

Factors Contributing to Acquire Muscle Weakness among Critical Ill Patients

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Abstract

Background: Intensive Care Unit Acquired Muscle Weakness (ICU-AW) is one of the most important complications occurs in the ICU. ICU-AW is a multifactorial syndrome characterized by generalized muscle weakness. Critical care nurses (CCNs) have an important role in the prevention of ICU-AW through increase mobility and applying of range of motion. **Design:** A descriptive exploratory design was utilized to achieve aim of this study. **Aim:** This study aimed to assess factors contributing to acquired muscle weakness among critical ill patients. **Setting:** the study was carried out in intensive care units of Beni-Suef University Hospital. **Subjects:** A Purposive sample of seventy five patients admitted in the previous mentioned setting. **Tools of data collection** were consisted of Patient assessment tool, muscle strength scale and indicators to incidence of ICU-AW and factors contributing to ICU-AW assessment tool. **Results:** revealed that more than half of the studied patients had ICU-AW. The majority of studied patients who had muscle weakness were older than the Non ICU-AW patients. Application of positioning and range of motion exercises were not done in the ICU-AW patients. Administration of corticosteroid and incidence of malnutrition was higher in the ICU-AW patients than the Non ICU-AW patients. There were no statistically significant relation between incidence of ICU-AW and gender, admission medical diagnosis, administration of parenteral nutrition and application of positioning and walking exercises. **Conclusion:** More than half of studied patients developed ICU-AW. The contributing factors of ICU-AW are patient age, WBCs level, not applying range of motion and chair sitting exercise to ICU patients, administration of corticosteroid and malnutrition. **Recommendations:** Further researches are recommended to study extensively the effect of nutritional status on incidence of ICU-AW. Also, examine the incidence of ICU-AW in sedated and unconscious patients.

Key words: Factors, Intensive Care Unit, Acquired Muscle Weakness, Critical Ill Patients.

Introduction

Intensive Care Unit Acquired Muscle Weakness (ICU-AW) is one of the detrimental effects of critical illness on physical function. This term refers to a wide

variety of disorders characterized by acute onset of neuromuscular impairment for which there is no other plausible cause than the critical illness. It is characterized by bilateral symmetrical flaccid weakness of the limbs, Facial and ocular muscles are often

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spared, and deep tendon reflexes are usually reduced (*Castro, Seron, Fan, Gaete & Mickan, 2015*).

The majority of patients admitted to an intensive care unit (ICU) has identified with generalized weakness. It found to be a common and troublesome problem. There are different terminologies used to label this generalized weakness as critical illness associated polyneuropathy, myopathy and neuromyopathy (where both neuropathy and myopathy coexist). These syndromes are now all included under the clinical diagnostic label of intensive care unit acquired muscle weakness (ICU-AW) (*Appleton, Kinsella & Quasim, 2015*).

The reported incidence of ICU-AW varies depending on the patient, timing of assessment and diagnostic methods used. ICU-AW is common and range from 26-65% for patients intubated for a duration of 5-7 days, and up to 67% of patients with prolonged 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 patients with acute respiratory distress syndrome (ARDS), an estimated 60% of them develop ICU-AW. The incidence of ICU-AW is significantly higher in individuals with sepsis and it has been reported to be high 50–100% (*Nakamura & Yonclas, 2017*).

The development of ICU-AW is correlated to two major factors (patient and intensive care related factor). Patient related factors include: patient age, female gender and severity of illness. Intensive care related factors include sepsis, the presence of organ failure involving two or more organs, duration of mechanical ventilation; length of stay in ICU, hyperglycemia, using of corticosteroids and neuromuscular blocking agents, malnutrition and immobility (*Davies, 2018*).

The mainstay prevention of ICU-AW is through the minimization of the risk factors. Current strategies to limit ICU-AW and optimize recovery from critical illness are focused around minimizing sedation and targeting early mobilization of patients, even while they are still undergoing mechanical ventilation. Patients who cannot be mobilized, passive exercises may also improve recovery. Limiting patient exposure to corticosteroids and neuromuscular blocking agents, good glycemic control and adequate nutritional intake are helping in the prevention of this syndrome (*Latronic et al., 2017*).

Aim of the study

This study aimed to assess factors contributing to acquired muscle weakness among critical ill patients.

Research question:

What are the factors contributing to acquired muscle weakness among critical ill patients?

Subject and Methods

The subject and methods for the current study were portrayed under the four main designs as the following:

- I. Technical design.
- II. Operational design.
- III. Administrative design.
- IV. Statistical design.

I) Technical design:

The technical design included research design, setting, subjects and tools of data collection used in this study.

Research design:

A descriptive exploratory design was conducted to achieve aim of this study.

Setting:

This study was conducted in three Intensive Care Units in Beni-Suef University Hospital (General, Chest and Internal Medicine ICU).

Subjects:

- Purposive sample of 75 patients admitted to the previously mentioned setting.
- The sample was selected based on statistical power analysis test (the confidence level of 90% and margin of error of 5%).

➤ **Inclusion Criteria:**

- Patients above 18 years in the ICU.
- Conscious critical ill patient.
- Able to follow simple commands.

➤ **Exclusion Criteria:**

• Patient with preexisting neuromuscular disease (myasthenia gravis, Guillain-Barre syndrome, spinal cord injury and stroke) and systemic vascular disorders such as lupus erythematous and with neuromuscular blocking agents were excluded from study.

Tools of data collection:

Three tools were used to collect necessary data to fulfill the study aim.

Tool (1): Patients assessment tool:

This tool was developed by the researcher after reviewing the related

literature (*Goldman & Andrew, 2015 and John & Flavio, 2016*) to assess patient status. It included 2 parts:

Part (I):- Patient Demographic data:

It was used to assess demographic characteristic of the studied patients as age, gender, level of education, occupation and residence.

Part (II):Patient medical data:

It was used to assess medical data. It included patient intensive care unit, date of admission, admission medical diagnosis, length of stay, past medical and surgical history, and lab investigations).

Tool(2):-Muscle Strength Scale /Medical Research Council (MRC) and Indicators to incidence of ICU-AW

• This tool was adopted from (*Hrmans et al., 2012*). It was used to monitor critically ill patients' indicators of ICU-AW and to assess limb movement manually.

• This scale was used to assess muscle strength of upper limb (right and left hand) and lower limb (right and left leg).

• The researcher asked the patient to make the following movement for upper and lower limb:

○ For the upper limb (shoulder abduction, elbow flexion, wrist extension).

○ For the lower limb (hip flexion, knee extension, ankle dorsiflexion).

• When the limb achieved the movement at any degree; give it score based on muscle strength scale that is designed for that purpose as the following:

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- **Grades of Muscle Strength Scale:**

- Grade 0 means No contraction visible or palpable

- Grade 1 means Flicker of contraction visible or palpable, although no limb movement

- Grade 2 means Movement with gravity eliminated over almost full range of motion

- Grade 3 means Movement against gravity over almost full range of Motion

- Grade 4 means Movement against moderate resistance over full range of motion

- Grade 5 means Normal power.

- Ideally each limb should achieve the 3 movements normally mean that (Grade 5 Normal power), this mean each limb took $(3 \times 5) = 15$ degrees.

- For the upper limb (right and left hand) and lower limb (right and left leg) $(15 \times 4) = 60$

- The researcher applied the scale by herself through asking help from physiotherapy who taught the researcher how to apply it on the pilot study.

- **Scoring system**

- * If muscle strength score was < 48 , this indicates that patient had ICU- AW.

- * If muscle strength score was range from 48 to 60, this indicated absence of ICU- AW.

Tool (3):-Factors contributing to Intensive Care Unit Acquired Muscle Weakness (ICU-AW) assessment tool.

This tool was developed by the researcher after reviewing the related literatures (*Goldman & Andrew, 2015 and John & Flavio, 2016*) to assess contributing factors for the occurrence of acquired muscle weakness in intensive care units.

It consisted of three parts:

Part (I): Procedures related factors:-

- It was used to assess application of ICU-AW preventive measures and contain four main items as following:

- Positioning and repositioning

- Range of motion exercises

- Chair sitting exercises

- Walking exercises

- **Scoring system**

- Each procedure done to the patient was given one degree.

- While the procedure not done to the patient was given zero.

Part (II): Drug related factor:-

- * It included patient prescribed medications during the ICU stay such as corticosteroid therapy.

- * The researcher assessed muscle strength daily during intake of corticosteroid therapy to see if it was the same score or decreased.

- * If the patient took any type corticosteroid therapy, the researcher put (Yes).

* If the patient didn't take any type corticosteroid therapy, the researcher put (No).

➤ **Scoring system:**

- Patient who took corticosteroid therapy, put Yes = 1 degree.

- Patient who didn't take corticosteroid therapy, put No = zero.

Part (III): Nutritional related factor:

*The researcher compared the actual nutritional intake versus the ideal nutritional requirements needed for each patient to know if the patient had enough or not enough nutrition.

*The researcher calculated the ideal nutritional intake for each patient using the following equations: (*Harris & Benedict, 1919*) equations to calculate the ideal nutritional intake.

Basal Energy Expenditure (BEE) equal

For men, B.E.E. = $66.5 + (13.75 \times \text{weight (kg)} + (5.003 \times \text{height (cm)} - (6.775 \times \text{age (year)}))$

For women, B.E.E. = $655.1 + (9.563 \times \text{weight (kg)} + (1.850 \times \text{height (cm)} - (4.676 \times \text{age (year)}))$

Total Caloric Requirements = B.E.E. x the sum of the stress and activity factors.

Stress plus activity factors range from 1.2 to over 2.

*Then the researcher calculated the actual nutritional intake for each patient, through observing the food and fluids the

patient took during the day and calculated how many calories the food and fluids the patient took during the day.

*If the actual nutritional intake was equal to the ideal nutritional requirements, it means that the patient was well nourished.

*If the actual nutritional intake was less than the ideal nutritional requirements, it means that the patient was malnourished.

➤ **Scoring system**

- The patient who was well nourished - give one degree.

- The patient who was malnourished - given zero degree.

II-Operational design

Preparatory phase:

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

Ethical considerations

The ethical research considerations include the following:

- The research approval for protocol was obtained from the faculty ethical committee before starting the study.

- The researcher clarified the objectives and aim of the study to patients included in the study before starting.

- The researcher assured maintaining anonymity and confidentiality of data of the patients included in the study.

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- Subjects were informed that they were allowed to choose to participate in the study or not and they had the right to withdraw from the study at any time.

- Ethics, values, culture and beliefs were respected.

- An approval was obtained from the director of Beni-Suef university hospital and directors of General, Internal medicine and Chest ICU units to conduct the study.

Content validity and reliability:

Testing validity (refers to how well a scientific test actually measures what it is intended to measure) of the proposed tools was done using face and content validity. **Face validity** aimed at inspecting the items to determine whether the tools measure what supposed to measure. **Content validity** was conducted to determine whether the content of the tools cover the aim of the study (*Wood & Haber, 2017*).

Validity tested through by a jury of 7 experts, one of them was a professor and three assistant professors of medical surgical nursing department at faculty of nursing, Ain Shams University and two were lecturers of ICU medicine at faculty of medicine in Beni-Suef University and one assistant professor at faculty of physiotherapy in Beni-Suef University. The expertise reviewed the tools for clarity, relevance, comprehensiveness, simplicity and applicability, minor modification was done.

Testing reliability refers to the extent to which the same answers can be obtained using the same instruments more than one time (*Wood & Haber, 2017*).

Reliability of patient assessment tool and factors contributing to intensive care unit acquired muscle weakness (ICU-AW)

assessment tool was done statistically by **Alpha Cronbach test**. Reliability of muscle strength scale was done statistically by the **intraclass correlation coefficient (ICCs)** and it was 0.95 (*Hrmans et al., 2012*).

Pilot study:

A pilot study was conducted to test feasibility and applicability of the study tools used in this study. It was carried out on 10% of patients (8 patients) with critical illness in the previous mentioned setting. No modifications were done

Field work:

Data were collected in 7 months, from beginning of August 2017 to the end of February 2018. Filling the data collection tool took about 80 to 95 minutes as the following:

- Assessment of patient demographic data, medical data and history, lab investigation and medications (Patient file) took about 15 minutes.

- Assessment of muscle strength for each patient took about 30 minutes for each study patient.

- Each patient was observed in the morning and afternoon shifts by the researcher during the actual performance of preventive measures (positioning, range of motion, chair sitting and walking) and it took about 15-20 minutes to see if preventive measures were done or not.

- Assessment of nutritional status for each studied patient took about 20-30 minutes to calculate the ideal and actual nutritional intake.

III-Administrative design:

An official letter was issued from the Faculty of Nursing Ain-Shams University to the director of Beni- Suef university Hospital and Director of General, Internal medicine and chest ICU units, at which the study was conducted, explaining the purpose of the study and requesting the permission for data collection from the study group.

IV-Statistical design:

All Data were collected, tabulated and subjected to statistical analysis, which is performed by SPSS in general (version 17). While Microsoft office Excel is used for data handling and graphical presentation. The statistical analysis included; number (No.), percentage (%), the arithmetic mean (\bar{X}), standard deviation (SD), chi-square (χ^2) and Z-Test.

The observed differences and associations were considered as follows:

P. > 0.05 insignificant difference (No difference)

P. ≤ 0.05 significant difference

P. ≤ 0.001 highly significant difference

- Standard Deviation (SD) and arithmetic mean (\bar{X}) were used for quantitative data e.g age and muscle strength score.

- Frequency (number and percentage) were used for Qualitative categorical variables.

- Chi-square and Z-test were used to test of association between incidence of ICU-AW and variables of study.

Result

Table (1): Frequency distribution of studied patients regarding 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		
Illitrate	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%

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Urban	18	24.0%
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Table (1): This table revealed the frequency distribution of studied patients regarding demographic characteristics. Regarding patient age, Mean \pm SD of studied patients were 48.29 ± 16.22 . As regarding to gender, the results revealed that 52.0% of studied patients were male. In relation to the level of education, 42.7% of them were illiterate. Regarding occupation of studied patients, 33.3% were house wife and 76.0% were from rural area.

Table (2): Frequency distribution of studied patients according to their admission medical diagnosis (n=75).

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%

Table (2): This table reported the frequency distribution of studied patients according to their admission medical diagnosis. The result revealed that 46.7% of studied patients had respiratory disorder. While cardiovascular and renal disorder represent 14.7% and 12.0% respectively. Meanwhile 1.3% of studied patients had cancer, infectious and endocrine disorders.

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

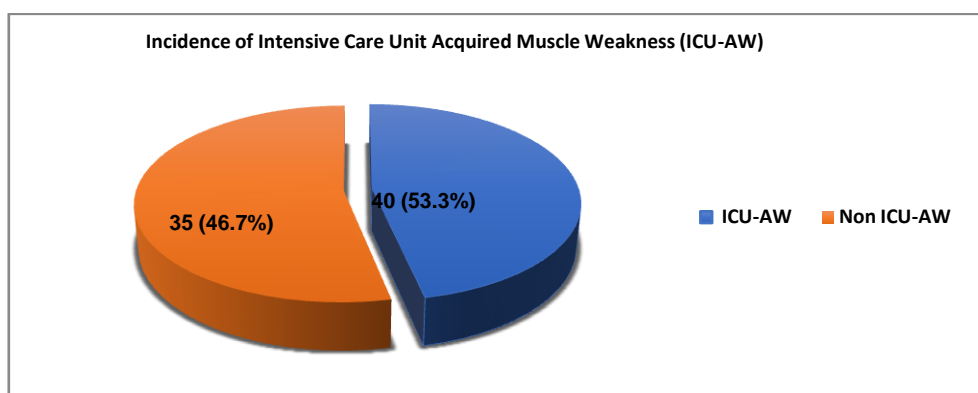
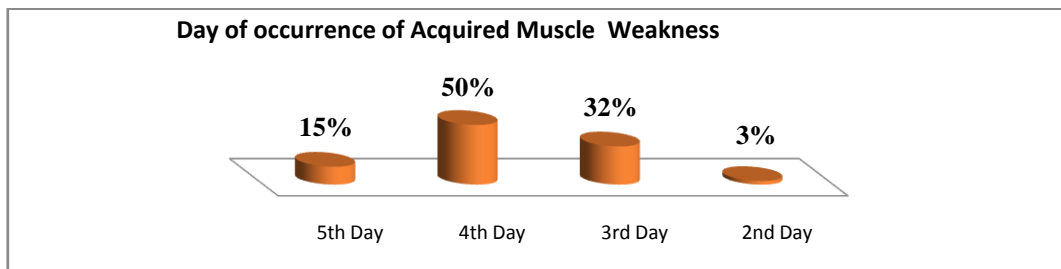


Figure (1): This figure illustrated that 53.3% of studied patients had intensive care unit acquired muscle weakness. While 46.7% of studied patients not had intensive care unit acquired muscle weakness.

Figure (2): Distribution of patients with acquired muscle weakness according to the day of occurrence (n=40).



Figure(2):This figure showed distribution of patients with acquired muscle weakness according to the day of occurrence. Regarding day of weakness the result revealed that 50.0% of studied patients had muscle weakness in the 4th day of admission, while 32.5%, 15% and 2.5% of them had muscle weakness in the 3rd, 5th and 2nd day of admission.

Table (3): Frequency distribution of procedures related factors application contributing to Intensive Care Unit Acquired Muscle Weakness among studied patients (n= 75).

Procedures related factors	Non ICU-AW (n=35)				ICU-AW (n=40)			
	Done		Not Done		Done		Not Done	
	No.	%	No.	%	No.	%	No.	%
Positioning	1	2.9%	34	97.1%	0	0.0%	40	100%
Range of motion exercises	16	45.7%	19	54.3%	0	0.0%	40	100%
Walking exercises	28	80.0%	7	20.0%	25	62.5%	15	37.5%
Chair sitting exercises	18	51.4%	17	48.6%	6	15.0%	34	85.0%

Table(3):This table showed the frequency distribution of procedures related factors application contributing to intensive care unit acquired muscle weakness among studied patients. For the Non ICU-AW patients, the application of procedures related factors was 80.0% for walking exercise, 51.4% for chair sitting, 45.7% for range of motion, and 2.9% for positioning. While for the ICU-AW patients, the application of procedures related factors was 62.5% for walking exercise, 15.0% for chair sitting exercise and 0.0% for positioning and range of motion.

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Table (4): Frequency distribution of drug and nutritional related factors that contributing to intensive care unit acquired muscle weakness among studied patients (n=75).

Factor	Non ICU-AW (n=35)		ICU-AW (n=40)	
	No.	%	No.	%
Drug related factor (corticosteroid)				
-No	29	82.9%	16	40.0%
-Yes	6	17.1%	24	60.0%
Nutrition related factor				
-Well Nourished	26	74.3%	11	27.5%
-Malnourished	9	25.7%	29	72.5%
Method of Nutritional Support Related factor				
-Oral	25	71.4%	21	52.5%
-Enteral	0	0.0%	1	2.5%
-Parenteral	10	28.6%	18	45.0%

Table(4):This table illustrated the frequency distribution of drug and nutritional related factors that contributing to intensive care unit acquired muscle weakness among studied patients. In the Non ICU-AW patients, 17.1% received corticosteroid, 25.7% were malnourished and 71.4% were feeding orally. While in the ICU-AW patients, 60.0% received corticosteroid, 72.5% were malnourished, 52.5% were feeding orally and 45.0% were on parenteral feeding.

Table(5):Relation between demographic data of studied patients and incidence of intensive care unit acquired muscle weakness (n=75).

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						
Illitriate	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%		
House wife	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 (5): This table revealed that there was a highly statistical significant relation between incidence of intensive care unit acquired muscle weakness and patient age at P value .0014. While, there was no statistical significant relation between incidence of intensive care unit acquired muscle weakness and other demographic characteristics such as gender, level of education, occupation and residence at P value (.19457, .65384, .26757 and .38588) repectively.

Table(6):Relation between application of procedures related factors contributing to muscle weakness and incidence of intensive care unit acquired muscle weakness among the studied patients (n= 75).

Procedures related factors	Non ICU-AW(n=35)		ICU-AW (n=40)		Test (Z)	P value
	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): This table revealed that there was a highly statistically significant relation between incidence of intensive care unit acquired muscle weakness and application of procedures related factors as range of motion and chair sitting at P .00002 and .00988 respectively. While, there was no statistical significant relation between incidence of intensive care unit acquired muscle weakness and application of other procedures related factors as positioning and walking exercise at P value .34634 and .89217 respectively.

Table (7): Relation between drug and nutritional related factors contributing to muscle weakness and incidence of intensive care unit acquired muscle weakness among studied patients (n=75).

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%		
Nutrition related factor				
-Well nourished	74.3%	27.5%	16.35	.00005*
-Malnourished	25.7%	72.5%		
Method of Nutritional Support				
-Oral	71.4%	52.5%	3.31	.19062
-Enteral	0.0%	2.5%		
-Parenteral	28.6%	45.0%		

NS (No Significant) P value > 0.05 HS (Highly Significant) * P value < 0.01

Table (7): This table revealed that there was a highly statistical significant relation between incidence of intensive care unit acquired muscle weakness and both drug & nutrition related factor at P value .00016 and .00005 respectively. While, there was no statistical significant relation between incidence of intensive care unit acquired muscle weakness and method of nutritional support at P value .19062.

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Discussion

Critical illness myopathy (CIM) and polyneuropathy (CIP) are common complications of critical illness. Both cause ICU-AW. Such acquired muscle weakness is characterized by a profound weakness that is expected from prolonged bed rest and in whom there is no plausible etiology other than critical illness (*Nordon-Craft, Moss, Quan & Schenkman, 2012*).

The aim of the current study was to assess factors contributing to acquired muscle weakness among critical ill patients. To fulfill this aim the following question was stated: What are the factors contributing to acquired muscle weakness among critical ill patients?

Part (I): Concerned with demographic characteristics and medical data of the patient under the study.

Regarding demographic characteristic of studied patients:

Regarding age of studied patients, the current study revealed that less than half of studied patients were equal or more than fifty years. **From the researcher point of view**, the numbers of elderly people were high in the study as the burden of comorbid and chronic disease rise with age and they were in need for hospitalization and ICU care.

This finding agreed with *Polly, Spuhler, Louise & Kristy, (2007)* who **conducted** a study titled "Early activity is feasible and safe in respiratory failure patients at respiratory intensive care unit (ICU) in Salt Lake City-United Kingdom (UK) and **found that** less than half of studied patients were more than fifty years.

Regarding gender, the current study revealed that more than half of studied patients were male. **From the researcher**

point of view, the numbers of critically ill male patients were high in the study because of the immunological effect of sex hormone on incidence of critical illness as estrogen hormone improve the heart, hepatic and immunity function and decrease number of illness in female than in male.

This finding agreed with *De litter et al., (2001)* who **conducted** a study titled "Risk for the development of polyneuropathy and myopathy in critical ill patients at the ICU of the St. Elisabeth Hospital- Tiburg)) and **mentioned that** more than half of studied patient were male.

Regarding medical data of the studied patients:

Regarding medical diagnosis on admission of studied patients, the current study revealed that the incidence of cardiovascular, respiratory and renal disorders were common and more than one third of studied patients had respiratory disorders, less than one fifth of them had cardiovascular disorders and a minority of them had cancer and infectious disorders.

From the researcher point of view, the incidence of cardiovascular, respiratory and renal disorders were high among studied patients due to increase percentage of cigarette smoking, high cholesterol and salty diet and sedentary life style and these disorders were life threatening situation and require intensive treatment. Also, patients with neurological and immunological disorders were excluded from this study.

This finding was supported by *Mehrholz, Muckel, Oehmchen & Pohi, (2015)* who **conducted** a study titled "First result about recovery of walking function in patients with intensive care unit acquired weakness from the general weakness syndrome therapy cohort study at Post-acute ICU and rehabilitation units in Germany)) and **found that** less than one fifth of studied patients had cardiovascular

disorder.

Part (II): Concerned with the muscle strength and indicators to incidence of Intensive Care Unit Acquired Muscle Weakness among the studied patients.

Regarding the incidence of ICU-AW, the current study revealed that more than half of studied patients developed ICU-AW.

From the researcher point of view, the incidence of ICU-AW were high as the majority of patient were old age, malnourished and received corticosteroid and all these factors decrease protein synthesis in the muscle and also decrease muscle strength and tone.

This finding was supported by **Sharshar et al., (2009) who conducted** a study titled "Presence and severity of intensive care unit acquired paresis at the time of awakening are associated with increased intensive care unit and hospital mortality at 2 medical, one surgical and one medico-surgical ICU in 2 University Hospital-Paris)) and **showed that** more than half of studied patients developed Intensive Care Unit Acquired Paresis (ICUAP).

This finding was inconsistent with **Yu, Wan, Wan & Huang, (2018) who conducted** a study titled "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-AW.

Regarding occurrence day of weakness of ICU-AW patients, the present study revealed that a minority of ICU-AW patients had weakness in the second day of admission. While one third of them had

weakness in the third day of admission and half of them had weakness in the fourth day of admission. **From the researcher point of view, in this study** number of cases with ICU-AW increased in the third and fourth day of admission then decreased in the fifth day; this might be number of cases admitted to ICU and meet criteria of ICU-AW but logically increase LOS in ICU lead to patients were exposed to factors that increase incidence of ICU-AW.

This finding disagreed with **Brunello, Haenggi, Porta, Takala & Jakob, (2010)** who conducted a study titled "Usefulness of a clinical diagnosis of ICU acquired paresis to predict outcome in patients with SIRS and acute respiratory failure in Bern University Hospital at Switzerland)) and **found that** less than one quarter of ICUAP patients had weakness in the third day of admission, less than half of them had weakness in the sixth day of admission and one third had weakness in the seventh day of admission.

Part III: Discussed factors contributing to Intensive Care Unit Acquired Muscle Weakness (ICU-AW):

Regarding application of procedures related factors contributing to intensive care unit acquired weakness. The current study revealed that application of procedures related factors in the Non ICU-AW patients was more than three quarter had done walking exercise, more than half for chair sitting and less than half for range of motion. While, the application of those procedures in ICU-AW patients were more than two third for walking exercise and less than one fifth for chair sitting. No one in the ICU-AW patients had done positioning and range of motion exercises.

From the researcher point of view, the application of procedures related factors were inadequate in the ICU-AW patients because some patients were immobilized

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due to their medical condition and some procedures not applied to them e.g walking and chair sitting exercise; new staff members were assigned to care for them and not had knowledge about the importance and application of these preventive measures and its effect on muscle strength.

These findings were consistent with **Asfour, (2016) who conducted** a study titled "Contributing factors for acquired muscle weakness in intensive care unit at Four general ICUs in two selected Hospitals in Makah in Kingdom of Saudi Arabia (KSA)) and **reported that** no one in the ICU-AW patients had done range of motion and in the Non ICU-AW patients nearly half of patients had done range of motion exercise.

Regarding distribution of drug related factors contributing to intensive care unit acquired muscle weakness. The current study revealed that two third of patients in the ICU-AW received corticosteroid. While less than one fifth in the Non ICU-AW patients were received the drug. **From the researcher 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 **De jonghe et al., (2002) who showed that** more than half in the ICUAP patients was received cortisone. While less than one fifth in the Non ICUAP patients was received the drug.

Regarding distribution of nutrition related factors contributing to intensive care unit acquired muscle weakness. The current study revealed that less than three quarter of the ICU-AW patients were malnourished. While less than three quarter of the Non ICU-AW patients were well nourished.

From the researcher point of view, incidence of malnutrition were high in ICU-AW patients due to neglecting of staff members about nutritional assessment of admitted patient, didn't give correct and healthy diet; absence of lab investigations that helping in identifying incidence of malnutrition e.g Pre-albumin and serum transferrin. Also, staff members didn't provide patient and relatives with information about correct healthy diet, and bed rest that decrease appetite and bowel movement.

This finding agreed with **Hermans et al., (2014) who** conducted a study titled "Acute Outcomes and 1-Year Mortality of Intensive Care Unit acquired Weakness. A Cohort Study and Propensity-matched Analysis at Medical ICU in University Hospital of Leuven-Belgium)) **and mentioned that** less than three quarter of Non ICU-AW patients were well nourished. While two fifth of ICUAW patients were malnourished.

Regarding distribution of nutritional support method related factors contributing to intensive care unit acquired muscle weakness. The current study revealed that parenteral nutrition was administered in the ICU-AW patients higher than in the Non ICU-AW patients who were administered oral nutrition.

From the researcher point of view, the administration of PN were high in ICU-AW patients because they were malnourished; unable to feed themselves as they were too old and critically ill; restriction of oral feeding in some patients; some time oral diet wasn't enough and patients need extra caloric requirement. So they were in need for PN to provide them with amino acid, lipid, fluid, glucose, vitamins and minerals.

This finding was in agreement with **Garnacho et al., (2001) who reported that** parenteral nutrition was given in the ICUAP

patients higher than in the Non ICUAP patients.

Part V: Relations between incidence of ICUAW and contributing factors.

Relation between demographic characteristic of studied patient and incidence of ICUAW:

Regarding 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 incidence of intensive care unit acquired weakness and patient age.

From the researcher point of view, this may be due 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, Garcia, Dargains & Settembrino, (2017) who reported that** the patients of ICU-AW were old age. So, the development of ICU-AW was associated with age.

Regarding relation between incidence of ICU-AW and other demographic characteristic of studied patient 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.

These findings were similar to **Rousti et al., (2010) who found no** significant difference between incidence of ICU-AW and gender.

These findings were contradicted with **Wieske et al., (2014) who found that** there was a significant relation between incidence of intensive care unit acquired weakness and female gender.

Relation between admission medical diagnosis of studied patient and incidence of ICU-AW, the current study findings revealed that there was no statistically significant relation between admission medical diagnosis and incidence of ICU-AW.

This finding was supported by **Asfour, (2016) who reported that** there was no significant difference regarding patient diagnosis on admission between ICU-AW patients and Non ICU-AW patients.

Relation between application of procedures related factors contributing to muscle weakness and incidence of intensive care unit acquired muscle weakness among studied patients

The current study revealed that there was a highly statistically significant relation between incidence of ICU-AW and application of procedures related factors as range of motion exercise and chair sitting exercise. While, there was no statistically significant relation between incidence of ICU-AW and application of other procedures related factors as positioning and walking exercise.

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

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These findings agreed with *Williams et al., (2015)* who conducted a study include applying a program consist of (passive and active range of motion, chair sitting, standing practice and walking exercise) to ICU patients especially patients with ICU-AW)) and **found that** manual muscle strength at ICU discharge was improved. So, there were a significant relation between incidence of ICU-AW and not applying preventive measures e.g chair sitting, walking and range of motion exercise

Regarding relation between drug related factors (corticosteroid) and incidence of intensive care unit acquired muscle weakness among studied patients:

The finding 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 *Witteveen et al., (2017)* who conducted a study titled "Increased Early Systemic Inflammation in ICU-Acquired Weakness; A Prospective Observational Cohort Study at mixed medical-surgical ICU of the Academic Medical Center in the Netherlands-Amsterdam)) and **reported that** there was highly significant relation between incidence of ICU-AW and using of corticosteroid in ICU.

This finding contradicted with Hermans, Dejonhe, Bruyninckx & Van, (2009) who found that no significant effect of corticosteroids on the incidence of CIP and CIM.

Regarding relation between nutritional related factors and incidence of intensive care unit acquired muscle weakness among studied patients:

The finding of the current study revealed that there was a highly statistically significant relation between incidence of ICU-AW and nutritional related factors.

In the researcher's opinion, Malnutrition is an important cause of muscle mass loss in critical ill patient as they receive calories less than required for their needs. So, adequate nutritional intake and an optimal dietary acid-base balance are important elements to preserve muscle mass and strength.

This finding was at the same line with *Michael & Van, (2014)* who reported in a clinical review article titled "Nutrition in the acute phase of critical illness)) that critically ill patients requiring vital organ support in ICU commonly have anorexia and may be unable to feed volitionally by mouth for periods ranging from days to months. Unless such patients are provided with macronutrients in the form of enteral or parenteral nutrition, they accumulate an energy deficit that rapidly reaches proportions that contribute to lean-tissue wasting and that are associated with adverse outcomes like severe skeletal-muscle wasting and weakness occurring during critical illness.

This finding was inconsistent with *Hermans et al., (2013) who conducted a study titled "Effect of tolerating macronutrient deficit in the development of intensive care unit acquired weakness at Medical Intensive Care Unit, University Hospitals Leuven – Belgium)) and found that* tolerating the macronutrient deficit early during critical illness didn't effect on wasting but allowed more efficient activation of autophagic quality of myofibers and reduce muscle weakness.

Regarding relation between method of nutritional support and incidence of intensive care unit acquired muscle weakness among studied patients: The current study revealed that there was no

statistically significant relation between incidence of ICU-AW and method of nutritional support.

This finding was consistent with **Bercker et al., (2005)** who stated that statistical analysis demonstrated no significant difference between group with and without ICUAP regarding frequency of parenteral nutrition.

This finding contradicted with **Casaer, (2015)** who stated in a clinical review titled "muscle weakness and nutrition therapy in ICU) that administration of parenteral nutrition increase incidence of ICU-AW.

Conclusion

Based on the findings of the current study, it can be concluded that: More than half of studied developed intensive care unit acquired muscle weakness (ICU-AW). Half of weakness patients developed this muscle weakness in the fourth day of admission. Application of positioning and range of motion exercises were not done in the ICU-AW patients. As well, more than half of ICU-AW patients received corticosteroid, less than three quarter of them were malnourished and nearly half of them were feeding parentally. There was a statistically significant relation between incidence of ICU-AW and patient age, WBCs level, drug and nutrition related factor and application range of motion and chair sitting exercises. Also, there was no statistically significant relation between occurrence of ICU-AW and patient gender, level of education, occupation, residence, admission medical diagnosis, serum albumin and CK level, administration of parenteral nutrition and application of positioning and walking exercises.

Recommendation

The results of this study projected the following recommendations:

A-Related to knowledge:

- Provide patient and CCNs with information about component of healthy diet required for each patient and the correct method of administration.
- Procedure technique book regarding application of preventive measures of ICU-AW (Range of motion, positioning, chair sitting and walking exercise) should be available in ICU.

B-Related to Practice:

- Application of muscle strength scale to assess muscle strength of all admitted patient to ICU in daily routine nursing assessment.
- Assessment of nutritional status of all admitted patient to ICU.
- Certain lab investigations e.g serum pre-albumin, albumin and transferrin should be done as daily routine for all ICU patients.

C-Related to Education:

- Provide continuous educational session and scientific courses for CCNs to revise their knowledge about risk factors, etiology and new technology & procedures helping in the prevention and treatment of ICU-AW.

D-Related to Research:

- This study should be replicated on larger probability sample in different hospitals in order to generalize the results.
- Further researches are recommended to study extensively the effect of nutritional status on incidence of ICU-AW. Further studies are needed to examine the incidence of ICU-AW in sedated and unconscious patients.

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