Intrinsic and Extrinsic Risk Factors for Nosocomial Pressure Injury among Hospitalized Adults at a Tertiary Hospital in Western Kenya

Otieno Laban Sterly Makori[1]
Dr. Rose Olayo, PhD[1]
Prof. Edwin Kadima Wamukoya, PhD

[1]makoristerly@gmail.com
[2]rolayo@mmust.ac.ke
[3]ewamukoya@mmust.ac.ke

[1]https://orcid.org/0000-0002-4773-3047
[2]https://orcid.org/0000-0002-8125-9625
[3]https://orcid.org/0000-0002-6455-2627

[1,2,3]Masinde Muliro University of Science and Technology, P.O. Box 190-50100, Kakamega, Kenya

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ABSTRACT

The high incidence and prevalence of nosocomial pressure injuries pose a threat to safe hospitalization and additional strain on the healthcare system. Analysis of pressure injury risk factors is necessary for efficient prevention and management as part of the program to ensure that no patient experiences any preventable harm while receiving care, as per the international patient safety goals. This study evaluated the intrinsic and extrinsic risk factors for pressure injury among cohorts of hospitalized adults using a prospective approach. The Braden Scale was used to assess the participants' level of risk and classify low (score 15 to 23) and high (score 6 to 14) cohorts prior to follow-up. Binary regression analysis was used to establish an association between the risk factors and the development of stage 2 and above pressure injuries and the odds reported. The intrinsic factors—nutrition, sex, age, and primary diagnosis—influenced the occurrence of pressure injuries. Similarly, the extrinsic factors—sensory perception, moisture, mobility and activity, presence of a medical device, friction, and shear—showed an association with the development of pressure injuries. Poor nutrition, impaired mobility, and persistent moisture, however, were statistically the most significantly associated risk factors, at OR 18.20, CI 2.18–151.69, p =.01; OR 20.93, CI 1.13–387.92, p =.04; OR 16.11, CI 2.02–128.52, p =.01, respectively, confirming a significant association between intrinsic and extrinsic risk factors and the development of hospital-acquired pressure injury. These identified risk factors can be used to tailor intervention earlier on admission and avert these preventable injuries. Standardized, timely risk assessment and proactive addressing of the identified risk factor among hospitalized patients are therefore recommended.

Keywords: Braden Scale, Nosocomial, Odds Ratio, Pressure Injury, Risk Factors

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I. INTRODUCTION

Nosocomial pressure injuries, or pressure ulcers, as formerly known, are pressure-related damage to the skin and underlying tissue around bonny bumps that occurs during hospitalization (National Pressure Ulcer Advisory Panel, 2009; EPUAP, NPIAP, & PPPIA, 2019). These generally preventable injuries remain high-cost and high-volume adverse health events, which may result in localized infection, sepsis, osteomyelitis, and sometimes progress to Marjolin's cancerous growth, with the risk of poor overall prognosis and premature mortality (Brem et al., 2010; JCI, 2019). The deterioration in the health of patients, extended hospital stay, increased cost of care, and reduced quality of life is a significant threat to universal health coverage (UHC, and has been marked for prevention as a universal human right (Bryant & Nix, 2012; Sociedad Iberolatino America, 2011; WHO, 2005).

Kenya, like many other developing countries, faces a triple burden of disease: infectious diseases, non-infectious diseases, and injuries, increasing hospitalization, which puts many patients at risk of nosocomial pressure injury, with a local prevalence of 5.5% (Nangole et al., 2009). Specific pressure injury risk factors, both intrinsic and extrinsic, have been identified; however, these vary considerably across patient populations and healthcare setups (Lyder et al., 2002). Whereas nurses in Kenya appreciate the magnitude of the health effects of pressure injuries and their preventability, there is neither a policy on risk assessment nor a standard tool adopted nationally for their management (Jane et al., 2021). There is also scanty evidence on the evaluation of the risk factors in Kenya, where limited studies have been done on the pressure injury subject, particularly in the western Kenya region, leaving a risk evaluation and mitigation gap (Nangole et al., 2009; Edwine et al., 2019).

This study longitudinally followed patients at Kakamega County Hospital with the objective of assessing the intrinsic and extrinsic risk factors and determining the level of association of these factors with the development of pressure injuries among inpatient adults at the facility. The study was guided by Braden and Bergstom's theory, the backbone of the Braden scale, which identifies pressure intensity and duration and tissue tolerance as the two main primary influences on the occurrence of pressure injury (Bergstrom & Braden, 1987). Factors influencing the intensity and duration of pressure include mobility, level of activity, and level of sensory perception (Cox, 2012). The presence of a medical device may also cause localized pressure of varying intensity (Black *et al.*, 2010). Tissue tolerance, on the other hand, is influenced by intrinsic or extrinsic risk factors (Bryant & Nix, 2012). The intrinsic contributors include nutrition status, age, sex, body mass index (BMI), and chronic co-morbidity, while the extrinsic factors include moisture/microclimate, friction, and shear (Kayser et al., 2019; Bryant & Nix, 2012).

This framework is the primary template on which the Braden Scale, as adopted in this study, for risk assessment for pressure injury is built (Iranmanesh et al., 2012; Coleman *et al.*, 2014). This scale has been validated through rigorous studies in diverse adult patient populations, including the dark skin population, which is the majority of the population targeted by this study, with commendable positive and negative predictive value (Cox, 2012).

These risk factors were organized into domains with directional influence and ultimate development of pressure injury, thus directing this study by highlighting and ordering its focus areas. Factors contributing to the intensity and duration of pressure (contact medical device, mobility, level of activity, and sensory perception) and factors that reduce tissue tolerance (age, sex, and clinical condition, level of nutrition, body mass index, moisture, friction, and shear), which are either intrinsic or extrinsic, are listed together as the independent variables (Cox, 2012). The development of a stage 2 or above pressure injury during the hospitalization period is mapped as the outcome of interest (dependent variable). This is summarized in the conceptual framework:

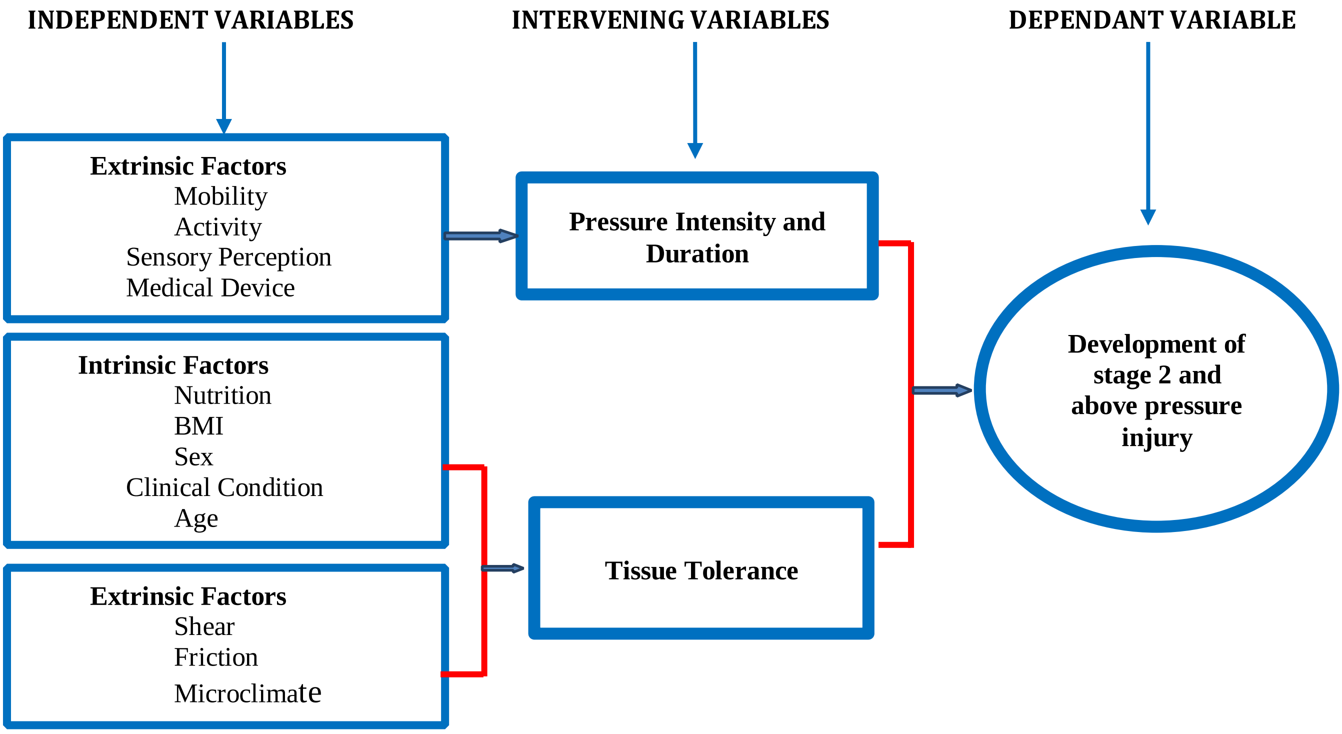

Figure 1
Conceptual framework adapted from Bergstrom and Braden with modification (Bergstrom & Braden, 1987)

II. METHODOLOGY

2.1 Study Area

This study was conducted for a period of three months at the Kakamega County General Teaching and Referral Hospital, a tertiary facility in Western Kenya.

2.2 Study Design

A cohort survey design was used. The subjects were followed prospectively from the time of hospitalization to the appearance of stage 2 pressure injuries or the end of their hospital stay.

2.3 Target Population

The population of interest for this study was hospitalized adults, both male and female. The study population was drawn from the male and female adults receiving care in selected admission wards at the facility. Eighty participants were picked systematically at admission, excluding those who had a pressure injury at first presentation.

2.4 Data collection and analysis

The Braden Score template for pressure injury risk analysis, embedded in a questionnaire, was used to examine and score the participants according to their characteristics of interest. A routine skin examination follow-up ensued, checking for the appearance of stage 2 and/or above-stage pressure injuries or until discharge. Chi square and odds ratio analyses were performed on the generated data to reveal the implicated risk factors and their level of association with the outcome.

III. RESULTS

3.1 Braden Scale Risk Assessment Score

According to the overall Braden risk score, about a third of the participants scored 6 to 14, categorizing them as a high-risk cohort (n = 24; 30.0%) as opposed to those scoring 15 to 23, categorizing them as a low-risk cohort (n = 56; 70.0%), with 32.5% of males and 27.5% of females falling into the high-risk category. 16.3% scored very limited to completely limited sensory perception (n = 13), and another 16.3% (n = 13) were either very moist or constantly moist during the screening. 41.3% were bedfast (n =33), and a similar proportion were either completely immobile or had very limited mobility. 50% of the participants had a very poor nutrition status score or probably received inadequate nutrients. Friction and shear were noted to be problems in 11.3% of participants (n = 9), and a potential problem in 60.0% of the participants (n = 48).

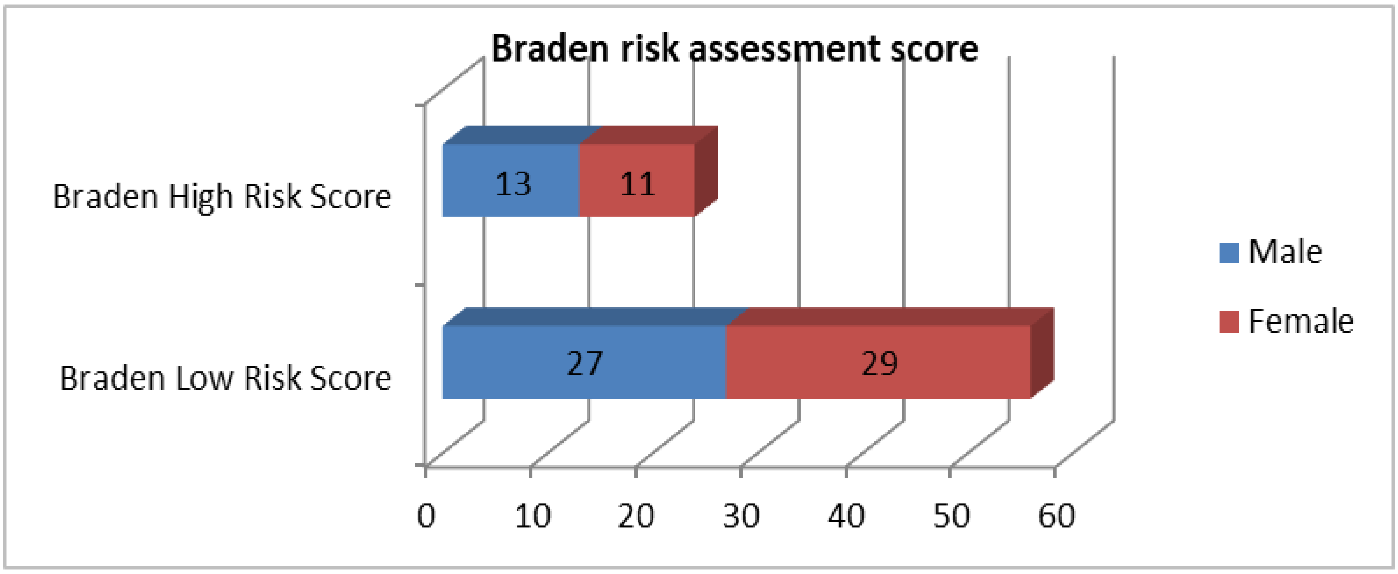

Figure 2

Participants' Braden Risk Score

3.2 Braden Risk Assessment Score and Outcome

The participants' mean Braden scale score was 15.9 (4.1). Those who developed HAPI, however, had a lower mean score of 11.0 (2.7), with 83.3% (n = 10) coming from the high-risk category. While 16.7% (n = 2) had no sensory perception impairment, 83.3% (n = 10) had impairments ranging from slight limitations (n = 4) to complete limitations (n = 2). Moisture from either fecal or urinary incontinence or excessive sweating was also widespread among participants, with 66.7% (n = 8) reported as very moist compared to 25% (n = 3) reported as occasionally moist. 83.3% (n = 10) were bedfast, while 16.7% (n = 2) would only walk occasionally. 66.7% (n = 8) of cases had very limited mobility, but 25% (n = 3) were completely immobile. 66.7% (n = 8) had very poor nutrition. Lastly, friction and shear were a potential problem in 75% (n = 9) and a problem in 25% (n = 3) of the 12 who developed HAPI in the study.

Table 1

Participants' Risk Assessment Scores and Outcome

NO (%) OF PARTICIPANTS					
VARIABLE		**TOTAL n = 80**	**WITHOUT HAPI n = 68**	**WITH HAPI n = 12**	***P*- Value**
Braden score Mean (SD)		15.9(4.1)	16.7(3.7)	11(2.7)	
Risk	High	24(30)	14(20.6)	10(83.3)	<0.01
	Low	56(70)	54(79.4)	2(16.7)	
Sensory perceptions	Completely limited	4(5)	2(2.9)	2(16.7)	<0.01
	Very limited	9(11.3)	5(7.4)	4(33.3)	
	Slightly limited	27(33.8)	23(33.8)	4(33.3)	
	No Impairment	40(50)	38(55.9)	2(16.7)	
Moisture	Constantly moist	2(2.5)	1(1.5)	1(8.3)	<0.01
	Very moist	11(13.8)	3(4.4)	8(66.7)	
	Occasionally moist	40(50)	37(54.4)	3(25)	
	Rarely most	27(33.8)	27(39.7)		
Activity	Bed fast	33(41.2)	23(33.8)	10(83.3)	0.01
	Walks occasionally	39(48.8)	37(54.4))	2(16.7)	
	Walks frequently	8(10)	8(11.8)		
Mobility	Completely immobile	4(5)	1(1.5)	3(25)	<0.01
	Slightly limited	35(43.8)	34(50)	1(8.3)	
	Very limited	29(36.3)	21(30.9)	8(66.7)	
	No limitation	12(15)	12(17.7)		
Nutrition	Very poor	13(16.3)	5(7.4)	8(66.7)	<0.01
	Inadequate	27(33.8)	24(35.3)	3(25)	
	Adequate	35(43.8)	34(50)	1(8.3)	
	Excellent	5(6.3)	5(7.4)		
Friction and shear	Problem	9(11.3	6(8.8)		0.013
	Potential problem	48(60)	39(57.4)	3(25)	
	No problem	23(28.8)	23(33.8)	9(75)	
Note: Chi-square tests were calculated between with/without HAPI and the variables.					

3.3 Intrinsic Factors

The presence of a chronic illness and poor nutrition (inadequate nutrient intake) were the most widespread intrinsic factors, occurring in up to 50% of the study participants. However, only age and nutrition were statistically significant, with p<0.05 values at 0.04 and <0.01, respectively. A further synthesis of this data resulted in the binary tables combined below:

Table 2: Intrinsic Factors' 2 by 2 contingency table

VARIABLE		**WITH HAPI (n = 12)**	**WITHOUT HAPI (n = 68)**	**TOTAL (N =80)**
Sex	Male	7	33	40
	Female	5	35	40
Age	>Mean (≥51)	8	30	38
	<Mean (≤50)	4	38	42
BMI	Abnormal	3	21	24
	Normal	9	47	56
Nutrition	Poor	11	29	40
	Good	1	39	40
Diagnosis	Trauma	6	24	30
	Medical	6	44	50
Chronic Illness	Present	5	36	41
	Absent	7	32	39
TOTAL		**12**	**68**	**80**
2x2 contingency table for intrinsic factors				

Bivariate analysis of the intrinsic variables showed an increased likelihood of pressure injury (OR >1.5) for males, old age, and poor nutrition. Nutrition had the highest odds ratio in this category (OR = 18.202, CI 2.14–151.687) and a *P* value of 0.007, hence being the only intrinsic risk factor significantly associated with hospital-acquired pressure injury development. BMI and the presence of chronic illness, however, had a negative correlation and showed no significance (BMI; OR = 0.327, CI 0.027–3.977, *P* = 0.381; and chronic illness; OR = 0.373, CI 0.045–3.070, *P* = 0.359). Even though male sex and old age showed an increased likelihood of developing HAPI, the associations were, however, not statistically significant, scoring *P* values >0.05.

Table 3
Odds Ratio for Intrinsic Factors

Intrinsic Factors	Odds Ratio	95% CI		P>z
Sex	1.88	0.35	10.19	0.47
Age	2.74	0.35	21.84	0.34
BMI	0.33	0.03	3.98	0.38
Nutrition	18.20	2.18	151.69	**0.01**
Diagnosis	1.24	0.13	12.10	0.85
Chronic Illness	0.37	0.05	3.07	0.36

NOTE: Table Showing level of association of intrinsic factors with HAPI
Odds Ratio calculated from the 2 by 2 contingency tables presenting with/without HAPI and the variables using binary logistic regression

3.4 Extrinsic Factors

The presence of a medical device, impaired sensory perception, persistent moisture, inactivity, limited mobility, shear, and friction had *p* values ranging from <.01 to.013 (<.05), signifying an association with the development of hospital-acquired pressure injury. The presence of a medical device was registered in 42.5% (n = 34) of participants. The Foley catheter was the most common at 70.6% of all the medical devices, occurring in 30% (n = 24) of the participants and particularly scoring a *p* value of.01. Friction and shear being a problem or a potential problem was the most prevalent extrinsic risk factor, affecting 71.3% (n = 57) and occurring in 100% of cases. Impaired sensory perception prevailed at 50% and affected 83.3% of cases. Mobility and activity impairment affected 41.2% (n = 33) of the participants each and had a p value of <.01 and.01, respectively. These extrinsic factors were grouped and tabulated as below:

Table 4
Extrinsic Factors' 2 by 2 Contingency Table

VARIABLE		WITH HAPI (n = 12)	WITHOUT HAPI(n = 68)	TOTAL (N =80)
Activity	Inactive	10	23	33
	Active	2	45	47
Mobility	Immobile	11	22	33
	Mobile	1	46	47
Moisture	Often moist	9	4	13
	Not Moist	3	64	67
Sensory	Impaired	10	30	40
	Not Impaired	2	38	40
Friction/Shear	Problem	12	45	57
	No Problem	0	23	23
Medical Device	Present	10	24	34
	Absent	2	44	46
TOTAL		**12**	**68**	**80**

2x2 contingency table for extrinsic variables

When assessed with odds ratio (OR) through a binary logistic regression model, all the extrinsic factors had a positive correlation with the development of pressure injury, with mobility and moisture showing the most significant statistical association at OR = 20.926, CI 1.129–387.915, p = 0.041 (mobility), and OR = 16.108, CI 2.019–128.524, p = 0.009 (moisture). Inactivity and the presence of a medical device showed increased chances of pressure injury occurring (odds ratios of 2.91 and 5.96, respectively), despite p values >0.05. The odds among the group with sensory impairment (OR = 1.29) never the less showed no appreciable difference in the likelihood of pressure injury development.

Table 5

Odds Ratio for Extrinsic Factors

Extrinsic Factors	Odds Ratio	95% CI		P>z
Activity	2.91	0.18	46.21	0.45
Mobility	20.93	1.13	387.92	**0.04**
Moisture	16.11	2.02	128.52	**0.01**
Sensory Perception	1.29	0.12	13.70	0.83
Medical Device	5.96	0.65	54.36	0.11
Friction and Shear	-	-	-	-

Note: Level of association of extrinsic factors with HAPI
Odds Ratio calculated from the 2 by 2 contingency tables presenting with/without HAPI and the variables using binary logistic regression
NB: Friction and shear variable excluded because of direct collinearity

IV. DISCUSSIONS

4.1 Intrinsic Risk Factors

A number of intrinsic factors were evaluated in this study and identified to influence the development of PI by primarily reducing skin tolerance to pressure and permitting degeneration under intense and prolonged exposure. These included age, sex, nutrition, and clinical condition. Most pressure injury cases were recorded among the elderly, males, those with poor nutrition, and those with trauma as the principle diagnosis and hypertension/diabetes comorbidity.

Most pressure injuries were recorded among the elderly, who generally present with complex health problems and age-related systemic deterioration, including reduced cell layers and vascularization that increase skin fragility. Most of these also present with limited mobility, which together decreases skin tolerance, increases pressure duration, and increases the risk of pressure injury, as has been established in other studies that associate age with pressure injury (Borsting *et al.,* 2018). Both studies by Nangole and Iranmanesh also reported a significant association (p<0.05) between age and pressure injury (Nangole *et al.,* 2009; Iranmanesh *et al.,* 2017), similar to the findings in this study.

The current epidemiological transition from communicable to non-communicable chronic conditions was evident, with 53% of all the participants having a chronic condition. 76.9% of the patients drawn from the medical ward had a chronic condition, requiring prolonged admission and increased dependence, which are known risk factors for PI, as seen from the study review by Ahmad and team (Ahmad *et al.*, 2018). However, no significant relationship was established between the presence of a chronic illness and the development of a pressure injury. Half (50%) of all the pressure injury cases that were recorded occurred in the traumatology patients category, closely reflecting the findings by Matozinhos *et al. (*2017), and the high incidence in this group was also reported by Molon and Estrella (2011). This is because most trauma cases result in impaired mobility or require that the patient be immobilized, as seen in most of the study subjects, a recipe for intensified and prolonged pressure, which is the primary risk factor for pressure injury.

Metabolism and general human health and function are very dependent on nutritional status. Poor nutrition results in specific nutrient deficiencies, which may make one more vulnerable to disease, including pressure injury. Skin cells and skin tissue generally rely on nutrients for their health; therefore, an inadequate supply of these nutrients in food or supplements exposes the skin to injury, explaining the strong relationship between poor nutrition and HAPI in this study. This is similar to findings by Iranmanesh *et al. (*2017 who did establish a strong relationship between nutrition and hospital-acquired pressure injuries.

Many other studies have demonstrated a significant relationship between participants' body mass index, BMI, and the development of pressure injury, with the very obese and underweight participants registering almost double the incidence compared to the normal weight group (Drake *et al.,* 2010), and the obese presenting with increased immobility, which makes them more susceptible to PI (Sookyung et al., 2014). This study, however, established no significant relationship between BMI and pressure injry, which can be explained by the difference in the populations studied by Darke et al. (2010), where >50% were obese, whereas in this study, only a handful, <30%) of participants were either underweight or obese.

4.2 Extrinsic Risk Factors

Many external factors were also noted to influence the occurrence of pressure injury, including micro-climate aberrated by fecal urinary incontinence, friction, and shear, both of which interfere with tissue tolerance to pressure, and mobility, activity, and sensory perception, which interfere with the duration and intensity of pressure, similar to other study findings.

As established in other studies, patients with impaired sensory perception are likely to be more dependent and therefore receive suboptimal care in inadequately staffed settings, increasing their susceptibility to preventable pressure injuries. This also limits their response to pain or discomfort by remaining in one position for a longer time, extending the duration of pressure, hence the many recorded cases among the group (25%) in this study and other studies, like Nangole and team, who recorded 68% prevalence in the spinal injury hospital in Nairobi, Kenya (Nangole *et al.*, 2009).

Impaired mobility or complete immobility means a reduced or inability to change position as often as the body may need, exposing the parts that are in contact with the surface to an extensive duration of pressure and increasing the risk of pressure injury development (Coleman *et al.*, 2013). Such patients may sit or sleep in the same position for long hours until help arrives to provide relief. This is common in acute trauma cases and chronically ill patients (Iranmanesh *et al.*, 2012).

The combination of immobility and inactivity is primarily responsible for the unrelieved pressure, which is the primary catalyst of pressure injury, hence the increased incidence in this category of patients in this study and the strong statistical relationship. This finding is consistent with other HAPI risk factor studies that also found a significant statistical relationship ($p<0.05$) between PI development and immobility and inactivity (Iranmanesh *et al.*, 2012). Cox also reported a similar significant association.

Friction and shear are another factor that prominently featured in the participants who developed pressure injuries, with 100% of all the cases having them as a problem. This concurs with findings by Brienza et al. (2015), who noted that friction and shear can independently result in injuries to the skin. When they occur alongside immobility, as is common with hospitalized patients, pressure injury occurrence is eminent, as seen in this study.

Huang *et al.* (2009), studying patients with nasal intubation and other studies, established a relationship between the presence of a medical device and the occurrence of pressure injuries. In this study, however, none of the pressure injuries could be attributed directly to the medical device. This may have been caused by the fact that most medical device-related pressure injuries occur in the mucus membranes and hardly achieve the stage 2 depths set for this study. The devices therefore only acted to indicate the complexity of the clinical condition of the patients, which could be the primary influence on the occurrence of the injuries.

4.3 Association between Intrinsic and Extrinsic Risk Factors and HAPI

Binomial regression analysis found an increased likelihood of pressure injury with the following intrinsic factors: sex, where being male had a near-double risk compared to being female; age, where being older than mean age had a near-thrice risk level compared to being younger; and those with poor nutrition status had an 18-fold likelihood compared to good nutrition. The extrinsic factors, on the other hand, were demonstrated to relate to HAPI as follows: participants with impaired activity were about three times as likely to develop PI as those who were active; immobility had a twenty-one times greater likelihood; those who were persistently moist were sixteen times more likely; and the presence of a medical device was associated with six times the greater likelihood of pressure injury compared to participants without impairment.

However, poor nutrition, impaired mobility, and persistent moisture were established to have the most significant statistical association with the development of nosocomial pressure injury, scoring a p value < 0.05. These findings agreed with other prospective studies, particularly those conducted by Iranmanesh and team (Iranmanesh et al., 2012). Molon and Estrella, on the other hand, only reported mobility and activity as the most significant risk factors, reflecting the dominant characteristics of the orthopaedic patient population they studied (Molon & Estrella, 2011).

This significant association is consistent with findings from most studies that analyzed pressure injury risk factors using both cross-sectional and cohort prospective studies. A prospective cohort study of 40 orthopaedic patients established impaired sensory perception and constant moisture as the most significant pressure injury development factors (Jan Noel & Emmanuel, 2011). In another study, mobility, activity, and the Braden Risk Score were identified as the most significant factors (Chan *et al.*, 2009). Age and nutrition also feature as major factors in various studies (Borsting *et al.*, 2018; De Souza *et al.*, 2010).

These specific risk factors were very prevalent in the studied population. Half of the study subjects had poor nutrition, 27.5% of whom ended up with pressure injuries, an equivalent of 92% of all the cases. Clearly, nutrition is a very common problem among hospitalized patients, hence the need for a supplimentary diet as stated in the international guidelines for pressure injury management. Similar statistics are seen with moisture, where 75% of all cases were often moist, and also impaired mobility, which was seen in 92% of all the cases. All three of these factors are modifiable and therefore good candidates for mitigation according to the international guidelines.

The consistency of this study's findings and other studies strongly supports the occurrence of pressure injury risk factors across populations that, if correctly analyzed, can predict the occurrence of pressure injury. This is in agreement with Braden and Bergstrom's theory of pressure injury development, which stipulates pressure-associated risk (extrinsic) factors and tissue-associated risk (intrinsic) factors. These factors are therefore signals whenever they occur independently or collectively in an individual and should be grounds for aggressive pressure injury prevention and management measures and care as soon as they are identified to minimize suffering from preventable injuries while receiving care.

V. CONCLUSION & RECOMMENDATION

5.1 Conclusion

The intrinsic factors implicated in the development of pressure injury in this study include age, sex, nutrition, and primary diagnosis, while the extrinsic factors include moisture, activity, mobility, sensory perception, medical device, friction, and shear, all correlating with the Braden score.

From binary regression analysis, the most significantly associated intrinsic risk factor for pressure injury in this study population is poor nutrition, scoring an odd ratio of 18.20, CI 2.18–151.69, p =.01, while the most significantly associated extrinsic risk factors include impaired mobility, odds ratio 20.93, CI 1.13–387.92, p =.04, and persistent moisture, odds ratio of 16.11, CI 2.02–128.52, p =.01.

5.2 Recommendations

This study recommends routine risk assessment with a focus on the identified significantly associated risk factors and customized targeted interventions to minimize the occurrence of these injuries. Comparative studies could be done in other facilities to further evaluate the risk factors and mitigation strategies.

DECLARATION OF CONFLICT OF INTEREST

The researchers declare no conflict of interest.

REFERENCES

Ahmad, T., Panos, P., Denis, A., & Laila, H. (2018, July). Pressure Ulcers Prevalence in the Acute Care Settings: A System Review, 2000-2015. *Journal of Clinical Nursing Research, 27*(6), 643-659.

Bergstrom, N., & Braden, B. (1987). The Braden Scale for Predicting Pressure Sore Risk. *Journal of Nursing Research, 36*(4), 205-210.

Black, J. M., Cuddigan, J. E., Walko, M. A., Didier, L. A., Lander, M. J., & Kelpe, M. R. (2010). Medical Device Related Pressure Ulcers in Hospitalized Patients. *International Wound Journal*, 311-350.

Borsting, T., Tvedt, C., Skogestad, I., Granheim, T., Gay, C., & Lerdal, A. (2018). Prevelance of Pressure Ulcer and Associated Risk Factors in Midle- and Old-aged Medical Inpatients in Norway. *Journal of Clinical Nursing, 27*(3-4), 530-540.

Brem, H., Maggi, J., Nierman, D., Rolnitzky, L., Bell, D., Rennert, R., . . . Vladeck, B. (2010). High Cost of Stage IV Pressure Ulcers. *The America Journal of Surgery, 200*(4), 473-477.

Brienza, D., Antokal, S., Herbe, L., Logan, S., Maguire, J., Van Ranst, J., & Siddiqui, A. (2015). Friction Induced Skin Injuries - are they pressure ulcers? An updated NPUAP white paper. *Journal of Wound Ostomy and Continence Nursing, 42*(1), 62-64.

Bryant, R. A., & Nix, D. P. (2012). *Acute and Chronic Wounds: Current Management Concepts.* St Louis: Elsevier.

Chan, W., Pang, S., & Kwong, E. (2009). Assessing predictive validity of the modified Braden scale for prediction of pressure ulcer risk of orthopaedic patients in an acute care setting. *Journal of Clinical Nursing, 18*(11), 1560-1570.

Coleman, S., Nixon, J., Keen, J., Wilson, L., McGinnis, E., Dealey, C., . . . others. (2014). A New Pressure Ulcer Conseptual Framework. *Journal of Advanced Nursing, 70*(10), 2222-2234.

Cox, J. (2012). Predictive Power of The Braden Scale for Pressure Sore Risk in Adult Critical Care Patients: A Comprehensive Review. *Journal of Wound Ostomy and Continence Nursing, 39*(6), 613-621.

De Souza, D., Santos, V., Iri, H., & Sadasue, O. M. (2010). Predictive validity of the Braden Scale for pressure ulcer risk in elderly residents of long-term care facilities. *Geriatric Nursing, 31*(2), 93-105.

Drake, D., Swanson, M., Baker, G., & al., e. (2010). The Association of BMI and Braden total score on the occurence of pressure ulcers. *Journal of Wound Ostomy Continence Nursing, 37*(4), 368-370.

Edwine, B., Peter, N., & Di, M. (2019). *Towards Universal Health Coverage in Kenya: Are We on the Right Path.* Nairobi, Kenya: Health Economics Research Unit, KEMRI Welcome Trust Research Program.

EPUAP; NPIAP; PPPIA. (2019). Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. (E. P. Panel, N. P. Panel, & P. P. Alliance, Eds.) *International Guideline.*

Huang, T.-T., Tseng, C.-E., Lee, T.-M., Yeh, J.-Y., & Lai, Y.-Y. (2009). Preventing Pressure Sores of the Nasal ala after Nasotracheal Tube Intubation. *Journal of Oral and Maxillofacial Surgery, 67*(3), 543-551.

Iranmanesh, S., Rafiei, H., & Sabzevari, S. (2012). Relationship between Braden Scale Score and Pressure Ulcer Development in Patients Admitted in Trauma Intensive Care Unit. *International Wound Journal, 9*(3), 248-252.

Jane, M. N., Priscillah, N. K., & James, O. (2021). Nurses' Management of Patients with Pressure Ulcers in Selected Health Facilities in Murang'a County, Kenya. *East African Journal of Health and Science, 3*(1).

Jan Noel, M., & Emmanuel, E. (2011). Pressure Ulcer Incidence and Risk Factors Among Hospitalized Orthopedic Patients: Results of a Prospective Cohort Study. *Osteomy Wound Management, 57*(10), 60-70.

JCI. (2019, September 17). International Patient Safety Goals (IPSG). *World Patient Safety Day*.

Kayser, S., VanGilder, C., & Lanchenbruch, C. (2019). Predictors of Superficial and Severe Hospital-Acquired Pressure Injuries: A Cross-sectional Study using the International Pressure Ulcer Prevelance Survey. *International Journal of Nursing Studies, 89*, 40-50.

Lyder, C. H., Shannon, R., Empleo-Frazier, O., McGeHee, D., && White, C. (2002). A comprehensive program to prevent pressure ulcers in long-term care: Exploring costs and outcomes. *Journal of Ostomy Wound Management, 48*(4), 52-62.

Matozinhos, F., Velasquez-Melendez, G., Tiensoli, S., Moreira, A., & Gomes, F. (2017). Factors Associated with the Incidence of Pressure Ulcer During Hospital Stay. *Rev Esc Enferm USP*, 2-9.

Molon, J. N., & Estrella, E. P. (2011). Pressure Ulcer Incidence and Risk Factors Among Hospitalized Orthopedic Patients: Results of a Prospective Cohort Study. *Journal Of Ostomy- Wound Management, 57*(10), 64.

Nangole, F. W., Khainga, S. O., & Kiboi, J. (2009, December). Pressure Ulcers Presentation and Management at Kenyatta National Hospital and Spinal Injury Hospital. *East African Medical Journal, 86*(12).

National Pressure Ulcer Advisory Panel. (2009). *Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline.* Cambridge: Cambridge Media.

Sociedad Iberolatino America. (2011). *Declaration of Rio De Janeiro on Pressure Ulcers Prevention as a Universal Human Right.* Rio De Janeiro: Ibero-Latin-American Society on Wounds.

Sookyung, H., Xiaobai, L., Brenda, V., Cheryl, N., Monica, F., Pacharmon, K., . . . Elizabeth, L. (2014, November). Body Mass Index and Pressure Ulcers in Intensive Care Patients. *American Journal of Criical Care, 23*(6), 495-501.

VanGilder, C., LachenBruch, C., Algrim-Boyle, C., & Stephanie, M. (2017, February). The International Pressure Ulcer Prevalence Survey: 2005 - 2015: A 10-Year Pressure Injury Prevelance and Demographic Trend Analysis by Care Setting. *Journal of Wound Ostomy and Continence Nursing, 44*(1), 20-28.

Wangia, E. D., & Kandie, C. D. (2019). *Refocusing on Quality of Care and Increasing Demand for Services; Essential Elements in attaining Universal Health Coverage in Kenya.* Nairobi: The Health Sector Monitoring and EvaluationUnit, Ministry of Health.

WHO. (2005). *Health Financing: Universal Health Coverage.* Geneva: World Health Organisation.

World Health Organization. (2017). *Patient Safety: Making health care safer.* Geneva: WHO.

World Health Organization. (2021). *World Health Statistics 2021: Monitoring Health for the SDGs, sustainable development goals.* Geneva, Switzerland: WHO.

Zhaoyu, L., Frances, L., Lukman, T., & Wendy, C. (2020). Global prevalence and incidence of pressure injuries in hospitalised adult patients: A systematic review and meta-analysis. *International Journal of Nursing Studies*. Retrieved March 17, 2022, from 10.1016/j.ijnurstu.2020.103546. Epub 2020 Jan 31. PMID: 32113142.