Risk Determinants of Incontinence associated dermatitis among Critically Ill Patients.

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Abstract

Background: Keeping skin integrity functioning and skin barrier protection is an important aspect of nursing care. ICU patients are susceptible to various skin complications, such as pressure ulcers and moisture-related skin damage. **Aim:** This study aimed to pinpoint incontinence-associated dermatitis (IAD) risk determinants among ICU patients. **Design:** A prospective observational research design was conducted. **Setting(s):** Data collection was done in two general ICUs. **Participants:** A convenience sample of 200 intensive care inpatients was involved. **Tools of data collection:** One tool, "Risk Determinants of IAD tool", was used to assess the determinants contributing to IAD. It consisted of three parts, part I used to assess demographic and clinical data; part II used to assess ventilation and hemodynamic patient data, and part III used to assess skin condition. **Results**: About 60.5% had male gender, with a mean age of 49.51 ± 10.54, and about 69.5.% of the overall sample had IAD. Concerning the severity of IAD, 78.4% had a risk for IAD with no redness and skin intact, 19.4% were categorized as grades I, and 2.2% were categorized as grade II. **Conclusion:** ICU patients' exposure to several risk factors can damage their skin integrity. It can be concluded that increasing age, female gender, sepsis, neurological disorders, a high score on the perineal assessment scale, fever, hypoalbuminemia, enteral nutrition, wet skin, poor hygiene practice, and watery diarrhoea are associated risk factors for IAD in patients with a critical illness. **Recommendation**: Early identification and management of IAD should be early by using standardized skin protocols and skin assessment tools.

Keywords: *Critical ill patients; Dermatitis; Skincare; Perineal assessment; Incontinent; IAD.*

Introduction

Impaired skin function due to damage or loss of large areas of skin results in impaired skin barrier function, hemodynamic instability, impaired thermal regulation, and metabolic and endocrine (Mueller &Tainter, 2022). Keeping skin integrity functioning and skin barrier protection as a body defence mechanism should be a fundamental part of nursing care. Exclusive of it, ICU patients can be at risk for complex problems, such as pressure ulcers, moisture. associated skin damage (MASD), tears of skin, and secondary infections from various sources (Southgate &Bradbur, 2016).

Pressure ulcers are one of the most skin damages, and prevention of their occurrence is a hospital concern. The development of pressure ulcers can lead to several serious complications, such as sepsis (Allman., Patrick, 2010; Coyer et al., 2017). As part of a normal skin evaluation, nurses must be able to distinguish between various skin types of damage and give an appropriate individualized plan of care. Nurses are accustomed to utilizing instruments to assess skin damage caused by pressure (Yates, 2020).

MASD refers to conditions of the skin produced by contact with excessive moisture, such as wound exudate, sweat, urine, and

faeces. There are various types of MASD conditions include IAD, Intertriginous, peri-wound, and peristomal moisture-associated dermatitis (Chianca et al., 2017; Yates, 2020). Health care provider may misdiagnose IAD as skin pressure damage, which may lead to improper nursing and medical management and care (Iblasi, 2019). The risk factors associated with IAD may categorized as impaired in the tissue tolerance, alteration in perineal environment, and toileting inability. Older age, increase comorbidities, increase body mass index (BMI), and impaired in skin hydration may cause impaired tissue tolerance. Decrease frequency to change absorbent pads and duration of contact skin to faeces or urine, being immobile with disturbed level of consciousness, and limited range of motion of the lower extremities may impaired ability to control toilet ability. Prolonged attached to invasive devices such as mechanical ventilator associated with impaired of cognition function may impaired ability for control toileting (Ichikawa-Shigeta et al., 2014; Millard, 2019).

IAD is a skin damage type that is described as inflammation and/or skin erosion caused by presence of urine and stool in contact with the skin. IAD is sometimes recognized as irritating contact dermatitis, which is a painful disease and a risk factor for pressure ulcers in patients admitted to ICUs with critical illness. IAD, also known as irritant contact dermatitis, is a painful condition and a risk factor for pressure ulcers for prolonged comatose patients in ICU (Fisher, 2020; Kayser et al., 2019).

Bliss et al. (2011) & Becker et al. (2017) found that the incidence rate of IAD was higher than the pressure ulcer incidence rate in patients admitted to ICUs and had prolonged ICUs stay. Lee et al. (2018) also reported that IAD is a common condition with prevalence ranging from 20% to 95% seen in the ICUs, and there is limited evidence addressing IAD. Unfortunately, poor ICU's formal IAD prevention and skin care management protocols are noticed, the main concern on pressure ulcer prevention.

IAD occurs when the skin is repeatedly exposed to moisture when this moisture is either urine and/or faeces. IAD can occur from faecal incontinence or urinary incontinence, or both, which indicated the presence of double incontinence. Patients who admitted to emergency or intensive care attached with a urinary catheter, they may be complain from urine incontinent, until iatrogenic urine leakage occur which accelerate the development of IAD symptoms. Impaired tissue tolerance; disrupted perineal environment; decrease frequency of skin care may cause changes in the skin pH, increase liability for infection and good media for bacteria or germs colonization, increase skin injury, pressure and friction, and prolonged immobility cause decreased toileting capacity which contribute to the pathophysiology of IAD (Coyer et al., 2020; Yates, 2020). Prolonged exposure to urine with skin becomes more at risk for injury and more inflamed due to urine being irritant alkaline with the formation of ammonia. Water from urine/faeces leads to wet, overhydration and damages the skin's acid mantle, usually pH 4.6-5.5. Watery faeces considered to be more damage than solid stools because they contained higher level of digestive enzymes. Double urine and faeces incontinence considered to be more damaging than urine or faeces alone (Yates, 2020).

IAD is needed to be included in the clinical nursing education program because their focus on pressure ulcers and IAD is lacking but needs to be improved (Yates, 2020). Nurses should have sufficient evaluation skills to recognize the IAD risk factors and avoid pressure ulcers. Heath care provide and hospital administrative department need to consider skin evidence base practice and skin care protocol to reduce the occurrence of IAD (Conley et al., 2014).

The critical care team should consider the training sessions using standardized tools to assess skin-related skin problems. Using evidence base practice to maintain skin integrity should be apriority to care those high-risk patients to deliver high quality of care. MASD including IAD prevention and care should include in nurses' educational programs to raise nurses' awareness of various skin damage problems caused by moisture was pursued (Fisher, 2020). Therefore, this study aims to recognize risk determinants of IAD among critically ill patients.

Significance of the study:

Critically ill patients are a vulnerable population for skin problems such as pressure ulcers and IAD, requiring critical care nurses' attention to identify associated risk factors. nurses are responsible and obligated to give the best possible care to patients. Pressure ulcers and prevention are the focal points for health care providers and researchers. IAD is a neglected area for research, and a little search on IAD prevalence or incidence in critically ill patients(Avşar & Karadağ, 2018; Munch et al., 2011; Pather & Hines, 2016).

Aim of the study:

To pinpoint risk determinants of incontinence-associated dermatitis between critically ill patients.

Research questions:

What are the risk determinants of incontinence-associated dermatitis among critically ill patients?

Material and Method

Study design

A prospective descriptive research design was conducted which aim to describe the studied variables without identifying a causal relationship.

Research settings:

The study was recruited in general ICUs at Damanhur Medical National institute hospital in Egypt. Those units received patients with severe conditions who required high monitoring and nursing care.

Subject:

This study included a convenience sample type, 200 ICUs admitted patients aged more than 18 years and had both or one with urinary or faeces incontinence or both of them. The sample size was determined using the following data from the power analysis: population size = 400 over six months; predicted frequency = 50 percent; tolerable error = 5 percent; and confidence coefficient = 95 percent; the minimum sample size was 197).

Exclusion criteria:

Patients admitted to ICUs with skin injuries such as pressure ulcers, wounds, open sore on perineal skin caused by pressure or shear, patients with colostomy and skin allergy were excluded from the study (Coyer & Campbell, 2018; Yates, 2020)

Tools Of Data Collection:

After relevant literature reviewing (Bergstrom, 1988; Nix, 2002; Borchert et al., 2010; Beeckman et al., 2011; Savik, Thorson, 2011; Ichikawa-Shigeta et al., 2014; Chance et al., 2017; Coyer & Campbell, 2018; Damme et al., 2018; NHS, 2019; Van Yates, 2020; Behairy& El-Mokadem, 2021; Bliss; Fisher, 2020; and Millard, 2019). "**Risk Determinants of IAD tool**", developed by the researcher after reviewing the related literature to pinpoint the risk determines of IAD between critically ill patients which include three parts:

Part I: Patient demographic and clinical data e.g., age, gender, past medical and surgical history, and current diagnosis. The severity of illness used sequential organ

failure assessment score (SOFA) and acute Physiology and Chronic Health Evaluation II scores (APACH II). The level of consciousness used the Glasgow coma scale (GCS), 3-8 score indicated unconscious, 9-13 indicated semiconsciousness, and >13 indicated unconscious patients. Also, the level of agitation using the Richmond agitation scale (RASS) ranged from +4 to -5. +4 means combative and -5 means Unarousable. The Confusion Assessment Method (CAM-ICU) score was used to assess the presence of delirium and classify patients into no delirium, hypoactive delirium, and hyperactive delirium. Edema was assessed throughout the observation days using an edema scale of +1 to +4. Medications include antibiotics**; body mass index (BMI) calculation** using the following formula: weight (kg) / height (m^2). BMI Categories: Underweight mean BMI less than 18.5; normal weight mean BMI ranged from18.5–24.9; Overweight mean BMI between 25–29.9; Obesity mean BMI equal 30 or greater. The **nutritional** route included oral, enteral, and parenteral.

Part II: Ventilation and hemodynamic patient data: hemodynamic parameters included temperature, pulse, calculating mean arterial blood pressure, assess delayed capillary refill, and fluid balance/24 hours. Ventilation parameters included partial pressure of arterial oxygen (Pao2) and friction-inspired oxygen (Fio2). Laboratory investigation included serum haemoglobin, haematocrits, albumin, bilirubin, creatinine, sodium, potassium, and blood glucose level.

Part III: Skin assessment data: The skin assessment of each patient was done from the first day of admission to seven consecutive days using the Braden Scale, the Perineal Assessment Tool (PAT), and the IAD severity instrument (IADS).

Braden scale adopted (Bergstrom, 1988), consists of 6 items sensory perception, moisture, activity, mobility, nutrition, friction, and shear. The total score is 18 when a score of 15-18 means mild risk, 13-14 means moderate risk, 10-12 means high risk, and equal to or less than 9 mean severe risk.

The perineal assessment tool (PAT) adopted (Nix, 2002) was used to assess the presence of IAD risk. It is a four-item grading instrument based on the four determinants of perineal skin breakdown: kind and severity of irritant, duration of contact with an irritant, perineal skin condition, and contributory variables such as low albumin, antibiotics, and tube feeding. Each item is given a score between one and three. Total PAT ratings varied from 4 (representing the least danger) to 12 (representing the most risk). The cumulative score suggests that the greater the score, the greater the risk of IAD.

The IAD severity instrument (IADS), adopted from Borchert et al. (2010), was used to determine the grade of IAD. The tool addresses the four criteria, including location based on 13 areas, such as the perianal skin, buttocks, genitalia, upper thigh, and skin folds between genitalia, as well as the presence of redness, skin loss, and rash. The worst form of skin damage for each of the 13 selected body areas was evaluated, and a single value representing the severity of the worst skin damage was recorded for each place. 0 to 52 is the range of potential scores. A low IADS score indicates that the skin condition has improved. It was determined that inter-rater reliability was 0.97 percent. The IAD severity was classified into three categories: patients at risk with no redness and skin intact, category I included patients with red but skin intact and indicated mild degree, and category II included patients with red with skin breakdown, which indicated moderate to severe grade.

Frequency of change in patient's position; diaper change; perineal care; the number of lines under the patient and bed bath were documented. The type of lotion used in skincare and towels during care, such as cotton or gauzed dressing, was documented.

Assessment of GIT pattern includes frequency of stool and stool consistency using the Bristol stool scale which was adopted from (Heaton & Lewis, 1997) and it had seven categories of the stool as the following types 1-2, constipation; types 3-4, ideal stools; types 5-7, diarrhoea. Skin colour, condition, and temperature were assessed.

Validity and Reliability:

Five-panel expertise in the critical care nursing field was revised to determine the content validity.

Reliability Cronbach coefficient alpha test was used to determine the reliability of the tool (a=0.77)

Pilot Study

Twenty patients from the research population were recruited for a pilot study to determine the practicability and use of the evaluation instrument. No modifications were necessary for the final version of the tool. These patients were excluded from the total sample size.

Procedures:

Before collecting data, official administrative permission was obtained from the hospital authorities was obtained. Data were collected within three months. Patients who met admitted to the previous setting who met exclusion criteria were included in the study. The validity and reliability of the tool were done. The pilot study was done to assess the clarity of the tool. Demographic and clinical data were collected within 24 hours of the patient's admission to ICU to the seventh day of observation. The skin assessment tool was done from the first day of admission and for seven consecutive days for each patient to assess risk for IAD using the Perineal Assessment Tool (PAT), and the IAD severity instrument (IADS). and pressure ulcers using the Braden Scale. The groups' demographic, clinical, ventilation, and perfusion data were compared to assess determinants contributing to IAD among studied patients. After data collection, the researcher categorized the patients into three groups to tabulate the results.

Ethical considerations:

Ethical approval from Damanhour University, Faculty of Nursing's Ethics Committee was obtained (code no 60-b). Administrative approval from hospital authority was obtained to collect data.

Statistical analysis

Data were handled and analysed using IBM-SPSS ver. 20.0 (Armonk, NY: IBM Corp). Non-parametric data were described by numbers and percentages. Normality was checked using the Kolmogorov-Smirnov test. Mean and standard deviation was used to describe quantitative data.

At the 5 percent significance threshold, the acquired findings were deemed significant. The Chi-square test indicated for categorical variables. Monte Carlo correction for chi-square when more than 20% of the cells had an anticipated count of less than 5 and the Kruskal Wallis test for abnormally distributed quantitative data were employed to compare.

Results:

Table 1 illustrates frequency distribution of the sociodemographic and clinical data between the studied groups and three categorized subgroups. Three categorizes used to classify the studied patients based on the risk for development of IAD and/or pressure ulcers; **Group I:** patients with intact skin and no risk for IAD and pressure ulcers; **Group II:** patients with no risk for pressure ulcers but the risk for IAD; **Group III**: patient with no risk for IAD but more risk for developed pressure ulcers. Group I, who experienced no risk for IAD and

pressure ulcers, comprised 13 % of the sample; Group II, who risk for IAD and no risk of pressure ulcers, comprised 69.5 % and Group III, who experienced risk for pressure ulcers and no risk IAD comprised 17.5 %. Group II was compared to other groups, and it was found that a higher mean in considering age, was 55.80 ± 9.88 years, and there was a significant relationship between age and group type (P<0.001). About 60.5% of the studied patients were male, 64.7% of group II were male, and 57.1 % of group III were female.

Regarding the history, about 55.5 % of the studied patients had heart failure. Three groups had a significant difference between in relation to the history of skin infection, heart, and respiratory failure. About 40.5% of the studied patients have been diagnosed with sepsis, and 39% were diagnosed with respiratory disease. The mean score of overall patients of APACH II was 22.70 ± 8.11, while the SOFA score was 19.54 ± 4.44. three groups had a significant difference regarding the APACHE II score and SOFA score (p <0.001, p <0.001, respectively). Regarding body mass index, the mean BMI of groups I, II, and III were 25.12 ± 7.11, 34.47 ± 7.51, and 38.89 ± 7.36 respectively. Three groups had a significant difference between the three groups concerning BMI (p <0.001). Enteral feeding nutrition was the most dominant feeding route among the studied sample (90.5%).

Regarding the disturbing level of consciousness, the mean of the Glasgow coma scale for the studied patients was 9.99 ± 2.79. Three groups didn't have a significant difference (p =0.075). About 49% of the studied patients had hyperactive delirium, and there was a highly significance difference between the three groups concerning delirium occurrence (p <0.001).

Concerning the RASS score, about 36.5% of the studied patients experienced restlessness, and 5% experienced very agitation. Three groups had a significant difference concerning the RASS score (p <0.001). About 51.5 % of the studied patients experienced Klebsiella infection, and 11% had Acinetobacter infection. There was a significant difference (p <0.001) between the three groups concerning Klebsiella, E. coli, and MRSA infection.

Table 2 represents frequency distribution of the patient's clinical assessment between the studied groups and three categorized subgroups. Three groups compared for medications used and a significant difference was found in relation to the vasopressor use, corticosteroid, insulin infusion, and lactulose. In comparison with other groups, group II had a mean of 2.80 ± 0.58 on the edema scale, and the mean of the fluid balance was 682.22 ± 87 throughout the observation days. Concerning vital signs, group II had a mean of 38.21 ± 0.62, while group III had 37.87 ± 0.79. The mean arterial pressure of group II was 88.34 ± 16.70 and for group III was 79.97 ± 17.73. The studied patients had a significant difference between them according to temperature (p = 0.005), heart rate (p=0.019), mean arterial pressure (p=0.037), and Spo2 (p= 0.008). Group II had a lower mean of albumin and haemoglobin (12.44 ± 1.28, 3.29±0.27), and three groups had a statistical difference in haemoglobin, haematocrit, and blood glucose levels; albumin; and bilirubin (p=0.018, 0.001, 0.015, and <0.001 respectively). About 61% of the studied patients had wet skin, 81% were warm, and 85.6% of group II had wet skin. Three groups had a significant difference (p <0.001) in relation to the skin conditions.

Table 3 indicated the frequency distribution of the hygiene nursing care between the studied groups and three categorized subgroups. Compared the three groups, about 60.5% of the studied patients used soap and water, and there was significance between them concerning the type of shower used in caring for the studied patient (p<0.001). Also, about 61 % of them

used dressing; there was significance between them concerning the type of towel used in caring for the studied patient (p<0.001). Most of the studied patients, 61% had a diaper change and perineal care once per day. Three categorized groups I, II, and III had a significant difference between them regarding frequency of diaper change and perineal care (p<0.001, p<0.001reectively). On the contrary, the studied patients had no significant difference between the three groups concerning change in position

Table 4 represented frequency distribution of the studied patient's skin assessment and comparison between three categorized subgroups. The mean score of the Braden scale of the overall groups was12.47 ± 2.74; group III was more at risk for pressure ulcers (mean 9.87 ± 2.32) than other groups, group 1 (13.46 ± 2.57) and group II (14.10 ± 2.24). Regarding the perineal assessment tool, the studied patients had a significant statistical difference between the three categorized groups (p=0.002) in relation to the perineal assessment score; the overall mean of perineal assessment score was 9.32 ± 1.38, mean for group 1 was 8.79 ± 1.35, group II was 11.42 ± 1.39, and group III was 8.19 ± 1.34. The overall mean score of the IAD severity instrument was 43.25 ± 4.95, the mean of group 1 was 40.61 ± 6.90, group II had a mean of 45.62 ± 4.80, and group III had a mean of 41.97 ± 3.53. The studied patients had a significant difference concerning the score of IAD (p =0.001).

Concerning the severity of IAD, the patients who classified in Group II was 69.5% from the total studied patient. About 78.4% of the were at risk of IAD and had no redness and skin intact, 19.4% were categorized as grades I and described as mild degree as they had red but skin intact, and about 2.2% were categorized as grade II described as had red skin associated with breakdown (moderate-severe).

Therefore, the risk of IAD increased with increasing age, female gender, sepsis, neurological disorders, a high score on the perineal assessment scale, fever, hypoalbuminemia, enteral nutrition, wet skin, poor hygiene practice, and watery diarrhoea are associated risk factors for IAD in patients with critical illness could calculate body mass index. Concerning, the history of chronic illness, more than half of them had no history.

Table (1): Frequency distribution of the demographic and clinical data between the studied groups and three categorized subgroups:

		Overall		Group. I*		Group.II *		Group. III*		Test of Sig.	p
		No	%	No	%	No	%	No	%		
	Group category	200	100	26	13%	139	69.5	35	17.5	-	-
Demographic Data	**Sex**										
	Male	121	60.5	16	61.5	90	64.7	15	42.9	χ^2=5.620	0.060
	Female	79	39.5	10	38.5	49	35.3	20	57.1		
	Age (Mean + SD.)	49.51 ± 10.54		30.81 ± 6.51		55.80 ± 9.88		52.19 ± 7.26		H=60.400*	<0.001*
	History										
	Heart failure	111	55.5	11	42.3	81	58.3	19	54.3	χ^2=2.286	0.319
	Respiratory failure	32	16.0	1	3.8	28	20.1	3	8.6	χ^2=6.071*	0.048*
	Diabetes	26	13.0	5	19.2	21	15.1	0	0.0	χ^2=8.331*	MC0p=0.012*
	Shock	19	9.5	3	11.5	11	7.9	5	14.3	χ^2=1.824	MCp=0.379
	Skin infection	49	24.5	5	19.2	36	25.9	8	22.9	χ^2=6.071*	0.048*
	Stroke	45	22.5	5	19.2	37	26.6	3	8.6	χ^2=5.406	0.067
	Diagnosis										
	Neurological	55	27.5	3	11.5	34	24.5	18	51.4	χ^2=14.018*	0.001*
	Respiratory	78	39.0	15	57.7	50	36.0	13	37.1	χ^2=4.405	0.111
	GIT	13	6.5	0	0.0	12	8.6	1	2.9	χ=2.744	MCp=0.249
	Cardiovascular	41	20.5	4	15.4	31	22.3	6	17.1	χ^2=0.936	0.626
	Trauma	53	26.5	1	3.8	44	31.7	8	22.9	χ^2=8.985*	0.011*
	Sepsis	81	40.5	20	76.9	56	40.3	5	14.3	χ^2=24.297*	<0.001*
Clinical examination	**APACHE II score**	22.70 ± 8.11		15.27 ± 6.93		23.75 ± 7.68		24.03 ± 7.89		H=29.124*	<0.001*
	SOFA score	19.54 ± 4.44		15.96 ± 4.11		17.71 ± 4.23		20.67 ± 4.06		H=36.310*	<0.001*
	BMI	36.37 ± 7.42		25.12 ± 7.11		34.47 ± 7.51		38.89 ± 7.36		H=36.310*	<0.001*
	Nutrition										
	Oral	13	6.5	5	19.2	7	5.0	1	2.9	χ^2=6.307	MCp=0.037
	Enteral	181	90.5	21	80.8	125	89.9	34	100	χ^2=7.056*	MCp=0.022*
	Parenteral	12	6.0	0	0.0	12	8.6	0	0.0	χ^2=4.661	MCp=0.069
	LOC (GCS)	9.99 ± 2.79		9.80 ± 3.27		9.82 ± 2.65		10.85 ± 2.88		H=5.190	0.075
	Delirium										
	No Delirium	54	27.0	12	46.2	24	17.3	18	51.4	χ^2= 23.872*	<0.001*
	Hypoactive delirium	48	24.0	7	26.9	35	25.2	6	17.1		
	Hyperactive Delirium	98	49.0	7	26.9	80	57.6	11	31.4		
	RASS score										
	+3 very agitation	10	5.0	0	0.0	10	7.2	0	0.0	χ^2= 28.410*	MCp= <0.001*
	+2 Agitation	25	12.5	2	7.7	18	12.9	5	14.3		
	+1 Restlessness	73	36.5	5	19.2	62	44.6	6	17.1		
	0 Alert and calm	31	15.5	10	38.5	16	11.5	5	14.3		
	-1 drowsy	61	30.5	9	34.6	33	23.7	19	54.3		
	Present of infection										
	Klebsiella	103	51.5	6	23.1	86	61.9	11	31.4	χ^2=20.040*	<0.001*
	E. coli	58	29.0	1	3.8	37	26.6	20	57.1	χ^2=21.836*	<0.001*
	MRSA*	88	44.0	3	11.5	76	54.7	9	25.7	χ^2=22.299*	<0.001*
	Acinetobacter	22	11.0	4	15.4	15	10.8	3	8.6	χ^2=0.841	MCp=0.672

SD: Standard. deviation H: H for. Kruskal Wallis test
χ2: Chi.-square test MC: Monte Carlo
p: p-value. for comparing the three studied groups
: Statistically. significant at p ≤ 0.05 MRSA
Group. I: No risk for IAD and pressure ulcer risk.
Group. II: No risk for pressure ulcers but risk or development for IAD.
Group. III: No risk for IAD but risk or development of pressure ulcers.

Table (2): Frequency distribution of the clinical assessment data between the studied groups and three categorized subgroups:

	Patient's parameters	Overall		Group. I*		Group. II *		Group. III*		Test of Sig.	p
		No	%	No	%	No	%	No	%		
Medications	Vasopressor	54	27.0	12	46.2	24	17.3	18	51.4	χ^2=23.872*	<0.001*
	Corticosteroids	91	45.5	15	57.7	54	38.8	22	62.9	χ^2=8.290*	0.016*
	Insulin infusion	48	24.0	7	26.9	35	25.2	6	17.1	χ^2=23.872*	<0.001*
	Sedatives	43	21.5	3	11.5	36	25.9	4	11.4	χ^2=5.226	0.073
	Diuretics	185	92.5	23	88.5	129	92.8	33	94.3	χ^2=0.964	MCp=0.693
	Lactulose	91	45.5	15	57.7	54	38.8	22	62.9	χ^2=8.290*	0.016*
	Proton pump inhibitor	31	15.5	1	3.8	27	19.4	3	8.6	χ^2=5.613	0.060
	Oedema scale	2.47 ± 0.58		1.71 ± 0.61		2.80 ± 0.58		2.70 ± 0.52		H=0.710	0.701
Vital signs	**Temperature**	37.90 ± 0.74		37.63 ± 0.48		38.21 ± 0.62		37.87 ± 0.79		H=10.693*	0.005*
	MAP	80.75 ± 18.51		92.10 ± 17.36		88.34 ± 16.70		79.97 ± 17.73		H=7.921*	0.019*
	Heart rate	102.31 ± 17.68		97.83 ± 21.47		101.85 ± 17.63		107.47 ± 13.58		H=6.606*	0.037*
	Spo2	92.15 ± 1.92		91.71 ± 1.22		92.32 ± 2.11		91.81 ± 1.40		H=9.661*	0.008*
	Fluid balance	590.64 ± 840.69		201.65 ± 773.03		682.22 ± 875.93		515.92 ± 653.69		H=14.096*	0.001*
Laboratory test	**Haemoglobin**	12.96 ± 1.41		13.13 ± 1.43		12.44 ± 1.28		12.70 ± 1.31		H=7.987*	0.018*
	Haematocrit	33.76 ± 5.56		33.98 ± 4.50		34.06 ± 5.91		32.39 ± 4.65		H=2.123	0.346
	Random blood sugar	178.75 ± 84.98		184.73 ± 79.83		216.55 ± 93.02		168.12 ± 81.51		H=13.496*	0.001*
	Sodium	138.21 ± 3.47		137.74 ± 4.05		136.96 ± 3.54		137.66 ± 3.89		H=1.004	0.605
	Potassium	3.79 ± 0.33		3.88 ± 0.36		3.77 ± 0.32		3.85 ± 0.35		H=0.002	0.999
	Albumin	3.42 ± 0.24		3.40 ± 0.27		3.29 ± 0.27		3.38 ± 0.27		H=8.427*	0.015*
	Bilirubin	1.02 ± 0.24		1.13 ± 0.31		0.90 ± 0.23		1.08 ± 0.30		H=21.243*	<0.001*
	Creatinine	0.82 ± 0.29		0.76 ± 0.22		0.83 ± 0.28		0.80 ± 0.36		H=2.966	0.227
Bristol stool form scale											
	Types 1-2. constipation	16	8.0	12	46.2	3	2.2	1	2.9	χ^2= 55.894	MCP <0.001*
	Types 3-4. ideal stools	46	23.0	11	42.3	27	19.4	8	22.9		
	Types 5-7. diarrhoea	138	69.0	3	11.5	109	78.4	26	74.3		
Number of past stools		2.86 ± 0.72		2.85 ± 0.54		2.93 ± 0.73		2.60 ± 0.77		2.86 ± 0.72	H=3.097	0.213
Skin colour											
	Pale	23	11.5	1	3.8	19	13.7	3	8.6	χ^2= 1.981	MCp= 0.322
	Redness	177	88.5	25	96.2	120	86.3	32	91.4		
Skin condition											
	Dry	74	37.0	26	100.0	20	14.4	28	80.0	χ^2= 132.299*	MCP <0.001*
	Wet	122	61.0	0	0.0	119	85.6	3	8.6		
	Normal	4	2.0	0	0.0	0	0.0	4	11.4		
Skin temperature											
	Warm	162	81.0	23	88.5	108	77.7	31	88.6	χ^2= 3.352	MCp= 0.481
	Cold	23	11.5	1	3.8	19	13.7	3	8.6		
	Hot	15	7.5	2	7.7	12	8.6	1	2.9		

S.D: Standard deviation H: H. for .Kruskal Wallis testχ2: Chi-..square test MC: Monte. Carlo p: p-value for comparing the three studied groups *: Statistically significant at p ≤ 0.05. Group. I: No risk for IAD and pressure ulcer risk. Group. II: No risk for pressure ulcers but risk or development for IAD. Group. III: No risk for IAD but risk or development of pressure ulcers.

Table (3): Frequency distribution of the hygiene nursing care between the studied groups and three categorized subgroups:

	Overall		Group. I*		Group. II *		Group. III*		Test of Sig.	p
	No	%	No	%	No	%	No	%		
Shower used										
Water only	1	0.5	0	0.0	1	0.7	0	0.0		
Soap and water	121	60.5	1	3.8	107	77.0	13	37.1	χ^2=	MCP
Artificial commercial shower	19	9.5	5	19.2	8	5.8	6	17.1	65.295*	<0.001*
Betadine shower	59	29.5	20	76.9	23	16.5	16	45.7		
Towel used during bath										
Cotton	74	37.0	26	100.0	20	14.4	28	80.0	χ^2=	MCP
Dressing	122	61.0	0	0.0	119	85.6	3	8.6	132.299*	<0.001*
Special towel	4	2.0	0	0.0	0	0.0	4	11.4		
Bed bath Frequency	1.16 ± 0.36		1.27 ± 0.45		1.13 ± 0.34		1.17 ± 0.38		H=3.336	0.189
Change the patient's position										
Irregular interval	33	16.5	7	26.9	20	14.4	6	17.1	χ^2=	0.285
Regular interval	167	83.5	19	73.1	119	85.6	29	82.9	2.511	
Diaper change										
Every 2 hours	4	2.0	0	0.0	0	0.0	4	11.4	χ^2=	MCP
Every shift	74	37.0	26	100.0	20	14.4	28	80.0	132.299*	<0.001*
Once per day	122	61.0	0	0.0	119	85.6	3	8.6		
Perineal care										
Every 2 hours	4	2.0	0	0.0	0	0.0	4	11.4	χ^2=	MCP
Every shift	74	37.0	26	100.0	20	14.4	28	80.0	132.299*	<0.001*
Once per day	122	61.0	0	0.0	119	85.6	3	8.6		

SD: Standard deviation H: H for Kruskal Wallis test
χ2: Chi-square test MC: Monte Carlo p: p-value for comparing the three studied groups*: Statistically significant at p ≤ 0.0. Group. I: No risk for IAD and pressure ulcer risk..
Group. II: No risk for pressure ulcers but risk or development for IAD. Group .III: No risk for IAD but risk or development of pressure ulcers.

Table (4): Frequency distribution of the studied patient's skin assessment and comparison between three categorized subgroups:

Patient's parameters	Overall	Group. I*	Group. II *	Group. III*	Test of Sig.	p
Braden skin Scale	12.47 ± 2.74	14.10 ± 2.24	13.46 ± 2.57	9.87 ± 2.32	H=36.563*	<0.001*
Perineal assessment tool	9.32 ± 1.38	8.79 ± 1.35	11.42 ± 1.39	8.19 ± 1.34	H=7.529*	0.001*
IAD Severity Instrument (IADS)	43.25 ± 4.95	40.61 ± 6.90	45.62 ± 4.80	41.97 ± 3.53	H=8.729	0.001*
Group II categorization (risk for IAD and no risk of a pressure ulcer) (n=139)						
The total number of patients in Group II	139		69.5		χ2= 55.894 MCP <0.001*	
No redness and skin intact (at risk)	109		78.4			
Category I: Red but skin intact (mild)	27		19.4			
Category II: Red with skin breakdown (moderate-severe)	3		2.2			

SD: Standard deviation H: H for Kruskal Wallis test χ2: Chi-square test MC: Monte Carlo p: p-value for comparing the three studied groups *: Statistically significant at p ≤ 0.05. Group .I: No risk for IAD and pressure ulcer risk. Group. II: No risk for pressure ulcers but risk or development for IAD; Group. III: No risk for IAD but risk or development of pressure ulcers.

Discussion:

Critically ill patients are susceptible to MASD due to prolonged exposure to different moisture sources such as perspiration, urine, faeces, wound exudations, and body secretion. Pressure ulcers and prevention are the focal points for health care providers and researchers than IAD. Coyer et al. (2017) and Pather & Hines (2016) reported that IAD is a neglected area for research. There is little search on IAD prevalence or incidence in critically ill patients. Using standardized IAD management protocols in ICUs was limited

evidence base practice. Most studied patients were at risk for developing IAD throughout the observation days. Less than a quartile of them categorized degree I characterized by mild skin red and intact, and few categorized degrees II as severe red with skin breakdown. This can interpret due to most of the studied patients with a disturbing level of consciousness, sweating skin, and increase body mass index which could increase the risk for IAD. This is consistent with the findings of Pather et al (2021). They reported that most of the sample experienced IAD development and the incidence of IAD in ICU patients fluctuated highly between categories1 to 2. Lee et al (2018) reported that IAD is a common condition seen in critically ill patients in the intensive care environment. Ma et al. (2017) reported that 30 patients from 104 of the studied patients had IAD with an occurrence rate of 28.85%. Behairy& El-Mokadem, (2021) investigated the effect of skin intervention protocol on incontinence-associated IAD and reported that one-third of the studied patients were at high risk for IAD, and two-thirds were affected.

Two methods can calculate the prevalence of IAD. The first method is to calculate the percentage of the overall hospitalized patients, including both continent and incontinent patients. Calculating the percentage of patients with IAD among incontinent patients is the second method (Kayser et al., 2019). Incontinent may be due to urine or faeces incontinent or double incontinent, both urine and faeces incontinent (Ribeiro et al., 2019). The current studied patient suffered from feces incontinence rather than urinary incontinent, due to most of them having disturbed level of consciousness and being unable to control their defecation as well as most of them complaining of diarrhea. Foley urethral catheter were used in the majority of studied patients as routine care in hospitals to monitor urine output and calculate the fluid balance. Patients may have urine incontinence from disconnection of the Foley urethral catheter or leakage of urine. Despite pressure ulcers receiving much attention, research has revealed that the estimated incidence of IAD in critically ill patients is frequently more significant than that of pressure ulcers (Fisher, 2020).

Moisture lesion of IAD is an excruciating condition. IAD is associated with increased length of stay, ICU days, patient irritability and restlessness, a significant increase in nurses' hours and effort for applying to nurse caring, and high-cost consumption of hospital resources. Early prevention of IAD may be indirectly caused by to decrease in the incidence of pressure ulcers (Kayser et al., 2019; Ma et al., 2017). A comparison between group 2 to the other groups exemplified the factors associated with increased risk of IAD, which included tissue tolerance, perineal environment, and toileting ability. Several studies (Chianca et al., 2017; Conley et al., 2014; Coyer & Campbell, 2018; Fisher, 2020; Kayser et al., 2019; Ma et al., 2017; Wang et al., 2018; Yates, 2020) supported the current finding and reported that these factors significantly associated with increased risk of IAD.

The present study shows that factors related to impaired tissue tolerance were older age, male sex, previous respiratory failure, diabetes, skin infection, current diagnosis with cardiovascular, trauma, and sepsis, increased body mass index, acquired hospital infection such as klebsiella, using medications such as vasopressor, corticosteroids, and lactulose, fever, hemodynamic instability, positive fluid balance, increase random blood sugar, condition, hypoalbuminemia, need for nutritional support. These factors increase the risk of IAD due to the disturbance in skin integrity, irritation of the skin, and increase liability to skin damage. The wet skin cause more damage acid mantle of the skin as PH ranges from 4.5 -5.5(Yates, 2020).

In this research, comparing men's age of the three groups, the mean age of group 2

was older. This can be interpreted as older patients' skin has less collagen and elastin fibers, which decrease skin moisture and atrophy the skin. This is in line with Wang et al. (2018), who reported an increased incidence of IAD concerning an increased age of the studied patients. This supported by Rippon et al. (2016) and Chianca et al. (2017), who reported that males were experienced IAD more than females, those who experienced a history of diabetes mellitus, a higher BMI, fecal incontinence rather than urinary incontinence and impaired cognitive function. In contrast, Kayser et al. (2019) reported that the female gender was one of the risk factors for developing IAD.

Most of the studied patients were diagnosed with sepsis and neurological disorder such as stroke. Skin irritation and discomfort may be had causal relation between disturbance level of consciousness, increased restlessness, and occurrence of hyperactive delirium in group 2. Kayser et al. (2019) and Ma et al. (2017) interpret that patients involved in their study who developed IAD were all immobile, bedridden patients, and most of them had a neurological disease and low GCS scores. The first sign of moisture lesion from IAD is a feeling of skin wetness or irritation. Increased skin moisture exposure time caused more damage to the skin. Moisture lesions may be very painful because they are shallow wounds and nerve endings are exposed. It may be a causal relationship between increased pain from moisture lesions and increased restlessness and agitation (Millard, 2019).

The current study shows factors related to toileting ability and impaired perineal environment. It included wet skin, moderate risk of bed scores using the Braden scale score, and high risk of IAD using the perineal assessment tool. Impaired ability to toilet due to impaired cognition status, increased agitation, restlessness, and watery diarrhoea. Bed bath practices such as using soap and water during bed bath and perineal care, using of dressing towel during the bath to rub patient skin, and decreasing the frequency of perineal care and diaper change. Wang et al. (2018) patients with double incontinence, a decreased score on the Braden Scale, and serum albumin levels are at a high risk of IAD. Critical ill patients are at risk for acute faecal incontinence with diarrhoea and are therefore at higher risk of skin damage (Fisher, 2020).

This study applied the Bristol stool form scale, proposed by (Heaton & Lewis 1997), to judge whether the patient had faecal incontinence and watery diarrhoea. Most of group 2 had types 5-7 diarrhoea, which consisted of Wang et al. (2018), who reported that more than half of the studied patients had faecal incontinence and the incidence of IAD was 23.9%. Patients with loose or watery stools are more likely to develop IAD than those with well-formed stools (Ma et al., 2017). Diarrheal in ICU is a multifactorial cause among critically ill patients, including critical illness pathophysiology, using enteral feeding, type of formula used, medications that contain sorbitol or magnesium, lack of fiber in enteral formulae, use of antibiotics and antacids leading to gastrointestinal flora changes, which reduced gut motility (Pather & Hines, 2016). The watery stool had high PH enzymes and pancrelipase and a large contact area with the skin, resulting in significant harm to the skin (Ma et al., 2017).

Critically ill patients are at greater risk for skin colonization and infection with multidrug-resistant organisms. Skin infections occur due to the invasion and multiplication of microorganisms such as bacteria, fungi, and viral on the skin, which is usually absent within the body (Balakrishnan &Appalasamy, 2016). IAD can be aggravated due to blood, respiratory, urine infection, and GIT infection associated with an increased risk for diarrhoea. The three groups had a significant difference concerning the occurrence of infection with Klebsiella, Acinetobacter, MRSA, and Escherichia coli. Sputum and skin cultures

confirmed infection in the previously studied units.

The current study finding is in line with Frank et al. (2021) and Grema et al. (2015), who reported that methicillin-resistant Staphylococcus aureus (MRSA) is a common cause of recurrent skin and soft tissue infections such as dermatitis. The gram-positive organism had an opportunistic pathogen and caused frequent epithelium colonization. Too the misuse and inappropriate use of antibiotics lead to poor infection prevention, which increases the development and spread of microorganisms and worsens skin infection (Balakrishnan &Appalasamy, 2016). Escherichia coli (E. coli) is a gram-negative bacillus and acts as a part of normal intestinal flora but can lead to lower GIT illness, especially diarrhoea and increased risk for dehydration, increase in severity of renal failure and septic shock (Mueller &Tainter, 2022).

Most of the studied patients were diagnosed with sepsis due to an increased risk of infection from IAD moisture lesions. Exposure to irritants such as urine and faeces causes skin structure and function damage. The Urine pH is different from the skin pH, so prolonged skin exposure to urine leads to skin weakness and decreases defenses against bacterial infection (Millard, 2019).

The body mass index of group 3 was more than the body mass index of groups 2 and 1. The overall classification of body mass index of the study group was obesity grade I. Group 2 experienced more fever and perspiration of the skin, which led to increased moisture of the skin and the development of IAD. This is consistent with Lee et al. (2018), who reported that dry skin could increase the risk of pressure ulcers due to an increase in friction against the skin, while hydration skin from excessive moisture, such as incontinence, wound exudate, or perspiration, could lead to all types of moisture-associated skin damage.

The present study found that the frequency of bath patients is usually once per day, and most of the studied patients had limited frequency for diaper and perineal area care. This can interpret as due to the work overload for nurses, lack of knowledge and skill in skin inspection, financial resources, lack of equipment, and no policy. Most of the studied patients had wet skin from hypoalbuminemia, which led to extravasation of serous fluid and wet the patient's line with a decreased frequency of change of bed bath. Also, sweating and perspiration from fever lead to the skin becoming over hydration. Also, dressing is the most common use of cotton while caring for the studied patients, and nurses rub patients' skin during bed baths, which increases the risk of skin epithelium damage. Using soap and water may increase the risk of skin irritation and damage.

The current study is in line with El-Soussi & Asfour (2016) and Lee et al. (2018), who reported that factors affecting bed-bath practice as reported by nurses were financial resources, lack of equipment, no policy, lack of knowledge, and workload. Soap and water are frequently used for patients' bed-bath. Also, they used bath water sampled after patients received a soap-and-water basin, and both gram-negative and gram-positive organisms were identified in bathing

Daily bed baths for critically ill patients are routine nursing interventions to improve patient hygiene, promote comfort and improve health outcomes according to the institution's policy. The frequency of bed baths depends on the patient's condition, such as hemodynamic stability, fever, and incontinence. Being disturbed level of consciousness and attached to a mechanical ventilator may lead to limited bed bath frequency. The current finding aligns with Lee et al. (2018), who found that the studied nurses reported that the most common frequency for patients' general bed baths was at least once a day. This reported frequency is consistent with several studies (Ma et al.,

2017; Avşar& Karadağ, 2018; Coyer & Campbell, 2018). Environmental factors play a vital role in the occurrence of IAD, such as environmental temperature and the number of linens under the patients (Kayser et al., 2019). Nurses play a vital role in the early identification of risk factors of IAD and need to differentiate between pressure ulcers and IAD. ICU nursing staffs need to implement early nursing interventions in patients who are supposed to be at high risk for IAD based on the Braden Scale Score, perineal assessment tool, and IAD severity instrument. Nurses need to use standardized IAD management protocols in ICUs to decrease the motility and morbidity associated with IAD. IAD is a hidden complication that causes the patient pain and increases the nurse's workload. Further ICU nursing staff training in clinical practices to differentiate a pressure ulcer from IAD and specific preventive nursing interventions for skin care.

Limitations: The convenient nature of the sample limited this study. Furthermore, data were collected from a single hospital, which can hinder the generalizability of the study results.

Conclusion and recommendation:

IAD is standard but unreported compared to pressure ulcers in the intensive care setting. IAD is a painful condition and is preventable. ICU patients' exposure to several risk factors can damage their skin integrity. It can be concluded that increased age, gender, sepsis, neurological disorders, a high score on the perineal assessment scale, fever, hypoalbuminemia, enteral nutrition, wet skin, poor hygiene practice, and watery diarrhoea are risk factors for IAD in critically ill inpatients. Intensive care units should consider the importance of protocols related to managing IAD in those patients identified as high-risk in this study to manage IAD early.

Nurses need to early identification of IAD from a systematic and accurate clinical assessment using a formal, standardized tool for IAD severity assessment. Nurses' staff should use research-based evidence to identify ICU patients at risk of IAD to improve their health outcomes and reduce morbidity. Nurses' staff should have educational training to differentiate between pressure ulcers and IAD using a scoring system, using standardized skin protocol intervention in the ICU to decrease mortality and morbidity associated with IAD.

Nurses must evaluate daily hygiene care such as skin cleansing and prophylactic protection to prevent IAD. Detailed documentation of skin assessment is the core of IAD prevention and management.

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