Acute Skin Failure in the Critically Ill Adult Population: A Systematic Review

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GENERAL PURPOSE: To present a systematic review of the literature conducted to define and extend knowledge of the risk factors, causes, and antecedent conditions of acute skin failure (ASF) in adult intensive care patients.

TARGET AUDIENCE: This continuing education activity is intended for physicians, physician assistants, nurse practitioners, and nurses with an interest in skin and wound care.

LEARNING OBJECTIVES/OUTCOMES: After participating in this educational activity, the participant should be better able to:

1. Outline the background information helpful for understanding the authors' systematic review of ASF in adult intensive care patients.
2. Summarize the results of the authors' review of the risk factors, causes, and antecedent conditions of ASF in adult intensive care patients.

ABSTRACT

OBJECTIVE: To define and extend knowledge of the risk factors, causes, and antecedent conditions of acute skin failure (ASF) in the adult intensive care patient cohort.

DATA SOURCES: The Cochrane Library, Joanna Briggs Institute Evidence-Based Practice Database, PubMed, Medical Literature Analysis and Retrieval System, Cumulative Index of Nursing and Allied Health Literature, and Google Scholar.

STUDY SELECTION: Studies were selected if they were qualitative or quantitative research that reported ASF in adult human patients in an ICU setting. The preliminary search yielded 991 records and 22 full texts were assessed for eligibility. A total of three records were included. Studies were appraised using the Mixed Methods Appraisal Tool.

DATA EXTRACTION: Data from the included studies were extracted by one reviewer and summarized in data collection tables that were checked and verified by a second reviewer.

DATA SYNTHESIS: Study authors identified five independent predictors of ASF: peripheral vascular disease, mechanical ventilation longer than 72 hours, respiratory failure, liver failure, and sepsis. However, the term ASF was applied to retrospective cohorts of patients who developed severe pressure injuries. This, combined with the absence of evidence surrounding the assessment, clinical criteria, and diagnosis of ASF, could impact these variables' predictability relative to the condition.

CONCLUSIONS: These results highlight a substantial evidence gap regarding the etiology, diagnostic biomarkers, and predictors of ASF. Further research focused on these gaps may contribute to an accurate and agreed-upon definition for ASF, as well as improved skin integrity outcomes.

KEYWORDS: acute skin failure, chronic skin failure, organ failure, perfusion, pressure injury, skin failure, unavoidable pressure injury

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INTRODUCTION

Skin failure (SF) is a term that first appeared in the literature in 1991. La Puma[1] theorized that the skin, like all other organs, can fail. As a result of this physical decline and organ failure, pressure injuries (PIs) can occur.[1] Since then, there have been multiple published definitions and variations on the term.[2–8] However, ongoing debate surrounds the definition of SF and associated terms such as acute SF (ASF), chronic SF, and end-stage SF, as well as the clinical presentation of and diagnostic criteria for the condition.[8]

The failure of human organs, such as the heart, lungs, liver, and kidneys, is well defined; associated biomarkers guide treatment and prognosis.[9–12] For patients in the ICU, evidence-based categorization instruments provide a numerical score to assess morbidity and illness severity and predict mortality. Such calculations are only achievable because objective measures of organ dysfunction are available. However, objective diagnostic markers and clinical parameters related to the integumentary system and SF are lacking;[13] this limits the formulation of a globally agreed-upon diagnosis, classification, and definition for this phenomenon.

Varying definitions for SF have been presented in both the dermatology and skin integrity/wound care literature (Table 1). Although these definitions refer to a pathophysiologic process that affects the skin, the definitions are very different. The SF definitions from the dermatology literature have been used to describe SF that is attributable to trauma, such as thermal burns, autoimmune disorders, and severe infection.[14] These definitions describe the etiology of SF as the result of a primary dermatologic condition with pathophysiologic changes resulting from integumentary inflammation and generalized loss of skin integrity.

In contrast, the skin integrity and wound care literature describes the etiology of SF as the result of a secondary pathophysiologic process that originates from failure of one or more organs other than the skin. As a result of organ failure elsewhere in the body, skin can be compromised and subsequently fail. Langemo and Brown's[5] 2006 definition suggested SF is an "event in which the skin and underlying tissue die due to the hypoperfusion that occurs concurrent with severe dysfunction or failure of other organ systems." In 2017, Levine[8] built on this definition and proposed SF be defined as a "result of compromised tissue where the cells can no longer survive in zones of physiological impairment that includes hypoxia, local mechanical stresses, impaired delivery of nutrients, and build-up of toxic metabolic by-products." Levine[15] describes this definition as a way to consolidate and simplify differing nomenclatures into a universal diagnosis, proposing that SF is the underlying pathophysiology in wounds occurring in "patients close to death, unavoidable pressure injuries, and skin impairment related to tissue ischemia." However, the association between SF and unavoidable skin changes remains unclear.

Pressure injuries are defined as "localized damage to the skin and underlying soft tissue usually over a bony prominence or related to a medical or other device. The injury occurs as a result of intense and/or prolonged pressure or pressure in combination with shear. The tolerance of soft tissue for pressure and shear may also be affected by microclimate, nutrition, perfusion, comorbidities and conditions of the soft tissue."[16] More than 100 intrinsic and extrinsic risk factors for PI have been identified, including impaired mobility, diabetes, and skin status.[17,18] It is plausible that a PI may develop in the presence of SF; however, skin damage occurring solely as a result of SF is not limited to areas of tissue loading alone. Therefore, PI development in the presence of SF is not certain, and SF may manifest in other ways; for example, gangrenous fingers or toes, blisters, or skin mottling.[19,20]

The multitude of interrelated terms and concepts used throughout the literature regarding SF, PI, unavoidable PI, terminal ulceration, and skin changes at the end of life has resulted in linguistic and conceptual confusion.[19] Currently, three types of SF are described within the literature: acute, chronic, and end stage.[5] Acute SF occurs concurrently with a critical illness such as septic shock.[7] Chronic SF occurs in the presence of an ongoing chronic disease state such as dementia.[21] End-stage SF occurs at the end of life. A Kennedy terminal ulcer (an event deeply embedded within the PI schema) is a manifestation of SF in patients at end of life.[22] These definitions are subjective, based on clinical judgment, and lack objective criteria to determine categorization or the potential transition between categories (eg, moving from ASF to chronic SF or from chronic to end-stage SF).[5] This has resulted in multiple terms being used interchangeably throughout contemporary literature. It is uncertain whether SF categories overlap or represent a continuum of acuity, although that issue is beyond the scope of this review. This problem does, however, highlight the need to clarify terminology through rigorous analysis of each concept, including similarities, differences, and interrelationships to improve clarity and ensure that concepts and terms have a solid theoretical and biologic basis.[19]

The primary aims of this systematic review were to assess and appraise the quality of studies conducted on ASF in adult patients in the ICU and identify evidence and gaps within the literature. The research questions were as follows:

1. What is the definition of ASF in the adult intensive care population?
2. What are the risk factors, causes, and antecedent conditions of ASF in the adult intensive care patient population?

Table 1. SKIN FAILURE DEFINITIONS

	Definitions			
Author	**Skin Failure**	**Acute Skin Failure**	**Chronic Skin Failure**	**End-Stage Skin Failure**
Irvine[2]	A loss of normal temperature control with inability to maintain the core temperature, failure to prevent percutaneous loss of fluid, electrolytes, and protein with resulting imbalance and failure of the mechanical barrier to penetration by foreign materials			
Isaac[3]	The interference with skin function as a result of damage or loss of large areas of skin resulting in loss of barrier function, hemodynamic problems, impaired thermal regulation, and metabolic, endocrine, and hemodynamic changes			
Inamadar[4]		A state of total dysfunction of the skin resulting from different dermatological conditions		
Langemo and Brown[5]	An event in which the skin and underlying tissue die due to the hypoperfusion that occurs concurrent with severe dysfunction or failure of other organ systems	An event in which skin and underlying tissue die due to hypoperfusion concurrent with a critical illness	An event in which skin and underlying tissue die due to hypoperfusion concurrent with an ongoing, chronic disease state	An event in which skin and underlying tissue die due to hypoperfusion concurrent with the end of life
Shanks et al[6]		Pressure-related injury concurrent with acute illness as manifested by hemodynamic instability and/or major organ system compromise		
Delmore et al[7]		The hypoperfusion state that leads to tissue death that occurs simultaneously to a critical illness.		
Levine[8]	The state in which tissue tolerance is so compromised that cells can no longer survive in zones of physiological impairment that includes hypoxia, local mechanical stresses, impaired delivery of nutrients, and buildup of toxic metabolic byproducts. This includes pressure injuries, wounds that occur at life's end, and in the setting of multisystem organ failure.			

3. Is there an association between ASF and PI in the adult intensive care patient population?

METHODS

Protocol Registration

This systematic review protocol has been registered in the International Prospective Register of Systematic reviews (PROSPERO): CRD42019126159.

Search Strategy

A preliminary literature search was undertaken using PubMed, MEDLINE (Medical Literature Analysis and Retrieval System), and CINAHL (Cumulative Index of Nursing and Allied Health Literature) to identify key terms and subject headings, with guidance from a specialized health sciences librarian. A systematic search for primary research was then undertaken in September 2018 using six databases: the Cochrane Library, Joanna Briggs Institute Evidence-Based Practice Database, CINAHL, Google Scholar, PubMed, and MEDLINE. The completed search strategy used for PubMed is detailed in Figure 1. The same keywords were used for all searches, and similar subject headings were used in the other five databases. Subject headings were explored where applicable. Limiters applied to the search were English language and dated from database inception to September 2018.

Figure 1. SEARCH STRATEGY FOR SYSTEMATIC REVIEW

#1.	MESH "pressure ulcer"
#2.	MESH "skin ulcer"
#3.	MESH "skin disease"
#4.	"Pressure injury"
#5.	"Skin failure"
#6.	"Acute skin failure"
#7.	"Skin injury"
#8.	"Decubitus ulcer"
#9.	"Bedsore"
#10.	"Kennedy terminal ulcer"
#11.	"Permissible pressure ulcer"
#12.	"Unavoidable pressure injury"
#13.	"Unavoidable pressure ulcer"
#14.	(#1 OR #2, OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13)
#15.	MESH "critical care"
#16.	MESH "Intensive Care Units"
#17.	"Multi organ failure"
#18.	(#15 OR #16 OR #17)
#19.	MESH "prevalence"
#20.	MESH "etiology"
#21.	MESH "risk factors"
#22.	(#19 OR #20 OR #21)

Inclusion and Exclusion Criteria

Qualitative or quantitative research studies that reported on ASF in critically ill adult human patients in the ICU setting were included.

Records were excluded if their study sample was animal or pediatric, if the study setting was not adult intensive care, and unrelated to SF. Studies were also excluded if they were written in a language other than English. Nonresearch publications, including conference papers, protocols, educational, opinion or commentary articles, other literature reviews, and guidelines, were excluded.

Study Selection

Abstracts were screened for eligibility and studies meeting the inclusion criteria were retrieved in full. The full-text publications were evaluated against the inclusion and exclusion criteria by two reviewers who worked independently and were blinded to each other's assessments until selection was complete. Disagreements were resolved through discussion and consultations with third reviewers who acted as arbitrators where necessary.

Data Extraction and Synthesis

Data from the included records were extracted by one reviewer and summarized in data collection tables, which were checked and verified by the second reviewer.

Quantitative data synthesis was not attempted because of extensive heterogeneity attributable to the descriptive design of each study, lack of similar comparators, and lack of comparable data presented within the studies. Further, only one study[23] used SF as a primary outcome; the other studies used PI development.[7,24] A narrative synthesis approach was chosen to summarize the selected studies using the PICO (Population, Intervention, Comparator, and Outcome) framework.[25] For each included record, study design, quality, population, intervention, comparator, outcome, and limitations were extracted. Each study also was assessed according to the National Health and Medical Research Council (NHMRC) evidence hierarchy.[26] The results of the selected studies were tabulated to highlight important similarities and differences among studies (Table 2). The NHMRC evidence hierarchy was then used to define the recommendation grades: grade A is a body of evidence that can be trusted to guide practice; grade D is a body of evidence that is weak, from which recommendations should therefore be applied with caution.[27]

Quality Appraisal

The quality of the studies was assessed by two independent reviewers using the Mixed Methods Appraisal Tool (MMAT), version 2018 (Table 3).[28] The MMAT is based on constructionist theory and has been used in more than 100 systematic mixed study reviews.[29] It is designed for systematic reviews that include qualitative, quantitative, and mixed-methods studies. It was chosen for this review to ensure the different design methods could be reviewed using the same tool. The MMAT categorizes research using an algorithm of study selection criteria; each category is then appraised using two screening questions and five method quality questions based on the study design category.[28] This enabled the authors to appraise the most common types of empirical studies concomitantly and effectively.[29]

The MMAT has separate categories for researchers to use depending on the type of research design to be assessed. Each category can be answered with yes, no, or cannot tell. The 2018 MMAT version discourages the calculation of an overall score. Using this method, each criterion can provide a more detailed presentation to better inform the quality of the included studies.[28] There was only one MMAT question for one study for which assessors disagreed (Nowicki and colleagues'[24] study had a clear research question), resulting in an overall interrater agreement of 95.24%. However, this disagreement was resolved through discussion.

RESULTS

The search returned 991 records. After duplicates were removed, 801 records remained. After titles and abstracts were screened against the inclusion and exclusion criteria, 779 records were excluded. Following the review of 22

Table 2. CHARACTERISTICS OF INCLUDED STUDIES

Author, Country, Year	Population, Design, Sample, Setting	Intervention, Indicator	Comparison	Outcome and Results	Level of Evidence	Limitations
Curry et al,[23] US, 2012	Prospective descriptive case series of ICU patients (n = 29) in a large tertiary hospital, single general ICU	Skin breakdown over a bony prominence, assessed as skin failure by wound care nurse Patient characteristic indicators	Nil	Failure of two or more organs present in patients with skin failure	IV	-Single site -No control group -Small sample size -Only descriptive analyses reported -No definition/description of how the wound care nurse diagnosed acute skin failure
Delmore et al,[7] US, 2015	Retrospective case control study of ICU patients (main analysis, n = 450; validation test, n = 102) in two Magnet-designated medical centers	Pressure injury formation Patient characteristic indicators	ICU patients without a pressure injury	Five risk factors for skin failure: -Peripheral arterial disease -Mechanical ventilation >72 h -Respiratory failure -Liver failure -Severe sepsis/septic shock	III–2	-Retrospective design -Included elective cardiac surgery patients
Nowicki et al,[24] Australia, 2018	Retrospective case series of ICU patients (n = 726) and non-ICU patients (n = 3,860) in a tertiary referral teaching hospital, single combined cardiac and general ICU	Hospital-acquired pressure injury prevalence	Non-ICU hospital patients who developed a hospital-acquired pressure injury	-Pressure injury incidence increased in ICUs from 71 in 2006 to 128 in 2015	IV	-Retrospective design -Pressure injury stages updated on site in 2012 -Skin failure postulated to be a result of severe critical illness and pressure injury development -Different reporting systems used over time

articles retrieved for full-text evaluation, an additional 19 studies failed to meet the inclusion criteria; therefore, 3 articles were included in this review.[7,26,24]

These were categorized as quantitative nonrandomized[7] and quantitative descriptive.[23,24] The purpose of all three studies was to identify and describe factors that contributed to ASF and determine predictors of ASF in intensive care. Two of the studies were set in a single site (tertiary hospital centers).[23,24] The third was a multicenter study involving a 55-bed ICU in a tertiary urban medical center and an 18-bed ICU in a suburban teaching hospital.[7] Two studies employed a retrospective design,[7,24] and the other used a prospective method.[23] The NHMRC level of evidence for the three studies ranged between III-2[7] and IV,[23,24] resulting in an overall D grade.[27]

No studies included in this review described a specific research question; rather, all presented an aim or research purpose. The data collected in two studies addressed the stated aims and purpose.[7,24] However, it was unclear whether the data collected in the other study addressed the stated aim: to identify and describe the characteristics of ICU patients with SF.[23] None of the studies were a "yes" for all MMAT criteria questions because of their potential risk of bias[7,23,24] and a lack of clarity regarding the completeness of the data sets analyzed.[7,24]

Retrospective analysis using databases and patient notes increases the risk of bias attributable to systematic errors, inaccuracies, and the potential for missing data.[30] This is evident in Nowiki et al,[24] in which recorded data for more than 3 years (June 2006 to October 2009) were only partially available because of limited data recording (ie, incomplete outcome data were reported). Further, Delmore and colleagues'[7] use of purposive sampling in the selection of patients with PI is prone to selection bias[31] because the research intentionally selected certain patients with the outcome measure of interest (PI) and randomly selected patients without PIs. Further, little information regarding the amount or nature of missing data was described within these two studies.[7,24] Curry and colleagues'[23] study is at risk of bias because the authors did not state the criteria used by the certified wound care nurses to diagnose ASF prospectively. This places the study at risk of research bias. It also may impact the validity of data collected in answering the research question.[23]

Participants

The studies included 1,307 intensive care participants, with 29 participants in the prospective study[23] and the remaining 1,278 participants in the retrospective studies.[7,24] Two studies were based in the US[7,23] and one study in Australia.[24] One study did not report the participants' sex, age, or race.[24] The other two included 328 males and 253 females, resulting in a 1.3:1 male-to-female ratio; this is representative of the ICU patient

Table 3. SELECTED MIXED METHODS APPRAISAL TOOL RESULTS FOR INCLUDED STUDIES

	Curry et al[23]			Delmore et al[7]			Nowicki et al[24]		
Quality Criteria	**Yes**	**No**	**Can't tell**	**Yes**	**No**	**Can't tell**	**Yes**	**No**	**Can't tell**
S1. Are there clear research questions?	√[a]			√[a]			√[a]		
S2. Do the collected data address the research question?		√		√				√	
3.1 Are the participants representative of the target population?[b]				√					
3.2 Are measurements appropriate regarding both the outcome and intervention (or exposure)?[b]				√					
3.3 Are there complete outcome data?[b]					√				
3.4 Are the confounders accounted for in the design and analysis?[b]				√					
3.5 During the study period, is the intervention administered (or exposure occurred) as intended?[b]				√					
4.1 Is the sampling strategy relevant to address the research question?[c]	√						√		
4.2 Is the sample representative of the target population?[c]	√						√		
4.3 Are the measurements appropriate?[c]	√						√		
4.4 Is the risk of nonresponse bias low?[c]		√						√	
4.5 Is the statistical analysis appropriate to answer the research question?[c]	√						√		

[a]The research question was implicit within the aims articulated in the study.
[b]Question refers to quantitative nonrandomized design in MMAT tool.
[c]Question refers to quantitative descriptive design in MMAT tool.

population, 60% of whom are male.[7,23,32] The age of participants in these two studies ranged from 19 to 99 years (mean, 71 [SD, 15.7] years[7] and 58.82 [SD, 15.29] years,[23] respectively). The majority of study participants were white (n = 457, 78%).[7,23] Other ethnic backgrounds represented were as follows: black/African American (n = 45, 8%), Hispanic (n = 47, 8%), Asian/Pacific Islander (n = 31, 5%), and other (n = 1, 0.2%), resulting in a rounded ratio of 4:1 white to cumulative minority groups.[7,23]

Indicators

Study authors defined ASF using the Langemo and Brown[5] definition in two of the three studies.[7,23] The third study provided no ASF definition; rather, the authors describe SF occurring as a result of hypoperfusion and secondary to the underlying patient condition and use of vasoactive drugs, causing poor tissue tolerance and leading to PI formation.[24] This study was included in the analysis because it met the inclusion criteria. Further, this distinction in terms demonstrates the linguistic and conceptual confusion currently surrounding this phenomenon.

In two retrospective studies, PI development was the primary outcome measure.[7,24] The third study used a certified wound and ostomy care nurse to assess ASF prospectively,[23] although again the diagnostic criteria were not described. As a result, the lack of diagnostic criteria may contribute to researcher bias and potentially influence reliability and consistency.

Comparator

Comparator groups were used in both retrospective studies.[7,24] One study compared PI rates in ICU patients with non-ICU patients and confirmed an increase in PI development over time in the ICU group (from 4.6% [71/1,532] PI incidence in 2006 to 7.5% [128/1,699] in 2015).[24] The other study compared the physiologic characteristics of ICU patients who developed PIs with a control group of ICU patients who did not develop PIs.[7] This comparison enabled a logistic regression analysis that showed independent predictors of ASF.[7]

Outcome

Risk factors for ASF were determined by one study's use of logistic regression analysis and reported statistically significant and independent predictors of ASF.[7] This study found the predictive variables for ASF were: peripheral arterial disease (odds ratio [OR], 3.8; 95% confidence interval [CI], 1.64–8.66), mechanical ventilation longer than 72 hours (OR, 3; 95% CI, 1.78–5.05), respiratory failure (OR, 3.2; 95% CI, 1.82–5.40), liver failure (OR, 2.9; 95% CI, 1.05–8.08), and severe sepsis/septic shock (OR, 1.9; 95% CI, 1.14–3.20). Another study found more than 90% of their cohort diagnosed with ASF had the following antecedent conditions: renal failure, respiratory failure, more than one organ system (other than skin) failing, and albumin levels less than 3.5 mg/dL.[23]

The final study found an increase in ICU PI incidence from 4.6% (71/1,532) of ICU episodes of care to 7.5% (128/1,699) of ICU episodes of care over a 9-year period (2006–2015).[24] This study also reviewed the clinical characteristics of a subset of 13 ICU patients with severe PIs (Stages 3 and 4)[24] and found 30% (4/13) of this cohort had an admission diagnosis of septic shock; 38% (5/13) required extracorporeal membrane oxygenation therapy; 69% (9/13) required renal replacement therapy; and 100% (13/13) were treated with more than two vasopressors

or inotropic pharmacologic agents. The authors hypothesized that the clinical characteristics of this subset of ICU patients may be more appropriately attributed to antecedents of SF rather than the predictors of PIs.[24]

Each study had several limitations. Single-site studies, although important, have limited generalizability.[23,24] One study's small sample size,[23] as well as the lack of documented ASF diagnostic criteria identified in any of the studies, impacted the generalizability of these findings.[7,23,24] A confounding bias for two studies was the use of PI development as a surrogate marker for ASF.[7,24] Given the lack of evidence substantiating a pathophysiologic link between ASF and PI, it cannot be confirmed that the findings from these studies are specific to ASF alone.

Two studies lack generalizability because of the use of unique subspecialties such as elective cardiothoracic surgical patients.[7,24] These patients are often stable prior to surgery and critically ill for only a short period.[7] The lack of generalizability was also evident in the cohort mix, with a disproportionate ratio of whites to other ethnicities (4:1) represented within the collective studies.[7,23]

The two retrospective studies, despite having the largest cohorts,[7,24] have limited generalizability because of their retrospective design. Further, one study had a 9-year timeline (2006–2015), resulting in data collection over a period in which differing classification systems were used to categorize PI stages.[24] These limitations may have also been compounded with the use of multiple reporting systems to collect these data.[24]

DISCUSSION

The few studies eligible for inclusion in this review illustrate that research is limited regarding ASF in the adult intensive care patient population. This includes the apparent lack of consensus and evidence to define ASF in this cohort; limited understanding of risk factors, causes, and antecedent conditions for ASF; and scant evidence supporting PI etiology and development because of ASF.

Globally, ASF has no agreed-upon definition, and related research remains inconsistent as a result. The definition of ASF, although previously described within dermatologic literature, was redefined by Langemo and Brown within the wound care literature, citing an alternative etiology for the condition (hypoperfusion in the context of patient acuity).[5] As a result, the definition of ASF not only lacks consensus within the wound care community, but it also has different meanings depending on whether it is used in the wound care or dermatology context.

Significant conceptual confusion surrounding ASF remains. This is most evident in the retrospective studies included in this review,[7,24] in which ASF may have been erroneously labeled as PI. However, ASF does not require factors necessary for PI development such as mechanical stress. Acute SF can occur on the body in areas of no mechanical stress, manifesting, for example, as necrotic digits.[14] Further, when the label ASF is applied retrospectively to only those patients who developed PIs, patients who may have developed ASF without PI development are missed. Whether this is right or wrong, this is the current point at which researchers and clinicians find themselves.

This systematic review illustrates a paucity of research available on ASF in the intensive care patient population and the need for rigorous analysis regarding the etiology and pathophysiology of ASF including similarities, differences, and interrelationships to other skin changes. This will ensure a solid theoretical and biologic foundation for defining the term and lead to practice improvement and global patient benefit.

Limitations

This review has some limitations. First, the search strategy was limited to original research written in English; gray literature was excluded. Gray literature consists of a wide range of formats and scopes that can often be a rich source of evidence, although it is usually not subject to peer review.[33] Second, the small number and heterogeneity of studies found on this topic prevented a true meta-analysis.

CONCLUSIONS

This systematic review aimed to present the current evidence regarding ASF by reviewing the risk factors, causes, and antecedent conditions; identifying associations between ASF and PI development; and understanding the definition of ASF in the adult ICU population.

The results of this systematic review highlight a substantial evidence gap in this area. Further research regarding etiology, diagnostic biomarkers, and predictors of SF is warranted to assist in formulating an accurate and agreed-upon definition, as well as improving skin integrity outcomes in patients who are critically ill.

PRACTICE PEARLS

- Skin, like other organs, can fail.
- There is no agreed-on definition or clinical markers for ASF.
- Pressure injury may or may not be associated with ASF.
- Despite a lack of consensus on the definition of SF, holistic evidence-based skin integrity care remains a priority for critically ill patients. ●

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