Response to Anticipatory Stress in Patients with Coronary Artery Disease) who reported that Fatigue and psychophysiological reactions to

mental stress are known to be problematic in coronary artery disease (CAD) patients.

Regarding **type of present cardiac surgery** the present study showed more than two third of them had CABG; **this may be due to that** blockages in any of the coronary arteries cause a corresponding defect in myocardial perfusion, ischemia and if unrepaired can lead to permanent infarct or damage to the myocardium. As evidence by basic assessment and supported by *Wang et al., (2021)* whose study is entitled (Three-year clinical outcome of unprotected left main coronary artery disease patients complicated with chronic kidney disease treated by coronary artery bypass graft versus percutaneous coronary intervention) who reported that any blockage of the coronary arteries can cause a corresponding defect in myocardial perfusion.

Regarding **duration of Chest tube** the present study showed all the studied patients had removed less than 48hr, **this may be due to that** in cases where no excessive drainage accumulates, early removal of the chest tubes was found to be a policy that improves the postoperative outcome and decreases the need for supportive treatment such as analgesics, physiotherapy, nurse care, and oxygen. As evidence by basic assessment and supported by *Adil et al., (2021)* whose study is entitled (Image-guided chest tube drainage in the management of chylothorax post cardiac surgery in children) who reported that chest tube removal done if no excessive drainage accumulates.

Regarding to **duration of mechanical ventilation weaning**, the present study showed the majority of them had weaned through less than 6 hr, **this may be due to that** stabilization with this time and the prolonged mechanical ventilation has been demonstrated to be associated with increased hospital and intensive care unit (ICU) lengths of stay, higher health care costs and morbidity resulting from atelectasis, intrapulmonary shunting, and pneumonia. As evidence by basic assessment and supported by *Na et al., (2022)* whose study is entitled (Factors associated with prolonged weaning from mechanical ventilation in medical patients) who showed that Prolonged mechanical ventilation has been demonstrated to be associated with increased hospital and intensive care unit (ICU) lengths of stay, higher health care costs and hospital mortality.

Regarding to **length of ICU stay**, the present study illustrated the all patients stay in the ICU less than 72hr, **this may be due to that** stabilization of the patients at this time and the Prolonged ICU stays are associated with lower survival rates, as well as reduced quality of life, They also lead to increased hospital costs and reduced ICU bed availability. As evidence by basic assessment and supported by *Diab et al., (2018)* whose study is entitled (The influence of prolonged intensive care stay on quality of life, recovery and clinical outcomes following cardiac surgery) who reported that

Prolonged ICU stays are associated with lower survival rates, as well as reduced quality of life.

Regarding to their **pain intensity scale, critical observation pain scale, physiological indicator scale and pain self-report** pre & post cold gel pack application during coughing, mobility, breathing exercise & use incentive spirometry, the present study illustrated that there was highly statistically significant decrease pain intensity scale, critical observation pain scale, physiological indicator scale and pain self-report post cold gel pack application compared to pre intervention during coughing, mobility, breathing exercise & use of spirometry, **this may be due to** the superficial cold gel application therapy which is an effective method for pain release this method decreasing circulation and decreasing the nerve conduction velocity Increased pain threshold.

As evidence by basic assessment and supported by *Rofi'ah et al., (2020)* whose study is entitled (Applied Cold Therapy Before Deep Breathing and Coughing Exercise on Acute Pain Inpatient Who Undergoing Cardiac Surgery), *Weheida et al., (2021)* whose study is entitled (The Effect of Applying Superficial Cold Gel Packs on Incisional Pain during Different Patients Activities post Coronary Artery Bypass Graft) and *Swan & Hamilton (2020)* whose study is entitled (Pain Management for Oregon Nurses and Other Healthcare Professionals) who reported that the cold therapy help decrease circulation and decrease the nerve conduction velocity Increased pain threshold.

Also, as evidenced by basic assessment and supported by *Hsieh et al., (2017)* whose study is entitled (Efficacy of cold application on pain during chest tube removal: a randomized controlled trial), *Chen et al., (2022)* whose study is entitled (Cold application for pain and anxiety reduction following chest tube removal: A systematic review and meta-analysis), *Ahmad (2018)* whose study is entitled (Essentials of physiotherapy after thoracic surgery) and *Mohammadi et al., (2018)* whose study is entitled (Effects of cold application on chest tube removal pain in heart surgery patients) who reported that cold application activates descending inhibitory neurons that prevent the ascending nociceptive neurons from sending pain signals to the brain, This thereby "closes the gate" to pain and our brain will not interpret the impulse as painful.

Regarding to **relation between patients demographic characteristics & their total pain intensity pre and post cold gel pack application**, the currant study show no statistically significant relation between total pain intensity level and all items of patients' demographic characteristics pre cold gel pack application except for items related to (working nature and change in work nature) there was a highly statistically significant relation, **this could be as a result** of that as patients age increase

their pain tolerance decrease also male patients had greater pain tolerance than female patients .

As evidence by basic assessment and supported by **Ertürk & Ünlü (2018)** whose study in titled ( Effects of pre-operative individualized education on anxiety and pain severity in patients following open-heart surgery) who reported that women have less tolerance for pain and expressed it more than male patients.

Regarding to **correlation between total pain intensity , critical pain observation tool and physiological pain indicator** pre and post intervention , the results of the current study revealed that there was statistically significant correlation between total pain intensity pre-intervention and total CPOT pre and post intervention moreover, there was a highly statistically significant correlation between total pain intensity pre-intervention and total physiological indicators at pre-intervention whenever there was statistically significant correlation total pain intensity pre-intervention and total Physiological indicators post-intervention ,**this could be as a result of** that presence of pain affect all physiological indicators, as when pain increase this may results in increasing pulse, high respiratory rate, slightly elevation in body temperature and other physiological function such as GIT disturbance, neurological function change and sleep disturbance.

As evidence by basic assessment and supported by **Gélinas et al., (2021)** whose study in titled ( Exploration of a multi-parameter technology for pain assessment in postoperative patients after cardiac surgery in the intensive care unit: the nociception level index ) who reported that Physiological parameters such as vital signs (eg, blood pressure, heart rate and respiratory rate) and number of skin conductance fluctuations have been found to increase during pain .

#### **Conclusion:**

In the light of the current study results, it can be concluded that, the mean age of the studied patients was 39 years, and half of them aged from 40 to <60, more than half of them were male, and majority of them were working, and three quarter of them were overweight, and majority of them had fatigue as a signs and symptoms of cardiac problem. Additionally, there was highly statistically significance decrease in pain severity post cold gel pack application compared to pre intervention during coughing exercise, deep breathing exercise, mobility and incentive spirometer.

As well the result indicted that , cold application is an effective technique to reduce the severity of pain during the procedural pain.It is a safe, in expensive, simple and cost effective method that can be used in intensive care unit and non-pharmacological nursing intervention that can recommended as a pain relief technique during the procedural pain post cardiac surgery. Nurses make

important decision regarding application of non-pharmacological therapeutic interventions for pain management.

#### **Recommendations:**

**Based upon results of the current study, the following recommendations were suggested:**

**Recommendations for better patients' outcome:**

- Using the cold application before ( the painful procedural ) for post cardiac surgery patients as a care of protocol and applying it after surgery as a routine and regular care to decrease the severity of pain associated with coughing, deep breathing exercise, incentive spirometer, and mobilization.
- Applying the comfort theory for patients complaining of pain.
- Exploring the influence of other confounding variable such as age, gender, educational level and prior pain experience on evaluating the cold application as a pain management intervention.

#### **Recommendations for future research:**

- Replicating the study on a larger probability samples selected from different geographic areas in Egypt is recommended to obtain data for more generalizability of findings.
- Further studies should compare the effect of different modes of cold application after cardiac surgery (e.g., ice pack, ice towel, ice massage, and ice chip) on incisional pain associated with the use of incentive spirometry, mobility, deep breathing exercise and coughing.

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