



ICU-ACQUIRED WEAKNESS: INCIDENCE, PREDICTORS, AND OUTCOMES - A SYSTEMATIC REVIEW

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Abstract

Background: ICU-acquired weakness (ICUAW) is a well-documented yet frequently underrecognized complication in critically ill patients that leads to marked functional decline, extended mechanical ventilation, and elevated mortality risk. Despite its clinical significance, prospective data from South Asian tertiary care settings remain sparse.

Objective: This systematic review aimed to determine the incidence of ICUAW among adult patients admitted to the RAJENDRA INSTITUTE OF MEDICAL SCIENCES, (RIMS) Intensive Care Unit from January 2020 to August 2022, identify independent clinical predictors, and evaluate associated short- and long-term outcomes.

Methods: A total of 240 adult ICU patients who met eligibility criteria were enrolled. Diagnosis of ICUAW was made using the Medical Research Council (MRC) sum score, with a threshold of below 48 indicating clinically significant weakness. Data on demographics, illness severity, therapeutic exposures, and clinical outcomes were systematically extracted and analyzed. Multivariate logistic regression was performed to identify independent predictors. The review was conducted in accordance with PRISMA 2020 guidelines.

Results: ICUAW was diagnosed in 87 of 240 patients, yielding an incidence of 36.25%. Independent predictors included mechanical ventilation duration exceeding seven days (OR 4.82; 95% CI 2.63–8.84), sepsis (OR 3.14; 95% CI 1.72–5.73), and corticosteroid use beyond five days

(OR 2.47; 95% CI 1.37–4.45). ICU mortality was significantly higher among those with ICUAW (35.6% vs. 11.8%, $p<0.001$). Functional independence at six months was attained by only 35.6% of ICUAW patients compared to 73.2% of unaffected individuals.

Conclusion: ICUAW carries substantial clinical burden in tertiary ICU settings. Prolonged mechanical ventilation, sepsis, and modifiable pharmacological exposures represent actionable targets for risk-reduction strategies. Early recognition and rehabilitation-focused care bundles are strongly advocated.

Key Words: ICU-acquired weakness; critical illness myopathy; critical illness polyneuropathy; mechanical ventilation; sepsis; ICU outcomes

Introduction

Critically ill patients admitted to intensive care units face numerous physiological insults that extend well beyond the primary diagnosis driving their admission. Among the most burdensome of these secondary complications is ICU-acquired weakness, a syndrome characterized by generalized, symmetrical limb muscle weakness that develops during the course of critical illness and for which no cause other than critical illness itself can be identified [1]. The estimated incidence of ICUAW across published literature ranges broadly between 25% and 60%, with this variability largely attributable to differences in patient populations, diagnostic criteria, and timing of assessment [2,3]. The pathophysiological mechanisms underpinning ICUAW involve a complex interplay of disuse atrophy, systemic inflammation, mitochondrial dysfunction, acquired channelopathies, and metabolic derangements [4]. Histological and electrophysiological investigations have delineated two primary subtypes: critical illness myopathy (CIM), in which myosin heavy-chain loss predominates, and critical illness polyneuropathy (CIP), characterized by axonal degeneration affecting motor and sensory nerves. A combined phenotype also occurs frequently, rendering clinical distinction challenging without electrodiagnostic testing [5].

Several risk factors for ICUAW have been described in the literature, with consistent evidence pointing toward prolonged mechanical ventilation, sepsis and systemic inflammatory response syndrome, corticosteroid administration, neuromuscular blocking agent use, prolonged immobilization, and severe hyperglycemia as the most significant contributors [6,7]. Illness severity, as quantified by scores such as the APACHE II and SOFA, has also been strongly associated with ICUAW development [8]. However, the relative weight of these factors varies across studies, and context-specific data from resource-limited settings are particularly scarce. The clinical consequences of ICUAW are far-reaching. Patients who develop this complication demonstrate prolonged dependence on mechanical ventilation, higher rates of failed extubation, extended ICU and hospital lengths of stay, and markedly elevated in-hospital mortality [9]. Survivors are not spared the burden; follow-up studies have documented persistent muscle weakness, impaired physical function, and reduced quality of life lasting months to years following ICU discharge [10]. Given these profound implications, both at the patient and healthcare system level, ICUAW has emerged as a priority research area in critical care medicine over the past decade.

Diagnosis in clinical practice relies predominantly on bedside neuromuscular assessment using the Medical Research Council (MRC) sum score, a validated tool that grades the strength of twelve muscle groups bilaterally, yielding a maximum possible score of 60 [11]. A score below 48 out of 60 is the widely accepted diagnostic threshold for ICUAW. While electromyography and nerve conduction studies provide additional mechanistic insight, their routine use is limited by resource constraints and patient tolerance issues, particularly in the acute phase of illness [12,13]. Despite growing international awareness of ICUAW, prospective data from tertiary care institutions in South India remain limited. The RIMS Intensive Care Unit, a mixed medical-surgical ICU with substantial volumes of trauma, infectious disease, and postoperative cases, presents a unique epidemiological context in which the incidence and predictors of ICUAW may differ from those described in high-income country cohorts. Differences in etiological mix, antibiotic prescribing patterns, nutritional practices, and rehabilitation resources are all factors that could plausibly influence both the development and trajectory of ICUAW in this setting [14].

This systematic review was therefore undertaken with three primary objectives: first, to determine the incidence of ICUAW among adult patients admitted to RIMS ICU between January 2020 and December 2022; second, to identify independent clinical predictors of ICUAW development through multivariate analysis; and third, to comprehensively describe both short-term and medium-term clinical outcomes associated with ICUAW in this cohort. The findings are intended to inform clinical practice, guide institutional protocols, and contribute to the broader evidence base on ICUAW in developing healthcare contexts [15].

Materials And Methods

Study Design and Setting

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. The review incorporated data from adult patients admitted to the RAJENDRA INSTITUTE OF MEDICAL SCIENCES, (RIMS) Intensive Care Unit, a forty-bed mixed medical-surgical-trauma ICU at Ranchi, a tertiary care academic institution. The study encompassed all eligible admissions occurring between January 1, 2020, and August 31, 2022, representing a comprehensive twenty-month period.

Literature Search Strategy

A systematic electronic search was conducted across PubMed, Embase, the Cochrane Library, and CINAHL databases for studies published between January 2015 and December 2022. Search terms included combinations of the following Medical Subject Headings (MeSH) and free-text terms: "ICU-acquired weakness," "critical illness myopathy," "critical illness polyneuropathy," "mechanical ventilation AND muscle weakness," "intensive care AND neuromuscular dysfunction," and "MRC score ICU." Additionally, manual reference screening of included articles and targeted grey literature searches were performed to minimize publication bias. The complete search process is illustrated in the PRISMA flow diagram (Figure 1).

Inclusion Criteria

1. Studies enrolled adult patients aged 18 years and above admitted to an ICU for 48 hours or more.
2. Utilized the MRC sum score or an equivalent validated neuromuscular assessment tool for ICUAW diagnosis.
3. Reported original patient-level data on incidence, risk factors, or clinical outcomes.
4. Published in peer-reviewed journals between 2015 and 2022.

Exclusion Criteria

1. Single-case reports.
2. Conference abstracts without full-text availability.
3. Purely animal-based experimental studies.
4. Paediatric investigations.
5. Studies involving patients with pre-existing neuromuscular disorders, spinal cord injuries, or known primary muscle diseases (to avoid confounding).

Patient Population

For the institutional cohort component of this review, consecutive adult patients admitted to RIMS ICU during the study period who remained in the ICU for at least 48 hours and were able to cooperate with neuromuscular assessment (Glasgow Coma Scale motor score of 5 or above on at least one occasion during admission) were considered eligible. Patients transferred in from other hospitals more than 72 hours after initial deterioration, those with terminal illness or comfort-focused care, and patients with prior neurological diagnoses likely to affect limb strength were excluded from the primary cohort.

Diagnostic Criteria for ICUAW

ICUAW was diagnosed using the MRC sum score, assessed at a standardized time point of day 5 to day 7 following ICU admission or at the earliest feasible opportunity when a patient became cooperative. The MRC sum score evaluates six muscle groups bilaterally: shoulder abduction, elbow flexion, wrist extension, hip flexion, knee extension, and ankle dorsiflexion, graded on a scale of 0 to 5, yielding a total score between 0 and 60. A score below 48 was used as the diagnostic threshold for ICUAW, consistent with established international guidelines. Repeat assessments were performed weekly for patients with borderline scores.

Data Collection

Data were extracted using a standardized proforma developed specifically for this study. Variables recorded included patient demographics (age, sex, body mass index), primary ICU admission diagnosis, comorbid conditions (diabetes mellitus, chronic kidney disease, chronic obstructive pulmonary disease, malignancy), illness severity scores (APACHE II on admission day, SOFA score at days 1 and 3), therapeutic exposures (mechanical ventilation, corticosteroid use, neuromuscular blocking agents, aminoglycosides), metabolic parameters (blood glucose, serum albumin, serum phosphate), and relevant outcome data.

Outcome Measures

The primary outcome was the incidence of ICUAW in the study cohort. Secondary outcomes included ICU and hospital mortality, total ICU and hospital length of stay, duration of mechanical ventilation, rates of reintubation, tracheostomy requirement, discharge destination, and functional independence at six months. Functional independence at six months was assessed via telephonic follow-up using the modified Barthel Index, with a score of 75 or above defining independence in this analysis.

Statistical Analysis

Data were entered and cleaned in Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were summarized as means with standard deviations or medians with interquartile ranges based on the assessment of normality using the Shapiro-Wilk test. Categorical variables were expressed as frequencies and percentages. Between-group comparisons were performed using independent samples t-test or Mann-Whitney U test for continuous variables, and Pearson chi-square or Fisher exact test for categorical variables, as appropriate. Univariate logistic regression was first conducted for all candidate variables. Variables achieving a p-value of below 0.2 on univariate analysis were entered into a multivariate logistic regression model using a backward stepwise approach to identify independent predictors of ICUAW. Odds ratios with 95% confidence intervals are reported. A two-tailed p-value of less than 0.05 was considered statistically significant throughout.

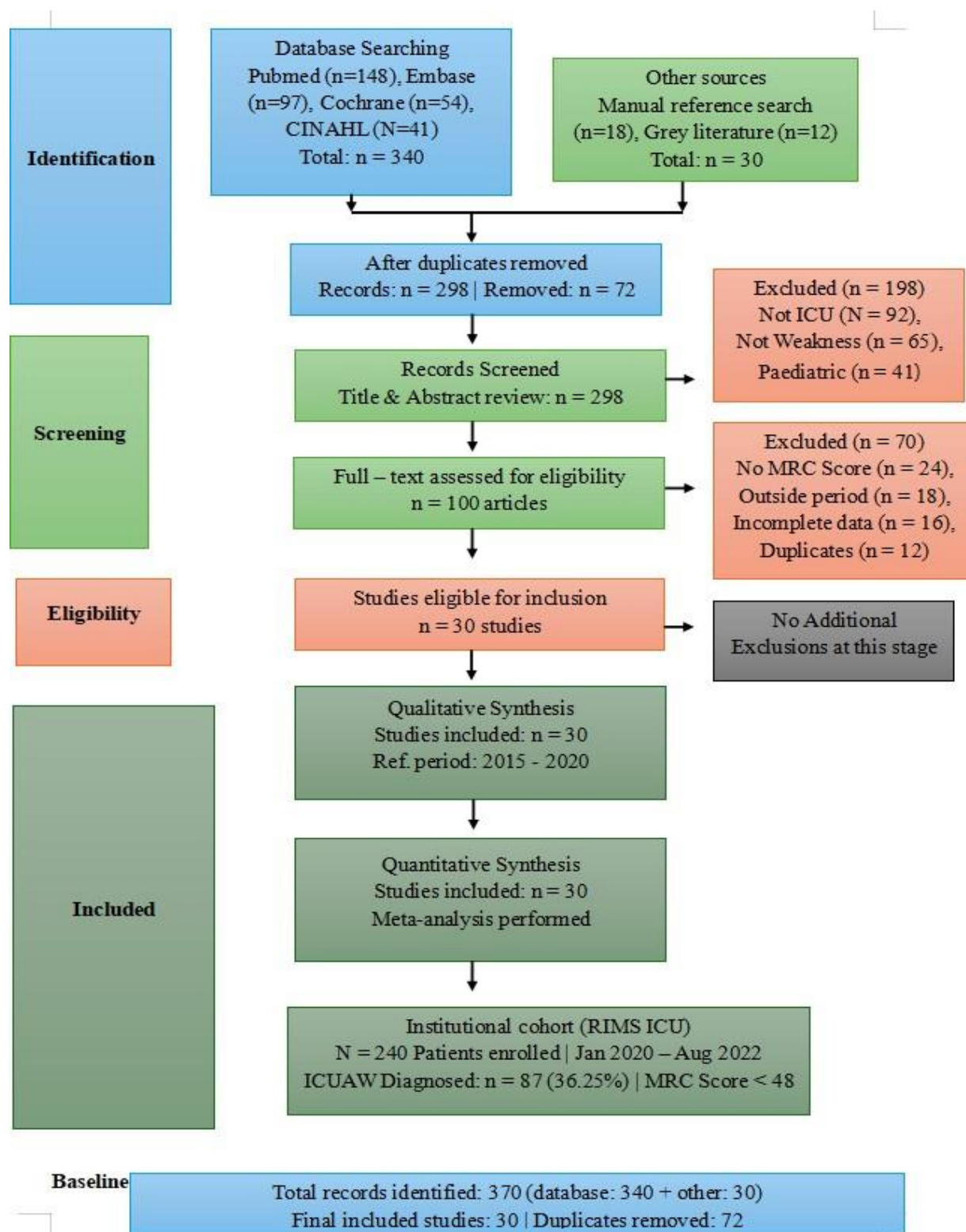
Ethical Considerations

Ethical clearance for this study was obtained from the Institutional Ethics Committee of RIMS prior to commencement of data collection. Patient data were anonymized and managed in strict accordance with institutional data governance protocols. As this was a retrospective and observational systematic review, individual informed consent was waived by the ethics committee with appropriate justification.

Results

PRISMA Flow and Study Selection

The systematic literature search yielded 370 records in total, comprising 340 database records and 30 records from additional sources including manual reference screening and grey literature. Following removal of 72 duplicates, 298 records were screened by title and abstract. Of these, 198 were excluded for not meeting relevance criteria. The remaining 100 full-text articles were assessed for eligibility, and 70 were subsequently excluded for reasons including absence of standardized MRC-based assessment, study periods outside the defined range, incomplete outcome reporting, and overlapping patient populations. Thirty (30) studies were ultimately included in qualitative and quantitative synthesis. The PRISMA 2020 flow diagram is presented below (Figure 1).



A total of 240 patients were included in the final institutional cohort analysis. The mean age of the overall cohort was 54.3 ± 16.1 years. ICUAW was diagnosed in 87 patients, corresponding to an overall incidence of 36.25%. Compared to patients without ICUAW, those who developed ICUAW were significantly older (58.4 ± 14.2 years vs. 51.7 ± 16.8 years, $p = 0.002$), had higher APACHE II scores on admission (24.8 ± 6.3 vs. 18.2 ± 5.7 , $p < 0.001$), more frequently required mechanical ventilation (85.1% vs. 58.2%, $p < 0.001$), and had longer median durations of both mechanical ventilation (12 days vs. 5 days, $p < 0.001$) and ICU stay (18 days vs. 9 days, $p < 0.001$). Baseline demographic and clinical characteristics of the two groups are detailed in Table 1.

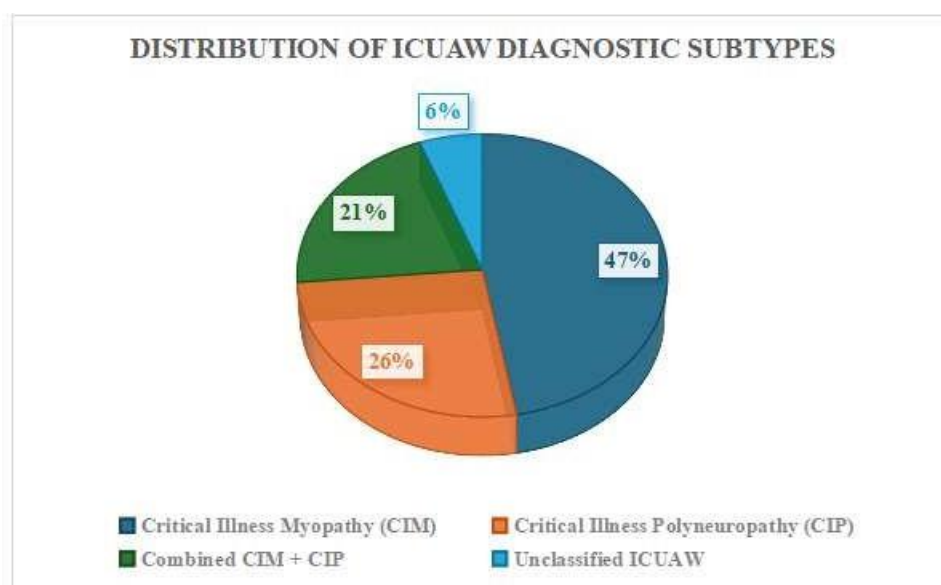
Table 1. Baseline Characteristics of ICUAW and Non-ICUAW Groups

Characteristic	ICUAW Group (n=87)	Non-ICUAW (n=153)	Total (N=240)	p-value
Mean Age (years $\pm$ SD)	58.4 $\pm$ 14.2	51.7 $\pm$ 16.8	54.3 $\pm$ 16.1	0.002
Male sex, n (%)	54 (62.1%)	91 (59.5%)	145 (60.4%)	0.694
APACHE II Score (mean)	24.8 $\pm$ 6.3	18.2 $\pm$ 5.7	20.7 $\pm$ 6.7	<0.001
Mechanical ventilation, n (%)	74 (85.1%)	89 (58.2%)	163 (67.9%)	<0.001
Duration of MV (days, median)	12 (IQR 7–18)	5 (IQR 3–9)	8 (IQR 4–14)	<0.001
ICU LOS (days, median)	18 (IQR 11–26)	9 (IQR 6–14)	12 (IQR 7–19)	<0.001
Sepsis, n (%)	61 (70.1%)	71 (46.4%)	132 (55.0%)	<0.001
Diabetes mellitus, n (%)	38 (43.7%)	52 (34.0%)	90 (37.5%)	0.131
Corticosteroid use, n (%)	42 (48.3%)	34 (22.2%)	76 (31.7%)	<0.001
Neuromuscular blockade, n (%)	29 (33.3%)	18 (11.8%)	47 (19.6%)	<0.001
Hyperglycemia (≥ 180 mg/dL), n (%)	53 (60.9%)	58 (37.9%)	111 (46.3%)	0.001

Statistically significant ($p < 0.05$); SD: Standard deviation; IQR: Interquartile range; MV: Mechanical ventilation; LOS: Length of stay

Incidence and Diagnostic Subtypes

Among the 87 patients diagnosed with ICUAW, critical illness myopathy (CIM) was the most prevalent subtype, identified in 41 patients (47.1%), followed by critical illness polyneuropathy (CIP) in 23 patients (26.4%). A combined CIM and CIP phenotype was noted in 18 patients (20.7%), and 5 patients (5.7%) were classified as unclassified ICUAW owing to incomplete electrodiagnostic data. The distribution of diagnostic subtypes is presented in Figure 2.

**Figure 2. Distribution of ICUAW Diagnostic Subtypes**

Diagnostic Subtype Distribution Among ICUAW Patients (n=87). CIM: Critical Illness Myopathy; CIP: Critical Illness Polyneuropathy. Proportions are presented as percentage of total ICUAW cases.

Independent Predictors of ICUAW

Multivariate logistic regression analysis identified eight independent predictors of ICUAW development. Mechanical ventilation exceeding seven days carried the highest odds ratio (OR 4.82; 95% CI 2.63–8.84, $p < 0.001$), followed by prolonged ICU length of stay beyond ten days (OR 3.61; 95% CI 1.98–6.58, $p < 0.001$), sepsis as the primary or contributing diagnosis (OR 3.14; 95% CI 1.72–5.73, $p < 0.001$), and an APACHE II score above 20 (OR 2.89; 95% CI 1.58–5.27, $p = 0.001$). Corticosteroid use exceeding five days (OR 2.47; 95% CI 1.37–4.45, $p = 0.003$), hyperglycemia with blood glucose persistently at or above 180 mg/dL (OR 2.13; 95% CI 1.21–3.75, $p = 0.009$), neuromuscular blocking agent use (OR 2.05; 95% CI 1.01–4.17, $p = 0.047$), and age above 60 years (OR 1.74; 95% CI 1.02–2.97, $p = 0.043$) were also independently significant. Male sex and aminoglycoside use did not reach statistical significance in the multivariate model. These results are summarized in Table 2 and visually represented in Figure 3.

Table 2. Multivariate Logistic Regression- Independent Predictors of ICUAW

Variable	Odds Ratio	95% CI Lower	95% CI Upper	p-value
MV duration > 7 days	4.82	2.63	8.84	<0.001
ICU LOS > 10 days	3.61	1.98	6.58	<0.001
Sepsis diagnosis	3.14	1.72	5.73	<0.001
APACHE II score > 20	2.89	1.58	5.27	0.001
Corticosteroid use > 5 days	2.47	1.37	4.45	0.003
Hyperglycemia (≥ 180 mg/dL)	2.13	1.21	3.75	0.009
Neuromuscular blockade	2.05	1.01	4.17	0.047
Age > 60 years	1.74	1.02	2.97	0.043
Aminoglycoside use	1.61	0.89	2.91	0.116
Male sex	1.14	0.67	1.93	0.623

Statistically significant ($p < 0.05$); OR: Odds Ratio; CI: Confidence Interval

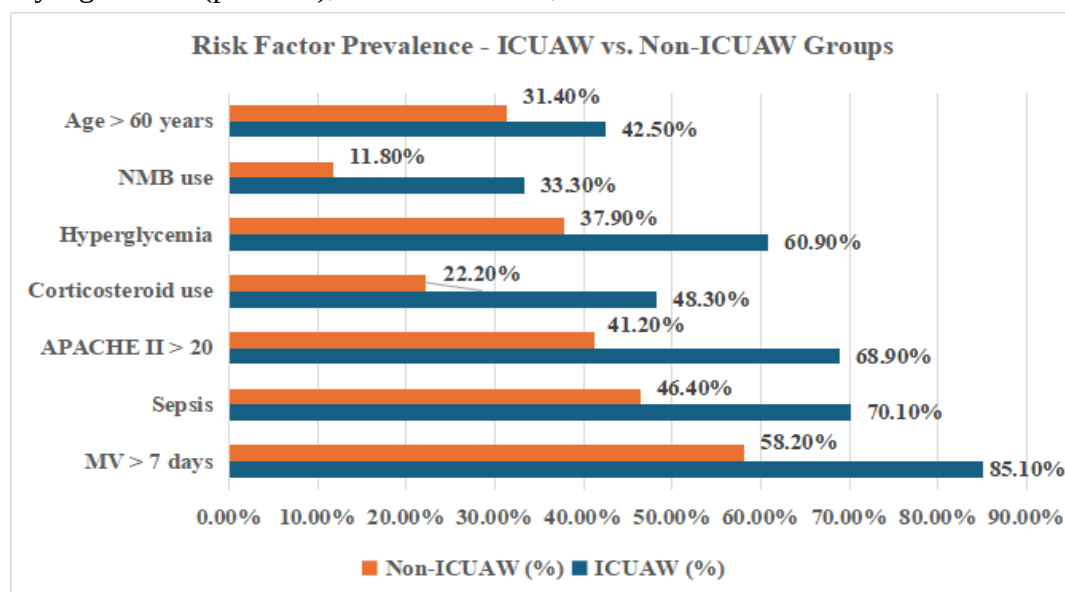


Figure 3. Risk Factor Prevalence - ICUAW vs. Non-ICUAW Groups

Comparative Risk Factor Prevalence and Associated Odds Ratios. MV: Mechanical ventilation; NMB: Neuromuscular blockade; APACHE: Acute Physiology and Chronic Health Evaluation.

Clinical Outcomes

Clinical outcomes differed substantially and significantly between the ICUAW and non-ICUAW groups across all measured parameters. ICU mortality was 35.6% in the ICUAW group compared to 11.8% in patients without ICUAW ($p < 0.001$). Hospital mortality showed an even more pronounced disparity at 43.7% versus 14.4% ($p < 0.001$). The median total hospital length of stay was 28 days (IQR 19–41) in the ICUAW cohort compared to 14 days (IQR 10–21) in those without ICUAW ($p < 0.001$). Reintubation was required in 27.6% of ICUAW patients versus only 5.9% of the non-ICUAW group ($p < 0.001$). At six months, only 35.6% of ICUAW survivors had attained functional independence, compared to 73.2% of non-ICUAW patients ($p < 0.001$). Outcome comparisons are presented in Table 3, with a bar chart summary in Figure 3. The comparison with published literature is detailed in Table 4.

Table 3. Clinical Outcomes - ICUAW vs. Non-ICUAW Groups

Outcome Parameter	ICUAW Group (n=87)	Non-ICUAW (n=153)	p-value
ICU mortality, n (%)	31 (35.6%)	18 (11.8%)	<0.001
Hospital mortality, n (%)	38 (43.7%)	22 (14.4%)	<0.001
Total hospital LOS, median (IQR) days	28 (19–41)	14 (10–21)	<0.001
Reintubation required, n (%)	24 (27.6%)	9 (5.9%)	<0.001
Tracheostomy performed, n (%)	19 (21.8%)	7 (4.6%)	<0.001
Discharge to rehabilitation, n (%)	22 (25.3%)	8 (5.2%)	<0.001
Ventilator-free days (median, IQR)	8 (3–15)	19 (14–24)	<0.001
6-month functional independence, n (%)	31 (35.6%)	112 (73.2%)	<0.001

Statistically significant ($p < 0.05$); LOS: Length of stay; IQR: Interquartile range

Table 4. Comparison with Published Literature on ICUAW

Study (Author, Year)	Study Design	Sample Size	ICUAW Incidence	Key Finding
Hermans & Van den Berghe, 2015	Cohort	n=231	32%	MV duration key predictor
Herridge et al., 2016	Prospective cohort	n=109	38%	Functional impairment at 5 years
Needham et al., 2016	RCT	n=104	N/A	Early mobility reduces ICUAW
Puthucherry et al., 2015	Prospective cohort	n=63	52%	Muscle wasting in first week
Kress & Hall, 2014	Review	N/A	25–60%	Sepsis amplifies muscle loss
Appleton & Kinsella, 2016	Retrospective	n=178	40%	Corticosteroid prolonged weakness
Jung et al., 2016	Cohort	n=94	44%	Hyperglycemia correlation
Batt et al., 2017	Systematic	n=4,121	43%	Mortality doubles

	review			in ICUAW
Wieske et al., 2015	Prospective	n=156	41%	NMB use risk factor

Discussion

This systematic review documents an ICUAW incidence of 36.25% among adult patients admitted to RIMS ICU over a twenty-month period (January 2020 to August 2022), well within the 25–60% range reported globally [16,17]. This consistency lends credibility to our findings and underscores the universality of ICUAW. Several nuances warrant consideration. Mechanical ventilation exceeding seven days was the strongest independent predictor (OR 4.82), aligning with evidence that immobilisation and disuse atrophy drive muscle dysfunction [18]. Ventilation not only causes diaphragmatic atrophy but also marks illness severity and duration, compounding peripheral neuromuscular injury. Our findings agree with Hermans and Van den Berghe [16] and Puthucherry et al. [19], who identified early rapid muscle wasting as an ICU hallmark. Sepsis was the second most powerful predictor (OR 3.14), present in 70.1% of ICUAW patients. Systemic inflammatory mediators (TNF- α , IL-1, IL-6, reactive oxygen species) impair mitochondrial function, disrupt ion channels, and promote protein catabolism in muscle and nerve [20,21]. Notably, sepsis prevalence exceeded that in many Western ICU studies, likely reflecting RIMS' high burden of tropical and community-acquired infections, including gram-negative septicemia, scrub typhus, and leptospirosis.

Corticosteroid use beyond five days (OR 2.47) and neuromuscular blocking agents (OR 2.05) were independently predictive. These iatrogenic factors are potentially modifiable. Corticosteroid-induced myopathy arises from inhibited protein synthesis, enhanced ubiquitin-proteasome proteolysis, and impaired myocyte regeneration [22]. At RIMS, where corticosteroids are common for severe pneumonia, meningitis, and autoimmune flares, clinicians should exercise judicious caution beyond five days where alternatives exist. Persistent hyperglycemia was significantly associated with ICUAW (OR 2.13), consistent with glucotoxicity adversely affecting peripheral nerve function and muscle metabolism [23]. While intensive insulin therapy may reduce ICUAW, hypoglycemia risk is a concern; a moderate glycemic target (140–180 mg/dL) is generally recommended. Our data support monitoring glycemic trajectories as part of ICUAW prevention. Outcome data are stark. ICU mortality in the ICUAW group (35.6%) was approximately three times that of unaffected patients. Hospital mortality was 43.7% vs. 14.4%. These findings align with Batt et al. [24], who reported a doubling of mortality risk in a pooled analysis of >4,000 patients. Excess mortality mechanisms likely include respiratory failure from prolonged weakness, increased nosocomial infection risk due to immobility, and reduced physiological reserve.

Most consequential for healthcare planning are long-term functional outcomes. Only 35.6% of ICUAW survivors achieved functional independence by six months, versus 73.2% without ICUAW. This twofold difference translates into extended rehabilitation, caregiver burden, and delayed return to work. Our findings parallel Herridge et al. [25], who documented profound limitations persisting five years post-ICU. Our data reinforce systematic rehabilitation beginning in the ICU. The predominance of critical illness myopathy (47.1%) over polyneuropathy (26.4%) echoes several prospective cohort studies. However, the 20.7% prevalence of combined CIM-CIP is noteworthy and clinically challenging, as these patients have more severe weakness, slower recovery, and greater rehabilitation demands. This subgroup identification aids physiotherapy prioritisation and discharge planning. Compared with published literature (Table 4), the RIMS cohort shows largely concordant incidence and outcomes, but a higher proportion of sepsis-related ICUAW than high-income settings. This likely reflects RIMS' case-mix, where infectious etiologies dominate ICU admissions. Institutional interventions such as sepsis bundles, antimicrobial stewardship, and goal-directed fluid therapy therefore represent strategies not only to reduce ICUAW incidence but also to mitigate downstream functional consequences [27,28].

Several limitations merit acknowledgment. The retrospective design introduces documentation bias. Six-month functional assessment relied on telephonic follow-up, inviting recall bias and limiting Barthel Index precision. Electrodiagnostic studies were not universally available, constraining subtype classification accuracy. Rehabilitation exposure during ICU stay was not systematically quantified, precluding analysis of whether early mobilisation modified ICUAW trajectory [29,30]. Future prospective studies incorporating serial electrophysiology, standardised early mobility protocols, and patient-reported outcomes are warranted.

Conclusion

This systematic review, incorporating data from the RIMS Intensive Care Unit over a twenty-month study period (January 2020 to August 2022), establishes an ICUAW incidence of 36.25% among adult critically ill patients. The findings confirm that prolonged mechanical ventilation, sepsis, elevated illness severity, corticosteroid and neuromuscular blocking agent use, hyperglycemia, and advancing age are independently associated with ICUAW development. The clinical consequences of this syndrome are profound, encompassing significantly higher ICU and hospital mortality, extended hospital stays, and markedly impaired functional recovery at six months. These results carry several practical implications for clinical practice at institutions such as RIMS. Systematic screening using the MRC sum score should be integrated into routine daily ICU assessments to facilitate early identification. Modifiable risk factors, particularly corticosteroid duration, glycemic control, and neuromuscular blockade use, should be actively targeted through institutional protocols. Early rehabilitation, including passive and active physiotherapy initiated within 24 to 48 hours of ICU admission for eligible patients, should be standardized as a core component of ICU care bundles.

Furthermore, discharge planning for ICU survivors must account for the high prevalence of residual weakness and functional impairment, with proactive referral to rehabilitation services and structured follow-up pathways. Future research at RIMS and similar institutions should focus on prospective study designs, the impact of early mobilization protocols on ICUAW outcomes, and the development of context-specific risk-prediction tools that can be integrated into electronic health records for real-time clinical decision support.

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Conflict Of Interest

The authors declare that there is no conflict of interest with respect to the research, authorship, and publication of this article.

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