

Risk Factors for Acquired Muscle Weakness Among Critically ill Patients

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Abstract: Background: One of the most common complications of Intensive Care Unit (ICU) is neuromuscular dysfunction due to critical illness, which may cause disuse atrophy. Large number of critically ill patients has severe muscle weakness, which has been named ICU-acquired weakness (ICU-AW). **Purpose:** The purpose of the study is to assess risk factors for acquired muscle weakness among Critical Ill Patients. **Research Design:** A descriptive exploratory design was utilized to achieve the purpose of this study. **Setting:** the study was conducted in the Intensive Care Units (ICUs) in Cairo University Hospital (general, chest and internal medicine ICU). **Sampling:** A Purposive sample of seventy-five patients admitted to the previous mentioned setting. **Instruments:** Three instruments were used for data collection. Instrument one: Characteristics of patients. Instrument two: muscle strength scale. Instrument three: - Factors contributing in Intensive Care Unit Acquired Muscle Weakness (ICU-AW) tool. **Results:** showed that more than half of studied patients had ICU-AW, most studied patients who had muscle weakness were older, abnormal WBCs level than the Non-ICU-AW patients. Administration of corticosteroid was higher in the ICU-AW patients than the Non-ICU-AW patients. There was no statistically significant relation between incidence of ICU-AW and gender, administration of parenteral nutrition and application of positioning, walking exercises. **Conclusion:** More than half of studied patients developed ICU-AW. The contributing factors of ICU-AW are patient age, abnormal WBCs level, not applying range of motion and chair sitting exercise to ICU patients, administration of corticosteroid. **Recommendations:** Further research is recommended to study extensively the effect of nutritional status on the incidence of ICU-AW. Also, the incidence of ICU-AW in sedated and unconscious patients' needs to be assessed.

Key words: - *acquired muscle weakness, critical ill patients, intensive care unit, risk factors.*

Introduction

Muscle weakness is one of the most frequent problems in the intensive care unit (ICU). The weakness can be caused by primary neuromuscular disorders that trigger the need for intensive care, such as myasthenia gravis, amyotrophic lateral sclerosis or multiple sclerosis, among others, but these types only account for <5% of all intensive care unit admissions. More often, muscle weakness occurs as a secondary disease rather than reason for ICU admission. This type has been termed "ICU-acquired weakness" with the implication that

this neuromuscular dysfunction has no plausible causes other than the critical illness and its treatments (Damian & Wijdicks, 2019).

Intensive Care Unit (ICU) -acquired weakness is typically generalized, symmetrical, and affects limb and respiratory muscles, whereas facial and ocular muscles are spared. Muscle tone is almost invariably reduced. Deep tendon reflexes can be reduced or normal. Weakness may originate from a neurogenic disturbance "critical illness polyneuropathy" (CIP), a myogenic disturbance "critical illness

myopathy” (CIM), or a combination thereof labeled “critical illness neuromyopathy” (Thabet et al., 2018). Incidence of ICU-acquired weakness varies between critically ill patients and according to risk factors, the timing of assessment, muscle function or overall body functional status and methods for diagnosis. ICU-AW is common syndrome and ranges from 26-65% among intubated patients for a duration of 5-7 days, and up to 67% of patients with long periods of intubation (>10 days). ICU-AW persisted for at least another 7 days following extubation in an estimated 25% of those ICU patients. In acute respiratory distress syndrome (ARDS), an estimated 60% of patients develop ICU-AW. Also, the incidence of ICU-AW is significantly higher in patient with sepsis, and it has been founded to be high 50–100% (Nakamura & Yonclas, 2019).

The development of ICU-AW is correlated with two major factors: not modifiable risk factor and modifiable risk factor. The first not modifiable risk factor includes the severity of illness, inflammation and sepsis, multiple organ failure, as well as the longer duration of mechanical ventilation and intensive care unit stay. Moreover, a higher risk of weakness may occur in women than men, and in older cases as compared with younger cases (Yang et al., 2019).

The second risk factor hyperglycemia that occur because the administration of parenteral nutrition but also several drugs that are used to treat critically ill patients and the severe stress of critical illness for example, dose and duration of vasoactive medications, mostly β -agonists, and the use of corticosteroids are associated with a higher risk of ICU-acquired weakness. Also, prolonged bed rest and immobility can affect the ICU-AW (Wolfe et al., 2020).

ICU-AW is diagnosed after the onset of critical illness; weakness is symmetrical and affects all 4 limbs and the respiratory muscles with sparing of the facial muscles. The muscle tone is almost invariably reduced, but deep tendon reflexes can be either reduced or normal. The diaphragm is often involved, leading to prolonged mechanical ventilation and difficult weaning (Yang et al., 2021).

Significance of the study

Intensive care unit-acquired weakness (ICU-AW) is a common neuromuscular dysfunction associated with cases in the ICU; it is a type of skeletal muscle dysfunction that usually occurs following hyperglycemia, mobility restriction, sepsis, and the use of neuromuscular blocking agents or glucocorticoids. ICU-AW can lead to delayed weaning of mechanical ventilation and extended hospitalization (Vanhorebeek et al., 2020), identifying risk factors for acquired muscle weakness among critical ill patients could provide the basis for more research into ICUAW, its prevention and possible treatment.

Purpose:

The purpose of the study was to assess risk factors for acquired muscle weakness among critically ill patients.

Research Questions

1. What are the risk factors for acquired muscle weakness among critically ill patients?

Methods

Study design

A descriptive correlation design was utilized in this study.

Setting:

The study was carried out in three intensive care units (ICUs) in Cairo University Hospital (general, chest and internal medicine ICU).

Sampling

Purposive sample of 75 critically ill patients admitted to the previously mentioned settings.

The study sample was selected based on statistical power analysis test (the margin of error of 5% and confidence level of 90%). Where is the power analysis formula???????

➤ **Inclusion Criteria:**

- The studied Patients should be above 18 years old.
- Full Conscious ICU patient.
- Have the ability to follow simple commands.

➤ **Exclusion Criteria:**

- Patients who have neuromuscular disease (gravis, myasthenia, spinal cord injury, Guillain-Barre syndrome, and stroke) and have systemic vascular disorders such as with neuromuscular blocking agents lupus were excluded from study sample because they already have muscular disorders.

Instruments

In order to achieve the purpose of the study the following instruments were used:

Instrument one:-Patients assessment tool:

The instrument was developed by investigators based on scientific review of literature which consist of two parts:

- **Part I:** Patient socio-demographic data which includes age, sex, occupation, level of education, and residence.
- **Part II:** Patient medical data which includes, admission medical diagnosis, date of admission, length of stay at ICU, past medical and surgical history, laboratory investigations and nutritional support methods.

Instruments two: - Muscle Strength Scale

Medical Research Council (MRC) and Indicators to incidence of ICU-AW:

It was adopted from Hrmans et al., (2012). It was conducted to evaluate critically ill patients' indicators of ICU-AW and to measure limb movement manually. The scale was used to monitor muscle strength of lower limb (left and right leg) and upper limb (left and right hand).

The diagnosis of ICU-AW is made with grading muscle strength in the upper and lower extremities. The measurement of muscle strength contains wrist extension, elbow flexion and bilateral shoulder abduction, for the upper limbs. Also, it includes knee extension, hip flexion, and dorsiflexion foot for the lower limbs.

Grading system for muscle weakness; Muscle strength in each group was scored according to the 6-point medical research counseling system, which are; no visible contraction which was given grade zero, visible contraction without movements of the limbs equal grade 1, movements of the limbs but not against the gravity equal grade 2, movement against gravity over (almost) the full range was given grade 3, active movement against gravity and resistance was given grade 4 and grade 5 was scored for presence of normal muscle power.

Scoring system:

- Patient had ICU- AMW if muscle strength score was < 48.
- Absence of ICU- AMW if muscle strength ranged from 48 to 60.

Instrument three:- Factors contributing in Intensive Care Unit Acquired Muscle Weakness (ICU-AMW) tool.

This instrument was developed by the investigator after reviewing the different related literatures (Goldman & Andrew, 2015 and John & Flavio, 2016) to monitor factors that contributed to the occurrence of acquired muscle weakness in ICU. It contained three parts:

Part one: Procedures related

factors: -

It was used to assess the application of ICU-AMW preventive measures. It included assessment of positioning and repositioning, range of motion exercises, walking exercises and chair sitting exercises.

Scoring system

- One degree was provided for each nursing care action provided for patients
- Zero was provided for non-provided actions.

Part two: Drug related factor:

It contains administered medications during hospitalization in the intensive care unit such as glucocorticoid medication. The response format contains yes (present) and no (not present).

Scoring system

- Yes (patient take corticosteroid therapy) = 1 degree.
- No (patient didn't take corticosteroid therapy) = zero.

Pilot study

A pilot study was done to measure applicability and feasibility of the present tools conducted in this study. It was applied on 10% of patients (8 patients) with critical illness in ICU. No modifications were made.

Validity

The instruments were reviewed for appropriateness of items by a jury of five experts; two of them were professors in critical care nursing and three assistant professors in critical care Nursing Department at Faculty of Nursing, Cairo University.

Reliability of the tools

Reliability of instrument two was $\alpha = 0.95$, reliability of instrument three was $\alpha = \dots? \dots$

Ethical considerations

Before starting the study, approval of the Faculty of Nursing Ethical and Research Committee in \dots was obtained.

Approaches to ensure the confidentiality of the study were performed. Confidentiality was achieved by the use of coded sheets without names of the participants were followed. All the participants were informed that the information they provided during the study would be kept confidential and used only for statistical purpose. Each patient was informed that participation in the study was voluntary, and he/she has the right to withdraw from the study at any time.

Procedure:

- An official letter was submitted from the Dean of the Faculty of Nursing, $\dots? \dots$ university to the director of Cairo University Hospital explaining the purpose and methods of data collection
- Data collection of data was conducted for 8 months, from the beginning of August 2021 to the end of March 2022. The data collection tool took about 75 to 90 minutes as the following:
- Assessment of patient demographic data, history, medical data and laboratory investigation and medications (From Patient file) consumed about 15 minutes.
- Assessment of muscle strength for each patient took about 35 minutes for each studied patient.
- Data collection was conducted in the morning and afternoon shifts by the researcher during the actual application of preventive measures (chair sitting, positioning, range of motion, and walking) and it took about 15-25 minutes to assess if preventive measures were applied or not.

Statistical analysis

Data were expressed in the form of number and percentage. Chi-square test was used for the comparison of variables with categorical data. The student's test was used Correlation coefficient test was used to test for correlations between two variables with continuous data. A statistical significant was considered if $P < 0.05$.

Results

Table(1): Shows the frequency distribution of the studied patients' demographic characteristics. Concerning patient age, less than half (49.3%) of the studied patients were 50 years old or. Regarding sex, the study findings indicated that more than half (52.0%) of the studied patients were males. For the education level, more than two fifths (42.7%) of them were illiterate. Regarding occupation of the studied patients, about one third (33.3%) of them were housewives and nearly three quarters (76.0%) of them were from rural areas.

Table(2): Frequency distribution of the studied patients according to admission medical diagnosis, the present findings demonstrated that less nearly half (46.7%) of the studied patients had respiratory disorder, while cardiovascular and renal disorder represented less than one fifth (14.7%) and 12.0% in them respectively. On other hand minority (1.3%) of the studied patients had cancer, endocrine and infectious disorders.

Figure(1): Demonstrates that more than one half (53.3%) of the studied patients had ICU acquired muscle weakness. While more than two fifths (46.7%) of the studied patients hadn't ICU acquired muscle weakness.

Table(3): Associative relation between socio-demographic data of studied patients and the incidence of ICU acquired muscle weakness. There was no statistical significant association at 5% level of statistical significance except for age (P value = .0014).

Table(4): Associative relation between laboratory investigations, method of nutritional support of the studied patients and the incidence of ICU Acquired Muscle Weakness. No statistical significant association was found except for WBCs (P value .04981).

Table(5): Associative relation between the application of nursing actions to prevent muscle weakness and the incidence of ICU acquired muscle No statistical significant association was found except for range of motion and chair sitting ($P = .00002$ and $P = .00988$) respectively.

Table(6): Associative relation between drug related factors contributing to muscle weakness and incidence of ICU Acquired Muscle Weakness. It was clarified that 60% of patients who received corticosteroids developed muscle weakness. Therefore, there was a very highly statistical significant association (P value = .00016).

Table (1) Frequency distribution of the studied patients regarding socio-demographic characteristics (n = 75).

Patient's demographic characteristics	No.	%
Age:		
18 - < 30 years	9	12.0%
30 - < 40 years	18	24.0%
40 - < 50 years	11	14.7%
≥ 50years	37	49.3%
Mean ± SD	48.29±16.22	
Gender:		
Male	39	52.0%
Female	36	48.0%
Level of education		
Illiterate	32	42.7%
Read/Write	15	20.0%
Secondary education	13	17.3%
Higher education	15	20.0%
Occupation		
Student	4	5.3%
Worker	17	22.7%
Employee	14	18.7%
Retired	15	20.0%
House wife	25	33.3%
Residence		
Rural	57	76.0%
Urban	18	24.0%

Table (2) Frequency distribution of the studied patients regarding their medical diagnosis on admission.

Admission medical diagnosis	No.	%
Cardiovascular disorders	11	14.7%
Respiratory disorders	35	46.7%
Infectious disorders	1	1.3%
Gastrointestinal disorders	5	6.7%
Endocrine/metabolic disorders	1	1.3%
Renal disorders	9	12.0%
Cancer	1	1.3%
Poisoning	3	4.0%
Falling from height	3	4.0%
Postoperative care	6	8.0%

Figure (1): Frequency distribution of the studied patients according to the incidence of ICU Acquired Muscle Weakness (n=75).

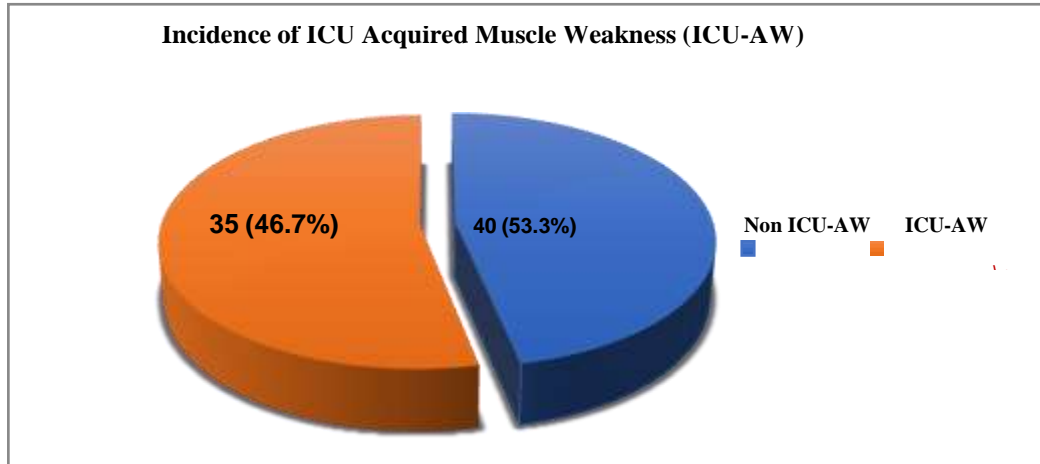


Table (3): Associative relation between socio-demographic data of studied patients and the incidence of ICU acquired muscle weakness.

Patient demographic Characteristic	Non ICU-AW (n=35)		ICU-AW (n=40)		Test χ^2	P value
	No.	%	No.	%		
Age:						
18 - < 30 years	7	77.8%	2	22.2%	15.43	.0014**
30 - < 40 years	11	61.1%	7	38.9%		
40 - < 50 years	8	72.7%	3	27.3%		
≥ 50years	9	24.3%	28	75.7%		
Mean ± SD	41.17 ± 14.4		54.53 ± 15.26			
Gender:						
Male	21	53.8%	18	46.2%	1.68	.19457
Female	14	38.9%	22	61.1%		
Level of education						
Illiterate	13	40.6%	19	59.4%	1.62	.65384
Read/Write	7	46.7%	8	53.3%		
Secondary education	8	61.5%	5	38.5%		
Higher education	7	46.7%	8	53.3%		
Occupation						
Student	3	75.0%	1	25.0%	5.20	.26757
Worker	8	47.1%	9	52.9%		
Employee	9	64.3%	5	35.7%		
Retired	7	46.7%	8	53.3%		
Housewife	8	32.0%	17	68.0%		
Residence						
Rural	25	43.9%	32	56.1%	.75	.38588
Urban	10	55.6%	8	44.4%		

Ns (No significant) P value > 0.05

HS (Highly significant)

**P value < 0.01

Table (4): Associative relation between laboratory investigations, method of nutritional support of the studied patients and the incidence of ICU Acquired Muscle Weakness.

Laboratory Investigation	Non ICU-AMW (n=40)		ICU-AMW (n=40)		Test X ²	P Value
	No.	%	No.	%		
Albumin						
-Normal	4	11.4%	1	2.5%	3.20	.20148
-Abnormal	8	22.9%	14	35.0%		
-Not done	23	65.5%	25	62.5%		
White Blood Cells (WBCs)						
Normal	7	48.6%	11	27.5%	3.54	.04981*
Abnormal	18	51.4%	29	72.5%		
Creatinine Kinase (CK)						
Normal	4	11.4%	3	7.5%	2.06	.35681
Abnormal	0	0.0%	2	5.0%		
Not done	31	88.6%	35	87.5%		
Method of nutritional support						
-Oral	25	71.4%	21	52.5%	3.31	.19062
-Enteral	0	0.0%	1	2.5%		
-Parenteral	10	28.6%	18	45%		

NS (No significant) - P value > 0.05

S (Significant) * P value < 0.05

Table (5): Associative relation between the application of nursing actions to prevent muscle weakness and the incidence of ICU acquired muscle.

Procedures related factors	Non ICU-AW (n=40)		ICU-AW (n=40)		Test (Z)	P Value
	Done		Done			
	No.	%	No.	%		
Positioning	1	2.9%	0	0.0%	.94	.34634
Range of Motion Exercises	16	45.7%	0	0.0%	4.22	.00002**
Walking Exercises	28	80.0%	25	62.5%	.14	.89217
Chair Sitting Exercises	18	51.4%	6	15.0%	2.58	.00988**

NS (No Significance) P value > 0.05

HS (Highly

Significant) * *P value < 0.01

Table (6) Associative relation between drug related factors contributing to muscle weakness and incidence of ICU Acquired Muscle Weakness.

Factor	Non-ICU-AW (n=35)	ICU-AW (n=40)	Test χ^2	P Value
	%	%		
Drug related factor (corticosteroid)				
-NO	82.9%	40.0%	14.29	.00016**
-Yes	17.1%	60.0%		

NS (No Significance) P value > 0.05

HS (Highly Significant)

* *P value < 0.01

Discussion

Reduced muscular force, as in intensive care unit (ICU)-acquired weakness (ICUAW), is observed in many, if not most, survivors of critical illness following various critical diseases. Clinical consequences of muscular weakness include, for example, impaired mobilization, prolonged bed rest, and extended ICU and/or hospital length of stay. This may induce a secondary complication and necessitates repeated and/or intensified medical therapy, which may again result in increased morbidity and mortality Kramer, (2019) So, the current study aimed to examine risk factors for acquired muscle weakness among critical ill patients.

Studied patients were more than fifty years.

Regarding the incidence of ICU- AW, the current study revealed that more than half of studied patients developed ICU-AMW. From the researcher point of view, the incidence of ICU-AMW were high as the majority of patients were old age, malnourished and received corticosteroid I These factors could decrease protein synthesis in the muscle and also decrease muscle strength and tone.

This finding was supported by Appleton et al., (2019) who conducted a study entitled " The incidence of intensive care unit acquired weakness syndromes: a systematic review" and

showed that more than half of studied patients developed Intensive Care Unit Acquired Paresis (ICUAP). This finding was inconsistent with Yu et al., (2018) who conducted a study entitled "Analysis of high-risk factors of intensive care unit-acquired weakness in patients with sepsis at Hospital of Kunming Medical University – China" and found that one quarter of the studied patients had ICU-AMW.

Regarding application of nursing actions contributing to prevention of intensive care unit acquired muscle weakness. The current study revealed that the majority of patients who performed walking exercise, more than half of patients who were used to sit on chairs and less than half of patients who made range of motion exercises did not develop muscle weakness. No one of patients who developed muscle weakness performed any exercise in the ICU. From the researcher point of view, the application of nursing actions which prevent muscle weakness was inadequate. Also, some required items were not available e.g., chairs for sitting exercise. Also, some nursing staff did not have knowledge about their importance or utilizations to increase muscle strength.

These findings were consistent with Asfour, (2016) who reported that no one of the ICU patients had done range of motion exercises. Regarding Non-

ICU-AMW patients, nearly half of them had done range of motion exercise. Also Mohamed et al., (2019) supported this finding in their study entitled "Factors Contributing to Acquire Muscle Weakness among Critical Ill Patients" and showed that the majority of patients in the Non-ICU-AW patients had done walking exercise. Moreover, and no one in the ICU-AMW patients had done positioning and range of motion exercises.

As regard. The current study revealed that two thirds of patients in the ICU-AW received corticosteroid. From the researcher's point of view, the incidence of respiratory disorders in ICU-AW patients was high; so they were in need for systemic or inhaled corticosteroid in ordered to treat airway obstruction and inflammation. This finding was similar to Li et al., (2020) who showed that two thirds of the ICU-AW patients received cortisone. While less than one fifth in the Non-ICU-AW patients received the drug.

Concerning relation between incidence of ICU-AW and age of studied patient, the findings of the current study revealed that the age of studied patients in ICU-AW were older than in the Non-ICU- AW patients. So that there was highly statistically significant relation between the incidence of intensive care unit acquired weakness and patient's age. From the researcher point of view, this may be due to the fact that elderly patients have some physiological changes occur in all the body like the muscle and the number and size of muscle fibers gradually decrease. The result of sarcopenia is a gradual loss of muscle mass and muscle strength.

This finding was supported by Pablo et al., (2017) who reported that the patients of ICU-AW were old age. So, the development of ICU-AW was

associated with age. Also, yang et al., (2018), found that there was highly statistically significant relation between incidence of intensive care unit acquired weakness and patient age in their study about " Risk factors for intensive care unit-acquired weakness: a systematic review and meta-analysis".

Concerning the association between the incidence of ICU-AW and other demographic characteristic of studied patient such as gender, level of education, occupation and residence, the present study showed that there was no statistical significance between incidence of ICU-AW and other demographic characteristics. This result was in the same line with Mohamed et al, (2019) who clarified no statistical significance between the incidence of ICU-AW and gender, occupation and residence. Conversely, these findings were contradicted with Yang et al., (2018), who found that there was a statistical significant relationship between the incidences of intensive care unit acquired weakness and female gender.

In relation to the relation between incidence of intensive care unit acquired muscle weakness and WBCs level and method of nutritional support, the current study revealed that there was a statistical significant relation between the incidence of intensive care unit acquired muscle weakness and WBCs level While there was no statistical significant relation between incidence of intensive care unit acquired muscle weakness and other lab investigations as albumin and serum CK level and method of nutritional support.

This finding was in agreement with Gupta & Mishra, (2019), who conducted a study entitled "A risk factor for sepsis-induced critical illness polyneuropathy" and found that there was statistical significant relation

between the incidence of intensive care unit acquired muscle weakness and WBCs level. Also, this finding supported with Vanhorebeek et al., (2020), who found no statistical significant relation between incidences of intensive care unit acquired muscle weakness and method of nutritional support.

Conversely, this finding contradicted with Gunst & Berghe, (2018) who stated in a study entitled "Intensive care nutrition and postintensive care recovery" that administration of parenteral nutrition increase the incidence of ICU-AMW.

Concerning the relation between applications of nursing care actions for the prevention of muscle weakness, the current study revealed that there was a highly statistically significant relation between incidence of ICU-AW and application required nursing care actions such as range of motion exercise and chair sitting exercise. While, there was no statistically significant relation between the incidence of ICU-AMW and application of other actions such as positioning and walking exercise.

From the researcher point of view, there were a significant relation between incidence of ICU-AMW and not applying range of motion and chair sitting exercises for ICU patients such as passive stretching to decrease stiffness and contracture, increase muscle excitability, improve muscle strength and prevent incidence of disuse muscle atrophy. So, not applying these actions for ICU patients increase the incidence of muscle weakness.

These findings agreed with Zhang et al., (2019) who conducted a study "Early mobilization of critically ill patients in the intensive care unit: a systematic review and meta-analysis" and found that there were a significant relation between the incidence of ICU-

AMW and not applying preventive measures e.g chair sitting, walking and range of motion exercise

For the relation between medications administration (corticosteroid) and the incidence of intensive care unit acquired muscle weakness among studied patients, the findings of the current study revealed that there was highly statistically significant relation between incidence of ICU-AW and using of corticosteroid. In the researcher point of view, corticosteroid had dangerous effect on muscle mass and strength due to its catabolic effect. This finding agreed with Vanhorebeek et al., (2020) who conducted a study entitled "ICU-acquired weakness" and reported that there was a highly statistical significant relation between the incidence of ICU-AMW and using of corticosteroid in ICU. On the other hand; this finding contradicted with Yang et al., (2021), who conducted a study on "Hyperlactacidemia as a risk factor for intensive care unit-acquired weakness in critically ill adult patients" and found no significant effect of corticosteroids on the incidence of ICU-AW among ICU patients.

Conclusion

From the result of the present study, one can conclude that:

The study concluded that more than half of studied cases developed muscle weakness following their hospitalization in Intensive Care Units Muscular weakness is most common among older patients (>50 yrs) It is more associated with abnormal white blood count, fewer exercises and administration of corticosteroids.

Recommendations

Of the present study the following recommendations were suggested:

A-Related to knowledge:

(Range of motion, Positioning, Chair sitting and walking exercises should be done in every Also, it should be included in Procedure books for students

Evaluation of nurses' knowledge must be continuously done is 1 to identify their educational needs

B-Related to Practice:

- Muscle strength should assess routinely.
- Early mobilization should be done for critically ill patients.

C-Related to Education:

- Educational sessions and scientific courses for nurses working in ICU to revise their knowledge about risk factors, & procedures helping in the prevention and treatment of ICU-AW.

D-Related to Research:

- Further studies should be conducted on larger probability sample for generalization of the results.
- Further studies are needed to examine the incidence of ICU-AW in unconscious and sedated patients.

References

Appleton, T., Kinsella, J., Quasim, T. (2019): The incidence of intensive care unit acquired weakness syndromes: a systematic review. *J Intensive Care Soc* 2019; 16(2):126e36.

Asfour, H. (2016): Contributing factors for acquired muscle weakness in intensive care unit, *Journal of Nursing Education and Practice* 2016, Vol. 6, No. 8; pp 102-111.

Chlan, L., Tracy, F., Guttormson, J., & Savik, K. (2018): Peripheral muscle strength and correlates of muscle weakness in patients receiving mechanical ventilation. *Am J Crit Care* 24:e91–98.

Damian, S., & Wijdicks, M. (2019): The clinical management of neuromuscular disorders in intensive care. *Neuromuscul Disord* 29:85–96.

Goldman L and Andrew L, (2011): *Golman.cecil Medicin E-book*. Chapter (104), 25th edition. Elsevier health science, USA, P. 653.

Gunst, J., & Berghe, G. (2018): Intensive care nutrition and postintensive care recovery. *Crit Care Clin* 34:573–583

Gupta, S. & Mishra, M. (2019): A risk factor for sepsis-induced critical illness polyneuropathy. *Neurol. India* 64, 640–645.

Hrmans G, Clorokz B, Vanbullebusch T, Segers J, Vanpes G and Robbeets C, (2012): Interobserver Agreement of Medical Research Council sum - score and Handgrip Strength in the Intensive care unit. *Critical Care Neurology Part 11 Muscle Nerve*, Page 45. Vol.141; Published online Jan 25-2011. Retrieved on: 4-5-2011 Available at <https://books.google.com.eg>.

John, M., & Flavio, L. (2016): *Surgical Intensive Care Medicine: Medicine & Health*. 3rd edition. Springer, Australia, P. 119.

Kramer, C. (2019): Intensive care unit-acquired weakness. *Neurol Clin* 2019; 35:723–736.

Li, Z., Zhang, Q., Zhang, P., Sun, R., Jiang, H., Wan, J., Wu, F., Wang, X., Tao, X. (2020): Prevalence and risk factors for intensive care unit acquired weakness: A protocol for a systematic review and meta-analysis. *Medicine* 2020; 99:36(e22013).

Mehrholz, J., Muckel, S., Oehmchen, F., and Pohl, M, (2015): First result about recovery of walking

- function in patients with intensive care unit acquired weakness from the general weakness syndrome therapy. Vol 5. No 12; published in 22 December 2015. Retrieved on 24 July 2018 Available at doi.10.1136/bmjopen-2015-008828.
- Mohamed, M., Hassan, M., Bakr, Z., & Amr, E. (2019): Factors Contributing to Acquire Muscle Weakness among Critical Ill Patients, Egyptian Journal of Health Care, 2019 EJHC Vol.10 No.3; pp 295-314.
- Nakamura, R., and Yonclas, P. (2019): ICU acquired weakness and neurocognitive decline. Vol 2. No 1; published in 3 April 2019. Retrieved on 25 July 2020.
- Pablo, L., Garcia, J., Dargains, N., and Settembrino, E. (2017): Weakness acquired in the intensive care unit incidence and risk factors. Vol 29. No 1; published in December 2017. Retrieved on 20 July 2018 Available at doi:10.5935/0/03.507x.20170063
- Raurell-Torreda, M., Arias-Rivera, S., Martí, A., Frade-Mera, R., Zaragoza-García, E., Gallart, N., Velasco-Sanz, L., & Jose-Arribas, M. (2021): Care and treatments related to intensive care unit acquired muscle weakness, Australian Critical Care 34 (2021) 435 - e445.
- Thabet, A., Tawfk, M., Abd El-Naby, A., Abo El-Fotoh, M., Saleh, N., Abd El-Hady, S. (2018): Neurophysiological study of critical illness polyneuropathy and myopathy in mechanically ventilated children; additional aspects in pediatric critical illness comorbidities. Eur J Neurol 25:991–e76.
- Vanhorebeek ,I., Latronico, N., and Berghe, G.(2020): ICU-acquired weakness, Intensive Care Med (2020) 46:637–653 <https://doi.org/10.1007/s00134-020-05944-4>.
- Wood G and Haber J, (2011): Nursing Research Methods and critical Appraisal for Evidenced Based practice. 9th edition. Elsevier, China, P262.
- Yang, T., Li, Z., Jiang, L., Xi, X. (2018): Corticosteroid use and intensive care unitacquired weakness: a systematic review and meta-analysis; Critical Care (2018) 22:187 <https://doi.org/10.1186/s13054-018-2111-0>.