Effect of Passive Muscle Exercises on Acquired Muscle Weakness among Critically Ill Patients

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Abstract

Background: Critically ill patients often develop muscle weakness which is unrelated to the primary pathology for ICU admission. This weakness may progress to a clinical syndrome known as acquired weakness. **Aim**: to evaluate the effect of passive muscle exercises on acquired muscle weakness among critically ill patients. **Design**: A quasi-experimental study. **Setting**: This study was conducted at Surgical Intensive Care Unit in Emergency Hospital of Tanta University Hospitals affiliated to Tanta University Hospitals**. Subjects**: A purposive sample of 60 adult patients. **Tools:** two tools were used: **Tool I:** Critically ill Patient Assessment, **tool II:** Manual Muscle Strength Test. **Results**: there was statistical significant differences related respiratory rate and saturation of peripheral oxygen (spo2) among the study and control group where P=<0.05 respectively. Statistically significant difference was found between the control and the study group regarding score of manual muscle strength at the end of the second week where p =0.002. **Conclusion:** It can be concluded that there was high statistically significant improvement in muscle weakness among critically ill patients in intervention group. Recommendations: Replication of the current study on larger sample at different setting. Critical care nurses should be provided with an educational program about AMW causes, clinical criteria and methods of prevention.

Key Words: Acquired muscle weakness, critically ill Patients and passive muscle exercise

Introduction

Acquired muscle weakness (AMW) is frequently experienced as a complication within intensive care units. Critically ill patients often experience AMW that is not associated with the primary pathology that led to their admission to the intensive care unit. This weakness may progress to a clinical syndrome known as acquired weakness, a clinically detected weakness in critically ill patients in whom there is no plausible etiology other than critical illness". **(Bax F. et al, 2021 & Damian M. et al, 2019)**

It was found to be prevalent in 26–65% of patients who had been on mechanical ventilation for 5-7 days. Additionally, patients may experience prolonged periods of immobility exceeding ten days at a rate of as high as 67%.(**Dres, M. et al, 2017).**

Acquired Muscle weakness is often ensues after hyperglycemia, mobility restrictions, sepsis, and the use of neuromuscular blocking medications or glucocorticoids which is associated with cases in the ICU. Furthermore, administration of drugs, mechanical ventilation, profound sedation, prolonged physical inactivity, systemic inflammatory response syndrome is important risk factors. "Crossland H. et al, 2019"

The physical examination of a severely sick patient may be challenging for a variety of reasons that hampered by pre-existing muscular disease, poor patient communication, delirium, partial sedation, prolonged neuromuscular blockade." **Connolly BA et al, 2013**"

Range of motion exercises which include active, passive, or active-assistive exercises is an important first step in any kind of rehabilitation and early mobilization is being encouraged and should be applied. .**(Fazzini B. et al, 2023 & Dres M. et al, 2017).**

It is known that ICU rehabilitation has a positive effect on patients' prognosis, as assessed by improvements in functional status such as exercise capacity, muscle strength, and walking ability at discharge, as well as reductions in the duration of mechanical ventilation, length of the ICU stay, and length of hospital stay. **(Price. et al, 2016; Rahiminezhad E. et al, 2022)**

Range of motion exercise is a fundamental strategy for assessing and initiating movement in therapeutic interventions. There are three distinct types of exercises: active, passive, and active-assistive. It affects all bodily structures that participate in motion, such as nerves, muscles, joint surfaces, ligaments, fascia, and arteries. The exercises also maintain the circulation, vascular dynamics, and the strengthening of the synovial action to feed cartilage, which helps to avoid muscle atrophy and enhance strength in immobilized patients**.) Fazzini B. et al, 2023 &Dres M. et al, 2017).**

Aim of the study:

Evaluate the effect of passive muscle exercises on acquired muscle weakness among critically ill patients **Research hypothesis:**

Critically ill patients who received passive muscle exercises were expected to exhibit lower muscle weakness rates compared to control group who didn't receive exercises

Subjects and Method

Design:

A quasi-experimental study design was utilized in the current study.

Study setting:

The study was conducted at Surgical Intensive Care Unit in Emergency Hospital of Tanta University Hospitals which is affiliated to Ministry of Higher Education and Scientific Research. This unit involved five rooms and each room had 4 beds and the total beds were 20 bed.

Subjects:

A Purposive sample of 60 adult patients was collected from the previously mentioned setting. The sample size was calculated through Steve Thompon equation for calculating the sample size. The adult patients were divided into two groups, 30 patient in each group as follows:-

Control group: - it consisted of 30 patients who received routine intensive care unit care such as changing patients' position every two hours only.

Study group: - it consisted of 30 patients who received passive muscle exercises which were implemented by the Master student of addition to the routine care of ICU.

The inclusion criteria were as follow:

- Newly admitted, adult patients aged 21-60 years.
- Patients with hemodynamic stability.
- No contraindication for elevating head of bed.

The exclusion criteria were as follow:

- Preexisting muscle weakness on admission to the ICU

- Neurological disorders as spinal cord lesions, brain stem problems, Guillain-Barre syndrome and myasthenia gravis.

Tools of data collections:

Two tools were used in this study as the following:

Tool I: Critically Ill Patients' Assessment

This tool was developed by the researcher after extensive review of the related literature by **Wollersheim T. et al, 2019 & Kong PW 2018**, and it included three parts as follow:

Part (a): Patients' demographic Characteristics it included age, gender**,** marital status and educational level.

Part (b): Clinical data of the studied patients Such as current diagnosis, past medical history, previous hospital admission, body mass index, corticosteroid administrations, state of consciousness based on GCS, mean arterial pressure, systolic

blood pressure, heart rate, oxygen saturation, respiration rate per minute, and arrhythmia.

Tool II: Manual Muscle Strength Test

This tool was measured by Medical Research Council sum score which was developed by **Hough et al., (2011) ,** it was used to assess muscle strength within the ICU, six muscle groups (shoulder abduction, elbow flexion, wrist extension, hip flexion, knee extension, and ankle dorsiflexion) was evaluated on both sides.

Scoring system

I. The score was evaluated from 0 to 5 point as the following:

0: Point indicated no muscle contraction visible or palpable

1: Point indicated flicker contraction visible or palpable although no limp movement

2: Points indicated full motion range without gravity

3: Points indicated gravity full motion range

4: Points indicated movement against moderate resistance over full range of motion,

5: Points indicated normal muscle strength.

II. Summation of scores was used to give MRC-sum score, which ranged from 0 to 60.

- Score below 36 indicated severe weakness
- Score between 36-48 indicated moderate weakness
- Score equal to or more than 48 indicated mild weakness
- Score between 50-60 indicated normal muscle strength**.**

Method

1-Administrative process:

A written approval to conduct the study was obtained from the responsible authority at Faculty of Nursing, Tanta University to the director of Surgical Intensive Care Unit of Emergency Hospital at Tanta University.

2- Written informed consent:

Patients or their first-degree relatives were asked to provide their informed permission before they could take part in the research. The goal of the study was explained to them, and they were assured that all data gathered would remain secret.

3- Ethical Consideration:-

a. Approval of the Scientific Research Ethics Committee of Faculty of Nursing was obtained with code number (166\12\2022) and the Scientific Research Ethics Committee of Faculty of Medicine with code number (36232/12/22)

b. The study didn't cause any harm to the patient.

c. Confidentiality and privacy was assured.

d. Patients had the right to refuse participation or withdrawn from the study at any time.

4- Tool development

Tool I was developed by the researcher after extensive review of the related literature and Manual Muscle Strength Test was developed by Hough et al (2011).

5. A pilot study:

Ten percent of patients who admitted to the Surgical Intensive Care Unit in Tanta University Hospital participated in the pilot trial. Since only minor adjustments were made, the patients from the pilot research were not included in the main study. The

goal of the pilot study was to assess the tool's usefulness and clarity, as well as to find out how long it would take to gather data from each patient.

6. Reliability

Reliability of tool I was tested by using alpha Cronbachs factor and the result was 0.950.

Reliability of manual muscle strength test was the Interclass correlation coefficients (ICC) ranged from 0.13 to 0.49.

7. Data collection

The data for this research was gathered over the course of six months, from April 2023 to September 2023.

8. The researcher started with control group patients first to prevent data contamination.

9. The present study was conducted on four phases which included:-

1. Assessment phase:-

In order to determine which patients were eligible to participate in the study and which ones were not, the researcher conducted an initial evaluation of all study participants (control and study groups) as soon as they were admitted. Tool I was used to gather baseline data for the assessment.

2.Planning phase:-

This phase was formulated based on assessment phase and literature review.

Expected outcome criteria include:

- Decreased muscle weakness
- Enhanced muscle strength
- Maintained hemodynamic parameters

3. Implementation phase:

Control group: received routine hospital care which included changing position of the patients every two hours.

Study Group: received passive muscle exercises which were implemented by the researcher as follows:

1. Range of motion exercises for the upper extremities:

The intervention started on the first day of admission. In addition to routine care, passive range of motion exercises was done by the researcher two times per day in morning and afternoon shift for two weeks.

-First, the patient was placed in a semi-fowler position.

-All exercises were done rhythmically in ten repetitions. The exercises took about 30–60 min

2. Lower Extremities PROM Techniques:

- For lower extremity, the PROM exercises included toe flexion and extension. Ankle dorsiflexion, inversion and eversion, knee flexion and extension and hip flexion, extension, abduction, adduction, and internal and external rotation.

4. Evaluation phase

Patients of both groups were evaluated by using tool I and II to assess muscle strength. Three times; on admission, at the end of 1st weeks and at the end of 2nd week to evaluate the effect of range of motion exercise on prevention of acquired weakness at Intensive Care Unit.

- **Limitations of the study:**

The field of work was overcrowded with other patients and visitors.

- **Statistical analysis:**

The collected data were organized, tabulated and statistically analyzed using SPSS software statistical computer package version 25

Results

Table (1): shows distribution of the studied patients regarding their demographic characteristics.

It was observed that 46.67% of the study group& sixty percent of the control group had age between (50-60) with the mean age and SD of the study group was 49.03±8.194, while it was 51.10±8.360 in the control group. Regarding patients' gender about two thirds (63.33%) of the study group and 70.00% of control group were males. No statistical significant differences were found between the two groups regarding age and gender where p=0.785 and 0.338, respectively.

Table (2) represents distribution of the studied patients regarding their clinical data, acute respiratory failure was found in 50% of the intervention group and 60% of the control group. As for past medical history, it was noticed that two thirds (66.67%) of the study group compared to less than half (46.67%) of the control group had diabetes mellitus. In relation to prior hospitalization, 73.33% and 56.67% of the study and the control group were previously admitted to hospital, respectively. No statistical significant differences were found between the two groups in relation to current diagnosis, past medical history and previous hospital admission where p=0.584, 0.587 and 0.279 respectively.

Figure 1 represents Distribution of the studied patients regarding their body mass index (BMI).

This figure showed that less than half (43.33%) of the study group and 23.33% of the control group had overweight.

Table (3): illustrates distribution of the studied patients regarding their level of consciousness throughout periods of intervention among the studied groups

This table revealed that there were more than two third (76.76%) of the study group and (73.33) of the control group were semiconscious on admission, while nearly half (43.33%) of the patients in the study group compared to (26.67%) of the control group were conscious at the end of the second week .No statistical significant differences were found between the control and the study group regarding GCS scores at the end of the second week where p >0.05.

Table(4)represents Mean scores of hemodynamic parameters of the studied patients throughout periods of intervention

This table showed that there was statistical significant differences related respiratory rate and saturation of peripheral oxygen (spo2) among the study and control group where P=<0.05 respectively. No statistical significant differences were found between the two groups regarding pulse, mean arterial pressure and while p> 0.05 respectively but within normal rang.

Table (5): Distribution of the studied patients according to their score of manual muscle strength throughout periods of intervention among the studied groups

This table described that half of the study group compared to 16.67% of the control group had mild muscle weakness at the end of the second week. Statistically significant difference was found between the control and the study group regarding score of manual muscle strength at the end of the second week where p =0.002.

Table (6): Correlation between level of consciousness of the studied patients and their level of manual muscle strength throughout periods of intervention among the studied groups

This table showed that there was no significant correlation between patients' total levels of consciousness and level of manual muscle strength at the end of the 1st and 2nd week of implementation of intervention among study group with 0.016, 0.933 and 0.046, 0.811 respectively. While no significant correlation was observed between the control group with P >0.05**.**

Table (1): Distribution of the studied patients regarding their demographic characteristics .

Characteristics	The studied patients (n=60)				χ^2 P
	Study group (n=30)		Control group (n=30)		
	N	%	N	%	
Age (in years)					
▪ (21-<30)	1	3.33	1	3.33	
▪ (30-<40)	4	13.33	3	10.00	1.117
▪ (40-<50)	11	36.67	8	26.67	0.773
▪ (50-60)	14	46.67	18	60.00	
Range	(28-60)		(28-60)		t=0.967
Mean ± SD	49.03±8.194		51.10±8.360		P=0.338
Gender					
▪ Male	19	63.33	21	70.00	FE
▪ Female	11	36.67	9	30.00	0.785

Statistically Significant at level P < 0.05 .

Table (2): Distribution of the studied patients regarding their clinical data .

Clinical data	The studied patients (n=60)				χ^2 P
	Study group (n=30)		Control group (n=30)		
	N	%	N	%	
Current diagnosis					
▪ Acute Respiratory Failure	15	50.00	18	60.00	0.300
▪ Acute Respiratory distress	8	26.67	6	20.00	0.584
▪ Metabolic disorders	7	23.33	6	20.00	
# Past medical history					
▪ Diabetes mellitus	20	66.67	14	46.67	
▪ Hypertension	10	33.33	14	46.67	0.295
▪ hyperthyroidism	1	3.33	1	3.33	0.587
▪ Rheumatic heart disease	4	13.33	8	26.67	
Previous hospital admission					
▪ Yes	22	73.33	17	56.67	FE
▪ No	8	26.67	13	43.33	0.279

More than one answer was chosen FE: Fisher' Exact test

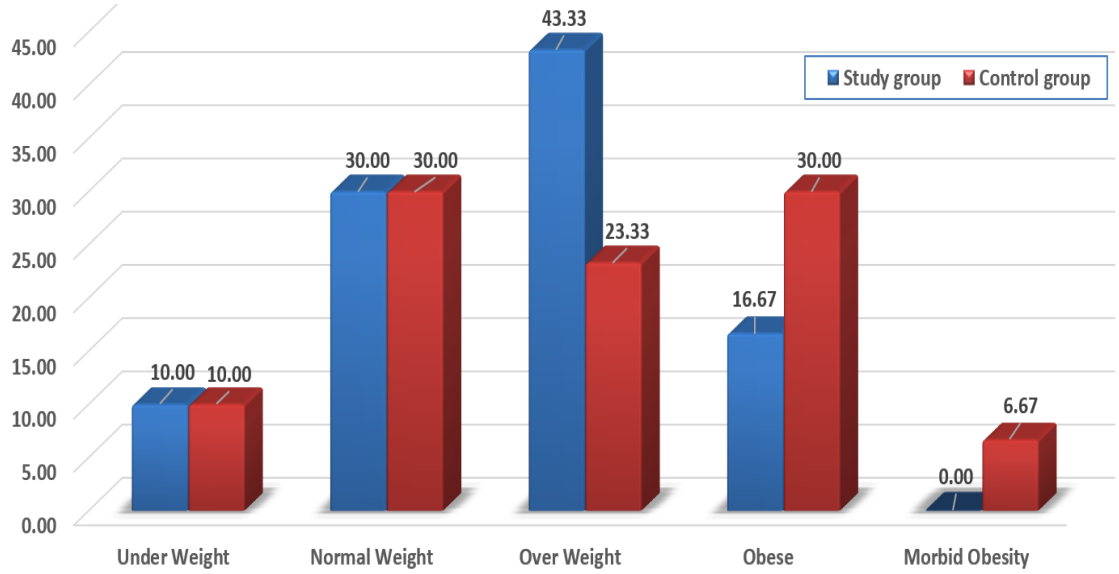

Figure 1: Distribution of the studied patients regarding their body mass index.

Table (3): Distribution of the studied patients regarding their level of consciousness throughout periods of intervention.

Level of Consciousness	The studied patients (n=60)													
	Study group (n=30)							Control group (n=30)						
	On admission		At the end of 1st week		At the end of 2nd week		χ^2 P	On admission		At the end of 1st week		At the end of 2nd week		χ^2 P
	N	%	N	%	N	%		N	%	N	%	N	%	
▪ Unconscious	2	6.67	1	3.33	0	0.00	6.449 0.168	3	10.00	3	10.00	7	23.33	8.926 0.063
▪ Semi-conscious	23	76.67	19	63.33	17	56.67		22	73.33	20	66.67	15	50.00	
▪ Conscious	5	16.67	10	33.33	13	43.33		5	16.67	7	23.33	8	26.67	
Range	**(8-15)**		**(8-14)**		**(9-15)**		F=2.358	**(6-14)**		**(6-15)**		**(8-15)**		**F=4.483**
Mean ± SD	**11.10±1.56**		**11.10±1.76**		**11.90±1.65**		P=0.101	**10.23±1.75**		**10.63±2.05**		**11.70±2.05**		**P=0.014***
Gp1 Vs Gp2														
χ^2	0.721		1.555		2.125									
P	0.697		0.460		0.346									

Unconscious (3-8) Semi-conscious (9-12) Conscious (13-15)

Statistically significant at level P<0.05.

Table (4): Mean scores of hemodynamic parameters of the studied patients throughout periods of intervention .

Hemodynamic parameters	The studied patients (n=60) Range Mean ± SD								t P
	Study group (n=30)				Control group (n=30)				
	On Admission	At the end of 1st week	At the end of 2nd week	F P	On admission	At the end of 1st week	At the end of 2nd week	F P	
5. Pulse	(50-136) 84.30±23.09	(60-122) 87.53±16.35	(59-118) 87.43±13.88	0.306 0.737	(50-112) 76.17±16.86	(57-108) 86.47±12.29	(65-106) 86.40±12.19	**5.413** **0.006***	0.306 0.760
6. RR	(16-39) 28.80±6.65	(17-34) 25.87±5.06	(18-35) 24.57±4.49	**4.703** **0.011***	(14-33) 21.93±4.76	(17-38) 25.63±4.83	(19-35) 25.47±4.48	**5.948** **0.004***	0.777 0.440
7. Blood pressure ▪ **Systolic**	(90-200) 130.00±34.94	(100-170) 128.00±19.19	(100-150) 121.33±15.03	1.021 0.364	(80-190) 120.00±33.01	(90-180) 124.00±22.98	(90-150) 122.00±19.37	0.181 0.835	0.149 0.882
▪ **Diastolic**	(50-110) 75.67±20.29	(50-100) 78.33±14.16	(60-100) 76.33±9.64	0.246 0.783	(50-110) 71.67±20.36	(50-100) 74.00±13.29	(50-100) 72.33±14.55	0.162 0.851	1.255 0.214
8. MAP	(63-136) 93.37±24.85	(66-123) 94.40±15.52	(73-116) 91.00±10.87	0. 280 0.756	(60-136) 87.53±24.21	(66-126) 90.40±15.77	(66-116) 88.57±15.62	0.176 0.839	0.700 0.486
9. SpO_2	(77-94) 86.80±4.75	(88-100) 93.27±2.86	(90-100) 95.63±2.58	**50.265** **0.000***	(77-96) 86.83±4.47	(90-100) 93.00±2.38	(90-100) 95.60±2.13	**60.587** **0.000***	0.055 0.957

t-test: Control group Vs Study group at the end of 2nd week .

* Statistically significant at level P<0.05.

Table (5): Distribution of the studied patients according to their level of manual muscle strength throughout periods of intervention .

Level of manual muscle strength	The studied patients (n=60)													
	Study group (n=30)							Control group (n=30)						
	On Admission		At the end of 1st week		At the end of 2nd week		χ^2 P	On admission		At the end of 1st week		At the end of 2nd week		χ^2 P
	N	%	N	%	N	%		N	%	N	%	N	%	
▪ Severe acquired muscle weakness	0	0.00	2	6.67	4	13.33		0	0.00	13	43.33	15	50.00	
▪ Moderate acquired muscle weakness	0	0.00	3	10.00	3	10.00	**16.264 0.003***	0	0.00	6	20.00	8	26.67	7.783 0.100
▪ Mild acquired muscle weakness	5	16.67	19	63.33	15	50.00		2	6.67	9	30.00	5	16.67	
▪ Normal muscle strength	25	83.33	6	20.00	8	26.67		28	93.33	2	6.67	2	6.67	
Range	**(48-60)**		**(24-55)**		**(28-55)**		**F=17.921**	**(50-60)**		**(5-6)**		**(6-55)**		**F=5.345**
Mean ± SD	**56±5.52**		**48±5.96**		**48±5.13**		**P=0.000***	**54±7.64**		**22.50±11.32**		**22.70±13.14**		**P=0.006***
Gp1 Vs Gp2														
χ^2	FE		4.858		**9.774**									
P	0.195		0.088		**0.002***									

Normal (50-60) ≥48 Mild (36-<48) Moderate <36 Severe

* Statistically significant at level P<0.05.

Table (6): Correlation between level of consciousness of the studied patients and their level of manual muscle strength throughout periods of intervention.

Level of manual muscle strength	The studied patients (n=60) Level of consciousness			
	Control group (n=30)		Study group (n=30)	
	r	P	r	P
On admission	0.200	0.289	0.113	0.552
At the end of 1st week	0.026	.892	0.016	0.933
At the end of 2nd week	0.112	0.556	0.046	0.811

r: Pearson' correlation coefficient

Discussion

The physical examination of critically ill patients on the ICU is frequently hampered by pre-existing neuromuscular disease, reduced patient cooperation, partial sedation, prolonged neuromuscular blockade (which would typically involve cranial nerve-innervated muscles), and/or presence of delirium, which may be particularly relevant for sensory testing as well as assessment of the MRC-SS**." Connolly BA et al, 2013"**

Concerning studied patients demographic characteristics, the current study results revealed that the mean age of the study group was 49.03±8.194, while it was 51.10±8.360 in the control group. This study result was in the same line with **Machado, et al (2017)** and **Rahiminezhad, et al** who found that the mean age of the study group was 44.64 ± 19.23, while it was 45.13 ± 18.91 in the control group.

It is possible that the incidence of ICU-AMW as the patients being old age, malnourished and receive corticosteroid is to blame for this outcome. Acquired muscular weakness may result from a decline in protein synthesis, strength, and tone in the muscles caused by these variables. These factors could decrease protein synthesis in the muscle and also decrease muscle strength and tone leading to acquired muscle weakness. The current result may reflect that the high proportion of patients with muscle weakness occur around 50 years old ,that increased with advanced age group due to the aging process changes especially with patients being in ICU. On the other hand this finding was inconsistent with **Yu et al., (2018)** who found that one quarter of the studied patients had ICU-AMW .

Regarding patients' gender, Patients' gender distribution was as follows: men made up around two-thirds of the research group and nearly three-quarters of the control group. The results of this research might be linked to the fact that men's jobs tend to put more stress on their muscles, which can lead to AMW. **Machado et al. (2017)** found that around 75% of the patients in the interventional group (those with ICU acquired muscular weakness) were men, which is consistent with our findings. But **Ahmed M. (2023)** discovered that almost two-thirds of the patients with ICU acquired muscular weakness were females, therefore this finding is contradictory.

Acute respiratory failure affected 50% of both the research and control groups, according to the findings. One interpretation of the data is that it corroborated what **Ahmed M. (2023)** found that over 50% of patients with ICU-Acquired Muscle Weakness also suffered from a respiratory ailment. This finding was also consistent with that of **Rahiminezhad, E. et al. (2022),** who found that among patients with Acquired Muscle Weakness, over 75% and over 26% of the study and control groups, respectively, suffered from respiratory diseases.

On the other hand, this result was in a disagreement with **Machado, A et al (2017)** who found that one third of both

the control and intervention group patients with Acquired Muscle Weakness had current neurological disorders.

As for past medical history, diabetes mellitus was present in two-thirds of the research group but in less than half of the control group, according to the participants' medical histories. The development of neuropathy, which in turn contributes to the onset of muscular weakness, may be the cause of this study's findings in diabetes mellitus. The findings were in line with those of "**Koukourikos et al. 2014,"** which noted that among the most prevalent and significant issues seen in critically sick patients with corticosteroid usage, immobilization, sepsis, and insufficient glycemic control is muscular atrophy.

Regarding body mass index (BMI) among the studied groups. It was found that both the study and control group had significantly lower rates of overweight and obesity. Obesity was associated with ICU-induced muscle weakness in this research, according to the results. While "**Anderson, M. R. 2021"** found no correlation between severe obesity and an increased risk of muscular atrophy and weakness due to critical illness, the results of this research contradict that finding.

Part II: Hemodynamic parameters

In relation to level of consciousness, by the conclusion of the second week, over half of the participants in the study group and about a third of the control group were conscious, according to the results of this research. Half or more of both the experimental and control groups were only partially aware by the end of week two. The fact that AMW and the accompanying disorders experienced by the patients in this research did not impact their degree of awareness may explain this finding.

This result was in the same line with **Younis, G (2015)** who reported that the mean of **Glasgow Coma Scale (GCS) scores** among the control group was 13. 33 ± 2.91 and among the study group was 14.21± 3.62.

Regarding Mean scores of hemodynamic parameters of the studied patients

The present results represents an increased RR that may be related to an increase the metabolic rate induced by passive exercises **(Trinity & Richardson, 2019).** An investigation was conducted by **Asgari et al. (2015)** to assess the effect of Early Mobilization program on the pulse and BP of patients with myocardial infarction showed a significant difference in the HR between the intervention and the control groups during the first and third days of mobilization.

Another study conducted by **Hickmann et al. (2020)** found that the RR was increased during each active exercise and returning to baseline values after the end of the exercise. The researchers exhibited that changing the patient's position and physical activity both improves respiratory physiology.

On the other hand, these study results are inconsistent with the findings of another study which reported a significant decrease in pulse and RR **(Yilmaz Y. et al, 2016).** This inconsistency may be due to the nature of the study population as their study involved chronic obstructive pulmonary disease (COPD) patients. Concerning to SPO_2, Oxygen saturation

measurement is a vital and essential indicator for the effectiveness of ICU patients. There was a statistical significant improvement in level of spo2 throughout periods of the study This finding is consistent with **Younis & Ahmed's (2015)** study. Additionally, **Hickmann et al. (2020)** reported improvement in the SPO2 value in the subjects performing physical activities. This finding is contradictory to a study that investigated the effects of an early bedside cycle exercise on intracranial and systemic hemodynamics in critically ill patients and reported no significant changes in the SPO2 value during the experimental procedure **(Thelandersson, Nellgård, Ricksten, & Cider, 2016).** This disagreement may be due to the small sample size, and that the majority of the participants were comatose and/or sedated to the nature of the study population. Also The present study found a significant increase in the patients' MAP readings towards the normal values over time in the intervention group. Our findings are contradicted with **Indriani, Santoso, Arwani, & Mardiyono (2018)** who noted a significant decrease in patients' MAP toward stability after the progressive mobilization. Similarly, another study that examined the effect of passive movement on cardiovascular indices among stroke patients showed a significant decrease in the DBP and MAP **(Hosseini Z. et. Al, 2019) .** The same study concluded that the passive movement can cause a rise in blood flow to the immobilized tissues of stroke patients.

On the contrary, a similar study revealed no significant differences in the hemodynamic parameters (SBP, DBP, and MAP) between the experimental and the control groups **(Rezaeikia et al., 2019).** This inconsistency may be because the passive movement in their study was only performed on the lower extremity, but in this study, passive exercises were performed on all body parts.

Part II: Assessment of muscle strength

Concerning **manual muscle strength,** the present result showed that; half of the study group compared to one fifth of the control group had mild muscle weakness at the end of the second week with statistically significant difference was found between the control and the study group. This result may be attributed to the efficacy of the exercise program performed by the researcher that had positive effect in variation between control and study group patients.

This result was in the same line with **"Rahiminezhad, E. et al, 2022** which also found that range-of-motion exercises increased muscular strength after an intervention compared to before.

Concerning correlation between level of consciousness of the studied patients and their level of manual muscle strength.

This study showed that there was positive significant correlation between patients' total levels of consciousness and level of manual muscle strength at the end of the 1st and 2nd week of implementation of intervention among study group. While no significant correlation was observed between the control groups**.**

This result may be attributed to the fact that with increased the level of consciousness ,the patient. can obey the nurse instructions, perform the exercise more effectively and become more

cooperative and so increase the strength of muscle and reduce its spasticity.

Conclusion &recommendation

It can be concluded that:

-The present study provides evidence supporting the implementation of a passive exercise program for critically ill patients with muscle weakness.

-There was a statistical significant differences related to hemodynamic parameters (respiratory rate and saturation of peripheral oxygen (spo2) among the study and control group where P=<0.05 respectively

Recommendations for administration

- An established guideline outlining the usual exercise regimen for patients with muscular weakness should be kept on file in intensive care units.

-In-service training programs should be conduct periodically and regularly for all nurses caring for critically ill patients with acquired muscle weakness.

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