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NURSING-LED DETERMINANTS OF VENTILATOR-ASSOCIATED PNEUMONIA (VAP) RESOLUTION: THE ROLES OF ENTERAL NUTRITION, COMORBIDITY BURDEN, AND RESPIRATORY MUSCLE STRENGTH

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Abstract

Background: Although most previous studies on ventilator-associated pneumonia have focused on risk factors and preventive bundles, limited attention has been given to recovery-oriented and resilience-enhancing variables, particularly in low- and middle-income settings such as Pakistan. This study examined the burden of comorbidity and the contribution of enteral nutrition to ventilator-associated pneumonia resolution, with respiratory muscle strength considered as a mediating variable influencing patient recovery outcomes. Methodology: A quantitative cross-sectional design was applied. Data were collected from intensive care unit nurses working in tertiary care hospitals in Lahore through standardized questionnaires. A total of 350 participants were included in the study. Statistical analysis was conducted using SPSS, and reliability testing indicated high internal consistency with a Cronbach alpha value of 0.917. Results: Among the 350 participants, 94.3 percent were female. Respiratory muscle strength demonstrated the highest mean score (4.07 ± 0.75). Enteral nutrition was positively associated with ventilator-associated pneumonia outcomes (r = 0.377). The analysis further revealed that respiratory muscle strength mediated the relationship between comorbidity burden and ventilator-associated pneumonia outcomes. The findings suggest that improved respiratory muscle strength, leading to faster recovery from ventilator-associated pneumonia, is strongly associated with timely enteral nutrition and a lower burden of comorbidities. Conclusion: The study highlights the importance of a synergistic nursing approach that integrates nutritional management and strengthening of respiratory function in the care of patients with ventilator-associated pneumonia. These findings provide practical implications for intensive care unit nursing practice and support the development of cost-effective interventions aimed at improving ventilator-associated pneumonia outcomes in resource-constrained healthcare environments.

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INTRODUCTION

Ventilator-associated pneumonia (VAP) is one of the most widespread hospital-acquired infections in patients on mechanical ventilators who are admitted to intensive care units (ICUs). It leads to high mortality rate, ICU stay, and healthcare spending rate in the world. (Al.Tawfiq, 2014). VAP is quite prevalent in the developing world, including in Pakistan because the countries in the developing world have fewer resources, and their ICUs are stricter, and they are less likely to comply with the evidence-based care practices. The prevalence rates of VAP in the Pakistani ICUs are reported to be moderate up to alarming (in the hospitals of the governmental sphere) as well (Molto, 2014).

Most of the existing VAP research studies have predominantly focused on the incidence, trends in the microbes, resistance to antibiotics as well as adherence to incivility to ventilator care stipulates. Inasmuch as such studies are necessary, they instead focus more on prevention but not recovery (Preiser, 1999). Minor efforts have been directed towards patient related protective factors that can enhance resilience and recovery after VAP has been developed. Such aspects are important to know how to improve the outcomes of patients, particularly when it is impossible to enforce some advanced technological interventions in a specific environment (Dou, 2018).

Enteral nutrition prevails in the critical care nursing practice and is critical in preservation of immunity, gut integrity, and muscle mass. The initial and adequate enteral nutrition was found to correlate with improved clinical results in patients on mechanical ventilating. However, the timing, materials, or wrong monitoring of enteral nutrition can also result in the development of such complications as aspiration and slow healing. Some of the issues that have often impacted the optimal feeding practices in the ICUs in Pakistan are the lack of personnel and inconsistent feeding policies (Dou, 2018; Modibbo & Inuwa, 2020; Russo, 2022).

Another important yet underinvestigated factor is comorbidity burden. The patients with less chronic illnesses tend to have more physiological stores, which may be utilized to come out of an acute infection such as VAP. It has been attributed to reduced comorbidity, which is attributable to the increased respiratory capacity and tolerance to mechanical ventilation. However, minimal studies have been carried out so far to examine the relationships between comorbidity burden and nursing interventions regarding the VAP outcome (Mehmood, 2022).

The muscle strength of respiratory muscles is a very crucial factor to determine success in weaning against mechanical ventilation and recovery against respiratory infections. Long term ventilation and critical illness is prone to respiratory muscle weakness which decreases the speed of extraction process and predisposes the occurrence of complications. Nurses should be leaders in interventions, including nutritional support and early mobilization, in the maintenance of respiratory muscle strength (Ufaq, 2019; Rashid, 2019; Khan, 2020).

In this paper, these variables are put together through the use of enteral nutrition and comorbidity burden as the predictors of VAP resolution and the respiratory muscle strength as the mediating variable (Mehmood, 2022). According to the Self-Care Deficit Nursing Theory developed by Orem, the study revolves around the nurses who play an active role in achievement of the physiological self-care needs of patients. The research will provide the Pakistani ICUs with a comprehensive and contextually viable framework to improve the outcomes of VAP since it focuses on recovery-oriented determinants (Rashid, 2019).

LITERATURE REVIEW

The Self-Care Deficit Nursing Theory (SCDNT) of Orem will be used as the basis of the current research since it will involve the nurse attempting to assist the patients who cannot meet their self-care needs independently. ICU patients who are in a critical state are entirely dependent on nurses to fulfil the main functions such as nutrition, airway management, and infection prevention. SCDN reports that self-care deficit is conquerable with the help of appropriate nursing intervention and results into recovery. This theoretical perspective is closely related to enteral nutrition and respiratory care as they promote the self-care needs of patients through physiological means (Aziz, 2020; Akbar & Hayat, 2020; Quader, 2024).

Early enteral nutrition has been established to boost the immune system and reduce the complications that are brought about by infections (Ali & Senturk, 2019; Raja & Iqbal, 2019; Muhammad & Yan, 2019; Rehman & Malik, 2020; Marc & Roussel, 2024; Marc et al., 2025). It has been found that high protein and energy formulas help in the maintenance of muscle mass like respiratory muscles of patients in mechanical ventilators. In contrast, enteral nutrition which is late or received

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insufficiently is associated with the risk of aspiration, and the prolonged ventilation. Standardized enteral feeding protocols are required, according to the international literature, in reducing comorbidities due to VAP (Alvina, 2022).

The overall impact of chronic diseases on patient outcomes is measurement comorbidity burden which can be measured using the Charlson Comorbidity Index. Patients having comorbidities will require a prolonged recovery, more reliable on ventilators, and high mortality. Evidence indicates that reduced load of comorbidity is associated with better functional recovery and reduced comorbidity associated ICU complications. However, research guidelines on the overall indirect effect of it on the outcomes of VAP through physiological mediators are limited, such as respiratory muscle strength (Dou, 2018; Ismail & Ali, 2020).

Proper breathing as well as coughing and to stop mechanical ventilation depends on the strength of respiratory muscles. Muscle weakness of the critical illnesses is a well-known problem within the ICUs and is associated with the prolonged length of ventilation as well as the high mortality of VAP. Studies have shown that improved performance of respiratory muscles is caused by proper nutrition and decreased burden of diseases. However, patient-respiratory muscle strength-patient outcome VAP is a poorly researched interrelation (Brink et al., 2018).

RESEARCH GAP

Although the existing body of literature can address the issue of enteral nutrition, comorbidity burden, and respiratory outcomes independently, one lacks a structure of joint effects of the three factors on VAP resolution (Odoom, 2025).

In particular, there is practically no empirical evidence of the Pakistani situation, which could justify nursing-based nutritional practices, resilience of patients, and recovery of VAP. This study fills this gap by establishing and testing a mediation model to describe the connection between respiratory muscle strength in the association between enteral nutrition and comorbidity load to VAP recovery (Odoom, 2025).

HYPOTHESES

H1: enteral nutrition and respiratory muscle strength have a positive relationship.

H2: Respiratory muscle strength has a positive association with light burden comorbidity.

H3: There is a positive relationship between respiratory muscle strength and VAP resolution.

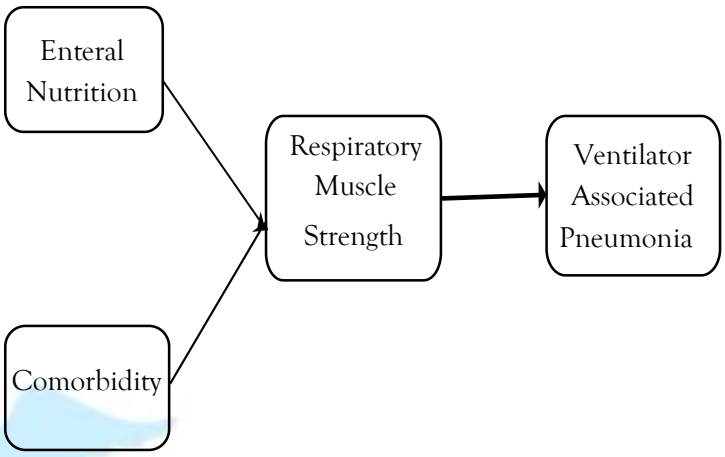
H4: There is a positive relationship between VAP resolution and enteral nutrition.

H5: The decreased comorbidity burden will have a positive correlation with the VAP resolution.

H6: Strength of respiratory muscles mediate the relationship between the burden of comorbidity and VAP resolution.

H7: The lower load of comorbidity was positively related to the enhancement of respiratory muscle strength and faster recovery of VAP.

THEORETICAL FRAMEWORK



RESEARCH METHODOLOGY

The focus area will be Lahore, as Lahore is a large health center, and Lahore boasts of large public hospitals and well-developed Intensive Care Unit where the ICU nurses experience a rich diversity of clinical experiences. Services Hospital Lahore and Punjab Institute of Cardiology are chosen as the most specialized critical care units and are near to the researcher, which will allow collecting data on this student-led study, with minimal cost and less time (Greenhalgh, et al., 2018; Yinusa & Ogoun, 2024).

SAMPLING METHOD

The sampling is conducted in a non-probability way since neither a complete and recent list of nurses working in the ICU nor the timetable of rotating shifts characteristic of critical care facilities is provided. The approach enabled the participants to engage at their convenience, without interfering with the care of the patient, and, hence, it was a time-constrained research performed in a hospital setting (Modupe, 2021; Sedgwick, et al 2015).

ONTOLOGY

The ontological position in this work concerns the realism, it assumes that the reality exists independently of any human perception, and it can be objectively seen in health care facilities. The assumption is that the patterns of patient recovery and nursing practice are constant phenomena, and

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the study may be selective to quantifiable and consistent variables at the level of the various individuals and ICUs (Crotty, et al.2015).

EPISTEMOLOGY

The epistemology employed in this study was the objectivist epistemology that knowledge is to be obtained through systematic observation and measurement rather than beliefs of an individual. Standardized instruments are also used, and the data is collected in a structured manner, which allows the study to be evidenced-based, testable, and verifiable findings (Blaikie, et al. 2018; Mehdi, 2019).

RESEARCH PARADIGM

This study adopts a positivist paradigm of the study due to its realist ontology and objectivist epistemology, which appeals to observation, measurement and statistical test to study about relationship among variables. Positivism allows applying the findings to other similar ICU units and evidence-based practice in nursing (Artino, et al.2020).

RESEARCH APPROACH

It is performed in a deductive approach in which theories derived on the basis of existing literature are made and refuted through quantitative approaches. This approach provides a logical and systemic platform upon which the theoretical anticipations are examined in actual ICU practice so that it can help to produce generalizable findings (Ketokivi et al 2012).

RESEARCH DESIGN AND CHOICE

The quantitative research design is applied to the study to quantify variables and compare statistical associations among the variables of the study. This is the best research design since it allows objective, consistent, and replicable data collection and analysis and is suitable to establish trends in nursing care and patient outcomes in the ICU (Coughlan et al. 2015).

RESEARCH STRATEGY

The research design adopted is the quantitative research design because the study will be centred on the structured data gatherings and numerical analyses in an attempt to answer these hypotheses and form the connection between variables. The reliability that is brought about by standardized instruments and statistical techniques gives the result the reliability to replicability and applicability in other similar ICU experiences (Hameed, 2020; Grove, et al.2021).

ETHICAL CONSIDERATIONS

The provision of ethical approval was done through the institutional review boards of the participating hospitals. The principles of the informed consent, confidentiality, voluntary participation, and a right to discontinue were observed, and the data collection process was well-designed without disrupting patient care and based on the concepts of beneficence, non-maleficence, and respect of participants (Beauchamp Fisher, et al. 2020; Akbar & Hayat, 2020; Carlo, 2025).

RESULTS

Descriptive statistics revealed that the majority of the respondents were female nurses aged between 26 and 45 years of age having bachelors education level and more than two years of experience of the ICU (Annex 1). Variables of Enteral Nutrition (EN), Comorbidity (COM), Respiratory Muscle Strength (RMS) and Ventilator-Associated Pneumonia (VAP) were the key variables of the study where descriptive statistics were established (Annex 2). Correlation analysis revealed that enteral nutrition was positively correlated with respiratory muscle strength, respiratory muscle strength and VAP resolution with strong positive relationships (Annex 3). Regression results indicated that enteral nutrition was a significant factor that affected the outcomes of VAP and burden of comorbidity. The mediation analysis established that the relationship between comorbidity load and VAP resolution partly depended on respiratory muscle strength that exhibited both direct and indirect relationships.

Statistics

		Gender	Age	Eduction	EMPLOYMENT	Organization	experience
N	Valid	350	350	350	350	350	350
	Missing	0	0	0	0	0	0

Frequency Table

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	20	5.7	5.7	5.7
	Femle	330	94.3	94.3	100.0
	Total	350	100.0	100.0	

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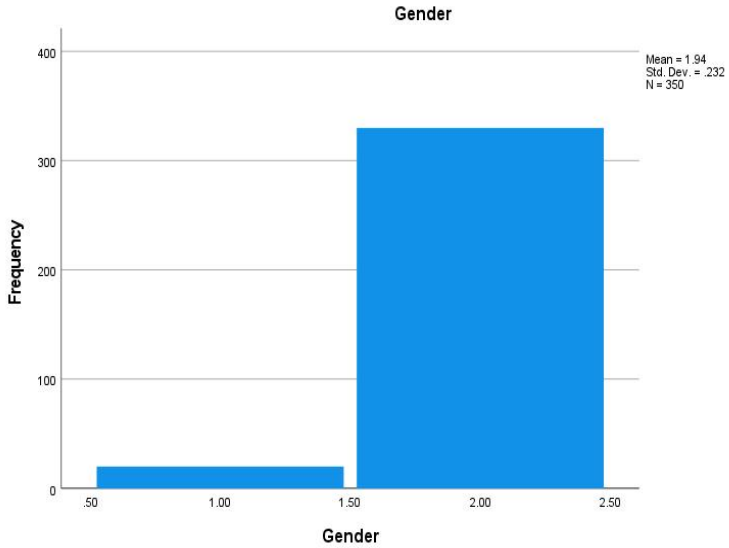
Gender Distribution

The frequency analysis revealed that of all the participants (n = 350) most were females (n = 330, 94.3%), with only 20 participants (5.7) being the males. It means that the sample of the study was mostly female which could be attributed to the gender balance in the study location or the accessibility of the sample in the collection of data.

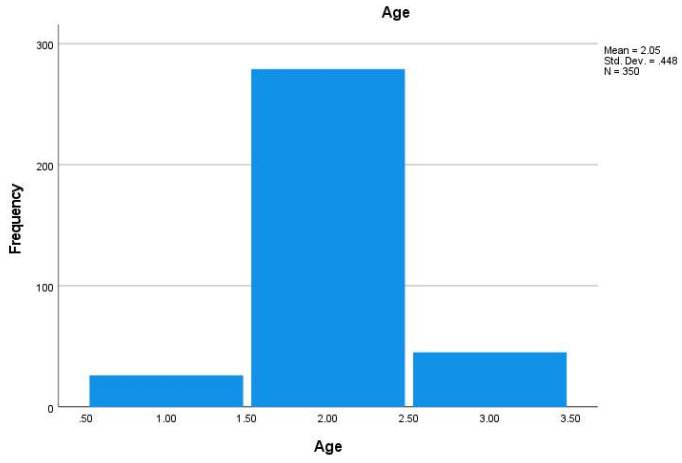


Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	up to 25	26	7.4	7.4	7.4
	26-45	279	79.7	79.7	87.1
	46-55	45	12.9	12.9	100.0
	Total	350	100.0	100.0	

Age Distribution

In terms of age, the majority of the respondents were between 26 and 45 years (n = 279, 79.7%) and then 46 to 55 years (n = 45, 12.9%). A reduced percentage of respondents were aged 25 years and below (n = 26, 7.4%). Such results indicate that most respondents were these middle-aged adults and this aspect is significant in the interpretation of the study results.



Eduction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	63	18.0	18.0	18.0
	Bachelors	236	67.4	67.4	85.4
	Masters	30	8.6	8.6	94.0
	SPECIALITY	21	6.0	6.0	100.0
	Total	350	100.0	100.0	

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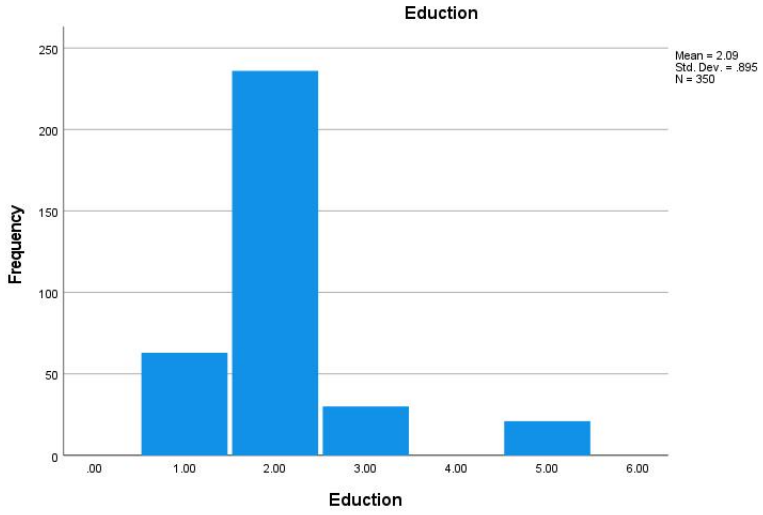
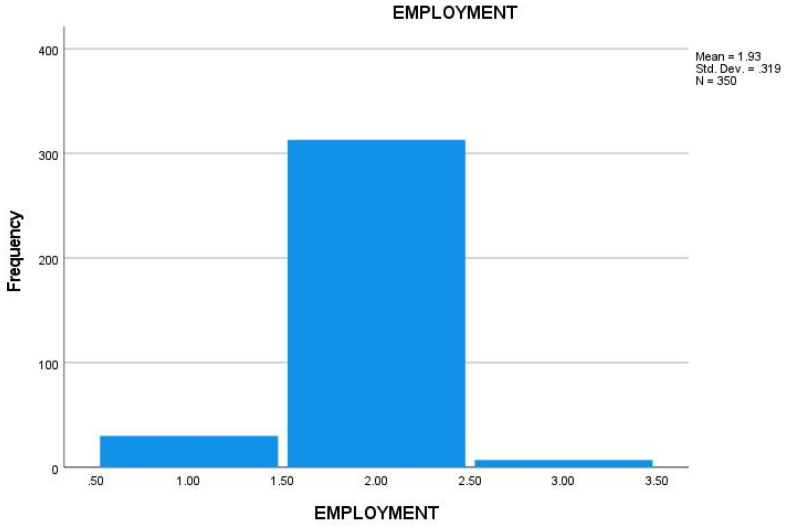


EMPLOYMENT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	CONTRACT	30	8.6	8.6	8.6
	PRMANENT	313	89.4	89.4	98.0
	OTHERS	7	2.0	2.0	100.0
	Total	350	100.0	100.0	



Organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pic	211	60.3	60.3	60.3
	Shl	62	17.7	17.7	78.0
	Jinnah	77	22.0	22.0	100.0
	Total	350	100.0	100.0	

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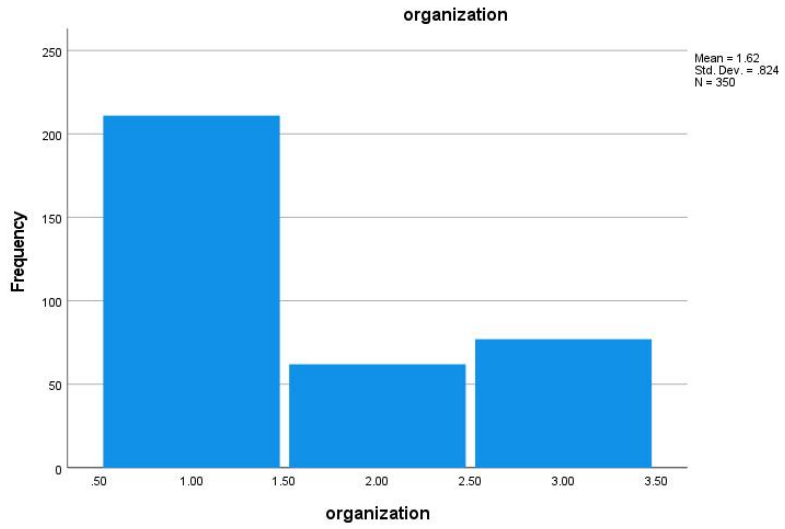
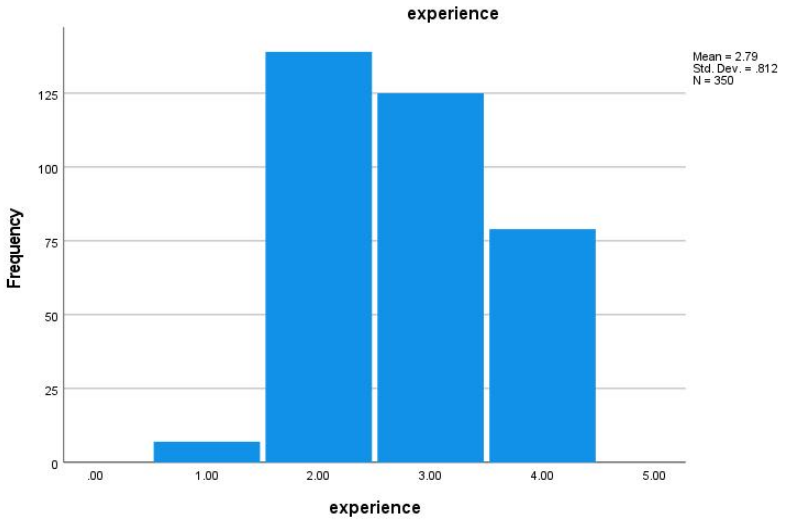


Experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	up to 1 yr	7	2.0	2.0	2.0
	25 yr	139	39.7	39.7	41.7
	5-10 yr	125	35.7	35.7	77.4
	10+ yr	79	22.6	22.6	100.0
	Total	350	100.0	100.0	



Case Processing Summary			
Cases	Valid	350	100.0
	Excluded[a]	0	.0
	Total	350	100.0

The summary of the case processing shows that there was no invalidity in all the 350 cases (100%), and all the cases were not eliminated in the analysis. This proves that the dataset was not missing values and therefore the statistical analysis is reliable and accurate.

Reliability Analysis of the Study Instrument

Cronbach alpha was used to test the internal consistency of the questionnaire. The findings revealed that Cronbach alpha of 87 items was 0.917 indicating high reliability. This alpha value is high which proves that the instrument that was utilized in the study was very consistent and can be further analyzed statistically.

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Cronbach's Alpha	N of Items
.917	87

Correlations

		EN	COM	RMS	VAP
EN	Pearson Correlation	1	.089	-.012	.377**
	Sig. (2-tailed)		.098	.816	.000
	N	350	350	350	350
COM	Pearson Correlation	.089	1	.186**	.139**
	Sig. (2-tailed)	.098		.000	.009
	N	350	350	350	350
RMS	Pearson Correlation	-.012	.186**	1	.315**
	Sig. (2-tailed)	.816	.000		.000
	N	350	350	350	350
VAP	Pearson Correlation	.377**	.139**	.315**	1
	Sig. (2-tailed)	.000	.009	.000	
	N	350	350	350	350

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation Analysis

The Pearson correlation analysis has been done to establish the relationship between Enteral Nutrition, Comorbidity, Respiratory Muscle Strength, and VAP. Enteral Nutrition was also positively and significantly correlated with VAP (r =.377, p <.01).

There was a positive significant relationship between comorbidity and RMS (r =.186, p <.01) as well as with VAP (r =.139, p <.01).

Respiratory Muscle Strength also proved to have significant positive relationship with VAP (r =.315, p <.01).

Enteral Nutrition and RMS did not show any significant correlation.

These findings suggest the existence of significant relationships between the variables under study, which is why additional regression and mediation analysis should be conducted.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.392[a]	.153	.148	.57768	1.774

a. Predictors: (Constant), COM, EN

b. Dependent Variable: VAP

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	20.978	2	10.489	31.431	.000[b]
	Residual	115.800	347	.334		
	Total	136.778	349			

a. Dependent Variable: VAP

b. Predictors: (Constant), COM, EN

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.604	.438		1.378	.169
	EN	.426	.057	.368	7.412	.000
	COM	.499	.233	.106	2.147	.033

a. Dependent Variable: VAP

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Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.0636	3.2819	2.6476	.24517	350
Residual	-1.45356	1.58212	.00000	.57603	350
Std. Predicted Value	-2.382	2.587	.000	1.000	350
Std. Residual	-2.516	2.739	.000	.997	350

a. Dependent Variable: VAP

The multiple linear regression analysis indicated comorbidity (COM) and enteral nutrition (EN) had a significant predictive value on ventilator-associated pneumonia (VAP). The model explicated 15.3 percent of VAP variance. Coefficient analysis showed that both EN and COM were both significant predictors: a higher score in EN and higher score in COM was correlated with a higher predicted score in VAP. The residual statistics also showed that the observed and predicted VAP values were distributed around the mean and were largely in acceptable ranges which illustrate that the regression assumptions were moderately addressed.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.189[a]	.036	.030	.73383	1.372

a. Predictors: (Constant), COM, EN

b. Dependent Variable: RMS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.896	2	3.448	6.403	.002[b]
	Residual	186.859	347	.538		
	Total	193.755	349			

a. Dependent Variable: RMS

b. Predictors: (Constant), COM, EN

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.257	.557		4.052	.000
	EN	-.040	.073	-.029	-.552	.581
	COM	1.055	.296	.189	3.571	.000

a. Dependent Variable: RMS

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.7321	4.2866	4.0701	.14057	350
Residual	-2.17239	1.10373	.00000	.73172	350
Std. Predicted Value	-2.405	1.540	.000	1.000	350
Std. Residual	-2.960	1.504	.000	.997	350

a. Dependent Variable: RMS

Multiple linear regression showed that comorbidity (COM) and enteral nutrition (EN) are both significant predictors of RMS but the overall model accounted only 3.6% in RMS, which demonstrated that comorbidity (COM) and enteral nutrition (EN) had a weak impact on RMS. Analysis of the coefficients revealed that the difference between the coefficients of COM and EN is that the former had a significant positive predictor of RMS, but the latter was not statistically significant. The result of residual statistics indicated that the predicted values of RMS were reasonably centered about the observed values, and the standardized residuals were reasonable, which implies that the regression assumptions were satisfied sufficiently.

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Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.315[a]	.099	.096	.59508	1.764

a. Predictors: (Constant), RMS
b. Dependent Variable: VAP

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.543	1	13.543	38.245	.000[b]
	Residual	123.235	348	.354		
	Total	136.778	349			

a. Dependent Variable: VAP
b. Predictors: (Constant), RMS

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	1.571	.177		8.884	.000
	RMS	.264	.043	.315	6.184	.000

a. Dependent Variable: VAP

Residuals Statistics[a]					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.0870	2.8934	2.6476	.19699	350
Residual	-1.62902	1.26523	.00000	.59423	350
Std. Predicted Value	-2.845	1.248	.000	1.000	350
Std. Residual	-2.737	2.126	.000	.999	350

a. Dependent Variable: VAP

The simple linear regression revealed that RMS was a significant predictor of VAP with a variance of 9.9%. The positive coefficient implies that the increase in RMS scores corresponded with the increased predicted values of VAP. Statistical residues showed that the observed and predicted VAP values were clustered around zero and within tolerable values, which, together with the fact that the regression assumptions were met, indicated the studied assumption.

Table 1: ***Regression Analysis Predicting RMS from EN***

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	F	df1	df2	Sig.
.013	.000	-.003	.7461	.054	1	348	.816

Coefficients

Predictor	B	Std. Error	Beta	T	Sig.	95% CI Lower	95% CI Upper
Constant	4.116	.201	—	20.49	.000	3.721	4.511
EN	-.017	.074	-.013	-.233	.816	-.163	.128

Table 2: ***Regression Analysis Predicting VAP from EN and RMS***

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	F	df1	df2	Sig.
.494	.244	.240	.546	56.04	2	347	.000

Coefficients

Predictor	B	Std. Error	Beta	T	Sig.	95% CI Lower	95% CI Upper

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Constant	.380	.218	—	1.74	.083	-.050	.809
EN	.441	.054	.438	8.16	.000	.335	.548
RMS	.268	.039	.367	6.84	.000	.191	.346

Table 3: ***Total Effect of EN on VAP***

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	F	df1	df2	Sig.
.377	.142	.139	.581	57.66	1	348	.000

Coefficients

Predictor	B	Std. Error	Beta	T	Sig.	95% CI Lower	95% CI Upper
Constant	1.484	.156	—	9.49	.000	1.177	1.792
EN	.437	.058	.377	7.59	.000	.324	.550

Table 4; ***Mediation Analysis: Direct and Indirect Effects of EN on VAP via RMS***

Effect Type	Effect	Boot SE	Boot LLCI	Boot ULCI
Total Effect	.4366	.0575	.3235	.5497
Direct Effect	.4412	.0541	.3349	.5475
Indirect Effect (EN → RMS → VAP)	-.0046	.0243	-.0612	.0366

DISCUSSION

This research paper explored the interventions of nursing in ventilator-associated pneumonia (VAP) resolve in intensive care unit (ICU) patients that are under the control of the nurse, which are enteral nutrition, comorbidity burden and respiratory muscles strength according to the Self-Care Deficit Nursing Theory. The findings indicate the role of the nurse in helping the critically ill patients who are not able to supply themselves with the fundamental physiological needs.

The enteral nutrition (EN) and VAP outcomes have a medium positive relationship (r =.377, p <.01) and enteral nutrition itself is the best predictor in the regression analysis (B = 0.426, 5 =.368, t = 7.412, p =.001). This would mean that the immediate and adequate nutrition is a direct means of increasing patient recovery. Correct nutrition is useful in the preservation of immune functions, muscle bulk and vitality to heal tissue, which is needed in fighting infection and mechanical ventilator tolerance. EN had also a significant relation to the outcome of VAP (r =.139, p <.01) and regression prediction (B = 0.499, 8 =.106, t = 2.147, p =.033). The patients who had less chronic illness were also observed to heal faster indicating that resilience of critical illness is determined by general health and physiological reserve. The strength of the respiratory muscles was also greatly predicted by the COM (B = 1.055, =.189, t= 3.571, p =.001), meaning that the healthier patients can get stronger respiratory muscles, which will also be able to assist them to overcome VAP. The received results show that nurses should consider not only acute but also general health status of the patient when structuring their care in the ICU. VAP (r =.315, p <.01) and recovery (B = 0.264, 8 =.315, t = 6.184, p = 0.001) also exhibited a positive EMS correlation and regression relationship respectively. The tightened respiratory muscles help a patient to breathe effectively, clear the secretions and accustomed to ventilator removal and this is helpful in weaning off ventilators. The mediated analysis has revealed that RMS did not mediate the association between EN and VAP (indirect effect = 0.0046, BootSE = 0.0243, 95% CI = -0.0612 to 0.0366), so the association between enteral nutrition and recovery is not mediated through RMS, but it could be mediated by other alternative processes, e.g. the increase of immune response or the suppression of inflammation, but not necessarily through respiratory muscle strength.

The findings can be related to the Self-Care Deficit Nursing Theory that is developed by Orem as he takes into consideration the fact that ICU patients are entirely dependent on the nurses who feed, provide respiration, and prevent infections. The explanation of how the nursing interventions can compensate the lack of self-care and become active agents of recovery is provided with the help of enteral nutrition and comorbidity management. The study also sheds light on the interdependence between the patient-related factors and the nursing care. To support this, the patients with superior outcomes of recovery had lesser burden of comorbidity and strong respiratory muscles, which emphasizes the necessity to adopt a personalized approach to the care planning.

These findings have implications on the nursing practice. In order to provide sufficient care, nurses are supposed to focus on feeding guidelines, focus on nutrition, and monitor the burden of

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comorbidity. Also mentioned should be positioning, airway maintenance, and early mobilization as the significant preservation of the respiratory muscles working. Together, these interventions assist in exposing the degree to which nursing-led care can significantly contribute to the recovery of critically ill with VAP patients.

CONCLUSION

The paper has examined the determinants of ventilator-associated pneumonia (VAP) resolution that is based on nursing among the ICU patients, it has also evaluated the enteral nutrition, comorbidity burden, and the strength of respiratory muscles. The findings reveal the necessity of nursing care in helping the patients who are unable to perform self-care that can be consistent with the Self-Care Deficit Nursing Theory by Orem. The patients in the ICU lack the power to feed themselves, administer respiratory and monitor their overall health status, which puts the emphasis on how the nursing interventions affect the recovery outcome.

The authors established that the enteral nutrition was the most significant predictor of VAP resolution with moderate positive relation with the outcomes ($r = .377$, $p < .01$) and significant regression coefficient ($B = 0.426$, $b = .368$, $t = 7.412$, $p = .001$). Intake of food on time and in the right manner eases the immunity system and assists in preserving the muscle bulk and providing the patient with the energy required to cope with the infection and survive the period of ventilator support. Comorbidity burden also had major impact on the result because patients with less chronic illness had superior recovery and respiratory muscle strength ($B = 1.055$, $b = .189$, $t = 3.571$, $p < .001$). The size of respiratory muscles ($B = 0.264$, $b = .315$, $t = 6.184$ and $p < .001$) was an independent predictor of VAP resolution and this implies that the muscle strength is significant in efficient breathing, secretion clearance as well as ventilator weaning. In mediation analysis, it was found that RMS did not mediate the interaction between enteral nutrition and VAP meaning that nutrition may impact recovery through other ways other than immune improvement or inflammation reduction.

Based on such findings, the nurses who practice in the ICU ought to be centered on the repetitive feeding program practice, a keen attention to nutrition, and assessment of the comorbidity load of clients to establish those who require additional help. The nursing interventions as well should target in achieving a condition in which the respiratory muscles are strong through proper positioning, airway control and prompt mobilization. These interventions can be used to enhance patient resilience, recovery, and reduce the ICU complications.

The study had certain weaknesses. Its cross-sectional will not enable it to make causal relationship and non-probability sampling may restrict its external validity. Reporting was done by the nurses rather than direct observation of the patients, thereby, causing a reporting bias. However, despite these shortcomings, the research provides a reasonable idea of factors influencing VAP recovery which are nurse-led in the context of resource-restricted ICU.

The future research should also consider longitudinal or experimental research design to establish a causal correlation between nursing intervention and VAP outcome. The evidence might be supported by the expansion of the research to multiple hospitals and objective parameters of the patient, such as ventilatory parameters and nutritional biomarkers. More studies on the influence of such factors as immune condition, early mobility, and nurse workload can also add their bit to the knowledge on VAP recovery and can be used to work out a comprehensive care plan.

In conclusion, this paper has identified that enteral nutrition, burden of comorbidity, and strength of respiratory muscle results in VAP. In the ICUs, the main role is played by nursing services to improve recovery and particular interventions, including nutrition, comorbidities and respiratory functions to enhance resilience of patients and ensure positive patient outcomes.

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