

Evaluating the Feasibility and Predictive Validity of the Braden Scale for Pressure Injury Risk Assessment among Nursing Staff in Public Hospitals, Addis Ababa, Ethiopia, 2021

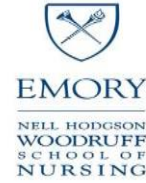
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Dissertation for the Degree of Doctor of Philosophy (PhD) in Nursing Addis Ababa University-Emory University Collaboration PhD Program, Addis Ababa, Ethiopia

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ADDIS ABABA, ETHIOPIA



ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

EVALUATING THE FEASIBILITY AND PREDICTIVE VALIDITY OF THE
BRADEN SCALE FOR PRESSURE INJURY RISK ASSESSMENT AMONG
NURSING STAFF IN PUBLIC HOSPITALS, ADDIS ABABA, ETHIOPIA,
2021.

A Dissertation Submitted to the School of Graduate studies of Addis Ababa University in partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (PhD) in Nursing, December, 2025.

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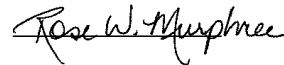
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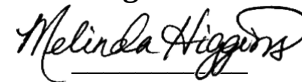
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DEDICATIONs

I dedicate this PhD dissertation to my parents, who gave me everything, love, guidance, and solid foundation that carried me through life and academic journey. Your sacrifices, encouragement, and faith pushed me forward even when things got tough. You both passed away while I was working on my PhD, but I still feel you with me everyday.

My father, you always eager to see me succeed and never once doubted what I could do. My mother, your warmth and steady encouragement helped me through my hardest day. So, this achievement truly belongs to both of you. Your memory stays close, stamped on my heart, and I carry your love and lessons with me as I keep moving forward. This accomplishment proves just how much you shaped my life.

Author's Statement and acknowledgement

Declaration

I, hereby declare that this dissertation is my original work and has not been submitted to any other institution or university for the award of any Degree, Diploma, or Certificate. All sources used and contributions from others have been properly acknowledged and referenced. I take full responsibility for the content and findings of this dissertation.

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Original Papars

This dissertation is based on the following three papars:

- I. Comparing Knowledge and Attitudes toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention.** *SAGE Open*. 2025 May;15(2):2158244025133785. (Published)
- II. Applying the Theory of Planned Behavior to Predict Nurses' Intention and Willingness to use the Braden Scale for Pressure Injury Risk Assessment in Public Hospitals, Addis Ababa, Ethiopia.** *Submitted manuscript to IJANS*
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Abbreviations/ Acronyms

ANOVA: Analysis of variance

CI: Confidence interval

CMC: Center of Medicaid and Medicare

DCs: Data collectors

DRL: Dependency related lesions

EPUAP: European Pressure ulcer advisory panel

ET: Endotracheal Tube

HAPI: Hospital acquired Pressure Injury

ICU: intensive care unit

InSPiRE: interventional patient skin integrity protocol

LTC: Long Term Care

LMIC: Low-to Midel income country

NG-tube: NasogastricTube

NIS: Nationwide in-patient sample

NPUAP: National Pressure ulcer advisory panel

NPV: Negative Predictive Value

PIs: Pressure Injuries

PPPIA: Pan Pacific Pressure Injury Alliance

PPV: Positive Predictive Value

TPB: Theoty of Planned Behavior

Abstract

Background: Pressure injuries (PIs) remain a significant global healthcare concern, affecting patients across various settings with differing levels of severity and prevalence. Patients admitted to healthcare facilities, particularly those in intensive care units (ICUs), are at increased risk of developing more severe and frequent PIs. Pressure injuries are extensively recognized as significant indicator of the quality care provided to hospitalized patients. Occurrence of PIs underscores the importance of the vital role of nurses in implementing effective prevention strategies. Various risk assessment tools, including the Braden scale, have been adopted in many countries to support PI prevention strategies. However, despite the availability of these tools and established prevention protocols, the PIs prevalence rate continues to increase. Despite routine PI risk assessment with preventive measures are essential, these practices are neglected in most clinical setting. In Ethiopia, PI risk assessment tools such as the Braden Scale have not been generally reported or implemented in hospital practices. This gap is frequently linked with inadequate planning and inconsistent implementation of preventive measures, which may result from limited knowledge and skill related to PI risk assessment and management among nurses. Effective prevention depends on identifying at-risk patient accurately. International pressure injury prevention (IPIP) guidelines strongly recommend the use of validated risk assessment tools like the Braden Scale. Varying level of predictive ability of the Braden Scale is reported, while its applicability and effectiveness within the Ethiopian healthcare context remains unexamined. Moreover, despite evidences supporting efficacy of the PI prevention strategies, their implementation remains suboptimal worldwide, particularly in low-and-middle income countries (LMICs) where standardized guidelines and resources are often limited. In LMIC settings such as Ethiopia, nurses often do not have been taught or not have the requisite skills to assess PIs risk with validated instruments such as the Braden Scale. In addition, no study has used a theory based framework to examine the intentions and acceptance among nurses for implementing the Braden Scale.

Objective: This study aims to evaluate the feasibility of the Braden Scale by examining changes in nurses' knowledge and attitudes after receiving education through various delivery methods, to assess the effectiveness of the Braden scale in predicting pressure injuries among hospitalized patients, and to examine the relationship between the Theory of Planned Behavior and Nurses'

readiness to implement and accept the Braden Scale for pressure injury risk assessment in Ethiopia.

Methods: the study was conducted using quasi-experimental cluster, prospective and cross-sectional study design in three public hospitals, Addis Ababa. The quasi-experimental cluster study was conducted on a sample of 159 nurses. The Participants were selected from units with patients often bedridden and more likely to develop a pressure injury during their hospital stay. Data was collected using structured self-administered questionnaires. A cross-sectional study design was utilized on 163 staff nurses enrolled from three public hospitals. The participants were full-time staff nurses working in units designated for critical patient care, including the ICU, Internal Medicine, Surgical, and Orthopedic unit. Data was collected using a structured self-administered questionnaire. A multiple regression analysis was employed to analyze the data. A Wilcoxon signed-rank test for pair t-test and one-way ANOVA and Kruskal-Wallis test for independent group test was used to analyze the data. With the prospective study 238 patients, from critical care units of the three selected public hospitals in Addis Ababa, Ethiopia. Participants enrolled using convenience sampling technique. The data collection was carried out using structured questionnaires. Data analyzed with Binary logistic regression and ROC analysis to assess variable relationships, evaluate the Braden Scale's predictive ability for pressure injuries development.

Results: Out of 145 nurse participants, 68.3% of nurses, were female, with a mean age of 29.4 ± 4.9 years and 66.7% had no prior information about the Braden Scale. The overall mean scores change of the pre-to-post educational intervention for knowledge and attitude was statistically significant, with a large effect size, ($d=1.95$ and 0.81), respectively $p < .001$. The analyzed 229 participant were predominantly male (59.8%), with a median age of 39 years. The mean score on the Braden Scale was 13.2 ± 2.95 on a scale of 6 – 23. Pressure injuries developed in 21.83% of participants. The Braden Scale score, age, and body temperature were significant predictors of pressure injury risk. A one-unit increase in the Braden Scale score reduced injury odds by 24.5%, while age and body temperature increased the odds by 2% and 2.27 times, respectively. ROC analysis revealed a sensitivity of 64% and specificity of 59.2% at a cut-off point of 13.5. The AUC value was 0.682 (95% CI: 0.611, 0.761), reflecting a statistically significant, yet insufficient capacity to predict the pressure injuries ($p < 0.001$). A total of 145 questionnaires

were completed by the nurses, resulting in a response rate of 89%. Four factors including Nurse's knowledge of the Braden Scale explained 56.7% of the variance in intention. Attitude, subjective norms, perceived behavioral control significantly predicted intention to use the Braden Scale, with β (95% CI) = (0.078 [0.032, 0.125], 0.390 [0.240, 0.539], and 0.302 [0.190, 0.414, $p < .001$]), respectively. Two factors, intention and perceived behavioral control explained 63.8% of variance in nurses' acceptance, with a β (95% CI) = (0.873 [0.697, 1.047] and 0.368 [0.220, 0.515], $p < .001$), respectively.

Conclusion and recommendation: This study has identified nurses attending a brief educational program are feasible and, as a result, are more knowledgeable, and have a more positive attitude about utilizing the Braden Scale, feasible for resulting significant change. Future research is needed on how educational programs such as the ones provided increase the acceptability and implementation of the Braden Scale in practice settings. In-service training for nurses, focusing on pressure injury risk assessments, is essential to update their knowledge, and improve patient outcomes; experts should also consider integrating a pressure injury risk assessment score in the nursing process format. This study also found the TPB beneficial for understanding nurses' intent to use the Braden Scale. Subjective norms strongly influenced intention, which in turn impacted acceptance. Strategies to improve utilization should focus on strengthening social support and increasing nurses' confidence in the effectiveness the Braden scale, while addressing and minimizing perceived barriers to its use. Future research should also examine external factors and organizational supports system that may affect implementation. The Braden Scale score, body temperature, and age are significant predictors of pressure injuries. However, the results indicate that the Braden Scale has limited predictive ability in identifying hospitalized patients at risk of developing pressure injuries. Further research with a larger sample size in specific clinical settings is needed to fully evaluate its effectiveness.

Key words: Braden Scale, Pressure Injury, nurse, knowledge, attitude, quasi-experimental, educational intervention, ROC analysis, AUC, Sensitivity, Specificity, and Theory of Planned Behavior.

CHAPTER-I: Introduction

Background and Justification

Pressure injuries (PIs) are a common occurrence in patients who are immobile and remain a global health concern with various levels of severity and prevalence rates across different healthcare settings (1). PIs are defined as localized injuries to the skin and/or underneath tissues that typically occur over bony prominences such as the elbow, heel, hip, shoulder, back, and occipital of the head (2, 3). Often PIs occur as a result of prolonged pressure alone or pressure in combination with shear (4).

Pressure injury prevention protocols include systematic and ongoing skin assessment, combined with the implementation of evidence-based PI preventive measures that include skin care, support surface, keep moving, incontinence management, and nutritional assessment (5). Evidence-based PI preventive implementations have resulted in lower cumulative incidence rates and less severe PIs (6). Another study demonstrated a significant reduction (>73%) in PI prevalence in cardio-thoracic ICU following the implementation of quality improvement programs for front-line healthcare staff, including nurses (7).

Globally, many PI risk assessment tools have been developed; including the Braden scales. All PI risk assessment tools are based on the most common predisposing factors, such as low sensory perception, physical activity, mobility, nutritional status, high skin moisture and pressure/shear. Hence, the Braden Scale utilizes six distinct sub-scales to evaluate the risk factors involved in pressure injury development (8). These sub-scales are categorized based on two main determinants: amount and duration of pressure applied, and the tissue's ability to tolerate it (8-10). The sub-scales for sensory perception, activity, and mobility functions are employed to assess the intensity and duration of pressure. In contrast, the sub-scales for moisture, nutrition, and friction/shears assess their impact on tissue tolerance.

These factors have been identified as prominent factors which place the person at higher risk for PI development (5). In the Braden Scale, each sub-scale rates from 1 to 4 points, except for friction/shear, this is rated from 1 to 3 points. The overall score ranges from 6 to 23, with lower scores indicating a higher risk of developing PIs. Numerous studies have provided evidence that a cut-off score of 18 or below signifies a high risk for the development of PI (8, 11). The risk

level is determined based on the total score as follows: a score of 19 – 23 signifies no risk, 15 – 18 indicates mild risk, 13 – 14 suggests moderate risk, 10 – 12 signifies high risk, and a score below 9 indicates very high risk (11, 12).

Literature Review

Pressure injury definition, classification, and risk factors

Pressure injuries (PIs) have been referred to by various terms, including pressure ulcers, pressure sores, Decubitus ulcers and bedsores. The term “pressure injuries” is now preferred, as the injury can include skin and tissue damage without open wounds. PIs arise from intense and/or prolonged pressure and soft tissue intolerance, exacerbated by factors like impaired mobility (leading to bed or chair confinement), medical devices, skin microclimate, nutrition, perfusion, co-morbidities, and soft tissue condition (2, 3, 13, 14).

According to the national pressure ulcer advisory panel (NPUAP), European pressure ulcer advisory panel (EPUAP) and Pan Pacific Pressure Injury Alliance (PPPIA) classification PIs are classified into six stage categories. These are characterized: “Stage I” as intact skin non-bleachable redness, “Stage II” as partial thickness skin loss involving the epidermis and/or dermis, “Stage III” as full-thickness skin loss, where the damage extends to subcutaneous, “Stage IV” as full-thickness tissue loss, with exposed bone, tendon or muscle, “Unstageable” as full-thickness skin and tissue loss with unknown depth as it is obscured by slough or eschar, and “Suspected deep tissue injury (sDTI)” as persistent, non-bleachable discoloration (often purple or maroon) or epidermal separation with blood filled blister; and further Mucosal membrane injury = related with a history of a medical device use at the location of the injury (1, 15-17).

In normal individual with intact sensory function, mobility and mental status, a prolonged pressure elicits a feedback response of body position change; but in case of deficient or impaired feedback response, persistent pressure leads to tissue injury (18). PI can arise when the skin and soft tissue is subjected to large amount of pressure for short period or smaller amount of pressure for longer period (19). As Mervis and Philips (2019) have cited, a force that exerts external pressure more than arterial capillary filling pressure (32 mm Hg), approximately 8 to 12 mm Hg, staying for 2 to 6 hours, obstructs blood flow and causes local tissue ischemia (20). A mechanical load or pressure results direct compression over the capillaries that supply blood for

the localized area (skin, subcutaneous and deep tissues); thereby impairs or obstructs microcirculation that transport nutrient to the cells; and leading to cell hypoxia, tissue ischemia and eventually becomes tissue necrosis (19, 20). Additionally, the deformed tissue occludes lymphatic flow in turn leads to buildup metabolic waste product (protein and enzymes) in the tissues, which can cause tissue damage (19).

Globally, more than 100 risk factors have been documented. PIs develop due to combination of factors: extrinsic (non-physiological) and intrinsic (physiological) factors (20, 21). External factors include pressure, shear, friction, prolonged immobility, and excess moisture. Intrinsic (patient-related) factors involve underlying health conditions such as sepsis, local infection, decreased autonomic control, altered level of consciousness, advanced age, low blood pressure, anemia, malnutrition, sensory impairment, muscle spasticity, joint contractures and vascular diseases (20, 22).

A comprehensive review of existing research shows a consistent group of risk factors strongly linked to the development of PI. Study reports highlight that older age and male gender increase vulnerability, especially when combined with poor nutritional status and weakened skin integrity caused by dryness or incontinence (15). Limited mobility, previous residence in a nursing home, and recent hospital stays also significantly elevate the risk (23, 24). Extended hospital stays, particularly within ICUs, significantly increase vulnerability, while specific conditions such as diabetes, underweight, cancer, and neurological disorders further heighten susceptibility (25-28). Medical interventions, including the use of vasopressor medications and presence of sensory impairment, further increase the likelihood of PI development (28, 29). Infrequent repositioning and increased exposure to friction and shear forces are also crucial factors influencing the development of PIs (28-30). Finally, a low Braden Scale score is indicative of greater risk (25).

Prevalence and Incidence of pressure injury

A worldwide systematic review of studies conducted between 2000 to 2015, revealed rates of PIs prevalence range from 6% to 18.5% (31). The national PI prevalence rate among countries appears in varying rates, ranging between 0% and 54%, across the world. For example reports from China, Japan, German, Indonesia, France, and Sweden, had revealed the rates as 1.58%, 2.5%, 7.3 %, 8%, 8.1%, and 16.6%, respectively (32-34). Reports of a single hospital survey conducted in different region of Norway and Turkey, revealed varying prevalence rates, ranging

from 12.7% to 18.2% (25, 35-37). Literature review of studies conducted in African also revealed that the prevalence rate in Nigeria, ranging between 0% and 6.9% (38) and in Ethiopia also range between 15% and 17% (29, 39). Among various healthcare settings the prevalence appeared higher in ICU than in Non-ICU settings. For example, in Australian PIs prevalence rate had been 11%, in ICU and 3%, in non-ICU (1), while the prevalence rate range of 12% to 19.7% was reported from California (40). The incidence rate report in Saudi Arabia seems highly increased, was reported as 39.3% (30).

Pressure injury risk assessment scales

Risk assessment is the first step in PIs prevention strategies. It is essential to find out a validated assessment tool for accurately identifying at-risk patients for PI and stratifying their risk level to apply appropriate preventive measures (41, 42). Currently, more than 40 PI risk assessment scales have been identified, worldwide (43, 44). The risk assessment scales are developed based on the risk factors contribute for PI development and are defined as a point scale (42). Some of the scales named include EMINA, Braden, Norton, Waterlow, Cubbin-Jackson, and Pressure Sore Predictor Scale (PSPS) scales (45).

Among these, the most well-known scales include Norton, Water-low and Braden scales. According the historical order the primary one was Norton scale, followed by Water-low and Braden scales (43). These scales are developed to use in distinct clinical areas. For example, Norton scale is suitable to assess elderly patient in hospital, while Waterlow and Braden scales are more appropriate to assess hospitalized patients (43). Regarding their validity, the predictive capacity of these scales, the highest was Braden Scale, followed by Norton, and Water-low, based on relative risk ratio (RRR) as of 4.26 3.69, and 2.66 respectively (45).

Predictability of Braden scale

Braden Scale is a simple, clear and concise assessment tool and often used by nurses for PI risk identification (46). Literatures had revealed consistent efficiency of Braden Scale in early identification of the PIs risk, particularly in critically ill patients; and supports to design effective preventive plan of care (41, 43, 47). It is also effective in home environment to predict PI's risk, with a cut-off score of 18 (48). The discriminating capacity of the Braden Scale demonstrated vary accuracy with the cut-off score 12 and 13; these had demonstrated sensitivity 85.7% and

71.4%, and specificity 64.6% and 83.1%, respectively (49). Finally, very high risk (less than 9 score) of Braden had produced the best predictive validity parameters described as sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), with 0.90, 0.26, 0.31 and 0.78 values, respectively (50). Application of the Braden Scale in long-term care facility, with the cut-off score 17 and 18, had also demonstrated very good discrimination with AUC-ROC of 0.81 and 0.79, respectively (51).

Knowledge and attitude of nurses about PI prevention and Braden scale

Pressure injury prevention is a fundamental aspect of the nursing care. The PI prevention protocol includes systematic and continuous assessment of patient's skin and risk assessment, integrated with implementation of personalized prevention measures. To assure successful PI prevention nurses must have adequate knowledge of PI in the topics of etiology, identification and classification, prevention and treatment strategies; further nurses have positive attitude toward PIs prevention (52). In the past couple of decades evidence-based guidelines for pressure injury prevention intervention have been developed and widely promoted, however, poor adherence had been reported.

Literatures had documented contradicting evidences on the nurses' knowledge concerning PI prevention. Some reports revealed good knowledge, while others report inadequate knowledge about overall PIs prevention (53-55). For example, in Saudi Arabia and Brazil, literatures had documented a sufficient knowledge of PI prevention among nurses (56, 57), while inadequate knowledge reported from Pakistan and north-western Ethiopia (58, 59). A study conducted in a particular region of Ethiopia revealed that about 91.5% of nurses displayed inadequate knowledge of PI prevention, which is frequently linked to insufficient training (60). Another report from northwest Ethiopia, nurses demonstrated inadequate knowledge and poor practice regarding pressure injury prevention strategies (59).

Regarding knowledge about Braden Scale, nurses in Iraq demonstrated moderate knowledge (61). As implementation can be influenced by knowledge of the topic, nurses in Egypt had shown improvement on predicting PI risk using the Braden scale after receiving effective educational intervention (62). Effective deployment of PI risk assessment using the assessment scale helps to identify at-risk individuals accurately and implement appropriate prevention strategies. However, many factors may protect the nurse from using risk assessment scale. Some

of the factors include lack of formal training about risk assessment scale, lack of institutional policies, absence of assessment form and positive attitude were reported as influencing factors (63).

Theoretical framework

The theory of planned behavior (TPB) framework presented as a suitable framework for predicting and explaining health-related behaviors and supporting the development of change behaviors (64, 65). According to Ajzen and Fishbein, TPB posits that individual behavior is predicted on rational thought process, wherein individuals systematically consider available information and evaluate potential outcomes prior to making a behavior (66). The TPB provides a framework for understanding situation-specific behaviors. It proposes that an individual's intention to engage in a particular behavior as the primary determinant of action (66, 67). This behavioral intention is shaped by three key constructs: attitudes, subjective norm, and behavioral control (perceived and actual behavioral control). Furthermore, these constructs are, in turn, influenced by background factors such as demographic characteristics (68).

Behavioral Intention

Within the TPB, the behavioral intention refers to an individual's willingness or readiness to carry out a specific behavior. It is a core component of the theory and serves as immediate predictor of actual behavior (67). Behavioral intention also reflects an individual's motivation or desire to act and indicates how likely the behavior is performed (67, 69). According to Fishbein and Ajzen, behavioral intention is influenced by attitude, subjective norm and perceived behavioral control either independently or in combination (70). When individuals hold a more positive attitude, perceive supportive subjective expectation, and feel greater control over the behavior, their intention to act becomes stronger (70). In this study, behavioral intention specifically refers to nurses' intention to use the Braden Scale for identifying patients at risk of PI. This concept helps explain how positive attitude, supportive social influence, and stronger perceived control collectively shape nurses' intention and willingness to utilize the Braden Scale in PI risk assessment.

Attitude toward the Behavior (Braden Scale)

Attitude toward a behavior refers to how positively or negatively an individual views performing a particular behavior. It is an important independent factor that influences behavioral intention,

while also being shaped by perceived social expectations (subjective norm) and individual's sense of control over the behavior (71). An individual who may poses a positive attitude and recognizes the value of a particular action; they are more likely to engage in it. In nursing practice, attitudes towards the Braden Scale play an important role in influencing nurses' intention to use it. Nurses' perceptions toward the tool's usefulness and relevance in identifying at-risk patients for PI development, strongly impacts its acceptance. The theory posits that positive attitude towards the Braden Scale is associated with higher level of use, while, negative perceptions may limit its implementation. Research indicates that nurses who consider the Braden Scale a valuable assessment tool are more likely to apply it effectively in healthcare setting for at-risk patient, highlighting the significance of attitude in influencing nurses' behavioral intention (63, 72).

Subjective Norms

The subjective norm (SN) refers to the perceived social pressure that an individual feel to either perform or avoid a specific action (67, 70). It reflects how a person interprets the expectations of important others, such as peers, supervisors, and organizational leaders. In healthcare setting, the colleagues and workplace culture play a significant role in shaping nurses' intentions and behaviors. As a key determinant of behavioral intention, SN represents nurses' perceptions of whether influential groups approve or disprove of using the Braden Scale for PI risk assessment in hospitalized patients. Supportive leadership and active encouragement can strengthen these social norms and promote a culture of evidence-based practice. When prevailing norms within the healthcare setting favors the use of the Braden Scale, nurses are more likely to adopt the behavior and consistently apply it in patient care (73).

Perceived Behavioral Control

Perceived behavioral control (PBC) refers to an individual's belief about how easy or difficulty it is to carry out a specific behavior. Fundamentally, reflects an individual's confidence in their ability to perform a behavior and the extent to which they feel they have the necessary skills, resources, and opportunities to do so (67). Training, resources, and organizational support serve as key determinants of this perception. Within the context of the study, PBC helps to understand the nurses' belief about the factors that may facilitate or hinder their intention to employ the Braden Scale in patient's risk assessment. Thus, PBC reflects nurses' feelings about their competence in using the Braden Scale effectively. Prior research indicates that when nurses feel adequately equipped and supported by organization, their intention to implement the behavior increases significantly (74, 75).

Behavior or Action

In the TPB, behavior is defined as the observable actions of individual that are directly influenced by the intentions. These intentions are shaped by three key factors: attitude towards the behavior, subjective norm related to the behavior, and perceived behavior control. Within the TPB framework, behavior is considered the outcome variable (67). In the context of the study, acceptance of Braden scale implementation in hospitalized patients is regarded as the behavior of interest. Fundamentally, TPB posits that individuals are more likely to perform the behavior if they hold a positive attitude towards it, believe that significant others approve it, and perceive that they have the ability to execute it. Applying this theory can help clarify the relationship between nurses' intention to adopt the Braden Scale and their acceptance of its implementation. In turn, this acceptance is shaped by their intention, which is influenced by factors such as attitude, subjective norm, perceived behavioral control (PBC), and knowledge.

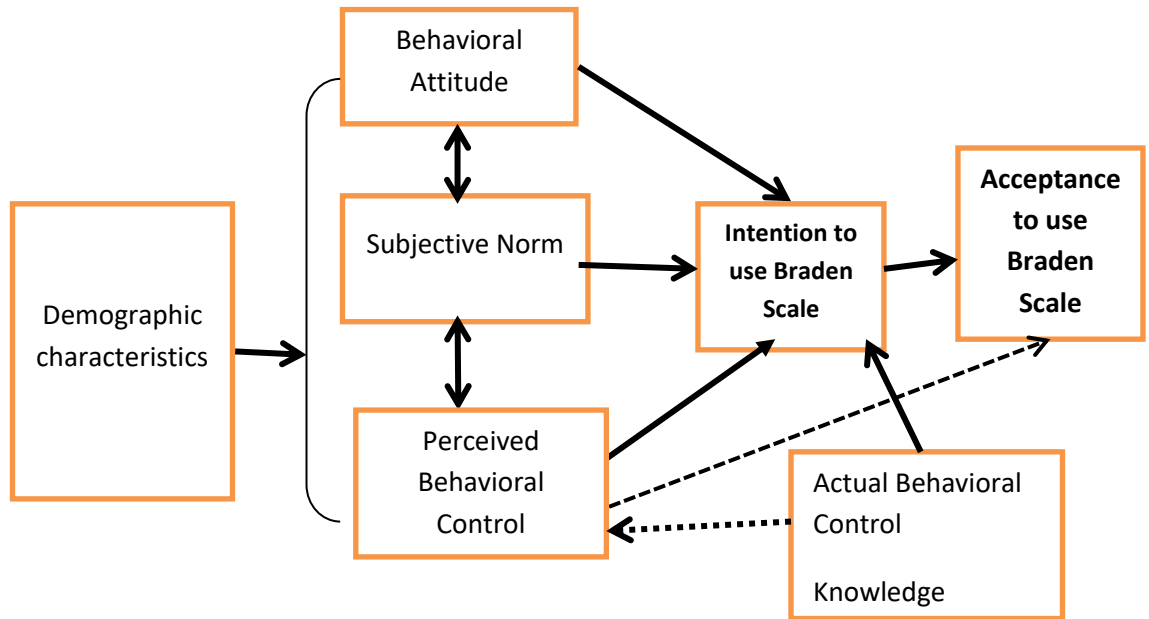


Figure 1 Conceptual framework of the Theory of Planned Behavior adapted from Icek Ajzen, 1991

Statement of the Problem

The presence or absence of a pressure injury is one metric used to measure the quality of nursing care (76). Nurses play a key role in preventing and managing pressure injury as they are directly involved in risk assessment and preventative strategies before the PIs occur (77, 78). HAPI is a sensitive quality indicator of nursing care so, nurses are responsible for assessing and identifying patients at high-pressure injury risk (79), and implementing appropriate evidence-based prevention strategies (80, 81). Prior studies have shown that the involvement of nurses in pressure injury prevention and quality improvement projects results in a significant reduction in the incidence of HAPI (82, 83).

Pressure injuries are devastating complications for hospitalized patients and commonly occur in severely ill and highly care-dependent patients (44). The global prevalence of PI is 12.8%, which indicates the significance of this adverse health incidence (84). The prevalence is highest in low to middle-income countries, where prevalence rates approach 31.3% (56). Reports from different regions indicate that the incidence of hospital-acquired pressure injury (HAPI) varies widely, ranging from 0.63% to 39.3% (15, 32, 40, 85, 86).

Pressure injuries cause several suffering for patients such as, pain, infection; sepsis, prolonged hospital stays, and raised healthcare costs. In the United States alone, the annual cost of treating

PI is estimated at approximately \$11billion (87), accounting for a substantial portion of the annual health care budget in most countries (88-91), representing a considerable burdens on healthcare budget worldwide. PI treatment is generally more expensive than preventing them (92). However, prevention efforts are not less costly as they often require substantial human and material resources (42, 93). For this reason, early and accurately identification of at higher risk individuals is crucial to ensure timely and appropriate prevention measures (18).

The international pressure injury prevention (IPIP) Guideline provides comprehensive direction on planning and implementing effective PI prevention strategies (4). Conducting risk assessment using an evidence-based assessment tool is recognized as a critical initial step within the prevention initiatives. Globally, several validated PI risk assessment scales have been developed (20), which are point-based tools with the known risk factors that help determine a patient's susceptibility to PI development. Risk assessment tools also support nurses in designing effective and targeted prevention plans (94, 95). Among these tools, the Braden Scale consistently demonstrated strong predictive accuracy for PI development in high-risk hospitalized patients (82). The Braden Scale is routinely administered by nurses in many healthcare settings, as part of nursing assessment (76-78) and it offers a practical, user-friendly method for identifying patients at risk (96).

Despite the availability of the risk assessment tools and established prevention strategies, optimal reductions in the prevalence rates of PI are often not achieved. This gap may be explained by several factors, including limited knowledge and inconsistent nursing practice in patient assessment for PI risk, care planning, and the implementation of preventive strategies (80). Furthermore, skin assessments are often inadequately documented, with limited details regarding PI characteristics, staging, and planned interventions (97). Many nurses also continue to depend on outdated knowledge and personal experience rather than evidence-based practices (78). Prior studies have shown that some nurses are reluctant to adopt evidence-based approaches for the identification and management of the PIs (54). Factors such as, improved knowledge, positive perception of usefulness, ease of use, manageable workload, strong leadership support, and effective interdisciplinary collaboration have been identified as a key facilitators that can enhance nurses' acceptance implementation of the Braden Scale (63, 73, 74, 98).

In Ethiopia, there is a lack of clear, specific guideline documents that focus on the prevention of PIs through the use of standardized risk assessment tools. Most existing research in the area has mainly examined nurses' knowledge, attitudes, and practices related to PI prevention, with limited attention given on risk assessment approaches. The available literature has consistently identified gaps in both knowledge and practices regarding pressure injury prevention (59, 60, 99). However, there is limited evidence addressing the use of formal risk assessment tool, particularly the Braden Scale. At present, no studies in the region have used the TPB framework to explore nurses' intentions and willingness to use the Braden Scale for identifying PI risk.

Failure to use the Braden Scale in a healthcare setting can weaken PI prevention efforts, resulting in increased patient suffering, raised treatment costs, greater legal risks, and reduced overall efficiencies within the healthcare system (4, 20, 100-103). This study aims to address these research gaps by examining the feasibility and predictive accuracy of Braden scale in the context of Ethiopian healthcare facilities. To achieve the overall research objectives, a set of hypotheses and specific research questions have been developed to guide the investigation. By carefully examining these questions, the study aims to generate clear evidences on the usefulness and predictive strength of the Braden Scale, thereby, helping to strengthen evidence-based practice and inform policy decisions.

Hypotheses and Research Questions

Hypotheses

Aim1: Compare Knowledge and Attitudes toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After an Educational Intervention delivered through oral, written, or a combination of both

Hypothesis 1: Nurses who receive an educational program will demonstrate higher knowledge and a more positive attitude towards the implementation of the Braden Scale in healthcare settings than those who do not.

Hypothesis 2: Nurses who receive the combined educational modality will demonstrate higher knowledge and a more positive attitude towards the Braden Scale implementation in healthcare settings compared to those receiving only written materials or an oral presentation.

Research questions:

Aim2: Predict Nurses' Intention and Willingness to use the Braden Scale for Pressure Injury Risk Assessment using Theory of Planned Behavior in three Public Hospitals, in Addis Ababa, Ethiopia.

Question1. Which Theory of planned behavior (TPB) constructs strongly predicts Nurses' intention and acceptance of the Braden Scale implementation among nurses?

Aim3: Evaluate the Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia

Question2. How effective is the Braden scale on predicting pressure injury development among admitted patients?

Objectives

General Objective

- To evaluate feasibility and predictive validity of the Braden Scale for Pressure Injury risk assessment, in public hospitals, used by nurses.

Specific aims

Aim1: Compare Knowledge and Attitudes toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After an Educational Intervention

Aim2: Predict Nurses' Intention and Willingness to use the Braden Scale for Pressure Injury Risk Assessment using the Theory of Planned Behavior in three Public Hospitals, in Addis Ababa, Ethiopia.

Aim3: Evaluate the Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia

Significance of the study

Internationally, PI prevention guidelines are implemented with the involvement of all healthcare professionals across the world (77). While many countries are developing and customizing evidence-based prevention practices to reduce the risk of HAPIs, currently, there is no published evidence in Ethiopia regarding such efforts. Furthermore, overall patient assessment in Ethiopia

typically falls under the purview of physicians, unlike the usual practice in many other countries. Consequently, PI risk assessment may not be prioritized, potentially leading to inadequate assessment and poorer patient outcomes. Beside that none of, any of, the PI risk assessment scale is introduced; particularly Braden scale is not well-known by nurses. As PI is a common and serious incidence among hospitalized patients, its occurrence on admitted patient causes great challenge on nurses, and highlights nurses are more responsible as they are central care provider for hospitalized patient. Therefore, improvement on the PI prevention practice through enhancing nurses' knowledge, attitude, intention, and acceptance of the PI risk assessment tool implementation specifically the Braden scale through targeted intervention is a pressing matter that necessitates grater effort to establish in the study area.

The Braden Scale is extensively utilized by nurses in hospitals, long-term care facilities, and home care settings, reflecting its broad acceptance and effectiveness (104). Research consistently demonstrates the Braden Scale's effectiveness in predicting the development of PIs in at-risk individuals (10, 105, 106). Numerous studies have evaluated its ability to assess PI risk, revealed satisfactory sensitivity and specificity at various cut-off points ranging from 11 to 17 (95, 107). Its ability to predict PI risk is further reflected in reported area under the curve (AUC) values ranging from 0.6 to 0.9, indicating that its performance can vary from poor to excellent (108-110). Moreover, literature has shown that applying the Braden Scale to guide preventive interventions in high-risk populations can substantially reduce the occurrence of PIs (95, 104, 111).

Despite its proven effectiveness, the routine use of standardized PI risk assessment tool in prevention practices remains limited across the world, including Ethiopia (112). Inconsistent PI risk assessments practice and the failure to use the Braden Scale to guide preventive care have been widely reported (85). Nurses' intentions to adopt and consistently use the Braden Scale are influenced by several factors. Evidence, including studies from Ethiopia, shows that limited knowledge of PI prevention, especially risk assessment procedures, is a major challenge for nurses (59, 113, 114). Additional barriers include shortages of staff and equipment, as well as lack of clear institutional policies or guidelines to support implementation of the Braden Scale (72). Factors such as, improved level of knowledge, perceived usefulness and ease of use of the tool, manageable workload, and strong leadership support, patient outcomes, and

interdisciplinary collaboration all play important roles in shaping acceptance of the Braden Scale (63, 73, 74, 98). Evidence from Egypt indicates that nurses who received targeted educational training showed an improved ability to predict PI risk using the Braden Scale (62). This suggests that improving nurses' knowledge through effective education enhances implementation and highlights the practicality of using the Braden Scale for PI risk assessment.

The TPB is widely used to explain and predict health-related behavior, including healthcare professionals' intentions to follow clinical guidelines (64, 65, 71, 115-117). The theory explains how behaviors change occurs by focusing on three key components: attitudes, subjective norms, and PBC. Researchers have used TPB to better understand nurses' willingness to engage in patient care and adopt evidence-based guideline (64-66, 71, 115-117). Nurses' attitudes toward the Braden Scale play an important role in shaping their intention to use it, with more positive perceptions leading to higher levels of adoption (63, 72). Subjective norms shaped by colleagues, leadership, and organizational culture, also influence intention, as encouragement and support from peers and supervisors increase acceptance. PBC reflects nurses' confidence in their ability to use the scale effectively, which is strongly influenced by access to adequate training and resources. When nurses feel capable and supported, they are more likely to apply the scale in practice. Together, these three components interact to influence nurses' intentions to adopt clinical guidelines. Evidence from international studies supports this framework. For example, research from Iran and south China identified subjective norm as the strongest predictor of nurses' intentions to engage in patient safety behaviors and to care for patient with COVID-19 (115, 118). In Canada, both attitude and perceived behavioral control significantly influenced nurses' intention to use filter needles in clinical practice (71). Studies from Malaysia and Taiwan further show that intention is a key driver of actual behavior (64, 73, 119). Overall, these findings highlight the usefulness of TPB in understanding how attitude, subjective norm, and PBC shape nurses' clinical practice.

Rational of the Study

Even though treating PIs are widely acknowledged as more expensive than preventing them (92), prevention itself is not always cheap and easy process. Effective prevention often requires substantial investments in both human and material resources to deliver targeted interventions for individual at greatest risk. Because of this burden, many countries now recognize PI as a major

public health concern and have established national programs focused on prevention and comprehensive assessment of the problem. To reduce the risk of PI development, these programs have incorporated international PI prevention guideline into routine clinical practices (80). The international PI prevention guideline emphasizes the use of risk assessment tool to identify patients who are likely to develop PIs before they occur (102). Similarly, the NPUAP/EPUAP/PPPIA guidelines provide comprehensive, globally accepted recommendation for best practices in PI prevention practice (4). Research has consistently shown that evidence-based PI prevention strategies lead to lower overall incidence rates and reduce severity of PIs when they do occur (6).

Pressure injury prevention protocols include regular and systematic skin assessment combined with the application of evidence-based preventive strategies such as appropriate skin care, use of suitable support surface, encouraging mobility, managing incontinence, and conducting nutritional assessment. Conducting a comprehensive patient assessment is fundamental to develop effective prevention plans, as it helps healthcare providers identify individual risk factors and apply targeted evidence-based interventions (5). Regularly assessing patients using structured assessment tools is essential and should ideally be done consistently. The first risk assessment should be completed within the first 8 hours of hospital admission to detect risks early and help plan quick effective interventions. While assessing PI risk is a crucial step, it is essential to remember that it is just a starting point. The main goal is to use this assessment to guide targeted interventions that address and reduce factors putting the patient in at risk (5).

Globally, more than 40 PI risk assessment scales have been developed (43, 44). The Braden Scale emerging as one of the most widely used tools. The Braden Scale is appreciated for being simple, clear, and easy-to-use. Nurses often rely on it to help identify patients who might be at risk (46). A substantial body of research has consistently demonstrated its effectiveness in early risk detection, particularly among critically ill patients and enabling healthcare team to develop targeted and effective preventive care plans (41, 43, 47).

Purpose of the Study

Given the vital role of the Braden Scale in detecting at-risk patients for PIs development, it is important to address the limited documented evidence on specific topics related to the Braden

Scale use in specific clinical settings. Understanding the factors that influence the feasibility of adopting the Braden Scale is essential for planning targeted intervention, eventually improving patient care and health outcomes. This research provides baseline information on nurses' knowledge and attitudes toward the Braden Scale, thereby, helps identify the most effective and cost-efficient educational strategies, especially important in resource-limited settings such as Ethiopia. The results of this study provide valuable insights for healthcare professionals, educators, and institutions looking to improve patient care. These findings can help to shape future training programs and strengthen overall efforts to prevent PIs. By focusing on targeted education, nurses can deepen their understanding of the Braden Scale, making it easier to use it effectively in their daily work and integrate it into nursing process. This will lead to more thorough documentation and more accurate risk assessment, ultimately enhancing patient safety and care quality.

This study is based on the TPB and aims to understand what influences nurses' intentions and willingness to accept the Braden Scale. The main goal is to improve PI prevention practices by helping nurses identify at-risk patients earlier in selected hospitals. Specifically, the research looks at how personal attitude, subjective norms, and PBC affect their intention, and how these intentions and PBC influence their willingness to use of the Braden Scale. This highlights the importance of understanding nurses' perspective and suggests that targeted, theory-based approaches can strengthen the use of the Braden Scale, leading to better PI prevention in clinical settings.

This study is among the first in Ethiopia to explore how well the Braden Scale works in predicting the risk of PIs. Its findings are expected to provide valuable initial evidence about how accurately the scale can identify at-risk patients in our local healthcare settings. By generating this evidence, the study aims to encourage nurses to become more engaged in comprehensive patient assessment, helping healthcare professionals identify at-risk patients and prioritize the preventive intervention according to each patient's level of vulnerability. The primary aim of this research is to support and motivate nurses to routinely use the Braden Scale as part of their patient evaluations. Regularly assessing PI risk allows nurses to implement timely and targeted prevention strategies, ultimately leading to better patient outcome and higher quality of care.

Research Methods

Study Design

This study employed three complementary study designs: quasi-experimental, cross-sectional, and prospective study approaches. The quasi-experimental, with pretest and posttest design, was used to evaluate nurses' knowledge and attitude towards Braden Scale before and after intervention. A cross-sectional design was applied to assess nurses' intention and acceptance of the use of the Braden Scale in clinical practice. The prospective study design utilized to evaluate the predictive ability of the Braden Scale in identifying pressure injury development among hospitalized patients.

Study Participant and Setting

The study was conducted in three selected public hospitals located in Addis Ababa, Ethiopia. These selected hospitals are teaching and referral centers, where provide care for bedridden patients, who are at a higher risk of developing PIs during their hospital stay. These facilities include units such as ICU, orthopedics, internal medicine, general surgery, and neurology. The selected hospitals are Tikur Anbessa Specialized Teaching Hospital (TASH), Saint Paul's Hospital Millennium Medical College (SPHMMC), and Menelik II Referral Hospital. They are known teaching and referral hospitals in city. Additionally, they are government-owned hospitals, all have consistent nurse staffing levels, and the nurses have similar opportunities for on-the-job training. These selected hospitals possess varying number of beds and staff nurses. Menelik II Referral Hospital possessed a total of 390 nurses and 350 beds, while 95 nurses and 177 beds belong to specific units. Tikur Anbessa Specialized Teaching Hospital possessed a total of 627 staff nurses and 600 beds, while 150 nurses working within the specific units and 287 beds belong to above mentioned specific units. Saint Paul's Hospital Millennium Medical College possessed a total of 880 nurses and 392 beds, while 160 nurses and 287 beds belong to specific units.

Source and Study Population

Aim 1 and 2: The study included all nurses employed at the chosen hospitals: Tikur Anbessa Specialty Hospital, Saint Paul Millennium Medical College Hospital and Menelik-II Referral Hospital. The target population for these objectives consisted of nurses working in specific departments such as, ICU, orthopedic, medical, surgical and neurology units within these hospitals, who are directly involved in patient care. The inclusion criteria comprised staff nurses

employed in medical, surgical ICU, orthopedic, internal medicine, general surgery, or neurology units who were directly engaged in patient care. Participants who are full-time nursing staff or supervisors were included in this study. Additionally, individuals who received printed materials outlining the study's purpose and, after reviewing them without any questions, were invited to sign a written informed consent form to participate in the study.

Aim 3: With this aim patients admitted to three selected public hospitals in Addis Ababa, TASH, SPHMMC, and Menelik-II Referral Hospital, specifically, admitted to the ICU, orthopedic, medical-surgical, or neurology units within these hospitals during the data collection period were enrolled to participate in the study. Participant recruitment took place from February to April 2021. Patients, with the age of 18 years or older, admitted within the 24 hours, and had the Braden Scale score of 18 or below were eligible. Patients who had existing pressure injuries, other skin lesions or scars at the time of admission, or patients those discharged due to transfer or death before fifth day of hospitalization were excluded from the study.

Sample Size Determination and Sampling Methods

Aim 1: The sample size of this study was calculated using G* power software. The calculation used parameters: an F-test for repeated measures was applied with an 80% statistical power, an effect size of 0.25, a significance level of 0.05, three comparison groups, and two measurement points. A non-sphericity correction factor of 1 was assumed. Based on these parameters the required total sample size was determined to be 159 participants. The total sample was proportionally allocated across the three selected hospitals according to the size of their nursing staff: 59 nurses from TASH, 63 nurses from SPHMMC, and 37 nurses from Menelik-II Referral Hospital. Participants were then selected from specific units using a simple random sampling technique. To do this, a list of all nurses in each selected unit was gathered, and then random samples were drawn from these lists.

Aim 2: The sample size for this aim was calculated using G* power software, with applying the Z-test family for logistic regression. Sample size was calculated based on an 80% statistical power, an effect size of 0.5, and a significant level of 0.05. These parameters yielded a total sample size of 163 nurses. The sample was proportionally allocated across the three hospitals according to the number of nurses working in specific units: 61 nurses from TASH, 64 from SPHMMC, and 38 from Menelik-II Referral Hospital. Nurses were selected using a simple

random sampling method, in which each eligible nurse was assigned a unique number and chosen through a lottery system.

Aim 3: For the third aim, the sample size was calculated using a single population proportion formula, based on pressure injury prevalence rate of 17%, with 80% power, a 95% confidence level, and a margin of error of 5%. To account for possible non-response rate, an additional 10% was considered to be added to the sample size. The calculation has yielded total sample size of 238 participants. The sample proportionally distributed across the hospitals according to beds capacity: 94 patients from TASH, 88 from SPHMMC, and 56 from Menelik-II Referral Hospital. Prior to data collection, all participants were screened for eligibility by using the Braden Scale assessment for PI risk. According to the scale patients those classified at mild to high risk for PI development were included in the study.

Data Collection

In this study, different data collection methods were employed. Custom-designed data extraction forms and standardized tools were used to gather information on demographics, knowledge, attitudes, constructs of the Theory of Planned Behavior (TPB), Braden Scale scores, and pressure injury stages. A summary of the instruments and the variables measured is presented in Table 1.

Table 1 Summary of variables and measurement instrument

Study type	Variables	Instrument	Instrument description	Psychometric property
Study 1 (Quasi-experimental study)	Socio-demography (nurses)	Self-reported	age, gender, marital status, income, overall work experience in years, PI care experience, workload (nurse-to-patient ratio), special training, and access to reading material about PIs	
	Knowledge	Adapted	A 12-item multiple-choice knowledge test assessed understanding of Braden Scale, covered definition, purpose, assessment components, and scoring. Each item was rated with yes, no, or do not know. Correct answers scored as 1 and others as 0, totaling 0 to 17 and converted to percentages. Based on Bloom's criteria, scores classified knowledge as high (80-100%), moderate (60-79%), and low (<60%), with higher scores indicating better knowledge (120-122).	Cronbach's alpha: ranging from .54 to .75
	Attitude	Adapted	An 11-item Likert scale assessed attitudes (1=strongly disagree to 5=strongly agree), with some items reverse scored. Scores ranged from 11 to 55, with higher scores indicating more positive attitudes. According to Bloom's cutoffs, attitudes were classified as positive (44–55), neutral (33–43.5), or negative (below 33) (123).	Cronbach's alpha: 0.79
Study 2 (Cross-sectional study)	Socio-demography (nurses)	Self-developed	age, gender, marital status, income, overall work experience in years, PI care experience, workload special training, and access to internet/ reading material about PIs.	
	TPB constructs	Adapted	The TPB model has 33 items across attitude (11), subjective norms (2), perceived control (3), actual control (12), behavioral intention (2), and Braden Scale acceptance (3), rated on a 5-point Likert scale. Higher scores reflect more positive attitudes, stronger norms, greater perceived control, and higher intention, indicating greater acceptance; lower scores suggest reduced likelihood of	Cronbach's alpha: Attitude = 0.79 SN = .80 PBC = .75 Knowledge=.54 Intention = .71 Acceptance

			engagement (120-127).	=.85.
Study 3 (Prospective study)	Socio-demography (Patient's)	Self-reported	Age (in years), sex, body mass index (BMI)	
	Clinical data	Review of Medical records	Blood pressure (in mmHg), body temperature (in degrees Celsius), unit/ward where admitted, and current medical diagnosis and reasons for admission	
	Braden Scale	Adopted	The Braden Scale checklist consists of six sub-scales. Each sub-scale was rated with a 4-point Likert scale, except friction/shear rated with 3 points. The total sum score ranged from 6 to 23 points. Risk level based on total scores: 19–23 (no risk), 15–18 (mild risk), 13–14 (moderate risk), 10–12 (high risk), and below 9 (very high risk) (128).	Cronbach's alpha: Ranging from (0.64-0.78) (121).
	Skin assessment	Adopted	The checklist records the presence of PIs (Yes/No), their count, location, stage, and assessment date (4).	

Data Collection Procedure

Prior to the start of data collection, ethical approval was obtained from the Institutional Review Board (IRB), formal permission was secured from each participating hospital, and written informed consent was collected from all participants. Data were collected by trained nurse professionals holding BSc or MSc qualification, along with the principal investigator, who also provided training to the data collectors. In response to the emerging of COVID-19 pandemic, appropriate safety measures were implemented. These include strict adherence to infection prevention guidelines to protect both data collectors and study participants during data collection and educational sessions.

Aim 1 Data Collection

Data collection procedures were standardized across the three hospitals. Participating nurses completed baseline questionnaires prior to the educational intervention. The intervention was then provided after a two-week interval, followed by distribution of second questionnaire within one month to the same nurses who had completed the initial survey.

For the educational intervention, each hospital was randomly assigned a different method of delivery. The researcher implemented three approaches: distributing written materials, oral presentations supported with poster, and a combined approach that include both written material and oral presentation. One hospital received only printed brochures, another only oral instruction, and the third received both. All nurses across the three study groups received the same standardized training on using the Braden Scale to minimize variation and prevent cross-contamination between units. Training sessions were conducted over one week in a quiet area near the nurses' station, and were scheduled to accommodate all work shifts. The written material was provided as a brochure, while the oral presentation consisted of a 45-minute face to face presentation. The combined approach included both written material and oral instruction methods. The educational content was identical across all three methods. Following the intervention, a post-intervention survey, identical to the pretest was administered to evaluate changes in knowledge and attitude. Data collection for this phase took place between November 16 and December 30, 2020.

Aim 2 Data Collection

Data collection procedures for aim 2 were consistent across all three hospitals. Each questionnaire began with a brief introduction explaining the purpose of study. The principal investigator distributed the questionnaires to each unit after obtaining the list of staff nurses from the head nurse. Eligible nurses were then randomly selected and invited to complete the questionnaires at a time that was convenient for them. After filling them out, nurses were asked to submit the completed questionnaires to the head nurse's office, where the researcher collected them. Data collection took place from January 30 to February 28, 2021.

Aim 3 Data collection

The data was gathered by nurses who were not members of the hospital staff involved in the study. These data collectors examined patients within 24 hours of admission and then performed follow-up assessments every other day until the patient developed a pressure injury or discharged after a two-week stay. Additionally, the data collectors initially evaluated the patients' eligibility by assigning a score of 18 or lower on the Braden Scale.

Data Management and Analysis

The data management and analysis plan include preparation of code book for simplicity of the data entry. The coded data were entered into the Epi.info version 4.3 software and transported to SPSS version 25.

Aim 1 Comparing Knowledge and Attitudes toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention

Descriptive statistics included the mean and standard deviation for continuous variables with a normal distribution, the median and inter-quartile range for those with a non-normal distribution, and frequencies with percentages for categorical variables.

Prior to analysis, data were examined for normal distribution, outliers, and missing values. The Kolmogorov-Smirnov test indicated a non-normal distribution, necessitating the use of non-parametric tests. Independent sample t-tests compared knowledge and attitude scores based on socio-demographic factors. To assess changes in scores before and after educational interventions and to compare the three different teaching methods, paired sample t-tests and one-way ANOVA were employed. Non-parametric analyses included the Wilcoxon signed-rank test, Mann-Whitney U-test, and Kruskal-Wallis test. For groups that satisfied the assumptions of normality and equal variances ($p > .05$), paired t-tests were used. A p-value less than .05 was considered statistically significant.

Aim 2 Applying the Theory of Planned Behavior to Predict Nurses' Intention and Willingness to use the Braden Scale for Pressure Injury Risk Assessment in Public Hospitals, Addis Ababa, Ethiopia.

Descriptive statistics: frequency, percentage, mean, and standard deviation were calculated to summarize socio-demographic data and factors influencing intention to use the Braden Scale.

Pearson correlation coefficients were calculated to summarize the linear relationship between the TPB constructs: the nurses' attitude, subjective norm, perceived behavior control, knowledge, intention, and acceptance of the Braden Scale utilization. A multiple regression analysis was conducted to assess the relationship between attitude, subjective norm, PBC, and intention and nurses' acceptance to use Braden Scale risk assessment tool. All assumptions were checked and met the assumptions. The results are presented with un-standardized coefficients, which reflect the change in intention and acceptance for each one-unit increase in the respective predictors. The level of significance was determined at p value < 0.05 .

Aim 3 Evaluation of the Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia

Frequencies, percentages, means, and standard deviations (SD) or medians of various variables were calculated to describe and summarize the participants' demographic and health-related characteristics. The Pearson Chi-Square test and Student's t -test were used to examine the significance of potential predictor variables associated with the development of PI. Binary logistic regression analysis was then performed to assess the relationship between these predictive factors and the occurrence of PIs. Statistical significance was declared at p -value of 0.05, with results reported using a 95% confidence interval (CI). To evaluate discriminative performance of the Braden Scale, receiver operation characteristics (ROC) analysis was computed. Its diagnostic accuracy was determined using the value area under the curve (AUC), along with sensitivity and specificity values. The overall AUC ranges from 0 to 1, where values of 0.5 or less indicate no discrimination ability, 0.6–0.7 indicate poor discrimination, 0.7–0.8 indicate acceptable discrimination, 0.8–0.9 indicate excellent discrimination, and a value of 1.0 represents perfect discrimination (129-131).

Ethical Consideration

Ethical approval for this study was obtained from several relevant authorities, including the Institutional Review Board (IRB) of the College of Health Science, the IRB of Saint Paul's Hospital Millennium Medical College, as well as the Addis Ababa City Health Office. Approval was granted under the following specific protocol reference numbers: Ref. No. 040/20/Nursing, Ref. No. pm23/27, and Ref. No. A/A/A 281/227, respectively. The study was conducted with strict accordance with established ethical standards, including the principle outlined in the Declaration of Helsinki. For Aims 1 and 2, participating nurses were provided with written information explaining the purpose of study and gave written informed consent prior to participation. For Aim 3, participants were hospitalized patients in selected units, and informed consent was obtained verbally from the patient or their relatives after clear explanation of the study objectives. Participant confidentiality was ensured by using anonymous data collection method or de-identified coding system.

Strengths and Limitations of the Study

This study is among the first in Ethiopia to examine nurses' knowledge and attitudes toward the Braden Scale for PI risk identification. The findings showed that simple and targeted educational interventions can effectively improve both knowledge and attitudes of nurses. By applying the TPB, the study also provides valuable insights into nurses' intentions and acceptance of the Braden Scale in PI prevention practice. The use of a quasi-experimental cluster design across three referral hospitals helped minimize contamination between groups, thereby strengthening the reliability of findings. Additional strengths include the prospective study design, timely patient assessments, and inclusion of multiple hospitals with diverse patient population and lengths of stay.

Despite these strengths, the study has several limitations. The study's generalizability may be limited, as the study was conducted only to urban public hospitals and did not include private or rural healthcare facilities. The absence of a pilot study and adaptation of data collection tools from previously validated instruments may also affect the applicability of the findings. Furthermore, certain methodological constraints such as, short training sessions, lack of inter-rater reliability assessment, and omission of assessing hospital-specific contextual factors, may

have affected the overall accuracy of the results. Further research is necessary to determine the scale's relevance across different healthcare settings.

Dissemination of Findings

The final project report will be presented and submitted to Addis Ababa University, School of Graduate Studies. The findings of the study will be disseminated through presentation at professional seminars and conferences held at the national and international levels. Majority of the findings of this study have already been published on international and nationally peer reviewed journals and disseminated to the scientific community.

- IV. Woldemariam EB, Murphree RW, Degu WA, Higgins MK, Gary RA. Comparing Knowledge and Attitudes toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention. SAGE Open. 2025 May;15(2):21582440251337857**
- V. Applying the Theory of Planned Behavior to Predict Nurses' Intention and Willingness to use the Braden Scale for Pressure Injury Risk Assessment in Public Hospitals, Addis Ababa, Ethiopia. Prepared in publishable manuscript form**
- VI. Woldemariam EB, Murphree RW, Degu WA, Higgins MK, Gary RA. Evaluation of the Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia. The Ethiopian Journal of Health Development. 2025 Feb 20; 39(1).**

Structure of the dissertation

Table 2 Tabular Summary of the Methods applied in the Dissertation

S.N	Aims	Study Design	Study Subject	Sample Size	DC tool	Data analysis
1.	To Compare knowledge and attitudes toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention	Quasi-experimental study design	Staff Nurses	159	Structured questionnaire adapted from different literature	Descriptive analysis Parametric analysis: Paired sample t-tests and one-way ANOVA Non-parametric analyses: Wilcoxon signed-rank test, Mann-Whitney U-test, and Kruskal-Wallis test
2.	To Apply TPB to explore the influencing factors of intentions and acceptance among nurses to implement the Braden Scale	Cross-sectional study design	Staff Nurses	163	Structured questionnaire adapted from different literature	Descriptive analysis Pearson correlation Multiple regression analysis
3.	To Evaluate the Predictive Capacity of the Braden Scale for PI Development among Hospitalized Patients	Prospective Study design	Hospitalized patient	238	Structured checklist adopted from literature	Descriptive analysis Chi-square and Student's t-test Binary logistic regression ROC Analysis

Table 3 Summary of Main Findings Manuscripts 1 - 3

MS.	Study title	Main findings
1.	Compare knowledge and attitudes toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention (SAGE Open. 2025 May;15(2):21582440251337857)	- Data from 145 nurses were analyzed: 68.3% female, with a mean age of 29.4 ± 4.9 years and an average work experience of 6.3 ± 4.88 years; bedside care experience averaged 5.3 ± 3.9 years. About 89% held a bachelor's degree, 6.9% a master's degree, and 4.1% a diploma prepared. Half (50.3%) were married. Most, 67.2%, had pressure injury care experience, but 94.5% had not received recent specialized training. Over half (51.1%) had a workload of 1:5 nurse-to-patient ratio, and 66.7% lacked knowledge of the Braden Scale, despite 65.5% having access to reading materials or the internet. - Knowledge score before and after educational intervention: Pretest showed 91.7% of nurses scored below 60%, indicating low knowledge, while 60% scored above 80% on the post-test, reflecting high level knowledge. - Attitude score before and after educational intervention: post-education, nurses' attitude scores increased (median=36) from pre-intervention (median=31). Based on Bloom's cut-offs, attitudes shifted from negative pre-intervention to more neutral afterward. - Mean Comparison of the Knowledge and Attitude Score in Pre-To-Post-Education Intervention: significant improvements in knowledge and attitude scores were observed from pre- to- post-test, with large effect sizes of 1.95 and 0.81, respectively and ($p<.001$). - The Knowledge and Attitude Score among the three Education Delivery

		Methods: Evaluation of educational delivery methods: printed, oral, or combined both following the educational intervention showed nurses had higher knowledge and attitude scores, but no significant differences among modes.
2.	Applying the Theory of Planned Behavior to Predict Nurses' Intention and Willingness to use the Braden Scale for Pressure Injury Risk Assessment in Public Hospitals, Addis Ababa, Ethiopia. (Prepared in publishable manuscript form)	• Cross-tabulation revealed that nurses over 29, male, married, MSc holders, earning above 6,500 ETB/month, with over 6 years of experience, PI care experience, specialized training, and access to reading materials or the internet showed more favorable attitudes toward the Braden Scale utilization. Knowledge scores were similar overall, but higher among diploma-trained nurses and those with special training, especially if they lacked prior training. • The correlation analysis among the TPB constructs: the study found significant positive correlations among the TPB construct such as attitudes, subjective norms, and PBC with nurses' intentions and acceptance of the Braden Scale to use for PI risk assessment, with a significance level of $p < .001$, except for knowledge. A series of multiple linear regression analyses: • The first regression analysis: Only marital status (single) and access to reading materials/internet significantly predicted nurses' attitudes toward Braden Scale use ($F(2, 142) = 9.276, p < .001$). Access to resources increased attitudes ($\beta = 3.619, p = .001$), while being single decreased them ($\beta = -2.827, p = .006$). These variables explained 11.6% of the variance. • The second regression analysis: A regression analysis of intention to use the

		Braden Scale, based on the TPB, was significant ($F(4, 140) = 45.821, p < .001$), explaining 56.7% of the variance. Attitude, subjective norm, and perceived behavioral control significantly predicted intention, with stronger associations for subjective norm ($\beta = 0.390, p < .001$) and perceived behavioral control ($\beta = 0.302, p < .001$) than attitude ($\beta = 0.078, p < .001$). • Third regression analysis: a regression model predicting nurses' acceptance of the Braden Scale for PI risk assessment was significant ($F(2, 142) = 152.903, p < .001$), explaining 68.3% of the variance. Both intention ($\beta = 0.873, p < .001$) and PBC ($\beta = 0.368, p < .001$) significantly predicted acceptance.
3.	Evaluation of the Predictive Capacity of the Braden Scale for PI Development among Hospitalized Patients. <i>(The Ethiopian Journal of Health Development. 2025 Feb 20;39(1))</i>	• Out of 238 patients assessed, 229 (96.2%) completed the questionnaire. At admission, all had no PIs. Over half 137 (59.8%) were male, with ages 18-98 years and a median age of 39. The majority 110 (48.03%) were admitted to the ICU, and the mean BMI was $21.52 \pm 3.58 \text{ kg/m}^2$. The average Braden Scale score was 13.2 ± 2.95, indicating moderate PI risk. The sensory perception sub-scale scored highest (3.07 ± 1.04), while activity and friction/shear scored lower (1.59 ± 0.754 and 1.62 ± 0.68), respectively. • Among the admitted patients, 64 (27.9%) were diagnosed with traumatic injury, and 59 (25.8%) of them had multiple disease diagnoses. • Among admitted patients, 50 (21.8%) developed new pressure injuries (PIs), with 60% being male. Most PIs (92.3%) were stages I-II, mainly in the sacral area. ○ Incidence varied across hospitals: TASH had 28 cases (12.2%), while

		SPHMMC and Menelik II each reported 11 cases (4.8%), a significant difference ($\chi^2 = 7.616$, $p = .022$). PIs typically developed after the second day and peaked within ten days. • Binary logistic regression: Significant links were found between PI development and age, body temperature, and Braden Scale score. Each additional year increased PI odds by 2% ($p = .030$), and a 1°C rise in temperature raised the risk by 2.27 times. Conversely, each point increase in the Braden Scale reduced PI risk by 24.5%. The very high risk category had a significantly higher PI likelihood ($p < .001$). • ROC analysis: showed the optimal Braden Scale cut-off for predicting PI development was 13.5, with 64% sensitivity and 59.2% specificity, and the AUC was 0.682 (95% CI: 0.611–0.761, $p < .001$).
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Chapter 2: Paper1 (Original Article)

COMPARING KNOWLEDGE AND ATTITUDES TOWARD THE BRADEN SCALE FOR PRESSURE INJURY RISK ASSESSMENT BY NURSES: BEFORE AND AFTER THE EDUCATIONAL INTERVENTION

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ABSTRACT

Background: Pressure injuries are considered an adverse quality care indicator among hospitalized patients. Despite the importance of routine assessment and pressure injury prevention strategies, nurses may often neglect them. In Ethiopia, pressure injury risk assessment tool such as the Braden Scale has not been reported or implemented in hospital settings.

Objective: to examine the feasibility of the Braden Scale by assessing the knowledge and attitude of nurses before and after an educational intervention, and testing three delivery methods: printed, oral, or a combination.

Methods: A quasi-experimental cluster study, on a sample of 145 nurses was conducted. The Participants were selected from units with patients often bedridden and more likely to develop a pressure injury during their hospital stay. Data was collected using structured self-administered questionnaires. A Wilcoxon signed-rank test and independent group test (one-way ANOVA and Kruskal-Wallis test) were used to analyze the data.

Result: 68.3% of nurses, were female, with a mean age of 29.4 +4.9 years and 66.7% had no prior information about the Braden Scale. The overall mean scores change of the pre-to-post educational intervention for knowledge and attitude was statistically significant, $P < 0.001$, with a large effect size, 1.95 and 0.81, respectively.

Conclusion: Nurses attending a brief educational program are feasible and, as a result, are more knowledgeable and have a more positive attitude about utilizing the Braden Scale. Future research is needed on how educational programs such as the ones provided increase the acceptability and implementation of the Braden Scale in practice settings.

Keywords: Braden Scale, Pressure Injury, Nurse, Knowledge, Attitude, Educational intervention, Quasi-experimental.

INTRODUCTION

Pressure injuries (PIs) are a common occurrence in patients who are immobile and remain a global health concern with various levels of severity and prevalence rates across different healthcare settings (1-3). The global prevalence of pressure injury is 12.8%, which indicates the significance of this adverse health occurrence (4). The pressure injury prevalence increases with age (5) and is highest in low to middle-income countries, where prevalence rates approach 31.3 % (6). Pressure injury is considered an adverse health occurrence, a negative quality care indicator, and a patient safety risk during hospitalization; thus, it is referred to as hospital-acquired pressure injury (7, 8). The hospital-acquired pressure injury (HAPI) incidence report worldwide ranges from 0.63% to 8.4% (2, 4, 9-11). PIs are also often linked to the use of medical devices such as endotracheal and nasogastric tubes (12), a pattern that may reflect a greater illness severity.

These injuries cause a significant burden on patients and healthcare system similarly. They are responsible to cause severe pain, life-threatening infections, reduced quality of life, delayed recovery, higher mortality rates, and increased healthcare costs (12). In the United States, the annual cost for PI treatment is estimated at around \$11 billion (13), accounting for a substantial portion of the annual healthcare budget in most countries (14-17). Despite the costs and patient burden of PIs, most are avoidable with early identification using a risk assessment tool and applying appropriate preventive strategies (18, 19).

The presence of pressure injury is a sensitive quality indicator of nursing care. Nurses are responsible for assessing and identifying patients at high-pressure injury risk (20) and implementing appropriate evidence-based prevention strategies (8, 21). Studies have shown that the involvement of nurses in pressure injury prevention and quality improvement projects results in a significant reduction of hospital-acquired pressure injuries (22, 23).

Research suggests nurses use clinically validated pressure injury risk assessment tools for accurate pressure injury risk prediction. Many pressure injury risk assessment tools have been developed, including the Braden Scale. The Braden Scale is a consistent and precise predictor of pressure injury occurrence in high-risk hospitalized patients (23). Additionally, in many hospitals, the Braden Scale is administered by nurses and integrated into nursing assessment (24-26) and is also easy to use for pressure injury risk person identification (27). All pressure injury risk assessment tools are based on the most common predisposing factors, such as low sensory

perception, physical activity, mobility, nutritional status, high skin moisture, and pressure/shear. These factors have been identified as prominent factors which place the person at higher risk for pressure injury development (28).

The presence or absence of a pressure injury is one metric used to measure the quality of nursing care (24). Nurses play a key role in preventing and managing pressure injury. In addition, they are directly involved in risk assessment and preventative strategies before they occur (25, 26). Nurses should perform a pressure injury risk assessment and skin inspection during or soon after hospital admission and repeat on a routine basis among patients at higher risk, such as those who are immobilized or if their clinical status deteriorates (27). Pressure injury prevention protocols include systematic and ongoing skin assessment, combined with the implementation of evidence-based pressure injury preventive measures that include skin care, support surface, keep moving, incontinence management, and nutritional assessment (28). These have resulted in lower cumulative incidence rates and milder grades of pressure injury (29). Moreover, one study showed a significant (>73%) reduction in pressure injury prevalence in cardio-thoracic ICU after the intervention of quality improvement programs for the front-line healthcare staff including nurses (30).

Despite the availability of risk assessment tools and prevention strategies, optimal reductions in the prevalence rates of pressure injury are often not achieved. Reasons include poor knowledge regarding pressure injuries and poor performance by nurses in assessing, planning, and implementing pressure injury prevention strategies (8). There is also a poorly documented skin assessment by nurses about pressure injury characteristics, staging, and intervention planning (31). Utilization of evidence-based assessment tools is often not performed but relies on outdated knowledge and experience to make decisions about pressure injury intervention care (25). Many nurses are unwilling to adopt evidence-based methods for identifying or managing pressure injuries (32). There has been no published research on pressure injury risk assessment tools in Ethiopia, and guidelines are nonexistent. Several studies have identified gaps in PI prevention practice among Ethiopian nurses (33), with 95% of nurses showing insufficient knowledge in PI prevention (34).

The quality of nursing care is closely linked to nurses' attitude toward pressure injury prevention. These attitudes are also influenced by both knowledge and personal behavior, highlighting the importance of education and positive perceptions in improving PI prevention

practices (35-38). In Ethiopia, one study reported that over 50% of bedside nurses had adequate knowledge, favorable attitudes, and were optimistic regarding pressure injury prevention practices (33). This contrasts with another report in northwest Ethiopia, where nurses demonstrated inadequate knowledge and poor practice regarding pressure injury prevention strategies (38).

Despite several evidence-based validated pressure injury risk assessment scales being available, they are currently not being utilized in practice settings in Ethiopia. This study aims to assess Ethiopian staff nurses' knowledge and attitudes toward using the Braden Scale pressure injury risk assessment before and after a pre- and post-educational intervention. A secondary aim of the study is to determine which educational intervention delivery (oral, written, or a combination of the two) is most effective for improving nurses' knowledge and attitude toward Braden scale, pressure injury risk assessment.

Methods

Study Design and Setting

A quasi-experimental cluster design was conducted in three government-owned hospitals in Addis Ababa, Ethiopia. All three were teaching and referral hospitals and had similar specific units/ wards where higher-risk patients for pressure injuries are admitted, including adult general ICU (both medical and surgical), orthopedic, internal medicine, general surgery, and neurology.

Study Population

Participant recruitment took place in specific units after IRB approval and after the purpose of the study was explained. Inclusion criteria included nurses working in medical or surgical ICU, orthopedic, internal medicine, general surgery, or neurology units and directly involved in patient care. Participants had to be working full-time as nursing staff or as a supervisor. The participants also received printed information explaining the purpose of the study and, if there were no questions, were asked to provide their written informed consent for study participation.

Sample Size and Sampling Methods

The sample size was calculated using the G-power software program, using the F-test family repeated measures with the values: Power ($1 - \beta$ error probability) = 80%, Effect size $f(V) = 0.25$, the error probability = 0.05, number of groups = 3, number of measures = 2, non-sphericity correction $\epsilon = 1$ were considered. The final calculated total sample size (159) was proportionally

allotted for each hospital Tikur Anbessa Specialty Hospital = 59, Saint Paul's Hospital Millennium Medical College = 63, and Menelik-II Referral Hospital = 37; and was based on a total number of nurse staff. The nurse participants were selected randomly from the specific units.

Data Collection

Data Collection Instruments

The data were collected using self-administered structured questionnaires adapted from the literature (39-42). The instrument contained three sections: socio-demographic data and knowledge and attitude questions regarding the Braden Scale.

Socio-demographic characteristics included age, gender, education level, monthly income, years of work experience, bedside work experience, experience with pressure injury care, the workload nurse-to-patient ratio, special training, and access to reading material about pressure injuries.

Knowledge questions regarding the total Braden Scale and sub-scales were adapted from the literature (39-41, 43, 44) with a Cronbach alpha coefficient of 0.83. This instrument contained 12 multiple-choice items with response rates recorded as correct, incorrect, or do not know. Knowledge questions consisted of the definition of the Braden Scale, the reason for use, and assessment components (sensory perception, mobility, activity, moisture, nutrition, and friction/shear) and their rating score. Correct responses were scored as "1" and incorrect as "0," ranging from 0 to 17 points. We used the total sum of the correct answers and converted them into percentages ranging from 0 to 100. Using Bloom's cut-off points, the knowledge level was classified into three categories: high = 80 – 100 %, moderate = 60 – 79 %, and low = less than 59%. Higher scores reflected better knowledge of the Braden Scale (45).

A modified 11 items Likert-type scale of the attitude instrument is produced. The content part adapted from Beeckman et al. (2010), Attitude towards Pressure ulcer Prevention instrument with the Cronbach alpha = 0.79, and from Moor and Price (2004) the five points scale has been adapted (46). The original Attitude questions had 13 items covering 5 domains (personal competency, items 1,2,3; priority, items 4,5,6; impact, items 7,8,9; and responsibility, items 10, 11; and confidence, items 12, 13) with each item scored as 1=strongly disagree, 2=disagree, 3=agree and 4=strongly agree. For the modified scale used in this study, only the first 11 items of the attitude questions were used (the 2 confidence items were removed) as they were not in line

with the objective and each five-point scale refers: strongly disagree = "1", disagree = "2", neither disagree nor agree = "3", agree = "4", and strongly agree = "5"; and reverse rating for negative questions (items 3, 4, 5,7,8,10), total sum measure ranges from 11 to 55 points with a higher score reflecting more positive attitude. We measured with a total mean score of the Likert scale items (11 items), which had been previously validated for PI prevention (36). Using Bloom's cut-off point of the total sum, the attitude was grouped into three categories (positive attitude = 44 - 55, Neutral = 33 - 43.5, negative attitude = < 33 points) (47).

Data Collection Procedure

Data collection was carried out similarly for each of the three hospitals. Questionnaires were distributed to participating nurses before the first educational intervention session. After a 2-week time frame, the educational program was provided. After the educational intervention, the second questionnaire was distributed within one month to the same nurses who completed the pretest.

Education Intervention

Among the three participating hospitals, each received a randomly selected mode of educational intervention delivery. One hospital received written materials for the intervention; another received an oral presentation delivery; the remaining hospital received a combination of written and oral presentations. The nurses in that hospital all received the same intervention on using the Braden Scale for pressure injury risk assessment. This helped to avoid contamination of interventions across units. The principal investigator provided the education intervention at each of the three hospitals. The intervention was conducted in a quiet place near the nurses' station. All three nursing shifts were provided with the intervention over one week for the selected units at each hospital. The educational session for those assigned to the written information group was provided with a printout in the form of a brochure. Nurses who received the oral presentation were provided verbal instruction on the Braden Scale. Those who received the combination intervention received a written brochure and oral poster presentation. Each method of delivery had the same content and was delivered in the same manner for all sessions. The two groups' oral presentations took approximately 45 minutes to receive this intervention component. For the written material, the Principal Investigator stayed for about 15 minutes to answer any questions raised about the Braden Scale. After the educational sessions, the post-intervention survey was conducted. The post-test included the same question as the pretest.

Data Management and Analysis

Descriptive and inferential statistical analyses were conducted. Data were entered into the Epi.info software version 4.6 and transported to SPSS version 26. Data were checked for normal distribution, outliers, and missing data before analysis. The data on inspection and testing using the Kolmogorov-Smirnov test showed an abnormal distribution requiring a non-parametric test. Independent sample t-tests were used to compare knowledge and attitude scores concerning socio-demographic characteristics. A paired sample t-test and one-way ANOVA were used to compare the knowledge and attitude score changes from before and after education interventions and to compare the three educational delivery methods. The Wilcoxon rank test, Mann-Whitney U-test, and the Kruskal Wallis test were used for non-parametric analysis. For the groups that met the assumptions of normality and homogeneity of variance ($p > 0.05$), paired t-test was utilized. Statistical significance was determined with a p-value less than 0.05.

Ethical Approval and Consent to Participants

Ethical Approval was obtained from IRB of the College of Health Science, Saint Paul's Hospital Millennium Medical College, and Addis Ababa city health office, with Protocol No: 040/20/Nursing, Ref. No.pm23/27 and Ref. No. A/A/A281/227, respectively. All methods were carried out in accordance with relevant guidelines and regulations or declarations of Helsinki. Thus, all participants received printed information explaining the purpose of the study and, provided their written informed consent for study participation.

Results

A total of 159 questionnaires were distributed to three government-owned hospitals: Tikur Anbessa Specialty Hospital (59), Saint Paul Millennium Medical College Hospital (63), and Menelik-II Referral Hospital (37). The completed questionnaires were collected from each hospital: Tikur Anbessa Specialty Hospital (58), Saint Paul Millennium Medical College Hospital (62), and Menelik-II referral Hospital (25), with 145 (91.2%) returning the completed questionnaires. Fourteen (8.8%) were excluded due to a lack of participation at both time points (pre-post-education sessions) (Figure 2).

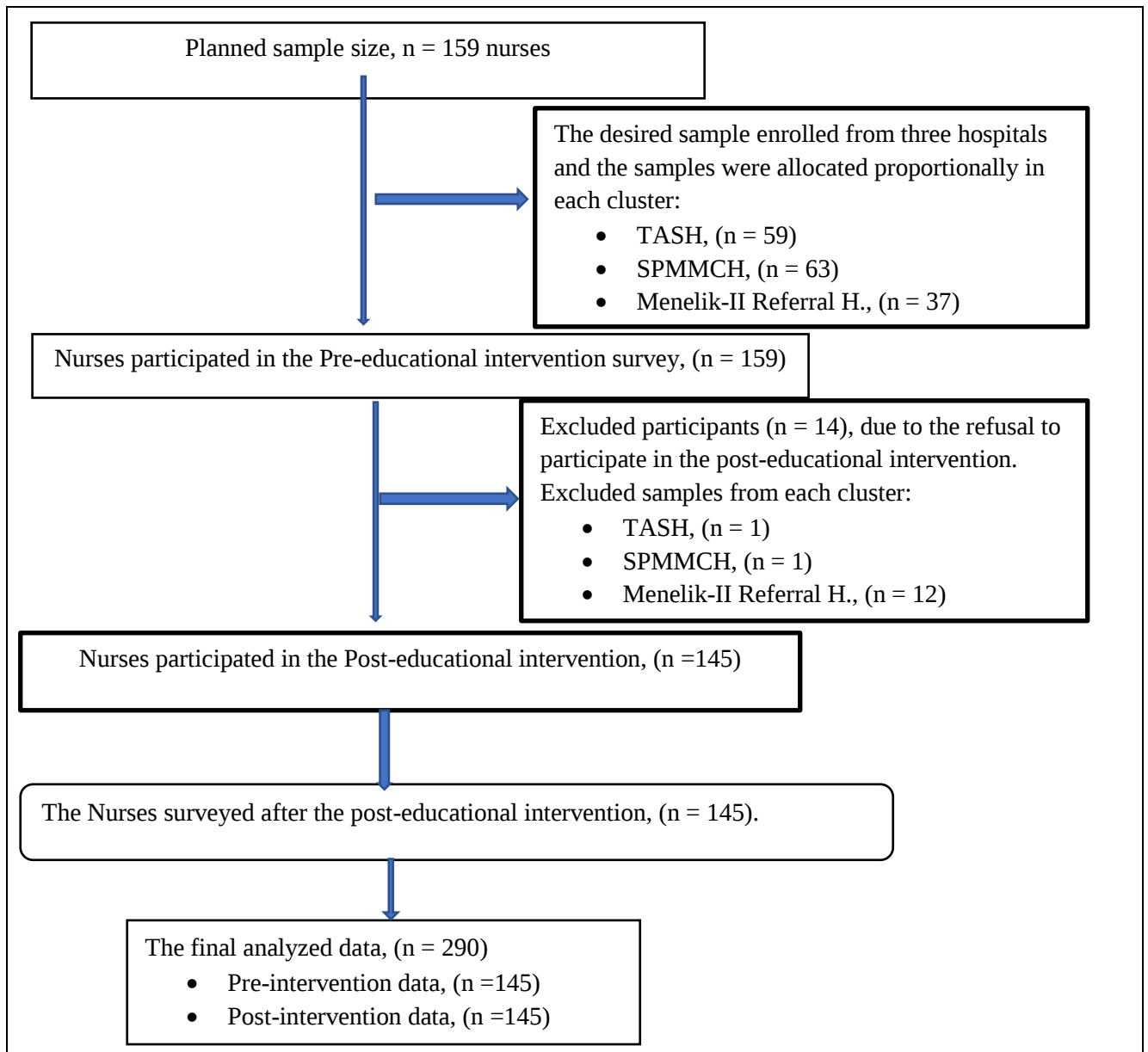


Figure 2: Flow chart, illustrating the process of participant inclusion in the analysis

Nurse Participants' Socio-Demographic Characteristics

Of the sampled 145 nurse participants, 68.3% were female, with a mean age of 29.4 ± 4.9 years. Most 65.5% (n = 95) were between the ages of 23 and 29. Their mean (SD) work experience duration was 6.3 ± 4.88 years. The nurses had similar bedside care experience, with a mean (SD) of 5.27 ± 3.9 years. The majority of participants, 89% (n = 129), were bachelor's prepared, while 4.1% (n = 6) and 6.9% (n=10) participants were diploma and master's prepared, respectively. Their average monthly income was $6,504 \pm 1,711$ birr, equal to 108 ± 29 US dollars (\$), and

approximately half, 50.3% (n = 70), were married. Most nurses, 67.2% (n = 98), had pressure injury care experience, but 94.5% (n = 137) had not received special training within the last six months. More than half, 51.1% (n = 74) of the nurses had a workload of 1:5 nurse-to-patient ratio. Regarding the respondents' awareness of the Braden scale, 66.7% (n = 97) of the nurses had no information about it, even though 65.5% (n = 95) had access to reading material or the internet.

Knowledge Score between Before and After the Educational Intervention.

Most nurses were unaware of the Braden Scale; 66.9% (n = 97) and 70.3% (n = 102) did not know the correct definition of the Braden Scale. Less than half, 44.1% (n=64), understood the importance of the Braden scale for pressure injury risk assessment, while only 17.2% (n = 25) of nurses correctly identified the number of Braden parameters. In addition, 64.8% of the participants did not correctly answer the correct elements of the Braden Scale. Scores improved on the post-test, with 65.5% (n = 95) of nurses responding correctly to the Braden Scale definition to predict pressure injury risk. The importance of the Braden Scale also improved, with 80.7% (n = 117) identifying the correct answer that the Braden Scale is important to assess and predict pressure injury risk. A majority of participants, 63.4% (n = 92), also correctly identified the six Braden sub-scales, and 73.3% correctly stated the elements of the Braden Scale (i.e., sensory perception, mobility, activity, moisture, nutrition, and friction/shear). A similar percentage of nurses (13.8%, 24.1%, and 13.1%) had identified the correct pressure injury risk category expressed by very high risk, moderate risk, and no risk, respectively (Table 4). In their overall knowledge scores, the pretest results showed 91.7% (n=133) nurses scored less than 60%, indicated a low knowledge level, while 60% (n=87) of them scored significantly greater than 80%, a high knowledge level on the post-test evaluation. Based on their score the nurses' knowledge level is categorized to high (80% – 100%), moderate (60% – 79%), and low (less than 59%) knowledge level.

Table 4 Nurses' knowledge assessment questions regarding the Braden Scale in pre- and post-educational intervention, 2021.

S. N	Questions	Response	Pretest		Posttest	
			N	%	N	%
Q1	Ever heard about Braden Scale	Yes	48	33.1	124	85.5
		No	97	66.9	21	14.5
Q2	What is the Braden scale?	The assessment tool used to guide PI prevention	26	17.9	32	22.1
		The assessment tool used to predict PI risk (Correct Answer)	43	29.7	95	65.5
		The assessment tool used to guide nurses to treat PI	21	14.5	13	9.0
		Don't know	61	42.1	6	4.1
Q3	What is the importance of Braden Scale for the patient?	Use to move body parts	11	7.6	12	8.3
		Use to hasten wound healing	14	9.7	12	8.3
		Use to assess and predict the PI risk (Correct Answer)	64	44.1	117	80.7
		Don't know	61	42.1	6	4.1
Q4	What is the number of sub-scales in the Braden scale?	Four sub-scales	21	14.5	21	14.5
		Five sub-scales	10	6.9	15	10.3
		Six sub-scales (Correct Answer)	25	17.2	92	63.4
		Ten sub-scales	9	6.2	6	4.1
		Don't know	80	55.2	11	7.6
Q5	Which elements of the Braden scale are used in PI risk assessment? (Multiple responses)	Sensory perception (Correct Answer)	28	19.3	107	73.8
		Mobility (Correct Answer)	51	35.2	116	80.0
		Activity (Correct Answer)	38	26.2	111	76.6
		Moisture (Correct Answer)	35	24.1	109	75.2
		Nutritional status (Correct Answer)	29	20.0	102	70.3
		Friction/shear (Correct Answer)	38	26.2	102	70.3
		Don't know	19	13.1	17	11.7
Q6	Which element of Braden Scale doesn't take the same rating scale?	Sensory perception	18	12.4	11	7.6
		Mobility	19	13.1	17	11.7
		Nutrition	15	10.3	15	10.3
		Friction/shear (Correct Answer)	15	10.3	94	64.8
		Don't know	82	56.6	19	13.1
Q7	A Braden scale total score falling between 13 – 14 means	Sever risk	31	21.4	12	8.3
		Moderate risk (Correct Answer)	35	24.1	121	83.4
		No risk	6	4.1	4	2.8
		Don't know	74	51	8	5.5
Q8	Excessive and persistent moisture to the skin is rated as	One (Correct Answer)	15	10.3	91	62.8
		Two	23	15.9	26	17.9
		Three	17	11.7	10	6.9
		Four	19	13.1	7	4.8
		Don't know	71	49.0	11	7.6
Q9	In nutritional status assessment, eating a small portion or ½ of the served meal is rated with	One	15	10.3	11	7.6
		Two (Correct Answer)	24	16.6	107	73.8
		Three	15	10.3	16	11
		Four	15	10.3	4	2.8
		Don't know	76	52.4	7	4.8
Q10	Which sub-scale examines patient's ability to change position?	Physical Activity	26	17.9	16	11.0
		Mobility (Correct Answer)	60	41.4	116	80.0
		Sensory perception	12	8.3	7	4.8
		Don't know	96	66.2	139	95.9
Q11	The total score of the Braden scale equal to or less than 9 indicates	Very high risk (Correct Answer)	20	13.8	117	80.7
		High risk	15	10.3	11	7.6
		Moderate risk	25	17.2	8	5.5
		No risk	10	6.9	3	2.1
		Don't know	76	52.4	6	4.1
Q12	The high point (19 – 23) total sum of Braden's score indicates	Very high risk	27	18.6	8	5.5
		High risk	17	11.7	7	4.8
		Moderate risk	6	4.1	6	4.1
		No risk (Correct Answer)	19	13.1	117	80.7
		Don't know	76	52.4	7	4.8

Nurses' Attitude towards the Braden Scale

A description of the nurses' attitude towards the Braden Scale before and after the educational intervention in both time points is presented in table below. The participants' attitudes improved from pre- to post-test, indicating great confidence in using the Braden Scale, and they were more optimistic about implementing it in clinical practice. Although a significant number, 62.1% (n=90) of nurses strongly disagreed with being responsible for pressure injury risk assessment using the Braden Scale after the educational intervention (Table 5).

The attitude scores of nurses after the education session were higher (median = 36) than before-educational intervention scores (Median = 31). According to Bloom's cut-off point, the overall attitude score of the nurses is categorized to positive (44 - 55), neutral (33 - 43.5), and negative attitudes (less than 33) points. The pre-intervention attitude indicated a negative attitude, while the post-intervention became more neutral or positive.

Comparison of the Baseline Knowledge and Attitude Scores by Nurse's Characteristics

There were no statistically significant differences in baseline (pre-educational intervention) knowledge or attitude scores when comparing nurse characteristics including gender, age, nursing education level, total work experience in years, bedside care experience in years, pressure injury care experience, having special training, workload (nurse-to-patient ratio) and have access of reading material.

Mean comparison of the Knowledge and attitude score in pre- to- post-education intervention

The mean comparison of the participant's knowledge and attitude score before and after receiving the educational intervention, there were significant improvements in knowledge and attitude scores from pre- to- post-test evaluation, $p < .001$, with a large effect size, 1.95 and 0.81, respectively (Table 6).

Table 5: Description of the nurses' attitude score towards the Braden Scale between pre- and post-educational intervention, 2021.

Item	Pre-intervention						Post-intervention					
	SD	D	N	A	SA	Mean (SD)	SD	D	N	A	SA	Mean (SD)
Q1[+] I feel confident in my ability to use Braden Scale												
- Count	50	38	31	20	6	2.27 $\pm$ 1.19	23	31	41	38	12	2.9 $\pm$ 1.2
- Percent (%)	34.5	26.2	21.4	13.4	4.1		15.9	21.4	28.3	26.2	8.3	
Q2[+] I am well-trained to use BS												
- Count	89	19	24	6	7	1.78 $\pm$ 1.16	57	32	24	24	8	2.27 $\pm$ 1.29
- Percent (%)	61.4	13.1	16.6	21.4	4.8		39.3	22.1	16.6	16.6	5.5	
Q3[-] Implementing Braden Scale is too difficult for me												
- Count	50	36	21	16	22	3.52 $\pm$ 1.44	49	48	24	15	9	3.78 $\pm$ 1.19
- Percent (%)	34.5	24.8	14.5	11.0	15.2		33.8	33.1	16.6	10.2	6.2	
Q4 [-] Too much attention goes to implement Braden Scale												
- Count	43	36	38	14	14	2.45 $\pm$ 1.27	20	38	32	34	21	2.99 $\pm$ 1.28
- Percent (%)	29.4	24.8	26.2	9.7	9.7		13.8	26.2	22.1	23.4	14.5	
Q5 [-] Implementing Braden Scale for pressure injury prevention is not that important												
- Count	75	37	12	6	15	4.04 $\pm$ 1.30	85	39	12	5	4	4.35 $\pm$ 0.97
- Percent (%)	51.7	25.5	8.3	4.1	10.3		58.6	26.9	8.3	3.4	2.8	
Q6[+] Pressure Injury risk assessment is a priority												
- Count	35	22	42	20	26	2.86 $\pm$ 1.40	14	17	38	41	35	3.46 $\pm$ 1.25
- Percent (%)	24.1	15.2	29.0	13.8	17.9		9.7	11.7	26.2	28.3	24.1	
Q7 [-] Pressure injury rarely causes discomfort for a patient.												
- Count	60	30	27	8	20	3.7 $\pm$ 1.40	76	25	20	15	9	3.99 $\pm$ 1.28
- Percent (%)	41.4	20.7	18.6	5.5	13.8		52.4	17.2	13.8	10.3	6.2	
Q8 [-] Financial impact of pressure injury on patients should be exaggerated												
- Count	51	49	28	14	3	2.10 $\pm$ 1.06	40	53	23	24	5	2.43 $\pm$ 1.24
- Percent (%)	35.2	33.8	19.3	9.7	2.1		27.6	36.6	15.9	16.6	3.4	
Q9 [+] Financial impact of pressure injury on society is high												
- Count	40	43	32	19	11	2.40 $\pm$ 1.24	26	31	34	39	15	2.90 $\pm$ 1.27
- Percent (%)	27.6	29.7	22.1	13.1	7.6		17.9	21.4	23.4	26.9	10.3	
Q10 [-] I am not responsible to assess patient using Braden Scale												
- Count	71	33	18	6	17	3.93 $\pm$ 1.36	90	25	18	7	5	4.30 $\pm$ 1.08
- Percent (%)	49.0	22.8	12.4	4.1	11.7		62.1	17.2	12.4	4.8	3.4	
Q11[+] I have an important task in implementing the Braden Scale												
- Count	45	26	41	20	13	2.52 $\pm$ 1.30	25	18	28	43	31	3.26 $\pm$ 1.38
- Percent (%)	31.0	17.9	28.3	13.8	9.0		17.2	12.4	19.3	29.7	21.4	
Total Attitude score						31.26 $\pm$ 6.06						36.3 $\pm$ 6.44

Note: SD = Strongly Disagree, D = Disagree, N = neither disagree nor agree, A = agree, SA = Strongly Agree; SD = Standard deviation.

Table 6 Summary of the nurse's knowledge and attitude scores toward the Braden scale before and after educational intervention, 2021

Groups	Before education		After education		Paired difference			Wilcoxon signed-rank test
	Mean (SD)	Median	Mean (SD)	Median	Mean (SD)	Std. error	Effect size (D)	
Knowledge	23.23 ±22.58	18.75	73.88 ±28.98	87.5	50.65 ±33.68	2.797	1.948	P=0.001
Attitude	31.26 ±6.06	31	36.3 ±6.44	36	5.04 ±7.736	0.642	0.806	P < 0.001

Note: SD: Standard deviation, Std. error: Standard error, IQR: Inter-quartile range, Cohen's D: Effect size

The knowledge and attitude score among the three education delivery methods.

The knowledge and attitude differences were compared by education mode of delivery for printed material, oral presentation, or a combination of both after education intervention. The nurses' knowledge and attitude scores were higher after the education intervention, but there were no differences in how the information was presented (Table 7).

Table 7 Summary of the nurse's knowledge and attitude scores toward the Braden Scale among the three education delivery methods, 2021.

Groups	Oral presentation (n=26)		Reading material (n=61)		Combined both reading and oral presentation (n=58)		ANOVA
	Mean (SD)	Std. error	Mean (SD)	Std. error	Mean (SD)	Std. error	
Knowledge	74.2788 ±29.9649	5.877	75.3074 ±29.4575	3.772	72.198 ±28.441	3.735	P=0.694
Attitude	36.54 ±7.511	1.473	35.07 ±5.879	0.753	37.5±6.369	0.836	P=0.117

Note: SD: Standard deviation, Std. error: Standard error, IQR: Inter-quartile range

Discussion

This study tested knowledge and attitudes among Ethiopian staff nurses employed at three hospitals about the information on a pressure injury risk assessment tool, the Braden Scale, before and after an educational intervention using three delivery methods. Based on the results,

approximately two-thirds of the participants were unaware of the Braden Scale. With the educational intervention, the participant nurses have improved their knowledge and awareness of monitoring pressure injuries. Scores improved in knowledge and attitude from pre- to post-test, with no difference observed in how the information was delivered. In addition, we found no differences in knowledge and attitude scores based on nurse characteristics.

Similar to our study, across most studies conducted on the Braden Scale or pressure injury risk assessment, there were changes in knowledge scores that occurred from pre- to post-education interventions (132-137). In India, a study evaluated the effectiveness of structured teaching programs on knowledge score change in the Braden Scale and observed significant changes from pre- to post-test. Other studies show similar findings on nursing students and nurses working in specialized areas such as perioperative and international settings (138). Notably, most of the literature and evidence on using the Braden scale for pressure injury risk assessment has come from high to middle-income countries, with little to no research conducted in low and middle-income countries and is an area for further research investigation.

Regarding knowledge of the Braden Scale, our study report is similar to prior studies conducted in Japan (38%), South East Nigeria (36.3%), India (Vijayapur) (40%), and district Hisar (India) (38.3%) (63, 132, 139, 140). Furthermore, unlike ours, in a study report from the Hirsan district, more than 1/3 of the sample (38.3% of nurses) had previous experience with using Braden Scale for pressure injury risk assessment (132). It may reflect differences in the educational system or training.

In prior studies, most nurses showed poor knowledge of the Braden Scale (59, 141, 142). For example, in Singapore, the highest proportion (85.6%) of the nurses scored less than 60% on knowledge of the Braden Scale, which is similar to our results. Another study conducted by Sarkar (2018) that examined pre- and post-test changes using an observational checklist revealed that a significant number of nurses (63%) had inadequate knowledge of the Braden Scale assessment, particularly during the pretest (143). In a study conducted in Gondor, Ethiopia less than 50% of nurses scored as having poor knowledge on the Braden Scale and PI risk assessment. In contrast to our findings, some reports from India have shown that a lower proportion, 16%, and 20.7%, of staff nurses, had inadequate knowledge of the Braden scale (133, 144). Gagandeep et al. (2021) reported that no nurse in their study had poor knowledge of the Braden Scale, including during the pretest assessment (132). This wide variation likely reflects

differences in nursing education and training or resources available for implementing the Braden Scale.

Training on pressure injury prevention was low in the current study. In contrast to our findings, other studies in Nigeria, India, and Australia have shown that a significant number of nurses (ranging from 20% to 40%) received training on either Braden Scale risk assessment or general pressure injury prevention (63, 134, 140). Nurses reportedly received formal and specialized training on the pressure injury and risk assessment scales: in Nigeria (37.4%) and Australia (20%) in the last two years.

We found no difference in knowledge of the Braden Scale when considering nurses' socio-demographic characteristics, work-related experience, and history and years of nursing. This is consistent with prior studies conducted in Belgium, India, and Nigeria (133, 145, 146). Even though the comparisons were among different categories of nurses, between nurses and nurse assistants, among nurse students, and among staff nurses (before and after the structured teaching program), their characteristics did not change the overall knowledge score on pressure injury risk assessment. However, other studies from India and Indonesia have shown significant knowledge differences due to nurse age, education, and additional training on pressure injury risk assessment (132, 147, 148).

Although many studies, including ours, had shown a difference in knowledge score from pre- to post-intervention, no significant differences were reported utilizing different education methods (printed material, oral presentation, and combination of both) (149). A randomized controlled trial conducted by Farshbaf-Khalil, Jasemi, and Seyyedzavvar (2021) on surgical nurses compared knowledge scores regarding pain management using two education-delivering methods. Nurses in the electronic learning group scored significantly higher in knowledge than those in the lecture format (150). Providing education in cost-effective ways is essential for nurses to utilize evidence-based practice, such as pressure injury risk assessment, and is an area for further research.

In the current study, we showed significant differences in attitude scores on the Braden Scale between pre- and post-educational intervention. Similar to knowledge, however, there were no attitude differences that occurred due to nurse characteristics or mode of educational delivery. Few studies have been conducted on nurse attitudes related to the Braden Scale or pressure injury risk assessment. Aslan and Yavuz Van Giersbergen (2016) conducted a study in Turkey to

assess nurses' attitudes toward pressure injury prevention. They reported no significant variations in attitude scores based on characteristics except for the last training received. Al-Busaidi et al. (2019) reported that attitude has a significant positive correlation with working experiences in implementing evidence-based practice by nurses (151). A study by Farshbaf-Khalil, et al. (2021) had also shown a significant change in attitude scores after using different education methods, with higher attitude scores toward pain management in the e-learning group than in the lecture group (150). Several studies have reported that attitude positively correlates with knowledge of pressure injury prevention and recommends continuing education to improve attitude (145, 152).

Strengths and limitations of the study

- This study is one of the first studies in Ethiopia to examine nurse knowledge and attitudes on the Braden Scale to identify pressure injury risk. Findings from this study indicate that a simple education intervention can change both knowledge and attitudes and serves as a director for future interventions.
- The study had several strengths including the use of a quasi-experimental cluster design, utilizing nurses working in three referral hospitals. Because the cluster design was used we were able to avoid contamination between the different educational delivery groups.
- The nurses were also very similar across all 3 hospitals, with no significant differences in work experience or socio-demographics which strengthen our findings.
- The study also had limitations such as not being able to be generalized to all nurses working in other types of hospitals in Ethiopia such as private, smaller, or rural hospitals.

Conclusion and Recommendations

The educational intervention provided was successful in positively changing the knowledge and attitude of nurses, regarding the Braden Scale and its potential use in clinical settings for identifying pressure injury-risk patients. All educational delivery methods were equally effective, indicating that further research is required to identify the most cost-effective one feasible in resource-limited countries such as Ethiopia. It is suggested that in-service training for nurses, focusing on pressure injury risk assessments is essential to update their knowledge and improve patient outcomes. The nurse experts should also consider integrating Braden Scale scoring in the nursing process format as a unified entity.

Chapter 3: Paper 2 (Submitted to IJANS)

Applying the Theory of Planned Behavior to Predict Nurses' Intention and Willingness to Use the Braden Scale for Pressure Injury Risk Assessment in Public Hospitals in Addis Ababa, Ethiopia.

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ABSTRACT

Background: Despite the proven efficacy, worldwide pressure injury (PI) prevention practices are reported to be low, particularly in low to middle income countries (LMICs) where guidelines are often lacking. In LMIC settings such as Ethiopia, nurses often do not have been taught or not have the requisite skills to assess PIs risk with validated instruments such as the Braden Scale. In addition, no study has used a theory based framework to examine the intentions and acceptance among nurses for implementing the Braden Scale.

Objective: The purpose of this study was to examine the relationship between the Theory of Planned Behavior and Nurses' readiness to implement and accept the Braden Scale for pressure injury risk assessment in Ethiopia.

Methods: Across-sectional study design was utilized. A sample of 163 staff nurses from three public hospitals participated. The participants were full-time staff nurses working in units designated for critical patient care, including the ICU, Internal Medicine, Surgical, and Orthopedic unit. Data was collected using a structured self-administered questionnaire. A multiple regression analysis was employed to analyze the data.

Results: A total of 145 questionnaires were completed by the nurses, resulting in a response rate of 89%. Four factors including Nurse's knowledge of the Braden Scale explained 56.7% of the variance in intention. Attitude, subjective norms, perceived behavioral control significantly predicted intention to use the Braden Scale, with β (95% CI) = (0.078 [0.032, 0.125], 0.390 [0.240, 0.539], and 0.302 [0.190, 0.414], $p < .001$), respectively. Two factors, intention and perceived behavioral control explained 63.8% of variance in nurses' acceptance, with a β (95% CI) = (0.873 [0.697, 1.047] and 0.368 [0.220, 0.515], $p < .001$), respectively.

Conclusion and recommendations: This study found the TPB beneficial for understanding nurses' intent to use the Braden Scale. Subjective norms strongly influenced intention, which in turn impacted acceptance. Strategies to enhance use should target social influences and nurses' belief in the Braden scale's effectiveness while reducing perceived barriers. Future research could further explore external factors and organizational supports.

Key words: Theory of Planned Behavior, Nurse, Braden Scale Implementation, Intention, and Acceptance

INTRODUCTION

Background

Despite the international prevention practice guidelines that indicate increased attention to pressure injury (PI) prevention by nurses, the overall prevalence rate remains unchanged worldwide (153, 154) and are reported to be higher in low-to middle income countries (LMICs). Hospital-acquired pressure injury (HAPI) also remains a priority agenda in patient safety evaluation (86). The global prevalence rate of PI ranges from 6% to 18.5% (31), while the HAPI incidence rate varies among countries, some show reductions (17, 32, 85, 155). Most PIs are avoidable and considered a nurse-sensitive care quality indicator (156). The European Pressure Ulcer Advisory Panel (EPUAP), National Pressure Injury Advisory Panels (NPIAP), and Pan Pacific Pressure Injury Alliance (PPPIA) developed an international PI prevention guideline. The guideline encompasses PI risk assessment, skin and tissue assessment, and skincare interventions (4). The UK National Health Service also developed another approach to implement evidence-based PI prevention interventions and known as S.S.K.I.N (skin, surface, keep moving, incontinency, and nutrition) (157).

Risk assessment is the initial step in preventing pressure injuries (PIs). It helps accurately identify at-risk individuals and guides healthcare professionals in delivering effective interventions. Consequently, a well-implemented risk assessment practice is associated with a lower overall PI rates; PI rates tend to decrease as risk assessment practices increase (153). Preventing PIs involves the collaboration among clinical teams, with nurses playing a crucial role since they are at the bedside more than any other profession (45). Nurses' ability in accurately identifying patients at-risk for developing PI, plays key roles in managing care efficiently and reducing the costs associated with unnecessary interventions of preventive care (158).

The Braden Scale is known for being simple and easy to use, especially when compared to other PI risk assessment tools. Nurses across hospitals, long-term care facilities, and home care settings commonly depend on it, reflecting how widely accepted and practice it in everyday care (48). Research has shown that the Braden Scale is quite effective at predicting the risk of PI, especially for patients who are at high-risk, such as those who are frequently bedridden. Interventions that applied the Braden Scale in these high risk populations showed reduced PI rates (48, 95, 111). Despite the proven efficacy, worldwide practices for PI prevention, including

Ethiopia, are reported to be low (112). Inconsistent uses of PI risk assessments have also been documented as well as not using the Braden Scale to guide preventive measures (159).

Several factors have been cited to influence nurses' intention and acceptance of the Braden Scale. Studies have shown that among nurses, these factors include insufficient knowledge about pressure injury prevention strategies, such as risk assessment procedures (59, 114, 160). Other factors such as the shortage of resources (staff and equipment), and the absence of clear policies or guidelines hinder the effective use of the Braden Scale (161). Additionally, the factors including knowledge, perceived usefulness, easiness in use, workload, support from leadership, patient outcome, and interdisciplinary collaboration, can influence nurses' acceptance of its implementation (63, 73, 98, 162).

The theory of planned behavior (TPB) is a suitable framework for predicting and explaining health-related behaviors and supporting the development of change behaviors (64, 163). According to Ajzen and Fishbein, TPB is based on the idea that individuals are rational beings who thoughtfully consider available information and evaluate potential outcomes before deciding to engage in a behavior (66). Furthermore, numerous studies have indicated that the Theory of Planned Behavior (TPB) is the most suitable framework for explaining healthcare professionals' intentions to implement clinical guidelines, including those involving nurses (71, 115, 117, 164). According to the TPB, a person's intention to act is influenced by three key factors: their attitudes toward the behavior, subjective norms, and perceived control (PBC). Many researchers have applied this theory to better understand nurses' intentions and willingness to engage in a specific patient care practices, like using the Braden Scale for PI risk assessment (27-33). The TPB provides a helpful framework for explaining how different factors shape nurses' intentions and willingness to using the Scale.

A Nurse's attitude towards the Braden Scale is especially important; it significantly impacts in their intention to use it. If nurses perceive the scale as useful and relevant to patient care, they are more likely to adopt and use it regularly in their clinical practice. Conversely, negative perceptions about its usefulness can lead to reluctance or resistance. Studies have shown that nurses who believe the scale is beneficial tend to use it more effectively during patient assessments, which highlights the importance of positive attitude in promoting its use (63, 161). Subjective norms are about the social expectations and pressures from colleagues and organizational culture that can influence whether someone decides to adopt a particular behavior.

The influence of colleagues' pressure and organizational culture are especially important in shaping nurses' intentions. Supports from leadership and encouragement from peer can strengthen these norms and promote a culture of evidence-based practice. If the Braden Scale is supported and valued within a healthcare organization, nurses are more likely to adopt it in their routine care practice (73).

Perceived behavioral control refers to nurses' confidence in their ability to effectively use the Braden Scale. This confidence is influenced by access to training, resources, and organizational support. Evidence suggests that when nurses feel adequately prepared and supported, their intention to implement the scale increases substantially (162, 165).

In Ethiopia, most research has focused on examining nurses' knowledge, attitudes, and practices related to PI prevention, with little attention given to risk assessment perspectives. Moreover, no studies in the region have applied the TPB framework to explore nurses' intentions and acceptance of using the Braden Scale. Given the absence of documented evidence on this topic, this research was structured around the TPB to explore the influencing factors of intentions and acceptance among nurses to implement the Braden Scale. The ultimate goal is to strengthen PI prevention practices by improving the identification of at-risk patients in selected hospitals. Specifically, the study aimed to assess nurses' intention and acceptance of the Braden Scale and to analyze the relationships among the TPB components: attitude, subjective norms, perceived behavioral control, intention and acceptance.

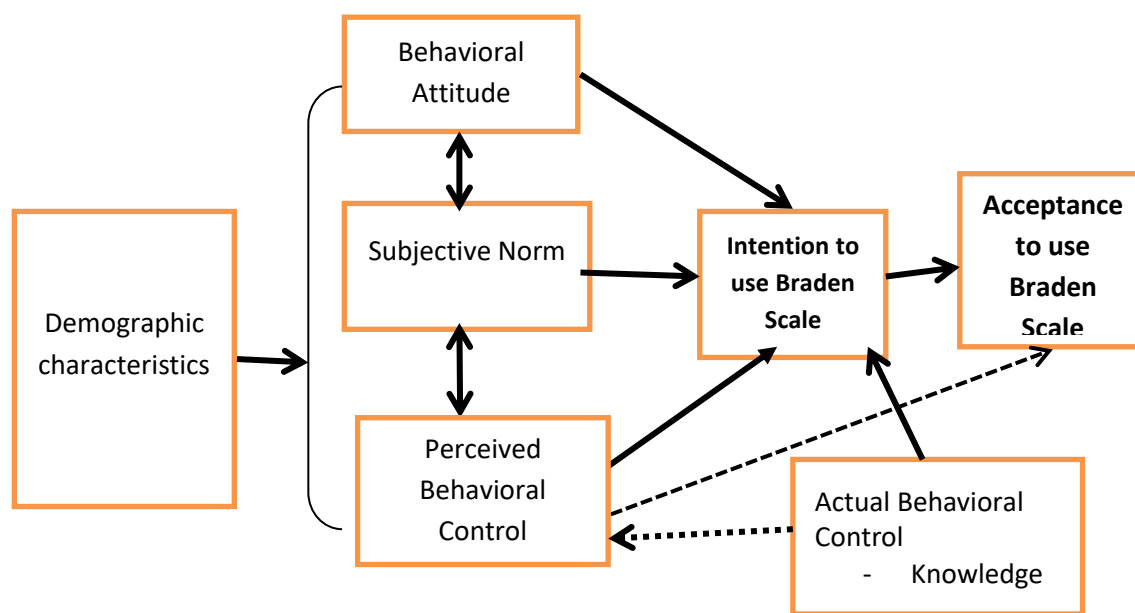


Figure 3 Conceptual Framework of the Theory of Planned Behavior Adapted from Icek Ajzen, 1991

Methods

Study Design, Setting, and Population

A cross-sectional study was conducted in three selected public hospitals, in Addis Ababa, Ethiopia. Staff nurses were selected using a cluster sampling approach, followed by simple random sampling from each hospital. All three hospitals function as teaching and referral centers and include specialized units that care for patients at higher-risk of developing PI. These units included adult general intensive care units (ICUs), orthopedic, internal medicine, general surgery, and neurology units. Nurses who are working full-time in these units, including staff nurses and nursing supervisors and directly involved in patient care, were eligible to participate in the study. After receiving clear explanation of the study's purpose, verbal consent was obtained from all participants. Study participant recruitment took place within specific units with the assistance of the unit head, and only after obtaining ethical approval from the IRB.

Sample Size and Sampling Methods

The sample size was calculated using the G*power software program, applying the Z-test family for a logistic regression analysis. The calculation was based on an 80% statistical Power, an effect size of 0.5, and significant level of 0.05. This resulted in a final total sample size of 163 nurses. The sample was then allocated proportionally across three hospitals according to the number of nurses working in specific units. Consequently, 61 nurses were selected from Tikur Anbessa Specialty Hospital (TASH), 64 from Saint Paul's Hospital Millennium Medical College (SPHMMC), and 38 from Menelik-II Referral Hospital. Nurses were randomly selected from each unit using a simple random sample and a lottery system, with each nurse assigned a unique number.

Data Collection

The data were collected using self-administered structured questionnaires adapted from the literature on PI risk assessment and other nurses' professional practices (61, 62, 123, 124). The instrument contained socio-demographic data and a TPB questionnaire that refers to the Braden scale PI risk assessment.

Measurements

Sociodemographic characteristics included age, gender, education level, marital status, monthly income, overall work experience in years, PI care experience, workload (nurse-to-patient ratio),

special training, and access to reading material about PIs. The TPB model consists of a total of 33 items including behavioral attitude, normative belief (subjective norms), control belief (perceived behavior controls and actual behavior control), behavioral intention, and the behavior (acceptance of the Braden Scale utilization). Except for the knowledge questionnaires that were rated with correct, incorrect, or do not know responses, all TPB constructs were rated with a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). A higher score on the overall TPB constructs indicates a more positive attitude, stronger subjective norm, greater perceived behavioral control, and increased behavioral intention, leading to greater acceptance of the behavior. Conversely, a lower score suggests a reduced likelihood of engaging in the behavior.

Nurses' Attitudes toward the Braden Scale utilization were measured by eleven items, adapted from a literature showing satisfactory psychometric properties (Cronbach's alpha of 0.79) (123). The nurses' attitudes were described by calculating the total sum scores, ranging from 11 to 55 points. Subjective norms were assessed using two item scale, adapted from Muhamed et al (2020) study that demonstrated a Cronbach's alpha of .80 (39). The items were modified to assess the nurses' normative belief in the Braden scale utilization, as of "Most people who are important to me appreciate my Braden Scale practice" and "Most nurses like me exercise Braden Scale Implementation". Each item was rated with a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The subjective norms score was calculated by total sum of the scores of the two items ranging from 2 – 10 points. The knowledge of nurses about Braden Scale were assessed using twelve-item multiple-choice questionnaires adapted from different literatures that demonstrated internal consistency with Cronbach alpha ranging from .54 to .75 (120, 122, 166). Each item was rated with yes, no, or do not know responses. Then the responses were scored as "1" for correct response and "0" for incorrect or do not know response. The total sum of score were converted into percentages ranging from 0 to 100%. Each nurse's knowledge level was determined by the Bloom's cut-off score that suggested high level knowledge with total score of > 80% and low with < 60% score (125) the nurses' knowledge that measured by questionnaires consisting of questions. Perceived behavioral control (PBC) was assessed using three-item scales, adapted from literature with acceptable internal consistency a Cronbach's alpha of .75 (167). The items were modified to assess feasibility of the Braden Scale utilization by nurses in selected hospitals, these were stated as "There is sufficient time to practice the Braden

Scale”, “Most staff make an effort to implement the Braden Scale”, and “Necessary resources for Braden Scale implementation are available”. Each scale was rated with a 5-point Likert scale. The total sum scores of the scale produced a range of 3 to 15 point.

The intention was assessed using a two-item scale adapted from literature that demonstrated acceptable internal consistency, with a Cronbach's alpha of 0.71 (126). The items were modified to assess the intention to utilize the Braden Scale for pressure injury prevention, stated as “I intend to use the Braden Scale regularly in the future” and “I will use the Braden Scale regularly in the future”. Each item was rated with a 5-point Likert scale. The intention score was calculated by the total sum of the two items that ranges from 2 to 10 points.

The acceptance of Braden Scale implementation by nurses was assessed using three-item scales, adapted from literature that showed excellent internal consistency, with a Cronbach's alpha of .85 (127). The items were modified and stated as “I would ultimately incorporate the Braden Scale into routine nursing care,” “Participating in Braden Scale implementation would be feasible for me,” and “I would feel comfortable participating in Braden Scale implementation”. Each item was rated with a 5-point Likert scale. The total sum calculation produced scores ranging from 3 to 15 points.

Data Collection Procedure

Before data collection, approval was secured from the Institutional Review Board (IRB) and written informed consent from all participants. The IRB approvals were granted by CHS, SPHMMC, and the Addis Ababa City Health Office, under Protocol No: 040/20/Nursing, Ref. No: pm23/27, and Ref. No: A/A/A281/227, respectively. Data collection procedures were uniform across the three hospitals. An introduction explaining the study's purpose was attached to each questionnaire. The principal investigator delivered the questionnaires to each unit in the study hospital. The head nurse in each unit provided us with the list of staff nurses, select eligible ones using a simple random selection technique and then we approached them to fill out the questionnaires at their convenience. Upon completing the questionnaire, the nurses were requested to place the completed questionnaires in the head nurse's office, where the researcher could easily collect them. Data collection was conducted between January 30 and February 28, 2021.

Data Analysis

The collected data was entered into Epi-data version 4.3 and transported to SPSS version 25 for analysis. Descriptive statistics: frequency, percentage, mean, and standard deviation were calculated to summarize socio-demographic data and factors influencing intention to use the Braden Scale. Pearson correlation coefficients were calculated to summarize the linear relationship between the TPB constructs: the nurses' attitude, subjective norm, perceived behavior control, knowledge, intention, and acceptance of the Braden Scale utilization. A multiple regression analysis was conducted to assess the relationship between attitude, subjective norm, PBC, and intention and nurses' acceptance to use Braden Scale risk assessment tool. All assumptions were checked and met the assumptions. The results are presented with unstandardized coefficients, which reflect the change in intention and acceptance for each one-unit increase in the respective predictors. The level of significance was determined at p value < 0.05 .

Results

Participant Characteristics in Relation to TPB Constructs

A total of 163 questionnaires were distributed to the nurse participants, of which 145 completed questionnaires were returned, yielding a response rate of 89%. The remaining 11% of questionnaires were excluded due to incomplete responses. The results presented in Table 8 illustrate the cross-tabulation of participants' demographic characteristics with the TPB variables. Participants who were aged over 29 years, male, married, held an MSc degree, earned more than 6,500 ETB per month, had more than 6 years of work experience, had experience in PI care, received special training in PI care, and had access to reading materials or the internet, demonstrated a more favorable attitude towards the use of the Braden Scale compared to their counterparts. Knowledge scores were generally similar among most nurses, with higher scores observed in those with educational preparation at the diploma level and special training, particularly among those who had not received such training.

A comprehensive descriptive analysis of TPB constructs was conducted and is presented in Table 9.

Table 8 Cross-tabulation of Socio-demographic characteristics with the TPB constructs among the nurse participants (n = 145)

Variable	Measures	Scores of TPB variables (Mean, Standard deviation)					
	(n,%)	Attitude	SN	PBC	Knowledge	Intention	Acceptance
Age Years							
< 29 yrs.	93 (64.1%)	35.49±6.44	5.12 ±2.03	8.20±2.87	70.23 ±30.96	6.29±2.35	9.17±3.44
> 29 yrs.	52 (35.9%)	37.75±6.24	5.35±2.17	7.92±2.55	80.41 ±23.97	6.21±2.16	9.63±3.22
Gender							
Male	46 (31.7%)	37.30±7.06	5.15±1.93	8.33±2.51	75.68 ±27.68	6.52 ±2.31	9.17±3.52
Female	99 (68.3%)	35.77±6.11	5.22±2.15	8.00±2.87	73.04 ±29.66	6.14 ±2.31	9.41±3.30
Marital status							
Single	69 (47.5%)	34.91±6.97	4.87 ±2.12	7.94±2.85	74.09 ±29.61	6.29 ±2.29	8.99±3.44
Married	72 (49.7%)	37.60±5.82	5.43 ±2.03	8.32±2.72	73.52 ±29.25	6.18 ±2.39	9.67±3.35
Divorced	2 (1.4 %)	36.50±2.12	7.00±.0	6.50±.71	75.00 ±.00	7.50±.71	10.50±.71
Others	2 (1.4 %)	37.50±2.12	6.50±.71	7.50±2.12	78.13 ±22.10	7.00±1.41	8.50 ±.707
Level of education							
Diploma	6 (4.1 %)	34.17±4.88	5.67 ±2.25	9.33±2.42	77.08 ±27.86	6.83±1.85	10.0±3.10
BSc	129 (89 %)	36.05±6.43	5.12 ±2.11	8.00±2.73	73.92 ±29.04	6.13±2.35	9.17±3.40
MSc	10 (6.9 %)	40.08±6.37	5.83 ±1.53	8.58±2.64	71.88 ±31.14	7.42 ±1.73	10.75 ±2.83
Monthly income							
< 6504 Et.B	91(62.8%)	35.29±6.51	5.05 ±2.12	7.93±2.82	72.73 ±28.47	6.26 ±2.46	9.12±3.53
> 6504 Et.B	54(37.2%)	38.02±6.00	5.44 ±1.99	8.39±2.64	75.81 ±29.99	6.26 ±2.05	9.70 ± 3.05
Total work experience							
< 6 yrs.	100 (69%)	35.96±6.72	5.21 ±2.09	8.15±2.91	71.69 ±30.47	6.33 ±2.43	9.24±3.53
>6 yrs.	45 (31%)	37.07±5.77	5.20 ±2.07	8.00±2.40	78.75 ±24.98	6.11 ±2.04	9.56 ± 2.97
Experience in PI care							
No	104(71.7%)	34.76±5.88	5.17 ±2.22	8.17±2.22	68.29 ±32.06	5.90 ±2.36	9.29±3.16
Yes	41 (28.3%)	36.91±6.58	5.21 ±2.03	8.08±2.80	76.08 ±27.52	5.16 ±2.28	9.36 ± 3.44
Receiving special training within the last 6 months							
No	138(95.2 %)	36.24 ±6.44	5.21 ±2.09	8.13±2.77	74.09 ±29.29	6.25 ±2.35	9.35±3.42
Yes	7 (4.8%)	37.57 ±6.99	5.00 ±1.83	7.57±2.57	69.64 ±23.23	6.43 ±1.40	9.14 ±1.77
Nurse-to-patient ratio							
1:1	42 (29.0%)	37.43 ±6.87	5.50 ±2.11	8.05±2.63	75.00 ±28.32	6.48 ±2.32	10.02 ± 3.43
1:3	16 (11.0%)	35.63 ±7.23	5.44 ±2.16	8.75±2.84	66.02 ±33.62	5.94 ±2.54	9.133 ±.79
1:5	77 (53.1%)	35.65 ±6.10	4.29 ±2.10	7.99±2.88	75.00 ±28.84	6.06 ±2.26	8.86±3.32
1: >5	10 (6.9%)	37.70 ±1.49	5.70 ±1.49	8.20±2.39	75.13 ±27.33	7.40 ±2.17	10.5 ±2.01
Access to reading material/internet							
No	52 (35.9%)	34.08 ±7.03	4.18 ±2.27	7.52±2.91	70.43 ±30.85	5.44 ±2.24	8.4 ±3.49
Yes	93 (64.1%)	37.55 ±5.76	5.42 ±1.94	8.20±2.63	75.81 ±27.86	6.72 ±2.23	9.86 ±3.18

Note: SN refers to Subjective norm, PBC refers to perceived behavioral control

Table 9 Descriptive statistics of the TPB variables scores (n = 145)

Variable	Measurements			
	Mean (SD)	Median	Minimum	Maximum
Attitude	36.3 ±6.44	36.0	22	51
Subjective norms	5.20 ±2.08	5.0	2	10
PBC	8.10 ± 2.76	9.0	3	15
Knowledge	73.88± 28.98	87.5	0	100
Intention to use the Braden Scale	6.26 ± 2.31	6.0	2	10
Acceptance to use Braden Scale	9.34 ±3.36	9.0	3	15

The correlation analysis among the TPB constructs is presented in Table 10. The results of the study revealed significant positive correlations between each TPB construct, with the exception of nurses' knowledge regarding the Braden Scale. Specifically, nurses' attitudes, subjective norms, and PBC were found to be positively correlated with their intentions and acceptance of the Braden Scale to use for PI risk assessment, with a significance level of $p < .001$.

Table 10 Correlation matrix of the TPB variables in the study (n = 145)

	Acceptance	Intention	Attitude	Subjective norms	PBC	Knowledge
Acceptance	1.00					
Intention	.793**	1.00				
Attitude	.542**	.520**	1.00			
Subjective norm	.648**	.627**	.407**	1.00		
PBC	.685**	.637**	.415**	.525**	1.00	
Knowledge	.080	.059	.239*	-.037	.048	1.00

**, Correlation significant level $p = 0.001$ and * $p = .05$

A series of multiple linear regression analyses were conducted to examine the predictors of nurses' behavioral attitude, intention, and acceptance regarding the use of the Braden Scale for pressure injury (PI) risk assessment. The first regression analysis aimed to predict nurses' attitudes toward the use of the Braden Scale. The overall predictors such as age, gender, marital status, educational level, work experience, special training, work load, and access of reading material or internet were evaluated. The model was statistically significant, with two predictor variables. Marital status (specifically, being single) and access to reading materials or the internet emerging as significant contributors to the model, $F(2, 142) = 9.276$, $p < .001$. These variables accounted for approximately 11.6% of the variance in nurses' attitudes toward Braden Scale use. Specifically, access to reading materials or the internet was associated with a significant increase in attitude scores ($\beta = 3.619$, 95 % CI [1.529, 5.710], $p = .001$), whereas

being unmarried was associated with a decrease in attitude scores ($\beta = -2.827$, 95 % CI [-4.835, -0.820], $p = .006$). The second regression analysis examined the intention to use the Braden Scale, based on the Theory of Planned Behavior (TPB) variables: attitude, subjective norm, perceived behavioral control (PBC), and knowledge. The model was statistically significant, $F(4, 140) = 45.821$, $p < .001$, explaining 56.7% of the variance in intention ($R^2 = .567$). All predictors except knowledge made significant contributions to the model. Increases in attitude, subjective norm, and PBC were associated with corresponding increases in the intention to use the Braden Scale, with β coefficients of 0.078 (95% CI [0.032, 0.125], $p < .001$), 0.390 (95% CI [0.240, 0.539], $p < .001$), and 0.302 (95% CI [0.190, 0.414], $p < .001$), respectively. Detailed results are presented in Table 4. A third regression analysis was performed to assess predictors of nurses' acceptance of the Braden Scale for PI risk assessment, with intention and perceived behavioral control as independent variables. The model was statistically significant, $F(2, 142) = 152.903$, $p < .001$, accounting for 68.3% of the variance in acceptance ($R^2 = .683$). Both intention and PBC significantly predicted acceptance, with intention yielding a β coefficient of 0.873 (95% CI [0.697, 1.047]) and PBC a β coefficient of 0.368 (95% CI [0.220, 0.515], $p < .001$). Detailed results are provided in Table 11.

Table 11 Regression analyses results of intention to utilize Braden Scale (dependent variables) with the TPB variable (n = 145 nurses)

Variable	Coefficients			t-statistics	P value	95% CI	
	unstandardized Beta	SE	Standardized Beta			LL	UL
Attitude	.078	.023	.218	3.338	.001	.032	.125
SN	.390	.076	.351	5.151	$\leq .001$	.240	.539
PBC	.302	.057	.361	5.328	$\leq .001$	.190	.414
Knowledge	.003	.005	.038	.655	.513	-.006	.012

Note: SN refers to Subjective norm; PBC refers to perceived behavioral control

Table 12 Regression analysis results for nurses' acceptance of Braden Scale utilization with intention and PBC variable (n = 145 nurses)

Variable	Coefficients			t-statistic	P value	95% CI	
	Unstandardized Beta	SE	Standardize. Beta			LL	UL
Intention	.873	.089	.601	9.792	$\leq .001$	.697	1.047
PBC	.368	.075	.302	4.924	$\leq .001$	.220	.515

Note: PBC refers to perceived behavioral control

Discussion

In this study, nurses showed significant changes in their behavioral intentions and acceptance to use the Braden Scale for pressure injury (PI) risk assessment in preventive care practices. These changes were the effect of several key predictors, providing valuable insights into the factors that influence nurses' readiness and willingness to adopt the Braden Scale. The main identified determinants included nurses' personal attitudes, subjective norms, and perceived behavioral control (PBC) related to the use of the Braden Scale.

There are only limited research applying the Theory of Planned Behavior (TPB) to understand nurses' intentions and acceptance of using the Braden Scale in PI prevention practices. As a result, evidence from other studies using TPB in other area of nursing practice was used to help interpretation and contextualize the findings of this study.

This study finding showed that all three TPB components significantly influenced nurses' intention to use the Braden Scale. Of these, subjective norms emerged as the strongest predictor, followed by PBC and attitude highlights the powerful role of social influence in shaping nurses' intention within this context. Align to the study, results have been reported in studies from Iran, where subjective norm strongly influence nurses' intention to engage in patient safety practice, and from South China, where it influenced nurses' intention to care for patients with COVID-19 (118). A Canadian study found that attitude and PBC were the main predictors of nurses' intention to use filter needles at work (71). That is a bit different from what this study shows, it probably comes down to differences in the nurses' background and the healthcare system they work in. Here subjective norm was the top factor in this study so if the goal is to get nurses to uses the Braden Scale more often, the focus should be on social influences, such as peer pressure, leadership support, and overall organizational culture. Focusing just on attitude or perceived behavioral control doesn't go far enough, because social influence clearly impacts a lot.

The study also found that both intention and PBC predict whether nurses accept the Braden Scale, but intention was the strongest predictor. That is consistent with the core assumption of the TPB (168) and matches findings from Malaysia and Taiwan (169-171). Basically, nurses who expressed stronger intention to use the Braden Scale were much more likely to actually accept it in their daily work. However, findings from China showed that intention did not significantly predict nurses' behavior on physical restraints reduction in long-term care settings

(172), suggesting that contextual factors may influence these relationships. The positive influence of PBC indicates that nurses who feel confident in their ability to use the Braden Scale are more likely to accept and apply it in practice. These results highlight the need to address both intention and PBC in interventions designed to promote the use of the Braden Scale. Interventions should focus on encouraging nurses' motivation, strengthening confidences in the Braden Scale effectiveness, and reducing perceived barriers through adequate training, access to resources, and ongoing organizational support.

The TPB suggests that socio-demographic characteristics can influence attitudes, which in turn indirectly impact intentions and behaviors of nurses. In this study, predictors such as age, gender, marital status, educational level, work experience, special training, work load, and access of reading material or internet were evaluated. However, only two variables (marital status and access to reading material or internet) were found to be statistically significant predictors of the nurses' attitude. Marital status (specifically, being single) was associated with a decrease in attitude scores, while having access to reading materials or the internet was associated with a significant increase. In contrast, the nurses' attitude score increased with frequent PI training; furthermore, positive attitude was exhibited with higher education status (173-175). Given that the utilization of the Braden Scale for pressure injury (PI) risk assessment is not yet implemented within the Ethiopian healthcare context, there are no directly comparable studies in this specific area. Studies on how nurses prevent pressure injury have produced mixed results. Some demonstrate nurses are doing a good preventive practices, there is even a link between the PI prevention behavior and marital status, particularly divorced nurses were doing good (176). In contrast, other research points out some gaps in PI prevention behaviors. Nurses missing clear guidelines or policies, getting inadequate leadership support, having limited resources, low job satisfaction, and unbalanced patient-to-nurse ratios were major contributors to suboptimal prevention practices (59, 156, 177). Unlike the current approach, these findings underscore several critical areas that require focused and targeted interventions to strengthen their prevention practices that include implementation of comprehensive PI risk assessment strategies. These differences probably come from things like the study design, study area, and which tool used to measure results. This highlights the need for further research to better understand factors that influence PI prevention practice. In this area needs more research to figure out what really works, so we can come up with better, and more targeted strategies that actually fit the situation.

Overall, the study findings emphasize the importance of understanding the nurses' intention to use the Braden Scale and then accept to adopt. Findings suggest that targeted interventions based on TPB can help improve its implementation and strengthen PI prevention practice by early detection using the Braden Scale across clinical settings.

Strength and Limitation of the Study

This study represents one of the first with application of the Theory of Planned Behavior (TPB) in Ethiopia to examine nurses' intentions to use the Braden Scale and adopt it for pressure injury risk assessment. Despite its contribution, the study had several limitations. It was conducted exclusively in urban referral hospitals and no pilot study was undertaken. In addition, the data collection tool was adapted from validated instruments used in other fields, which may limit its relevance in relation to the context. The findings may also lack generalizable to all nurses those working in other healthcare setting, such as private, smaller, or rural hospitals in Ethiopia. By conducting this study in three public referral hospitals, we got valuable insights of how the TPB components shape nurses' intentions and their willingness to use the scale. These findings lay a useful foundation for future interventions. The findings still highlight the need for further research to test the TPB framework in different healthcare environment.

Conclusion and Recommendations

The regression analysis resulted with the subjective norm being the strongest predictor for nurses' intention to use the Braden Scale, followed by perceived behavioral control and attitude. These findings can inform future interventions that aimed at enhancing nurses' intention and, ultimately, their acceptance of the Braden Scale in pressure injuries prevention practice. The study also showed that both intention and PBC significantly influence nurses' willingness to use the Braden Scale for PI risk assessment. These findings suggest that interventions to focus on increasing nurses' motivation to use the scale and their confidence in using it effectively, ultimately, may be successful in promoting its adoption in clinical practice. Given the crucial role of the Braden Scale in early detection of patients who are at risk for PIs, understanding the factors that influence its acceptance is also essential for improving patient care and health outcomes. Future research should further examine additional factors, such as organizational or external factors, and assess the applicability of the TPB framework in a wider range of healthcare

settings to provide a more comprehensive understanding of adopting the scale within the Ethiopian Healthcare system.

Chapter 4: Paper 3 (Original Article)

Evaluation of the Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia

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ABSTRACT

Background: Effective prevention of pressure injuries depends on accurately identifying the patients at risk. International pressure injury prevention guidelines recommend pressure injury risk assessment using tools like the Braden Scale. While the Braden Scale's predictive ability varies across studies, its effectiveness in Ethiopian healthcare setting remains unexamined.

Objective: The study aimed to investigate the predictive ability of the Braden Scale in diagnosing pressure injury development among hospitalized patients.

Method: A prospective study enrolled 238 patients from critical care units in three public hospitals in Addis Ababa, Ethiopia, using convenient sampling technique. Data were collected using structured questionnaires and analyzed using SPSS version 25. Binary logistic regression assessed variable relationships, and ROC analysis evaluated the Braden Scale's predictive ability for pressure injuries development.

Results: The study analyzed data of 229 participants, with male make up 59.8%, and a median age of 39 years. The mean score of the Braden Scale was 13.2 ± 2.95 of the range between 6 and 23 scale. Pressure injuries developed in 21.83% of participants. The Braden Scale score, age, and body temperature are emerged as significant predictors of pressure injury. Notably, for every one-unit increase in the Braden Scale, the likelihood of developing a pressure injury decreased by 24.5%, while age and body temperature increase the odds by 2% and 2.27 times, respectively. ROC analysis yielded a sensitivity of 64% and specificity of 59.2% at a cut-off point of 13.5. The AUC value was 0.682 (95% CI: 0.611, 0.761), indicated a statistically significant, yet insufficient capacity to predict the development of PI ($p < 0.001$).

Conclusion: The study highlights Braden Scale score, body temperature, and ages are significant predictors of pressure injuries. However, the results indicate that the Braden Scale has limited predictive ability in diagnosing pressure injury risk among hospitalized patients. Further research with a larger sample size in a specific clinical setting is necessary to fully evaluate the effectiveness.

Keywords: Braden Scale, Pressure Injury, ROC analysis, AUC, Sensitivity, Specificity

INTRODUCTION

Background

Pressure injuries (PIs) are devastating complications in hospitalized patients and commonly occur in severely ill and highly care-dependent patients (178). Reports from different regions, note a hospital-acquired pressure injury (HAPI) incidence ranges from 0.63% to 10% (15, 32, 40, 86, 179). The primary risk factors for PIs include friction/shear, immobility, moisture, poor sensory perception (105, 180, 181), and older age and hyperthermia (15, 25, 26, 94, 182). PIs lead to numerous suffering such as pain, serious infection, extended hospital stay, and increased treatment costs. A recent systematic review showed that the cost for treating PI is higher than the prevention cost (92). Preventing pressure injury is not always cheaper. It actually takes a lot of time, effort, and supplies (93, 183). That is why identifying a patient who is at most risk matters so much. When accurately identifying at higher risk individuals helps to implement appropriate prevention steps (18). The first thing to initiate prevention strategies is using an evidence-based assessment tool to recognize at risk individuals. Experts everywhere have come up with different validated PI risk assessment scales, all built around key risk factors. These tools work on a point system (20). They are basically there to help nurses see who is most vulnerable and plan how to keep the condition from getting worse (94, 184).

The Braden Scale for example uses six distinct sub-scales, all connected to why PIs happen (8). These sub-scales are categorized in two main determinants: how much and how long pressure hits a spot, and how well the tissue can tolerate it (8, 10, 185). The sensory perception, activity, and mobility sub-scale measure how much and how long the pressure last. Then moisture, nutrition, and friction/shears sub-scales show how well the tissues hold up. Put together, these help nurses to figure out where to focus and how to protect patient better. Each sub-scale rates from 1 to 4 points, except for friction/shear, which is rated from 1 to 3 points. The overall scores vary between 6 and 23, with lower scores indicating a higher risk of developing PIs. Numerous studies have provided evidence that a cut-off score of 18 or below signifies a high risk for the development of PI (8, 11). The risk level is determined based on the total score as follows: scores of 19 – 23 signifies no risk, 15 – 18 indicate mild risk, 13 – 14 suggest moderate risk, 10 – 12 signifies high risk, and scores below 9 indicate very high risk (11, 12).

The Braden Scale, a widely used tool is well-validated for assessing the risk of developing PI. Research consistently shows its accuracy in predicting the development of PIs in at-risk

individuals (10, 105, 106). Many studies have analyzed the ability of the Braden Scale to predict the risk of developing PIs and showed satisfactory sensitivity and specificity values at different cut-off points that range between 11 and 17 (95, 186). The diagnosing accuracy is also demonstrated with varying area under curve (AUC) values ranging from 0.6 to 0.9 that indicate poor to excellent accuracy (108, 110, 187). Experts recommend using both the Braden Scale score and nursing clinical judgment together as part of a comprehensive prevention program (12).

The 2019 International PI Prevention (IPIP) Guidelines lay out clear steps on how to plan and put effective prevention strategies in pressure injuries prevention (4). Regular risk assessment and proper documentation really makes a difference when it comes to prevent the risk of PIs. Accurately identifying who are at-risk matters; these are the people who need the most attention, just like the latest IPIP guideline points out (4, 11). In Ethiopia, there is a real gap: there are not enough specific guidelines focusing on preventing PIs, and using the Braden Scale for PIs risk assessment is not common practice.

This study set out to find out how often the PIs happen among hospitalized adult. The secondary objective looks what risk factors play a role on PIs occurrence and how well the Braden Scale works for predicting who might develop in three selected hospitals in Addis Ababa. The overarching idea of the study is to encourage nurses to use the Braden Scale for PI risk assessment, determining who is in danger, and then focus on the right prevention steps.

METHODS

Study Design, Setting, and Population

A prospective study design with convenient sampling technique was employed in three public hospitals located in Addis Ababa, Ethiopia. All three were teaching and referral hospitals and had similar specific units/ wards where higher-risk patients for PI development were admitted. Participant selection took place in specific units within February to April 2021, patients admitted to ICU, orthopedic, internal medicine, general surgery, and neurology units were included in the study. Patients admitted within 24 hours who were 18 years or older with a total Braden Scale score of 18 or less were included in the study. Patients with existing pressure injuries or other skin lesions or scars at the time of admission, or those discharged (due to transfer or deceased) before day five were excluded from study participation.

Sample Size and Sampling Methods

The sample size was calculated using a single population proportion. Using the prevalence rate of PI = 17%, power = 80%, with a 95% confidence interval and precision value = 5%, and add 10% non-response. The final calculated total sample size of 238 was proportionally allotted for each hospital based on the total number of beds. Ninety-four patients were selected from Tikur Anbessa Specialty Hospital (TASH), 88 from St. Paul's Hospital Millennium Medical College (SPHMMC), and 56 patients from Minelik-II Referral Hospital. Before data collection, the eligibility of the participants was determined by assessing their risk using the Braden Scale. We included patients who were at mild to high risk for PI development.

Data Collection

Data collectors were nurses with BSN or MSN qualifications and patient care experience. Eight nurses were enrolled for the data collection. Before the data collection, they received training about the PI and the Braden Scale including exercises of the Braden Scale scoring, skin assessment for signs of PIs, and staging of PI. The principal investigator held a training session for one day at each hospital before data collection. The training was delivered through oral presentations and practical patient assessments including PI risk and skin condition assessments. The principal investigator supervised the data collectors while performing patient assessments in the hospital.

Measures

A structured questionnaire was utilized for data collection. The questionnaire had three sections: the patient's demographic and clinical characteristics, a Braden Scale checklist, and a skin assessment checklist (128). The socio-demographic characteristics encompassed age (in years), sex, body mass index (BMI), blood pressure (in mmHg), body temperature (in degrees Celsius), unit/ward where admitted, and current medical diagnosis and reasons for admission.

The Braden Scale checklist was adopted from the original authors Braden and Bergstrom (128). The checklist consists of six sub-scales. Each sub-scale was rated with a 4-point Likert scale, except friction/shear rated with 3 points. The total sum score of the checklist was ranged from 6 to 23 points.

The skin assessment checklist was adopted from the National/European Pressure Ulcer Advisory Panel (NPUAP/EPUAP) guidelines (4). It includes an examination for the presence of PIs with yes/no response, documentation of the number of PIs, their specific location, stage, and date of

assessment. The grading of PIs was performed based on the NPUAP/EPUAP. Six stages of PI classification system, which includes: Stage-I (intact skin with non-bleachable redness or colour different from the surrounding), Stage-II (partial thickness skin loss with intact or ruptured blister presenting as red wound bed), Stage-III (full-thickness skin loss with visible subcutaneous layer), Stage-IV (full-thickness tissue loss), Unstageable (intact epidermis but affected area appears with purple or blood-filled blister over dark wound bed), and suspected deep tissue injury (sDTI) (full thickness skin and tissue injury, but the depth of the ulcer is obscured by necrotic tissue).

The information was collected by nurses who were not part of the hospital staff being studied. The data collectors conducted patient examinations within 24 hours of admission. Then, they continued reassessments every other day until the patient developed a PI or left the unit after a two-week stay. The data collector also initially assessed the patient eligibility status of a score of 18 or below using the Braden Scale.

Ethical Approval and Consent to Participants

Ethical approval was obtained from several relevant authorities, including the IRB of the College of Health Science and Saint Paul's Hospital Millennium Medical College, as well as Addis Ababa city Health Office, with specified Protocol and reference numbers: No. 040/20/Nursing, Ref. No. pm23/27 and Ref. No. A/A/A 281/227, respectively. The study stresses adherence to established guidelines, such as the Declaration of Helsinki. All participants or their relatives were adequately informed regarding the purpose of study and then consent was obtained verbally, by which indicating a commitment to ethical standards in research practices.

Data Management and Analysis

After data collection the data were checked, coded, and entered into Epi-data, version 4.6 software, and exported to SPSS, version 26.0, for analysis. Frequency, percentage, mean, and standard deviation (SD) or median of different variables were calculated to describe and summarize the demographic and health-related characteristics of the participants. Pearson Chi-Square test and student t-test were performed to compare the significant predictor variables in pressure injury development. Binary logistic regression analyses were calculated to examine the relationship between the factors and the development of PIs. The statistical significance of the predictor variables value of .05 was used at a 95% confidence interval (CI). A ROC analysis was performed to determine the Braden Scale's predictive ability. Using the AUC, sensitivity, and

specificity test values determined the diagnostic accuracy of the tests. The value for AUC can range from 0 to 1. A test value of 0.5 or less indicates (no discrimination), 0.6 - 0.7 (poor discrimination), 0.7 – 0.8 (acceptable discrimination), 0.8 – 0.9 (excellent discrimination), and 1.0 (perfect discrimination) (188-190).

RESULTS

A total of 238 patients were assessed, of which 229 patients completed questionnaire with response rate of 96.2%. Participants' demographic and clinical characteristics, at admission 229 patients had no PI. More than half of the samples 59.8% (137) were male, with age ranging from 18-98 years. The median age was 39.0 years. The majority, 110 (48.03%) were admitted to the ICU, and the mean body-mass index (BMI) was $21.52 \pm 3.58 \text{ Kg/m}^2$. All cases were evaluated for the risk of PI development using the Braden Scale score. The mean (SD) of the total Braden Scale score was 13.2 ± 2.95 points, indicating a moderate risk for PI development. The sensory perception sub-scale had the highest average score (3.07 ± 1.04), while the degree of activity and friction/shear sub-scales had lower scores of 1.59 ± 0.754 and 1.62 ± 0.68 , respectively. Detailed data description is presented in Table 13. Among the admitted patients, 64 (27.9%) were diagnosed with traumatic injury, and 59 (25.8%) of them had multiple disease diagnoses. Details are depicted in [Figure 4](#).

Table 13: Demographic and Clinical characteristics of participants admitted to selected public hospitals in Addis Ababa, Ethiopia, from February to April 2021 (n = 229)

Variables	Total	Frequency (n, %) Mean $\pm$ SD		Statistics X ² /t-test	P value
		No PI	PI		
Gender				X ² (1)= .001	.977
- Male	137 (59.8 %)	107 (46.7%)	30 (13.1%)		
- Female	92 (40.2 %)	72 (31.4%)	20 (8.7%)		
Age in years	42.14 $\pm$ 17.01	40.91 $\pm$ 16.64	46.56 $\pm$ 17.75	t (227) = -2.092	.038*
Body mass index (in Kg/M ²)	21.52 $\pm$ 3.58	21.57 $\pm$ 3.54	21.35 $\pm$ 3.75	t (227) = .387	.699
Systolic Blood pressure in mmHg	118.07 $\pm$ 19.75	117.49 $\pm$ 19.40	120.19 $\pm$ 20.99	t (227) = -.846	.398
Diastolic Blood pressure in mmHg	73.76 $\pm$ 12.19	73.50 $\pm$ 11.83	74.66 $\pm$ 13.80	t (227) = -.593	.554
Body temperature in °C	36.70 $\pm$ 0.87	36.59 $\pm$.75	37.07 $\pm$ 1.13	t (227) = -3.474	.001**
Total Braden Scales score	13.20 $\pm$ 2.95	13.59 $\pm$ 2.93	11.80 $\pm$ 2.58	t (227) = 3.911	<.001**
Braden sub-scales					
- Sensory perception	3.07 $\pm$ 1.04	3.15 $\pm$ 1.001	2.80 $\pm$ 1.125	t(227) = 1.964	.037*
- Skin Moisture	2.75 $\pm$ 0.728	1.66 $\pm$.712	1.32 $\pm$.760	t(227) = 2.038	.037*
- Activity	1.59 $\pm$ 0.754	2.80 $\pm$.780	2.56 $\pm$.587	t(227) = 3.345	.005*
- Mobility	2.004 $\pm$ 0.814	2.07 $\pm$.814	1.76 $\pm$.771	t(227) = 2.504	.016*
- Nutrition	2.19 $\pm$ 0.74	2.25 $\pm$.725	1.96 $\pm$.755	t(227) = 2.489	.016*
- Friction and shear	1.62 $\pm$ 0.68	1.68 $\pm$.675	1.40 $\pm$.639	t(227) = 2.666	.010*
PI risk category				X ² (3) = 19.917	< .001*
- Very high risk	32 (14.0 %)	19 (8.3%)	13 (5.7%)		
- High risk	54 (23.6 %)	41 (17.9%)	13 (5.7%)		
- Moderate risk	49 (21.4 %)	33 (14.4%)	16 (7.0%)		
- Low risk	94 (41.0 %)	86 (37.6%)	8 (3.5%)		
Admission ward				X ² (4) = 4.95	.292
- ICU	110 (48.03 %)	82 (35.8%)	28 (12.2%)		
- Medical	44 (19.2%)	34 (14.8%)	10 (4.5%)		
- Orthopedic	35 (15.3%)	27 (11.8%)	8 (3.5%)		
- Neurology	30 (13.1%)	28 (12.2%)	2 (0.9%)		
- Surgical	10 (4.4%)	8 (3.5%)	2 (0.9%)		
Number of diseases				X ² (1) = 2.268	.145
- Single disease	170 (74.2 %)	137 (59.8%)	33 (14.4%)		
- Multiple diseases	59 (25.8 %)	42 (18.3%)	17 (7.4%)		

Footnote: (**) refers correlation is significant at the .01 level, (*) correlation is significant at .05 levels

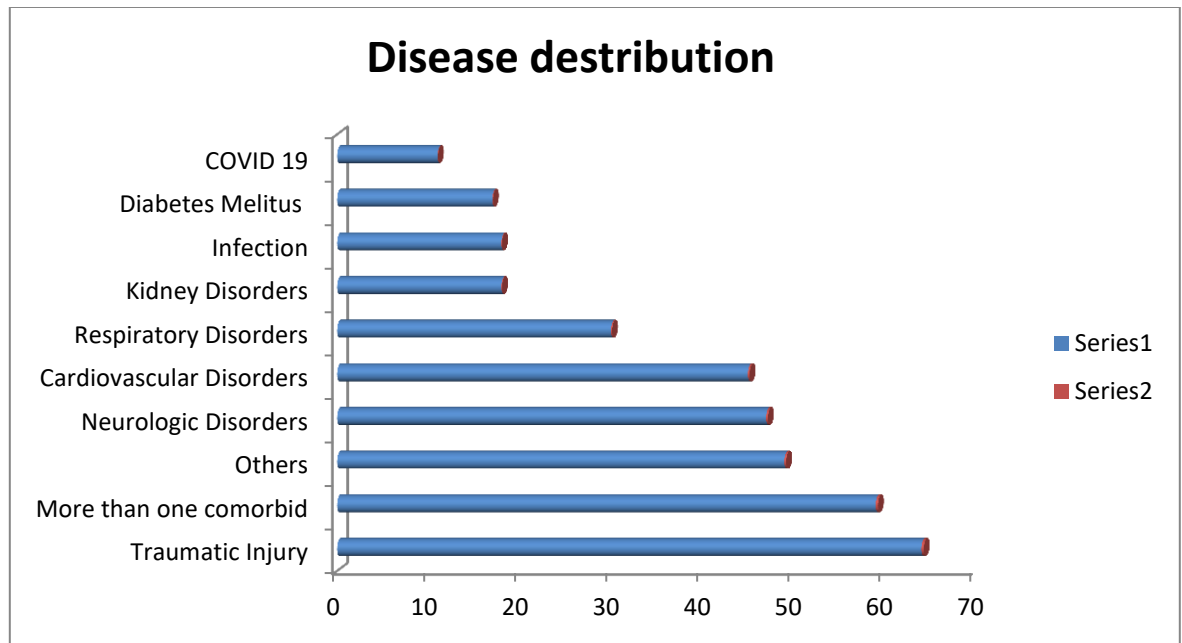


Figure 4 Graphic presentation of the distribution of disease diagnosis among the study participants admitted to three public hospitals in Addis Ababa, Ethiopia, from February to April 2021(n= 229)

Among the admitted patients, 50 (21.8%) developed a new PI at various sites after hospital admission, and of them, 30/50 (60%) were male. Most of the PIs 48/52 (92.3%) was classified as stages I and II, primarily located in the sacral area. The incidence of PIs varied considerably among the three hospitals: TASH had 28 cases (12.2%), while SPHMMC and Minelik II Referral Hospital each reported 11 cases (4.8%). This difference was statistically significant ($\chi^2 = 7.616$, $p = .022$). The PI development began after the 2nd day of admission. The larger number of PIs was recorded within ten days; details are shown in Table 14.

Table 14 The Pressure Injury among Participants admitted to selected public hospitals in Addis Ababa, Ethiopia, from February to April 2021(n =229)

Variable	Frequency (percentage)
Pressure injury (n = 229)	
- No	179 (78.2%)
- Yes	50 (21.8%)
PI cases among three Hospitals	
- TASH	28 (12.2%)
- SPHMMC	11 (4.8%)
- Minelik II Referral Hospital	11 (4.8%)
Location of PI (n=52)	
- Sacral area	28 (53.8%)
- Hip	14 (26.9%)
- Shoulder	5 (9.6%)
- Elbow	2 (3.8%)
- Heel & ankle	2 (3.8%)
- Ear	1 (1.9%)
Stages of the PI (n = 52)	
- Stage-I and II	48 (92.3 %)
- Stage-III	2 (3.85 %)
- Stage-IV and sDTI	0 (0.0 %)
- Unstageable	2 (3.85 %)
The onset of Pressure Injury in days (mean $\pm$ SD)	10.52 $\pm$ 2.62

Significant associations were observed between PI development and demographic and clinical characteristics such as age, body temperature, and Braden Scale score. These variables also showed significance in multiple binary logistic regression analysis, as age increased by one year, the odds of developing a PI increased by 2%, $p = .030$. For every one-degree Celsius ($^{\circ}\text{C}$) increase in body temperature, the likelihood of developing a PI increases by 2.27 times. Conversely, a one-point increase in the Braden Scale score is associated with a 24.5% decrease in the likelihood of PI development. Based on the PI risk categories, the risk of PI development was found to be more likely in the very high-risk category with $p < .001$ as shown in [Table 15](#).

Table 15 Statistically significant predictor variables on PI development among patients admitted to selected public hospitals in Addis Ababa, Ethiopia, February to April 2021(n =229)

Independent Variable	Dependent Variable		COR	AOR	P value	95% CI	
	No PI (n)	PI (n)				lower	upper
Age in years (mean±SD)	40.91±17.75	46.56 ±16.63	1.019	1.021	.030*	1.002	1.041
Body temp. in °C (mean±SD)	36.599±.752	37.072±1.138	1.823	2.270	≤.001**	1.537	3.351
Braden Scale score (Mean±SD)	13.59±2.937	11.80±2.587	0.813	0.755	≤.001**	.728	.908
PI risk category							
• Very High risk	86	8	7.355	11.274	≤.001**	3.773	33.685
• High risk	41	13	3.409	3.767	.009**	1.384	10.255
• Moderate risk	33	16	5.212	6.484	≤.001**	2.389	17.602
• Low risk	19	13	1	1	1		

Receiver operating characteristics (ROC) analysis: The ability of the Braden Scale to identify PI development was determined using the ROC analysis. The optimal cut-off point for the best balance of sensitivity and specificity was 13.5, providing 64% and 59.2%, respectively. The area under the curve (AUC) was calculated as 0.682 with a 95% CI (0.611, 0.761), $p < .001$. The AUC - ROC curve provides a measure of the test's overall ability to discriminate between true positive and true negative cases. A graphic illustration of the ROC curve with the plot of sensitivity versus 1-specificity (FPR) at various cut-off points is presented in [Figure 5](#).

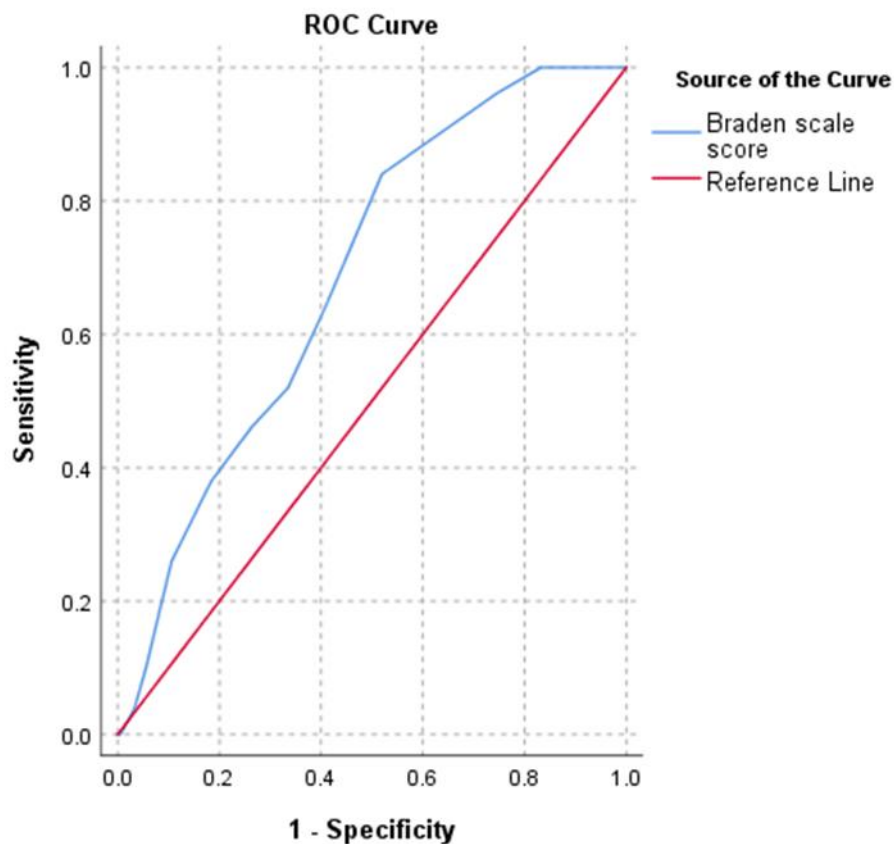


Figure 5 Illustration of the AUC-ROC curve of the Braden Scale with pressure injury development. ROC curve plots the true positive rate (sensitivity) against the false positive rate (1 - specificity) at various thresholds.

Strength and Limitations

This pioneering Ethiopian study assessed the Braden Scale's effectiveness in predicting pressure injuries development. Strengths included a prospective design, timely patient evaluation, uses adequate sample size, and multiple hospitals. The scale identified PIs in diverse patients, especially those with longer hospital stays. Limitations of the study included restriction to urban tertiary care centers, brief training, lack of inter-rater reliability assessment, and omission of hospital-specific factors, potentially compromising accuracy and generalizability.

DISCUSSION

Hospitalized patients who develop PIs are at risk for poor health outcomes; often reflect the quality of care provided. Preventing PIs is a top priority among critically ill patients, and one way to do so is by identifying individuals who are at risk using validated risk assessment tools like the Braden Scale. The study results indicated that the Braden Scale showed poor ability to discriminate the PI development, as $AUC = .686$, with 64% sensitivity and 59.2% specificity. In addition, more than 21 % of the newly admitted patients developed PIs, the majority was classified as stage I and II. The average total Braden Scale score suggested a moderate risk for PI development among the study sample. Additionally, in the binary logistic regression analysis, our study found that age and body temperature had a statistically significant relationship with PI development.

Contrary to our findings, several studies have indicated that the Braden Scale effectively predicts the occurrence of PIs at different threshold levels (108, 109, 191-193). For example, a retrospective cohort study conducted in an ICU in the US demonstrated satisfactory performance of the Braden Scale in predicting PI development, with an AUC of 0.737(187). Another study carried out among acutely ill veterans in the US found that the Braden Scale had moderate accuracy in predicting PI development, with sensitivity, specificity, and AUC values of 65%, 70%, and 0.70, respectively (108). Numerous meta-analysis studies conducted in different settings (ICU, long-term care facility, nursing home) also showed moderate predictive accuracy of the Braden Scale, with the summary ROC-AUC values ranging from 0.7 to .84 (191-193). However, it is important to note that while our study found similar results, studies also reported inadequate accuracy of the Braden Scale in predicting PI development with the value of AUC falling on .672 and .648 at optimal cut-off points 13 and 16, in several hospitals (194, 195). This discrepancy may be due to differences in the study areas and the participants' demographic and clinical characteristics as the risk assessment tool is more appropriate for geriatric and ICU-admitted patients.

The current study identified a PI incidence rate of approximately 22% among critically ill hospitalized patients. In contrast to our findings, prior studies reported higher rates of HAPI (28, 196-198). Other studies reported rates lower than ours, and additional investigations similarly noted reduced rates of HAPI (24, 86, 179, 187, 194, 199). Notably, majority of studies, including the current one, found that HAPIs occur within an average of 10 days, with the days ranging

from 2nd to 13th, regardless of prevention intervention (28, 86, 200). A notable exception was a single study that reported a shorter onset period of 6 and 8 hours (199), which is consistent with a systematic review examining various studies (201). However, this shorter time is inconsistent with our findings. These variations highlight the need for further research to understand the additional factors contributing to varying the PI's incidence time, thereby help to formulate more effective prevention strategies.

In addition to the Braden Scale factors, numerous risk factors played a role in developing PI among hospitalized patients. In this study, predictor factors such as gender, BMI, age, body temperature, blood pressure, and comorbid illnesses were evaluated to examine their significance in predicting the development of PI. However, only age and body temperature were found being significant predictors, which are intrinsic factors contributing to decreased tissue tolerance as suggested by Braden and Bergstrom (185). On the contrary, studies have documented numerous risk factors for PI development (20, 202). These include advanced age, high BMI, elevated lactate, use of vasopressors and antifungals medicine, male gender, diabetes, isolation, and placed on prolonged ventilation (187, 200). In addition, the use of vasopressor drugs, low blood pressure, and an extended stay in ICU have also been significantly associated with the development of PI (28). The study found only age and body temperature as significant predictors, whereas other studies have found numerous other contributors. This difference arises from variations in study design and methods and the range of variables investigated, highlights further research is needed.

The current study did not find a statistically significant association between PI development and BMI. However, prior studies had identified low BMI as significant predictors for PI development (20, 203). It is important to note that the variation in findings may arise from differences in study methods, particularly study population. Further research using similar instruments may assist in obtaining better insights into these risk factors.

Conclusion and Recommendation

The study has found out an incidence of hospital acquired pressure injuries (HAPIs) with the rate of 21.8%, suggesting the critical need for improved patient care and health outcomes in healthcare settings. An average of 13.2 scores has been produced with the Braden Scale, indicating many patients are at moderate risk for developing pressure injuries. Age and body temperature emerged as significant predictors of PI risk, highlighting these factors may need

monitoring along with PI prevention practices. However, in this study, the Braden Scale's showed limited ability to distinguish risk patients for developing PIs. This suggests that, the Braden Model may not be sufficient on its own for effective risk assessment.

Therefore, further research involving larger sample sizes focus on specific hospital units to generate more precise data is essential. Additionally, testing inter-rater reliability will be crucial for ensuring consistent application of the Braden Scale among various nurses. Overall, these steps are vital for enhancing PI risk assessment effectiveness and ultimately reducing the incidence of hospital-acquired pressure injuries.

Chapter 5: Integrative Summary

Pressure injury (PI) remains a widespread health challenge within healthcare settings. These injuries cause severe complications for hospitalized patients, particularly affecting those who are critically ill and highly dependent on care (44). Globally, the prevalence of PIs is approximately 12.8%, underscoring the significance of this health issue (84). The highest prevalence rates are observed in low-to-middle-income countries, reaching up to 31.3% (56), reports from Ethiopia shown that rates of 15% and 17% (29, 39). The 2019 International Pressure Injury Prevention (IPIP) Guidelines provide comprehensive recommendations for planning and effective prevention strategies implementation, which many countries have adopted it. With this approach the initial step in PI prevention involves risk assessment using evidence-based tools. Over the past two decades, guidelines for pressure injury prevention have been developed and promoted widely; however, adherence remains suboptimal. Proper use of PI risk assessment tools enables healthcare providers to identify at-risk patients accurately and apply suitable prevention procedures. Nonetheless, in Nigeria, several factors hinder nurses from utilizing these assessment tools effectively. These include lack of formal training on risk assessment scales, absence of institutional policies, unavailability of assessment forms, and negative attitudes toward their use (63). A study in a specific region of Ethiopia found that approximately 91.5% of nurses had inadequate knowledge of pressure injury prevention, primarily due to insufficient training (60). Similarly, other research indicates that Ethiopian nurses often demonstrate inadequate knowledge and poor practices regarding PI prevention strategies (59).

According to the international pressure injury prevention (IPIP) guidelines, an evidence-based PI risk assessment tool is essential as the first step in prevention strategies. However, in Ethiopia, there is a lack of specific guidelines addressing PI prevention through risk assessment tools. This study aims to provide practical evidence on the feasibility and predictive accuracy of the Braden Scale. The specific aim of the study includes:

Aim1: Compare Knowledge and Attitudes toward the Braden Scale using for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention

Aim2: Apply the Theory of Planned Behavior to Predict Nurses' Intention and Willingness to use the Braden Scale in Pressure Injury Risk Assessment in Public Hospitals, Addis Ababa, Ethiopia.

Aim3: Evaluate Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia

The study primarily aimed at assessing the feasibility and predictive accuracy of the Braden Scale for the PI risk assessment among nursing staff in three selected Public Hospitals, Addis Ababa, Ethiopia. To achieve this, the researcher employed multiple study designs: quasi-experimental, cross-sectional, and prospective study designs. The quasi-experimental and cross-sectional approaches were used to evaluate the feasibility, while prospective study design used to assess the scale's predictive capability for diagnosing PI risk. Specifically, the quasi-experimental component involved comparing nurses' knowledge and attitudes toward the Braden Scale before and after educational intervention. While the cross-sectional study applies TPB to identify the key predictors influencing nurses' intention and acceptance to use the scale for PI risk assessment. The prospective study evaluated how well the Braden Scale predicts for PI development in hospitalized patient.

The study findings showed that nurses' knowledge and attitude toward the Braden Scale improved following educational intervention. While the analysis of application of TPB provided valuable insights into the key factors influencing nurses' intention and willingness to adopt the Braden Scale. However, the scale predictive accuracy, findings indicated that its ability to distinguish at-risk patients for developing PIs was limited.

Within this study, the feasibility was examined through comparing their knowledge and attitude before and after educational intervention, and exploring the primary behavioral predictors of intention and acceptance of the Braden Scale use by applying the TPB framework. Knowledge, attitude, intention, and acceptance were considered as critical factors to influence feasibility. The research involves assessing nurses' awareness of the Braden Scale prior to and following an educational program that delivered through three methods: printed materials, oral presentations, and a combination of both. Its ultimate goal was identifying the most cost-effective and suitable practical approaches for resource-limited settings, like Ethiopia. Initial findings revealed that nearly two-thirds of the participants were unaware of the Braden Scale. After education intervention, nurses showed significant improvement on knowledge and more positive attitude towards Braden Scale. Although scores for knowledge and attitude increased from pre-to post-test, but no significant differences observed on the methods of delivery. The demographic factors also did not influence nurses' knowledge and attitude scores.

This research also employed TPB framework to predict nurses' intention and acceptance of the Braden Scale for PI risk assessment. Results identified three key predictors significantly influence nurses' intention: subjective norm (social influence), attitude and perceived behavioral control (PBC). Subjective norm emerged to be the strongest predictor here, which indicates that social influences and peer pressure matters a lot when it comes to shaping behavior. Consequently, if more nurses are needed to adopt the scale, focus on using social network and peer supports rather than targeting on changing attitude and boosting perceived controls. Both intention and PBC also strongly predicted whether nurses would accept the scale, but the intention was the main driver. In other words, nurses who actually motivated to use the Braden Scale are more likely to accept and use the scale in their practice. Confidence matters, too when nurses feel sure about their knowledge and skills, they are more likely to get on board to use the scale. All this points to one thing: intervention should focus on building motivation and showing how effective the scale can be. To promote a widespread adoption of the scale use among nurses, provide comprehensive training, adequate resources, and supportive environment, by which can avoid the perceived barriers as well.

In this study the social norms were measured by subjective norms, and found as the influential factor in predicting nurses' intention for Braden Scale adoption, emphasizing the importance of social pressure and peer influence. Interventions aiming to increase the scale use should therefore, focus on leveraging social networks and peer supports. Furthermore, both behavioral intention and PBC significantly predicted the nurses' actual scale adoption, with the intention demonstrating the greatest predictive power. This suggests that nurses' motivation and willingness to use the scale are crucial for its successful implementation.

The TPB also posits that socio-demographic variables can influence individual's attitudes, which subsequently exert an indirect effect on their intentions toward the behaviors. In the current study, various potential predictors including age, gender, marital status, educational level, work experience, special training, work load, and access of reading material or internet were assessed. Among these, only marital status and access to reading material or internet emerged as statistically significant predictors of the nurses' attitudes. Specifically, being unmarried was associated with a decline in attitude scores, whereas having access to reading resources or the internet was correlated with a significant increase in positive attitudes. These findings suggest that single nurses tend to exhibit less favorable attitudes towards utilizing the Braden Scales for

PI risk assessment, while having access to informational resources fosters a more positive outlook.

The prospective study evaluated how well the Braden Scale predicts the PI development in hospitalized patient. Our findings indicate a significant incidence rate of hospital-acquired pressure injuries, approximately 22%, highlighting a significant concern for patient safety and required improved prevention care for enhanced nursing care practices within healthcare settings. The Braden Scale score resulted in a mean score of 13.2 suggesting that substantial proportion of patients are classified at moderate risk for PI development.

Evaluating the scale's effectiveness within a specific context is essential to determine its feasibility in practice. Literature indicates that the discriminative ability of the Braden Scale is varying on certain cut-off scores. Discriminative accuracy of the scale was reflected with different value of Area under the curve (AUC), varying between 0.6 and 0.9, showing the accuracy from poor to excellent (108, 110). For instance, in long-term care facilities, the Braden Scale demonstrated strong discrimination, with AUC-ROC values of 0.81 and 0.79, with cut-off scores of 17 and 18, respectively (51). In this study the Braden Scale had shown an AUC of 0.686, which indicates a limited accuracy to distinguish patients who would or would not develop pressure injuries. Keep in mind that having low accuracy in this situation does not necessarily mean the tool is useless. Instead, it shows that further research is needed, especially after addressing the study's limitations.

Implications

This study's findings have significant implications on different stakeholders: future nursing practices, healthcare policy makers, care managers, and researchers.

For Future Nursing Practice

- The implementation of educational interventions results in an improvement in nurses' knowledge and attitudes. This underscore the importance of continuous in-service training, with particular focus on the assessment of PI risk using the Braden Scale, as essential approach for enhancing nurses' understanding of its prevention and ultimately contributing to better patient outcomes.
- To preserve and enhance nurses' positive attitudes, which directly influence their intentions and readiness to engage in the Braden Scale implementation, is

recommended that the institution should expand internet accessibility and provide adequate reading materials. Furthermore, providing psychological support for single nurses may serve to improve their attitudes toward the adoption of evidence-based risk assessment tools.

- The study findings indicated that three predictors (subjective norm, PBC and attitude) significantly influence nurses' intention to use the Braden Scale. These highlights that interventions should focus to help nurses build strong social support network, increase their motivation, and reduce any perceived obstacles, through comprehensive training, sufficient resources, and supportive work environments. With this way, nurses can be encouraged to perform at their best level.
- Perceived usefulness and relevance of the Braden Scale in PI prevention are crucial factors in influencing nurses' acceptance and their consistent use. While our study found that the Braden Scale has limited ability, this may be due to certain limitations with this study. However, by addressing these constraints, can improve the scale's usefulness.

For Guideline/ Policy Makers

- To ensure effective prevention practices health institutions should consider adopting international pressure injury prevention guidelines, including the Braden Scale use.

For Care Managers

- Healthcare manager should advocate for the effective use of Braden Scale in PI risk assessment, with the aim of appropriate prevention intervention, ultimately decreasing the occurrence of HAPIs.
- Nurse experts should also consider integrating the Braden Scale scoring for PI risk assessment into the nursing process format as a unified entity.

For Future research

- As all educational delivery methods were equally effective, indicating that further research is required to identify the most cost-effective one suitable in resource limited countries such as Ethiopia.

- Future study such as, an implementation science study to explore and overcome organizational factors affecting adoption of the Braden Scale and could explore additional determinants such as, external influences or organizational support that may contribute to enhance adoption of the Braden Scale use in nursing practice.
- Moreover, examining the applicability of the TPB framework across various healthcare settings would offer a more comprehensive understanding of the factors affecting the Braden Scale implementation within the Ethiopian healthcare system.
- Future study, with larger sample sizes and unit-specific study are necessary to validate the accuracy of the Braden Scale in predicting PI risk.
- In addition, conducting an inter-rater reliability testing study is important to ensure that the Braden Scale is used consistently and reliably by different healthcare practitioners.

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Appendix/Annexes

Appendix A: Confirmation Certificate for Submitted Proposal



ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES

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**Institutional Review Board
(IRB)**

Date of submission 17/05/2020

**CONFIRMATION
CERTIFICATE FOR YOUR
SUBMITTED PROTOCOL**

PI: - Emebet Berhane Woldemariam
Protocol Number:-040/20/Nursing

**Title:- Testing Feasibility and Predictability of the Braden scale using
for Pressure Injury Risk Assessment by Nurses in Government
Owned Hospitals, Addis Ababa, Ethiopia**

Dear PI

THANK YOU for submitting your protocol for Addis Ababa University
College of Health Science IRB office

Betselot Yirsaw
Secretariat officer,



P.O.BOX 9086
Addis Ababa, Ethiopia

Tele: +251 118961396
E-Mail:-chs.irb@aaau.edu.et

Appendix B: Certificate of IRB's Approval of the study
Approval from CHS-AAU IRB



ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES (IRB)
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Institutional Review Board

ANNEX 3
Form AAUMF 03-008

Meeting No: 05/2020
Protocol number: 040/20/Nursing

IRB's Decision

Meeting Date: May 28, 2020

Protocol Title: Testing Feasibility and Predictability of the Braden scale using for Pressure Injury Risk Assessment by Nurses in Government Owned Hospitals, Addis Ababa, Ethiopia	
Principal Investigator:	Emebet Berhane
Institute:	College of Health Sciences, AAU
Elements Reviewed (AAUMF 01-008)	☒ Attached ☐ Not attached
Review of Revised Application ☐ Yes ☐ No	Date of Previous review:
Decision of the meeting:	☒ Approved ☐ Approved with Recommendation ☐ Resubmission ☐ Disapproved

- I. Elements approved-
1. Protocol Version No: 2
 2. Protocol Version Date:
 3. Informed consent Version No.2
 4. Informed Consent Version Date:

II. Obligations of the PI-

1. Should comply with the standard international & national scientific and ethical guidelines
2. All amendments and changes made in protocol and consent form needs IRB approval
3. The PI should report SAE within 10 days of the event
4. End of the study, including manuscripts and thesis works should be reported to the IRB
5. The PI should report non-compliance and unanticipated events

III. TO NERC ☐

Institution Review Board (IRB) Approval: Period from: June 19, 2020 to June 18, 2021

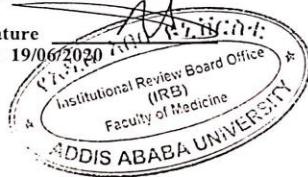
Follow up report expected in

3 Months _____ 6 months _____ 9 months ☒ one year _____

Chairperson, IRB
Dr. Adamu Addissie

Signature

Date: 19/06/2020



Approval from SPHMMC IRB

Ref. No. PM 22/27

Date: 14/7/2020

Institutional Review Board (IRB) of St. Paul's Hospital Millennium Medical College (SPHMMC)
Ethical Clearance

Research Title: - Testing feasibility and predictability of the Braden scale using for pressure injury risk assessment by nurses in government owned Hospital, Addis Ababa, Ethiopia

Principal Investigator: - Emebet Berhane Wodemariam

The IRB of SPHMMC has reviewed the above mentioned research proposal and made the following decision:

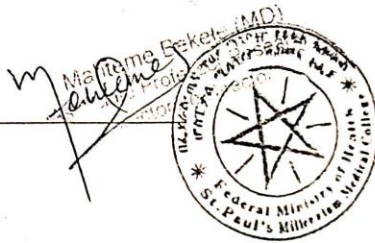
- Approved:- ☒
- Approved with recommendation:- ☐
- Approved on condition :- ☐
- Disapproved:- ☐

The decision is valid for 12 months and the research should be conducted in compliance with the protocol/proposal approved by the IRB of SPHMMC. Any subsequent revision/amendment of the protocol/proposal needs approval before conduct of the research. The researcher should also submit written summaries of the research status to the IRB every 03 months. Upon the conclusion of the study, manuscripts and thesis work to the final/completed research project needs to be submitted to the IRB.

IRB Chair:

Signature: _____

Date: July 10, 2020



Cc:

- Vice Provost for Academic and Research
- IRB

→ Emebet Berhane Wodemariam

SPHMMC

Approval from the Addis Ababa City Government Health Bureau IRB



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City Government of Addis Ababa Health Bureau

Ref.No. A/4/4/28/227

Date 15/11/2017

TO:

- MINILIK II REFERRAL HOSPITAL
Addis Ababa

Subject: Request to access Facilities to conduct approved research

The letter is to support Emebet Berhane Woldemariam "Testing Feasibility and Predictability of the Braden scale using for Pressure Injury Risk Assessment by Nurses in Government Owned Hospitals, Addis Ababa, Ethiopia" The study proposal was duly reviewed and approved by Addis Ababa Health Bureau IRB, and the principal investigator is informed with a copy of this letter to report any changes in the study procedures and submit an activity progress report to the Ethical Committee as required. Therefore we request the facility and staffs to provide support to the principal investigator.



With Regards

Ethical Clearance Committee

Cc

- Emebet Berhane Woldemariam
- To Ethical Clearance Committee

ዶ/ር ዮሐንስ ወ/ኪዳን
የህብረተሰብ ጤና ፖርቶል
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Appendix C: Participants' information sheet and consent form

Information sheet and consent form for objective 1 and 2

Addis Ababa University, College of Health Science, School of Nursing and Midwifery

Information sheet for participant (Clinical nurse):

Dear participant

Greeting!

My name is _____ I am a member of the research team, as data collector for the study that will be conducted to assess the pre-post knowledge, attitude, acceptability and feasibility of using the Braden scale for PI risk assessment among clinical nurses after an educational program, in selected government run hospitals, Addis Ababa, Ethiopia. The study is part of a PhD research requirement conducted by Sr. Emebet Berhane Woldemariam, studying her PhD in Addis Ababa University, College of Health Science, School of Nursing and Midwife, in collaboration with Emory University, Nell Hodgson Woodruff School of Nursing. The study contains self-administered questionnaires to explore necessary information about above mentioned issues. Thus, you are invited to take part in this study by giving genuine responses for all structured questions. Your cooperation and willingness is greatly appreciated and helpful in achieving the aim of the research.

Purpose of the study

The purpose of the study is to identify the feasibility of the Braden scale using in pressure injury risk assessment by examining the nurses' knowledge, attitude, intention, acceptability and feasibility before and after the education intervention programs.

Benefits of the study

The information that obtained from you will be useful in developing strategies that help to improve nursing care quality. If you are voluntary to participate in the study, you are requested to give your honest response for all questions and return the completed paper within one day, to complete the questionnaire is anticipated to take about 30 minutes but you can end the task any time based on your convenience. However, your honest response for the questions and your interest in continuing participation in the study will help in increasing better understanding of the Braden scale in your work setting and eventually will help in designing and implementing appropriate strategies for initiating PI prevention program using the Braden Scale across Ethiopian hospitals. Moreover, no financial payment will be made for your participation.

Risks and Discomforts

We can make sure participating in this study has no harm or risk of harm, unless taking your precious time; and will be conducted after getting approval from the college IRB.

Participants Right

Your participation is fully voluntary and you are not coerced to answer any questions that you feel uncomfortable. It is also your right to drop participation or skip questions at any point. Your participation or non-participation will not be related with your career.

Confidentiality

I would like to assure you that your name will not be written in this form in connection with any of the information you tell us; the data will not be used for any other analysis apart from this study, and would be kept confidentially with de-identified code.

Contact information

If you have any doubt on the study, you can raise questions at any time point for elaboration. It is also possible to communicate the IRB office or the researchers, when necessary through their telephone addresses.

Addis Ababa University, College of Health Sciences Institutional Review Board contact address:

- IRB office telephone number: +251118961396
- Email: aaumfirb@yahoo.com

Researchers contact address

- Sr. Emebet Berhane via telephone number +251911637761 and
- Dr. Wondwesson Amogne via telephone number +251911406179.

Verbal consent

With due understanding of the abovementioned information, are you willing to participate in this study?

Yes: ☐ (proceed with self-administered questions)

No: ☐ (stop)

Participant's signature _____ Date _____

Code No _____

Data collector's annotation

Name _____ Signature _____ Date _____

Supervisor's remarks _____

Name _____ Signature _____ Date _____

Information sheet and consent form for objective 3

Addis Ababa University, College of Health Science, School of Nursing and Midwifery

Information sheet for participant (Hospitalized patient):

Greeting Dear participant!

My name is _____ I am a member of the research team, as data collector for the study that will be conducted to assess the effectiveness of the Braden scale assessment for PI risk prediction among patients admitted in selected units of government run hospitals, Addis Ababa, Ethiopia. The study is part of a PhD research requirement conducted by

Sr. Emebet Berhane Woldemariam, studying her PhD in Addis Ababa University, College of Health Science, School of Nursing and Midwife, in collaboration with Emory University, Nell Hodgson Woodruff School of Nursing.

Purpose and procedure of the study

The purpose of the study focuses to assess the predictability of Braden scale risk assessment scale for PI development. The study contains Braden scale assessment checklist to determine the level of risk for PI development; and skin assessment checklist for staging the pressure injury. As a patient, you are selected to take part in this study by giving genuine willingness on time of data collection. The data will be gathered by inspecting your general condition using Braden scale and your skin condition using checklists. Your cooperation and willingness are greatly appreciated and helpful in achieving the aim of the research. The information that obtained from you will be helpful for understanding the predictive validity of Braden scale in the proposed study area. Thus, the study itself is part of the treatment care; will be conducted with all necessary precautions such as maintaining privacy. The data collection of skin condition inspection will be conducted while the routine nursing cares are given like bed-bath, bed making and turning position. If you are voluntary to participate in the study, hereby, you are requested to give your willingness to be assessed using Braden scale and skin assessment by the care provider while carrying out their routine nursing care tasks.

Rights and responsibilities

Your participation should be fully voluntary and you are not coerced while you feel uncomfortable with it. You have a right to drop or refuse participation at any point. Either participating or not participating in the study will not affect your overall treatment care.

Benefits

In addition, your honest participation in the study will help in increasing better understanding about the Braden scale in our setting and eventually will help to develop pressure injury prevention protocol using the Braden Scale risk assessment across hospitals, in Ethiopia.

Risks and Compensation

We can make sure participating in this study has no harm or risk of harm. There is no financial payment that will be made for your participation. The data will be collected by inspecting your skin within two weeks in alternate days for at most six days.

Confidentiality

I would like to assure you that your name will not be written in this form and will never be used in connection with any of the information we observed from you, it would be kept confidentially with de-identified code. The data will not be used for any other analysis apart from this study.

Contact information

If you have any doubt on the study, you can raise questions at any time point for elaboration. It is also possible to communicate the IRB office or the researchers, when necessary through their telephone addresses.

Addis Ababa University, College of Health Sciences Institutional Review Board contact address:

- IRB office telephone number: +251118961396

- Email: aaumfirb@yahoo.com

Researchers' contact address

- Sr. Emebet Berhane via telephone number +251911637761 and

- Dr. Wondwesson Amogne via telephone number +251911406179.

Verbal consent

With due understanding of the abovementioned information, are you willing to participate in this study?

Yes: ☐ (please put your signature and proceed with self-administered questions)

No: ☐ (stop)

Data collector's note:

Signature _____ Date _____

Supervisor's remarks:

Signature _____ Date _____

Amharic version Information sheet and consent form for objective 3

የተሳታፊዎች የሚረጃ እና የስምምነት ቅፅ

አዲስ አበባ ዩኒቨርሲቲ ፣ ጤና ሳይንስ ኮሌጅ፣ የነርስ እና የአዋላጅ ት/ቤት

የጥናቱ ሚረጃ

ሠላም!

ወድ ተሳታፊ፣

እኔ ስሜ _____፣ የምርምር ቡድን አባል ስሆን የምሳራውም ለጥናቱ ሚረጃ መሳተፍ ነው፡፡ የጥናቱ ርዕስ በአዲስ አበባ፣ ኢትዮጵያ፣ የመንግስት ሆስፒታሎች ታካሚዎች ለረዥም ጊዜ አልጋ ላይ በመተኛት ለሚፈጠረው ጉዳት መተንበይ የሚረዳ መሣሪያ ወይም የብራደን ስኬል ወጠታማ ት ላይ የሚካሄድ ጥናት ነው፡፡ ጥናቱ በዋናነት በ ሲስተር እማኔት ብርሃኔ ወልደሚያም በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ፣ የነርስ እና የአዋላጅ ት/ቤት ከኤሞሪ ዩኒቨርሲቲ፣ ኔል ሆድግሶን ወድሩፍ ነርንግ ት/ቤት ጋር በመተባበር በሚከተለው የዶክተራት ድግሪ ትምህርት ተመራ ሲሆኑ፤ ይህ ጥናትም የመረጃ ጥናት ፀሐፊ ዝግጅት አካል ነው፡፡

የጥናቱ ዓላማ እና ሂደት

የዚህ ጥናት አብይ ዓላማ ታካሚዎች ለረዥም ጊዜ አልጋ ላይ በመተኛት ለሚፈጠረው የሰውነት ጉዳት ስጋት ለመተንበይ የሚረዳ የብራደን ስኬል መሣሪያ አስተማማኝነት ላይ ጥናት ለመካሄድ ነው፡፡ ጥናቱ የሚካሄደው የብራደን ስኬል መሣሪያ ቅፅ በመጠቀም ይሆናል፤ የቅጹ ይዘት ታካሚዎች ለረዥም ጊዜ አልጋ ላይ በመተኛት ለሚፈጠረው የሰውነት ጉዳት የስጋት ተጋላጭነት ዝርዝር ይያዝ ነው፡፡ ለጥናቱ ስኬታማነት እረሶ እንደ ታካሚ እና የትናቱ አባል ቀና የሆነ ፍቃደኝነትዎን በመገርከት በዚህ ጥናት ላይ አስተማማኝ ሚረጃ እንዲሰጡ እንጠይቃለን፡፡ ሚረጃው የሚከበሰበው የብራደን ስኬል መሣሪያ ቅጽ በመታገዝ እና ጠቅላላ የሰውነት ቆዳዎ ሁኔታም ምልክታ ለማድረግ የሚረዳ መሳተፍ በቅፁ በመጠቀም ለረዥም ጊዜ አልጋ ላይ በመተኛት ለሚፈጠረው ጉዳት የሚከበሰበት ይሆናል፡፡ የእርስዎ ትብብር እና ፈቃደኝነት የዚህ ጥናት ዓላማ

ግብ እንዲመታ ያግዛል፡፡ ከእርስዎ የሚገኘው መረጃ በተመረጡት የጥናት ቦታዎች ላይ የብራደን ስኬል መሣሪያ ጠቀሙ በአግባቡ እንዲታወቅ ይረዳል፡፡ ስለዚህ ጥናቱ በራሱ የሕክምና አካል ነው፤ እናም ለዚህ አስፈላጊ የሆኑት ቅድመ ጥንቃቄዎች በመውሰድ የሚካሄድ ይሆናል፡፡ የቆዳ መረጃ የሚከበሰበው በነርቭ ግንባታ ጊዜ ለምሳሌ አልጋ ውስጥ ገላ በሚታጠብበት ጊዜ፤ አልጋ በሚተካከልበት እና ከተኛበት ጎን ወደ ሌላ ጎን በሚቀየርበት ጊዜ ማለት ነው፡፡ በዚህ ጥናት ላይ ለመሳተፍ ፈቃደኛ ከሆኑ ጥናቱ እስኪያበቃ ድረስ በተደጋጋሚ የቆዳዎን ምልክታ እንድናረግ እንጠይቃለን፡፡

መባቶች እና ሃላፊነቶች

በዚህ ጥናት ለመሳተፍ የእርሶ ፍቃደኝነት ላይ የተመሠረተ ሲሆን በማንኛውም ጊዜ ከተሳትፎ አቋርጠው የመውጣት መባት እንዳሉት ልናረጋግጥሎት እንወዳለን፡፡ በዚህ ጥናት ላይ ቢሳተፉም ባይሳተፉም በመግባት ሕክምና ላይ ምንም ዓይነት ጭንቀት አያሳድርም

ጥቅሞች

በተጨማሪም በዚህ ጥናት ላይ መሳተፍዎ የብራደን ስኬል መሣሪያ የተሻለ አረዳድ እንዲኖር ይረዳል፤ በዛውም በብራደን ስኬል የስጋት መታጠቢያ መከላከያ በመጠቀም ለረዥም ጊዜ አልጋ ላይ በመተኛት ለመፈጠረው የሰውነት ጉዳት የማይከሰት ስርዓት በመዳበር በሁሉም የኢትዮጵያ ሆስፒታሎች እንዲተዋወቅ እንዲሁም እንዲጀመር ይረዳል፡፡

ስጋቶች እና ማካካሻ

በዚህ ጥናት ላይ በመሳተፍዎ ምንም ዓይነት ስጋት የሌለ ሲሆን፤ በመሳተፍዎ ምክንያት የሚገኙትም ምንም ዓይነት ክፍያ የለም፡፡ መረጃው የሚከበሰበው አጠቃላይ የቆዳ ምልክታ በሚካሄድ ሲሆን በሁለት ሳምንት ውስጥ ቢበዛ ለስድስት ጊዜ የሚካሄደው ይሆናል፡፡

ሚኒፕራዊነት

በዚህ ቅፅ ላይ ስምዎት ይሁን እርሶን የሚያገልግል አይገለጽም እንዲሁም የሚከገን ማንኛውም መረጃ በሚኒፕራዊ የሚያዝ ሲሆን፤ ለሚኒፕራዊነቱም በተለየ ማለያ የሚለፅ ይሆናል፡፡ መረጃው ከዚህ ጥናት ውጭ ሌላ ዓላማ ጥቅም ላይ አይውልም፡፡

ጥናቱ የሚሞላበትቸው አካላት አድራሻ

በዚህ ጥናት ላይ ምንም ጥርጣሬ ቢኖርዎ በማንኛውም ጊዜ ማበራረያ ማጠየቅ ይቻላል፡፡ እንዲሁም ተመራማሪውን ወይም የተቋማዊ ግምገማ ቦርድ ጽ/ቤቱን ስልክ በመደወል ማበራረያ ማጠየቅ ይቻላል፡፡

ስለዚህ አዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ፣ የተቋማዊ ግምገማ ቦርድ አድራሻ፡ -

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የቃል ስምምነት መግለጫ

ከላይ የተጠቀሰውን መረጃ በመገንዘብ በዚህ ጥናት ላይ ለመሳተፍ ፍቃደኛ ነዎት?

አዎ፡ - ☐ (ጥያቄዎች ለመሞላት ይቀጥሉ)

አይ፡ - ☐ (እዚሁ ያቁማ)

የመረጃ ሰብሳቢ አስተያየት _____

ፊርማ _____ ቀን _____

የበላይ ተቆጣጣሪ አስተያየት _____

ፊርማ _____ ቀን _____

Appendix D: Data Collection Tools

Questionnaires for objectives -1 and 2

Part-I: Socio-demographic characteristics

S.N	Item	Description
1.	Gender	1. Male 2. Female
2.	Age in years	_____
3.	Marital status	1. Single 2. Married 3. Widowed 4. Divorced 5. Other, specify _____
4.	Level of Education on nursing profession	1. Diploma in nursing 2. BSc degree in Nursing 3. MSc degree or above in nursing
5.	Monthly income	_____
6.	Total Year of Experience	_____
7.	Work experience in Patient bedside	_____
8.	Do you have Experience of Pressure Injury care	1. Yes 2. No
9.	Do you get special training related to Pressure Injuries in the last 6 month	1. Yes 2. No
10.	Work load, ratio of nurse to patient	1. 1:1 2. 1:3 3. 1:5
11.	Have access to reading material, internet etc.	1. Yes 2. No

Part- II: -Knowledge Questionnaire for Braden scale

Please circle on the correct answer in the corresponding box of response option

S.N	Item	Response
1.	Have you ever heard about Braden scale?	1) Yes 2) No
2.	What is Braden scale according to your understanding?	1) An assessment tool used to guide for Pressure injury (PI) prevention 2) An assessment tool used to predict PI risks 3) An assessment tool used to guide nurse to treat PI 4) Don't know
3.	What is the importance of Braden scale for patients	1) Use to move body parts 2) Use to hasten wound healing 3) Use to assess and predict the PI risk 4) Don't know
4.	What are the number of sub-	1) Four sub-scale

	scale in Braden scale to evaluate a patient risk level	2) Five sub-scales 3) Six sub-scales 4) Ten sub-scale 5) I don't know
5.	Which of the following elements are used in Braden PI's risk assessment? (Can respond multiple answers)	1) Sensory perception 2) Mobility 3) Activity 4) Moisture 5) Nutritional status 6) Friction/shear 7) I don't know
6.	Which one of the following Braden scale elements doesn't take the same rating scale?	1) Sensory perception 2) Mobility 3) Nutrition 4) Friction/shear 5) I don't know
7.	A score between 13 – 14 scores in a patient's total Braden score means:-	1) Sever risk 2) Moderate risk 3) No risk 4) I don't know
8.	Excessive and persistent moisture to skin is rated as	1) One 2) Two 3) Three 4) Four 5) I don't know
9.	During nutritional status assessment, eating small portions or ½ of the served meals is rated with	1) One 2) Two 3) Three 4) Four 5) I don't know
10.	Which sub-scale examines patient's ability of changing position?	1) Activity 2) Mobility 3) Sensory perception 4) I don't know
11.	Total score of Braden Scale equal to 9 or less, indicates:-	1) Very high risk 2) High risk 3) Moderate risk 4) No risk 5) I don't know
12.	High points total sum (19 – 23) of Braden score indicates:-	1) Very high risk 2) High risk 3) Moderate risk 4) No risk 5) I don't know

Part-III: - Attitude Questionnaire

Likert scale type questions to assess the nurses' attitude toward Braden scale. Please put this "V" mark in the box corresponding to your response option.

Key: Strongly disagree = (1), Disagree = (2), neither disagree nor agree = (3), Agree = (4), Strongly agree = (5)

S.N	Item	1	2	3	4	5
1.	I feel confident in my ability to use Braden scale					
2.	I am well trained to use Braden scale					
3.	Implementing Braden scale too difficult for me					
4.	Too much attention goes to implement Braden scale					
5.	Implementing Braden scale for PI prevention is not that important					
6.	PI risk assessment is a priority					
7.	PI almost never cause discomfort for a patient					
8.	Financial impact of PI on a patient should not be exaggerated					
9.	Financial impact of PI on society is high					
10.	I am not responsible to assess a patient using Braden scale					
11.	I have an important task on implementing Braden scale					

Part IV: - questionnaires with (Likert scale type questions) to assess the TPB constructs: subjective norm, intention, acceptability and feasibility questions in relation to Braden scale.

Please put this "V" mark in the box corresponding to your response option.

Key: Strongly disagree = (1), Disagree = (2), neither disagree nor agree = (3), Agree = (4), Strongly agree = (5)

S.N	Items	1	2	3	4	5
	Subjective Norms					
1	Most people are important to me appreciate of my Braden scale practice for PI risk Identification					
2	Most nurses like me exercise Braden scale implementation					
	Intension					
3	I intend to use Braden scale for PI risk					

	assessment regularly in future					
4	I will use Braden scale for PI risk assessment regularly in future					
	Acceptability					
5	I would ultimately implement Braden scale in a routine nursing care plan					
6	Participating in Braden scale implementation would be feasible for me					
7	I would be comfortable with participating in Braden scale implementation					
	Feasibility					
8	There is adequate time to practice Braden scale					
9	Most Make effort to implement Braden scale					
1	Resources which are necessary for Braden scale implementation are available					

Questionnaire /Checklist for objective 3

Part – I: Patient’s Demographic data

S. No	Variable	Descriptions
1.	Gender	
2.	Age	
3.	BMI	
4.	Blood pressure	
5.	Body temperature	
6.	Current medical diagnosis	
7.	Admitted ward	

Part – II: Braden scale checklist

BRADEN SCALE For Predicting Pressure Sore Risk in Home Care

Patient's Name: _____		Evaluator's Name: _____		Date of Assessment: _____	
SENSORY PERCEPTION ability to respond meaningfully to pressure-related discomfort	1. Completely Limited Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation. OR Limited ability to feel pain over most of body.	2. Very Limited Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness. OR Has a sensory impairment which limits the ability to feel pain or discomfort over 1/2 of body.	3. Slightly Limited Responds to verbal commands, but cannot always communicate discomfort or the need to be turned. OR Has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.	4. No Impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.	
MOISTURE degree to which skin is exposed to moisture	1. Constantly Moist Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	2. Often Moist Skin is often, but not always moist. Linen must be changed as often as 3 times in 24 hours.	3. Occasionally Moist Skin is occasionally moist, requiring an extra linen change approximately once a day.	4. Rarely Moist Skin is usually dry; Linen only requires changing at routine intervals.	
ACTIVITY degree of physical activity	1. Bedfast Confined to bed.	2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	3. Walks Occasionally Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of day in bed or chair.	4. Walks Frequently Walks outside bedroom twice a day and inside room at least once every two hours during waking hours.	
MOBILITY ability to change and control body position	1. Completely Immobile Does not make even slight changes in body or extremity position without assistance.	2. Very Limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	3. Slightly Limited Makes frequent though slight changes in body or extremity position independently.	4. No Limitation Makes major and frequent changes in position without assistance.	
NUTRITION <u>usual</u> food intake pattern	1. Very Poor Never eats a complete meal. Rarely eats more than 1/3 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement. OR Is NPO and/or maintained on clear liquids or IV's for more than 5 days.	2. Probably Inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement. OR Receives less than optimum amount of liquid diet or tube feeding.	3. Adequate Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products) per day. Occasionally will refuse a meal, but will usually take a supplement when offered. OR Is on a tube feeding or TPN regimen which probably meets most of nutritional needs.	4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.	
FRICTION & SHEAR	1. Problem Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures or agitation leads to almost constant friction.	2. Potential Problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	3. No Apparent Problem Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair.		
				Total Score	

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Part-III: Checklist for skin assessment

Perform skin inspection every other day for 2 weeks and fill the spaces based on your observation, which are correspondent to date, PI, number of PI, location and grade / stage.

Comprehensive skin inspection				
Date	PI	Number of PIs	PI's Location	Grade
On day of admission				
2 nd day				
4 th day				
6 th day				
8 th day				
10 th day				
12 th day				
14 th day				

Appendix E: Curriculum Vitae

Curriculum Vitae of Principal investigator

Personal Details

- **Name:** Emebet Berhane Woldemariam
- **Gender:** Female
- **Date of birth:** March 30, 1972 G.C
- **Marital status:** Married, Mother of one daughter
- **Nationality:** Ethiopian
- **Academic rank:** Assistant Professor in Nursing department, School of Nursing and Midwifery, College of health Science, Addis Ababa University
- **Address:** Addis Ababa, Lemi Kora sub-city, Woreda 10

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1. EDUCATIONAL BACK GROUND

- Masters of Science in Nursing (Adult Health) from Department of Nursing and Midwifery, Faculty of Medicine, AAU (2008 – 2010 G.C)
- Degree in Nursing from Centralized School of Nurse, Medical Faculty, Addis Ababa University (2004-2007 G.C)
- Advanced Diploma in Ophthalmic Nursing from Malawi Health Science (1996-1997 G.C)
- Diploma in comprehensive nursing from Jimma Health Science Institute (1993-1995 G.C)
- High school, at Queen Sheba comprehensive Secondary School (1985 -1992 G.C)
- Elementary & Junior Secondary School at Queen Sheba Elementary School (1978 - 1984 G.C)

1. License and Awarded Academic Accreditations

- Certificate of Higher Diploma in Learning-Teaching in Higher Education from AAU, 2016
- License Certificate of Chief Expert Nurse Professional from FMAHCA Addis Ababa City Administration, 2025
- Degree of Masters of Science in Adult Health Nursing from Addis Ababa University, 22 July 2010

- Degree of Bachelor Science in Nursing with Distinction from Addis Ababa University in 23rd August 2007
- Advanced Diploma in Ophthalmic Nursing from Medical counsel of Malawi in 1997
- Diploma in Comprehensive Nursing from Jimma Institute of Health sciences in 21st March 1996

2. Teaching Experience

- Lecturer at Addis Ababa University, Department of Nursing & Midwifery (from 2010 G.C until now)
- Assistant Lecturer at Addis Ababa University, Faculty of Medicine, Centralized School of Nursing (from Dec.2009 - 2010 G.C)
- Graduate Assistant-II at Addis Ababa University, Faculty of Medicine, Centralized School of Nursing (from August 2007 - 2008 G.C)
- Technical Assistant at Addis Ababa University, Faculty of Medicine, Centralized School of Nursing (from December 2004 - 2007 G.C)
- Tutor at Mekele School of Nursing (from September 2003- August 2004 G.C)

3. Clinical Work Experience

- Ophthalmic Nurse at Shire Suhul Hospital, North Western zone of Tigray region (March 1997- September. 2003 G.C)
- RN Nurse at Adi-Daero Clinic, North Western zone of Tigray region (Sep.1996 – Dec. 1997 G.C)

4. Short-term/ in-job trainings Certificates

- Training on Simulation skill by Survival technology in South Africa (from November 2 to 6 2015 G.C)
- Training on Leadership, management & Governance (from August 11 to 15,2014 G.C)
- Training of Trainers (TOT) on National Comprehensive HIV Care/ART training (from January 24 to February 9, 2011)
- Training on Geriatric Care in Suzan Mubarek Women's Centre, Alexandria, Egypt (from Aprile 23 to May 8 2010 G.C)

5. Publications

- 6.1. Weyzer T. Tsehaye,¹ Daniel Mengistu,² **Emebet Birhanu,²** and Kalayou K. Berhe¹(2013). Assessment of Preference and Its Determinant Factors

- to Ward Modern Contraceptive Methods among Women of Reproductive Age Group in Shire Indaselassie Town, Northern Ethiopia, 2011. Hindawi Publishing Corporation International Journal of Family Medicine, Volume 2013 (8), Article ID 317609, <http://dx.doi.org/10.1155/2013/317609> (Co-author)
- 6.2. Getachew Mullu Kassa , **Emebet Berhane Woldemariam** & Nurilign Abebe Moges (2014). Prevalence of premarital Sexual practice and associated factors among Alamata High school and Preparatory School Adolescents, Northern Ethiopia. Global Journal of Medical research, Volume 14, Issue 3, Version 1.0, (Co-author).
 - 6.3. Tomas Yeheyis¹, **Emebet Berhanie²**, Manaye Yihun³ and Yinager Workineh^{1*}. Timely Initiation of Complementary Feeding and Associated Factors among Children Aged 6 to 12 Months in Addis Ababa Ethiopia, 2015. Epidemiology (Sunnyvale) 2016, 6:5. DOI: [10.4172/2161-1165.1000272](https://doi.org/10.4172/2161-1165.1000272) (Co-author)
 - 6.4. Esayas Aydiko Amele¹, Birhanu wondimeneh Demissie¹, Kalkidan Wondwossen Desta² and **Emebet Berhane Woldemariam²**. Prelacteal feeding practice and its associated factors among mothers of children age less than 24 months old in Southern Ethiopia. BMC Italian Journal of Pediatrics (2019)45:15; (Co-author) <https://doi.org/10.1186/s13052-019-0604-3>
 - 6.5. Tigist Demssew, Tefera Mulugeta, **Emebet Berhane**, Addis Adera, and Kenan Getaneh. Assessment on Psychosocial Wellbeing and Meaning in Life among Elders in the Elders' Home Setting Addis Ababa, Ethiopia. Health Science Journal (2016), volume 10 No. 5:16. ISSN 1791-809X. DOI: 10.21767/1791-809X.1000100516
 - 6.6. Girma Bacha Ayane¹, Kalkidan Wondwossen Desta², Birhanu Wondimeneh Demissie^{3*}, Netsanet Abera Assefa³ and **Emebet Berhane Woldemariam²**. Suboptimal child spacing practice and its associated factors among women of child bearing age in Serbo town, Jimma zone, Southwest Ethiopia. BMC Contraceptive and Reproductive Medicine (2019)4:4; (Co-author). <https://doi.org/10.1186/s40834-019-0085-1>.

- 6.7. Sisay Gedamu^{1*}, **Emebet Berhane**², Abebe Dires¹, Samuel Anteneh¹, Debrnesh Goshiye¹ and Lehulu Tilahun¹. Knowledge and Attitude of Nurses towards Palliative Care in Government Hospitals of Addis Ababa, Ethiopia. Journal of Nursing and Care 2019, 8:2; (Co-author).
- 6.8. Kidist Tamru ¹, Fekadu Aga ², **Emebet Berhanie** ², Yared Asmare Aynalem ³, Wondimeneh Shibabaw Shiferaw ⁴. Incidence of diabetic nephropathy in patients with type 2 diabetes mellitus at a tertiary healthcare setting in Ethiopia. Diabetic and metabolic Syndrome: Clinical research and Review. Volume 14(5), 2020, pages 1077 – 1083.
<https://DOI.org/10.1016/j.dsx.2020.06.028>.
- 6.9. Esubalew Mezgebu,¹ **Emebet Berhane**,² Leul Deribe². Predictors of Resilience Among Parents of Children with Cancer: Cross-Sectional Study. Dove press Journal, Cancer Management and Research. 16 November 2020, Volume 2020:12, Pages 11611—11621. DOI
<https://doi.org/10.2147/CMAR.S276599>
- 6.10. Girma Adugna , Zeleke Argaw, **Emebet Berhane**. Assessment of Nurses Knowledge and Associated Factors Toward Prevention and Management of Cytotoxic Extravasation in Selected Public Hospitals Oncology Units, Addis Ababa, Ethiopia: A Cross Sectional Study. International Journal of Cancer and treatment. November 2022, Vol: 5, Issu: 2 (09-15).
- 6.11. **Emebet B Woldemariam**^{1*}, Rose W Murphree², Wondwossen A Degu³, Melinda K Higgins², Rebecca A Gary ². Evaluation of the Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia. Ethiopia Journal Health Development 2025; 39(1).
- 6.12. **Emebet B. Woldemariam**¹, Rose W.Murphree², Wondwossen A. Degu¹, Melinda K. Higgins², and Rebecca A. Gary². Comparing Knowledge and Attitudes Toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention. Sage Open 2025: 1-13.

7. References

- Dr. Fekadu Aga, PhD (Associate Professor), Dean of School of Nursing and Midwifery, College of Health Sciences, Addis Ababa University; Phone No: +251911631634
- Dr. Daniel Mengistu PhD (Ass. Professor), head of Department of Nursing; College of Health Sciences, Addis Ababa University; Phone No: +25191119597

Curriculum Vitae of Supervisors

REBECCA ANN GARY, RN, PhD, FAHA, FAAN

Associate Professor, Tenured

Nell Hodgson Woodruff School of Nursing

Emory University

Telephone: (404) 712-8993

Email: ragary@emory.edu

EDUCATION

05/2006	Post-doctoral	Emory University	Nursing
05/2003	PhD	University of North Carolina Chapel Hill	Nursing
08/1979	MSN	University of Alabama at Birmingham	Nursing
06/1977	BSN	Medical College of Georgia	Nursing

LICENSES & CERTIFICATIONS

1975-Present	Registered Nurse, Georgia	80149-2
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HONORS & AWARDS

2012	Fellow American Academy of Nursing	American Academy of Nursing Council on Cardiovascular and Stroke Nursing
2009	Fellow American Heart Association	American Heart Association
2008	Young Investigator Award	Heart Failure Society of America
2005	Heart Failure Society Nursing Research Award	Finalist
2003	Arteriosclerosis/Heart Failure Research Prize	Council on Cardiovascular and Stroke Nursing
2003	Graduate Student Research Benefiting North Carolina UNC Graduate School.	

ACADEMIC EXPERIENCE

07/2011-Present	Associate Professor (tenured)	Nell Hodgson Woodruff School of Nursing, Emory University
08/2005 – 07-2011	Assistant Professor	Nell Hodgson Woodruff School of Nursing, Emory University
08/2004 – 08/2005	Postdoctoral Fellow	Nell Hodgson Woodruff School of Nursing, Emory University
08/2003 – 05/2004	Assistant Professor	Medical College of Georgia
07/1999 – 05/2000	Research Assistant	University of North Carolina
09/1996 – 05/1997	Teaching Assistant	University of North Carolina

PROFESSIONAL POSITIONS

03/1997 – 12/2001	Staff Nurse (204)	Chapel Hill, North Carolina Interim Health University of North Carolina
06/1997 – 08/1999	Staff Nurse (204)	Hospital King Faisal Hospital & Research Center
06/1992 – 07/1996	Coordinator Distance Learning	King Faisal Hospital & Research Center
05/1987 – 05/1991	Education Coordinator	King Faisal Hospital & Research Center
11/1984 – 01/1987	Instructor	King Khaled Eye Specialist Hospital
01/1981 – 10/1984	Staff Nurse (204) SICU	Shands Teaching Hospital & Clinics
08/1980 – 06/1984	Assistant Professor	University of Florida
09/1979 – 08/1980	Clinical Coordinator Med/Surg ICU	South Georgia Medical Center
08/1978 – 08/1979	Staff Nurse ICU	Birmingham Veterans Hospital
08/1977 – 08/1978	Staff Nurse ICU	Lake City Veterans Hospital
10/1976 – 08/1977	Staff Nurse ICU	Talmadge Memorial Hospital
08/1975 - 08/1976	Staff Nurse ICU	South Georgia Medical Center

SCHOLARSHIP: GRANTS & OTHER FUNDING Current Research Funding

Research Grants Funded by the National Institutes of Health (NIH)

Healing Hearts and Mending Minds in Older Persons Living with HIV (Fitbrain) (D Waldrop-Valverde, **RA Gary**)

R01NR014973

NINR

05/01/2015- 02/29/2020

Co-PI, 20% effort

\$2,867,392

Research Grants Completed

Healing Hearts and Mending Minds in Older Persons Living with HIV: Pilot study (**RA Gary**)

R0300044615

Center for Aids Research

09/01/15-12/31/17

PI, in-kind

\$38,352

Healing Hearts and Mending Minds in Older Persons Living with HIV: Pilot study (**RA Gary**)

R0300044615

Center for Aids Research Supplement Grant (**RA Gary**)

10/01/2015-9/30/2016

PI, in-kind

\$10,000

The Center for Cognition and Affect in Chronic Illness (D Waldrop-Valverde)

P30NR014134

NINR

09/27/2012-06/30/2017

Co-I, 20% effort

\$2,200,000

The Center for Cognition and Affect in Chronic Illness – Supplement (D Waldrop-Valverde)

P30 NR 14134-S1

NINR

09/30/15 – 06/30/16

Co-I, 20% effort

\$97,000

Caregiver Stress: Interventions to Promote Health and Wellbeing (S Bauer-Wu, E Corwin, AH Miller) 1P01NR011587-01

NINR

09/30/09-07/31/14

Co-Investigator, 12% effort

\$3,400,000

Cost Effectiveness of Quality of Life in Heart Failure Patients with Diabetes. (S Dunbar)

R01NR011888

NINR

09/01/09-08/31/12

Co-I, 5% effort

\$900,000

Improving Outcomes in Heart Failure Patients with Diabetes (S Dunbar)

R21NR011204

NINR and ARRA 9/01/09 -8/31/2011

Co-I, 5%

\$275,000

Family Partnership Intervention for Heart Failure (S Dunbar)

R01 NRO8800

NINR

6/01/04-5/31/09; No cost extension 11/30/09

Co-I, 5% effort

\$2,770,028

Research Grants in Preparation

Evaluation of Mechanisms and Effects of Exercise on Fatigue in Patients with Head and Neck Cancer (C Xiao, **RA Gary**)

To be Re-Submitted in October, 2019

National Cancer Institute Co-PI, 20% Effort

Total Costs: \$2,498,359

Improving Outcomes in Older Persons with Heart Failure and HIV (**R Gary**)

Submission in October 2019

National Institute of Nursing Research

Completed Research Grants Funded by other agencies

Fatigue in Head and Neck Cancer: Role of Pro- and Anti-Inflammatory Signaling (C Xiao, **RA Gary**) University Research Center Emory University Pilot Award

05/1/2017- 04/30/2019

Co-PI, in-kind

\$30,000

A progressive, home-based aerobic and resistance exercise program for heart failure patients (**RA Gary**) Emory Heart and Vascular Center

12/17/2008-12/16/2009

PI

\$50,000

Testing the Psychometric Properties of two fatigue instruments in Heart failure patients. Center for Symptoms Symptom Interactions and Health Outcomes (**RA Gary**)

07/01/2006-05/31/2008

PI, in-kind

\$20,000

Testing the feasibility of tele-monitoring for monitoring exercise adherence, symptom severity and HF self-care practices (**RA Gary**)

Cardicom, Inc.

06/01/2006-05/31/2007

PI, in-kind

\$5,000

Exercise and cognitive behavioral therapy as an intervention for depression in heart failure patients (**RA Gary**)

AHA Beginning Grant in Aid 0465203D

PI, 5% effort

2/2004-1/2006

\$110,000

Current Educational, Training, or Program Grants Funded Fogarty Global Health

Postdoctoral Fellowship (F Aga) NIH

Role: Faculty Advisor

\$30,000

07/01/2019-6/30/2020

Interventions to Improve Outcomes in Chronic Conditions (S Dunbar, M Song)

T32NR012715-06

NINR

Assistant Program Director

07/01/2018-6/30/2023

Completed Educational, Training, or Program Grants Funded Interventions to Improve

Outcomes in Chronic Conditions (S Dunbar) T32NR012715

NINR

Assistant Program Director

07/01/2012 – 06/30/2017

Effects of Exercise on Epigenetic Pathways in Persons with Heart Failure (B Butts)

F31 NR015180 NINR

Faculty advisor

\$64,680

Funding Period: 02/14 – 05/16 2015

A comparison of bioimpedance and anthropometric measurements in rural frail older women

(**RA Gary**, M Dougherty)

Predoctoral Traineeship (T-32), University of North Carolina at Chapel Hill. \$30,000.00 NINR

\$30,000

07/01/1998- 06/30/1999

Kellett Scholarship for Aging (**RA Gary**)

University of North Carolina at Chapel Hill

Pre-doctoral award

\$3000

2001-2002

Kellett Scholarship for Aging (**RA Gary**)

University of North Carolina at Chapel Hill
Pre-doctoral award
\$4000
1999-2000

Kellett Scholarship for Aging (**RA Gary**)
University of North Carolina at Chapel Hill
Pre-doctoral award
\$800
1998-1999

Glaxo-Wellcom Scholarship (**RA Gary**)
University of North Carolina at Chapel Hill
Pre-doctoral award
\$2500

SCHOLARSHIP: PUBLICATIONS (*data-based, +senior or corresponding author, student or mentee underlined)

Peer-Reviewed Publications – Published

1. *+Aga FB, Dunbar SB, Kebede T, Higgins MK, **Gary RA**. Correlates of Self-Care Behaviors in Adults with Type 2 Diabetes and Co morbid Heart Failure. *Diabetes Educ.* 2019;145721719855752, PMID: 31195903
2. *+**Gary RA**, Paul S, Corwin E, Butts B, Miller AH, Hepburn K, Williams, Waldrop-Valverde D. Exercise and Cognitive Training as a Strategy to Improve Neurocognitive Outcomes in Heart Failure: a pilot study. *Am J Geriatric Psychiatry*; Feb 2019, PMID: 30910420
3. *+Aga F, Dunbar SB, Kebede T, **Gary RA**. The role of concordant and discordant co morbidities on performance of self-care behaviors in adults with type 2 diabetes: a systematic review. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*; 2019;12 333–356.
4. *+Butts B, Butler J, Dunbar SB, Corwin E, **Gary RA**. Effects of Exercise on ASC Methylation and IL-1 Cytokines in Heart Failure. *Med Sci Sports Exerc.* 2018;50(9):1757- 1766. PMID:29683921
5. * **Gary RA**, Dunbar SB, Higgins MK, Corwin E, Hepburn K, Miller AH. An intervention to improve physical function and care giving perceptions in family caregivers of persons with heart failure. *Journal of Applied Gerontology*, 2018 1:733464817746757. PMID:29347863
6. Owen MI, Braun LT, Hamilton RJ, Grady KL, **Gary RA**, Quest TE. Weblogs: A Complex Data Source for Qualitative Research. *J Card Fail.* 2017;23(11):826-827. PMID:28842379
7. *+ Butts B, Butler J, Dunbar SB, Corwin E, **Gary RA**. ASC Methylation and Interleukin-1 β Are Associated with Aerobic Capacity in Heart Failure. *Med Sci Sports Exerc.* 2017; 49(6):1072-1078 PMID:280726324
8. *+ Butts B, **Gary RA**, Dunbar SB, Butler J. Methylation of Apoptosis-Associated Speck-Like With a Caspase Recruitment Domain and Outcomes in Heart Failure. *J Card Fail.* 2016 22(5):340-6. PMID:26700661

9. +Butts B, Gary R. 20 Things You Didn't Know About Exercise. *J Cardiovasc Nurs*. 2016 31(5):387-9. PMID:27513677
10. * Dunbar SB, Clark, PC, Reilly CM, Gary RA, Higgins MK, Stamp K. Family Partnership and Education Interventions to Reduce Dietary Sodium by Patients with Heart Failure Differ by Family Functioning. *Heart Lung*. 2016; 45(4):311-18. PMID: 27174641
11. *+ Butts B, Gary RA, Dunbar SB & Butler J. The importance of NLRP3 inflammasome in heart failure. *J Card Fail*. 2015; 21(7):586-93. PMID: 25982825.
12. * Dunbar SB, Reilly CM, Gary RA, Higgins MK, Butts B, Culler S, Butler J. Randomized Clinical Trial of an Integrated Self-care Intervention for Persons with Heart Failure and Diabetes: Quality of Life and Physical Functioning Outcomes. *J Card Fail*. 2015; 21(9):719-29. PMID:26028261
13. * Reilly CM, Dunbar SB, Gary RA, Culler S, et al. An Economic Evaluation of a Self-Care Intervention in Persons with Heart Failure and Diabetes. *J Card Fail*. 2015; 21(9):730-7. PMID:26164214
14. *Butts B, Gary R, Dunbar SB, Higgins MK, Miller A, Corwin E. [Caregiver Stress and Cardiovascular Disease Risk Among Female Family Caregivers of Persons with Heart Failure](#). *J Cardiovasc Nurs*. 2014;29(5):390-391.
15. +Butts B and Gary R. Coexisting frailty, cognitive impairment, and heart failure: implications for clinical care. *Journal of clinical outcomes management: JCOM*. 2015; 22(1):38-46.
16. *Stamp KD, Dunbar SB, Clark PC, Reilly CM, Gary RA, Higgins M, Ryan RM. Family partner intervention influences self-care confidence and treatment self-regulation in patients with heart failure. *Eur J Cardiovasc Nurs*. 2014; 13(6):541-8.
17. * Stamp KD, Dunbar SB, Clark PC, Reilly CM, Gary RA, Higgins M & Kaslow N. Family Context Influences Psychological Outcomes of Depressive Symptoms and Emotional Quality of Life in Patients with Heart Failure. *J Cardiovasc Nurs*. 2014; 29(6):517-27. PMID:24434821
18. Zeng B, Sun W, Gary RA, Li C, Liu T. Towards a conceptual model of diabetes self-management among Chinese immigrants in the United States. *Int J Environ Res Public Health*. 2014;11(7):6727-42. PMID:24978878
19. +Gary RA, Brunn K. Aerobic exercise as an adjunct therapy for improving cognitive function in heart failure. *Cardiol Res Pract*. 2014;157508. PMID:25105053.
20. * Dunbar SB, Clark PC, Reilly CM, Gary RA, Smith A, McCarty F, Higgins M, Grossniklaus, D, Kaslow N, Frediani J, Dashiff C. & Ryan R. (2013). A trial of family partnership and education interventions in heart failure. *J Card Fail*. 2013; 19(12): 829-4. PMID: 24331203.
21. Strath SJ, Kaminsky LA, Ainsworth BE, Ekelund U, Freedson PS, Gary RA, Richardson CR, Smith DT, Swartz AM, & American Heart Association Physical Activity Committee of the Council on Nutrition, Physical Activity and Metabolism and the Council on Clinical Cardiology (2013). A Guide to the Assessment of Physical Activity: Clinical and Research Application, A Scientific Statement from the American Heart Association. *Circulation*, 128(20), 2259-79. PMID: 24126387.
22. * Dunbar SB, Butts B, Reilly CM, Gary RA, Higgins MK, Ferranti EP, Culler S, & Butler J. A pilot test of an integrated self-care intervention for persons with heart failure and concomitant diabetes. *Nurs Outlook*, 2014; 62(2):97-111 PMID:24211112.

23. **Gary RA.** Aerobic exercise reduces depressive symptoms in patients with chronic heart failure. *Evidence-based Mental Health*, 2013; 16(2), 42. PMID: 23329053.
24. * Frediani JK, Reilly CM, Higgins MK, Clark PC, **Gary RA** & Dunbar SB. Quality and adequacy of dietary intake in a southern urban heart failure population. *J Cardiovasc Nurs*. 2013; 28(2), 119-128. PMID: 22343212.
25. **Gary R.** Evaluation of frailty in older adults with cardiovascular disease: incorporating physical performance measures. *J Cardiovasc Nurs*, 2012; 27(2), 120-131. PMID: 22334147.
26. * **Gary RA**, Cress ME, Higgins MK, Smith AL & Dunbar SB. A Combined Aerobic and Resistance Exercise Program Improves Physical Functional Performance in Patients with Heart Failure: a pilot study. *J Cardiovasc Nurs*. 2012; 27(5), 418-430. PMID: 21912268.
27. * Grossniklaus DA, Dunbar SB, **Gary R**, Tohill BC, Frediani JK, & Higgins MK. Dietary energy density: a mediator of depressive symptoms and abdominal obesity or independent predictor of abdominal obesity? *Euro J Cardiovasc Nurs*, 2011;11(4):423-31. PMID: 21530408.
28. * Kaplan BG, Abraham C & **Gary R.** Effects of participation vs. observation of a simulation experience on testing outcomes: implications for logistical planning for a school of nursing. *International J Nurs Educ Scholarship*. 2012; 29(9), PMID: 22850068.
29. * **Gary RA**, Cress ME, Higgins MK, Smith AL & Dunbar SB. A combined aerobic and resistance exercise program improves physical functional performance in patients with heart failure: a pilot study. *J Cardiovasc Nurs*. 2012; 27(5), 418-430. PMID: 21912268.
30. * **Gary RA**, Cress ME, Smith AL, Higgins MK & Dunbar SB. Combined Aerobic and Resistance Exercise Program Improves Task Performance in patients with heart failure. *Archives of Physical Medicine and Rehabilitation*. 2011; 92(9): 1371-1378. PMID: 21878207.
31. * **Gary RA**, Dunbar SB, Higgins MK, Musselman DL & Smith AL. Combined Exercise and Cognitive Behavioral Therapy Improves Outcomes in Patients with Heart Failure. *J Psychosom Res*. 2010; 69(2): 119-131. PMID: 20624510.
32. * Grossniklaus DA, Dunbar SB, **Gary RA**, Tohill B & Higgins MK. Psychological Factors are Important Correlates of Dietary Pattern in Overweight Adults. *J Cardiovasc Nurs*. 2010; 25(6), 450-460. *PMID: 20938248.
33. Grossniklaus DA, **Gary R**, Higgins MK, Frediani J, Dunbar SB. [Depressive Symptoms and Dietary Energy Density Independently Predict Abdominal Obesity](#). *J Cardiovasc Nurs*. 2010;25(5):362-363.
34. * Grossniklaus DA, **Gary RA**, Higgins MK & Dunbar SB. Biological and Psychological Differences between Overweight Adults with and without Waist Circumference Risk. *Res Nurs Health*. 2010; 33(6), 539-55. PMID: 21053387.
35. * Reilly CM, Higgins M, Smith A, **Gary RA**, Robinson J, Clark PC, McCarty F, & Dunbar SB. Development, Psychometric Testing, and Revision of the Atlanta Heart Failure Knowledge Test. *J Cardiovasc Nurs*. 2009; 24(6): 500-509. PMID: 19858959.
36. **Gary RA** & Davis LD. Diastolic heart failure. *Heart Lung*. 2008; 37(6), 405-416. PMID: 18992623.
37. * Dunbar SB, Clark PC, Quinn C, **Gary RA** & Kaslow N. Family Influences on heart failure self-care and outcomes. *J Cardiovasc Nurs*. 2008; 23(3), 258-265. PMID: 18437068.
38. * **Gary R** & Lee SY (2007). Physical Function and Quality of Life in Older Women With Diastolic Heart Failure: Effects of a Progressive Walking Program on Sleep Patterns. *Prog Cardiovasc Nurs*. 2007;22(2), 72-80. PMID: 17541316.

39. * **Gary R.** Exercise self-efficacy in older women with diastolic heart failure. *J Geron Nurs.* 2006; 32(7),31-39. PMID: 16863044.
40. * **Gary R.** Self-care practices in women with diastolic heart failure.*Heart Lung.* 2006;35(1), 9-19.PMID: 16426931.
41. * **Gary R,** Sueta C, Dougherty M, Rosenberg B, Cheek D, Preisser J, Neelon V & McMurray R.Home-based exercise improves functional performance and quality of life in women with diastolic heart failure. *Heart Lung* 2004;33(4): 210-218. PMID: 15252410.
42. * **Gary R,** Sueta CA, Rosenberg B & Cheek D. Use of the six-minute walk test for women diastolic heart failure. *J Cardiopulmonary Rehab.* 2004;24(4): 264-268. PMID: 15286534.
43. **Gary R& Fleury J.** Promoting physical activity in older women: Introduction. *Top Geriatr Rehab.*2002;(18):pp vi. Invited Editorial.
44. **Gary R& Rosenberg B.** Considerations for implementing a low-intensity, home-based walking program in older women with diastolic heart failure. *Top Geriatr Rehab.* 2002;18: 34-51.
45. **Gary R.** Promoting functional status through interdisciplinary collaboration.*Top Geriatr Rehab.*2002;17: Part II, pp. vi. Invited Editorial
46. **Gary R& Fleury J.** Nutritional Assessment: Key to successful rehabilitation in the elderly.*Top GeriatrRehab.* 2002; (17), 40-71.
47. **Gary R,** Marrone S & Boyles C. The use of gaming strategies in a transcultural setting.*J Contin EdNurs.*1998; 29(5), 221-227. PMID: 9923232.
48. **Gary R.** Nurse Development Program.*Nurs Admin Q.* 1992;(16): 25-29.
49. * Treloar D, Nalli B, Guinn P &**Gary R.** The effect of familiar and unfamiliar voice treatments on intracranial pressure in head-injured patients. *J Neurosurg Nurs.* 1991;23(5): 295-299.
50. **Gary R,** Jermier-Jax B & Hickey A. Stroke: The road back to recovery.*RN*Part 2—ContinuingEducation Credit. 1986;(49):49-54.
51. **Gary R,** Jermier-Jax B & Hickey A. Stroke: How to contain the damage (Continuing Education Credit.*RN.* 1986; 49(5): 36-42. PMID: 3635223
52. **Gary R.** Care of patients with cerebral aneurysms.*J Assoc Periop Reg Nurs.* 1983; 37(4): 631-642.
53. **Gary R.** Cerebral vasospasm: Issues, trends and interventions.*J Neurosurg Nurs.* 1981;(13): 256- 264.

Peer-Reviewed Publications – Submitted/Under review

1. * Xaio C, Beitler JJ, Higgins KA, Zhu Y, Zhao H, Bruner DW, Miller AH, **Gary RA.** Pilot Study of Combined Aerobic Resistance Exercise on Fatigue for Patients with Head and Neck Cancer: Inflammatory and Epigenetic Changes. *Cancer*, Submission, July 2019
2. *+ **Gary RA,** Paul S, Corwin E, Butts B, Miller AH, Hepburn K, Williams, Waldrop-Valverde D. Exercise and Cognitive Training Intervention improves Self-Care Management and Functional Capacity in Persons with Heart Failure. *International Journal of Geriatric Psychiatry*, Submission, June 2019
3. *+ Aga F, Dunbar SB, Kebede T, Higgins MK, **Gary RA.** Correlates of Self-Care Behaviors in Adults with Type 2 Diabetes and Comorbid Heart Failure. Submitted, *Diabetes Spectrum*, June 2019.

4. *+ Aga E, Dunbar SB, Kebede T, Higgins MK, **Gary RA**. "Sociodemographic and Clinical Correlates of Diabetes Self-Efficacy in Adults with Type 2 Diabetes and Comorbid Heart Failure" *Nursing in Research and Health*, April 2019, *Under Revision*

Other Publications (please label as book chapter, book review, research abstract, software, video, etc.)

1. Book chapter: Parker, KP, Dunbar, SB, **Gary RA**. *Sleep* (Chapter 8). In Cardiac Nursing (6th ed). Woods SL, Froelicher E, Motzer S, Bridges E (eds). Lippincott Williams and Wilkins, 2010, p 177-203. ISBN:978-0-7817-9280-6
Book chapter: **Gary R** (2004). Physical activity recommendations and the cardiovascular patient. *CVNursing Secrets*. L. Davis (ed), 425-434.

SCHOLARSHIP: PUBLISHED ABSTRACTS AND PROCEEDINGS (*data-based; +corresponding or senior author; authors underlined are students or mentees)

1. *+ Butts B, Butler J, Dunbar SB, Corwin EJ, **Gary RA**. Interleukin-1 beta and Methylation of Apoptosis Associated Speck-Like Protein Containing a Caspase Recruitment Domain are Associated with Aerobic Capacity in Heart Failure. *Circulation*, 2016;134:7.
2. *+ Butts B, Dunbar SB, Butler J, **Gary RA**. Effects of an Exercise Intervention on ASC Methylation and IL-1 Cytokines in Persons with Heart Failure. *Journal of Cardiac Failure*, 2016;22:S13.
- 3.* Dunbar SB, Corwin EJ, Gary RA, Higgins MK, Smith A, Butler J. Novel Correlates of Depressive Symptoms in Family Caregivers of Heart Failure Patients. *Circulation*, 2016; 134:A12706
4. * Dunbar S, Reilly CM, Gary RA, Higgins MK, Butler J. Characteristics of responders to an integrated self-care intervention for persons with heart failure and diabetes. *European Heart Journal*, 2015;36: 37.
5. * Butts B, Gary RA, Dunbar SB, Butler J. ASC Methylation and Expression are Associated with Depressive Symptoms, Anxiety, and Quality of Life in Heart Failure. *Journal of Cardiac Failure*, 2015;21:S6.
6. * Reilly CM, Higgins M, Butler J, Gary R, Culler SD, Dunbar SB. Cost Effectiveness of an Integrated Self-Care Intervention for Persons with Heart Failure and Diabetes. *Journal of Cardiac Failure*, 2015; 20: S5.
REBECCA ANN GARY, RN, PhD, FAHA, FAAN
08/01/2019
Page 11
7. * Dunbar SB, Reilly CM, Gary RA, Higgins MK, Culler S, Butler J. An Integrated Self-Care Education and Counseling Intervention for Persons with Heart Failure and Diabetes Improves Quality of Life and Physical Functioning. *Journal of Cardiac Failure*, 2014; Volume 20, Issue 8, Supplement, Page S118.
8. * Butts B, Gary R, Reilly CM, Higgins MK, Butler J, Dunbar S. Effects of an Integrated Self-Care Intervention on Frailty Risk in Persons with Heart Failure and Type 2 Diabetes Mellitus. *Circulation*, 2014;130:3
9. * Routledge FS, Gary RA, Rogers AE, Paul S, Dunbar SB. Association of Sleep Medication with Cardiorespiratory Fitness in Normotensives, Prehypertensives and Hypertensives. *Circulation*, 2014; (130):issue suppl 28.

- 10.* Dunbar, [Gary R](#), Corwin E, M, Higgins MK, Butler J. [Effects of a heart failure family caregiver intervention on caregiver strain and outcomes](#). *Circulation*, 2014;130(Suppl_2).
- 11.* Dunbar SB, Clark PC, Reilly CM, [Gary RA](#), Smith AL, McCarty F, Higgins MK, Grossniklaus DA, and others. [A Trial of Family Partnership and Education Interventions in Heart Failure](#). *Journal of Cardiac Failure*, 2013; Vol. 19, Issue 12, p829–84.
- 12.* Cress E, [Higgins MK](#), [Gary R](#). [Clinically important effects of exercise on functional performance inpatients with heart failure](#). *Gerontologist*, 2012; 52:586.
- 13.* [Gary R](#), [Higgins M](#), Cress E, [Smith A](#), Dunbar S. [Improved Physical Function Confers Greater Quality of Life Benefits for NYHA Class III Than for NYHA Class II Patients](#). *Journal of Cardiac Failure*, 2012, 18: s74.
- 14.* Dunbar SB, Clark PC, [Smith AL](#), [Reilly CM](#), [Gary R](#), McCarty F, Robinson J, [Kaslow N](#). [Family Partnership and Education Interventions Reduce Dietary Sodium Intake by Patients with Heart Failure](#) *Circulation*, 2009;120:S499.
- 15.* [Gary RA](#), Cress E, [Smith AL](#), [Higgins M](#), Dunbar SB. [Combined Aerobic and Resistance Training Improves Physical Functional Performance and Muscle Strength in Patients with Heart Failure](#). *Circulation*, 2009; 120: S511-S512
- 16.* Dunbar SB, Clark PC, [Gary RA](#), McCarty F, [Higgins M](#), [Reilly CM](#), Grossniklaus D, Robinson JM, [Smith AL](#). [Family member interventions improve their knowledge of heart failure and supportive communication](#). *European Heart Journal*, 2009;30:3.
- 17.* [Gary RA](#), Sueta CA, Dougherty MC, Rosenberg BS, Cheek DJ, Preisser JS, Neelon VJ, McMurray RG. Low to moderate intensity home-based exercise improves exercise tolerance and quality of life in women with diastolic heart failure, 2009; *Journal of Cardiac Failure*, Vol. 9, Issue 5, S59.
- 18.* Dunbar SB, Clark PC, [Gary RA](#), Quinn C, Reilly CM, Smith AL, Higgins MK. [HF Family Caregiver Outcomes and Associated Factors](#). *Journal of Cardiac Failure*, 2009: Vol. 15, Issue 6, S108–S109.
- 19.* Dunbar SB, [Gary R](#), Clark PC, McCarty F, [Smith A](#), [Kaslow N](#), [Reilly C](#), Quinn C. [Family functioning, self-management behaviors, and outcomes in patients with heart failure](#). *European Heart Journal*, 2008;29:760
- 20.* [Gary RA](#), Dunbar SB, Musselman DL, Cress EM, [Higgins MK](#). [Use of the symptom interactional framework to examine the multidimensional domains of fatigue and depression in heart failure patients](#). *Journal of Cardiac Failure*, 2008;14: S91.
- 21.* Dunbar SB, Clark PC, [Gary RA](#), [Reilly CM](#), Quinn C, [Smith A](#), Butler J. [Comparison of self-care behaviors and outcomes in HF patients with and without diabetes](#). *Journal of Cardiac Failure*, 2008: 14: S99-S100.
- 22.* [Reilly CM](#), Clark PC, [Gary RA](#), McCarty F, [Smith AL](#), Quinn C, Dunbar SB. [Health outcomes and associations with dietary sodium intake in heart failure patients](#). *Circulation*, 2008;117: E444.
- 23.* [Gary R](#), Dunbar S, Elaine C, Cotsonsis G. [Exercise and cognitive behavioral therapy reduces depression severity, increases physical function and enhances quality of life in New York heart association class II and III patients](#). *Circulation*, 2008;117: E436.

24. * [Gary RA](#), Dunbar SB, Clark PC, Cotsonis GA. Gender Is Not Associated with Depressive Symptoms in Heart Failure. *Journal of Cardiac Failure*, 2007; Volume 13, Issue 6, Supplement 2, Page S166
25. *Cress ME, Hayes DM, Moore TL, **Gary RA**. Physical Functional Performance in Patients with Class II and III Chronic Heart Failure. *Medicine and Science in Sports and Exercise*, 39(5), S287. American College of Sports Medicine. May;2007
26. * [Gary RA](#), Robinson JM, Clark PC, McCarty F, [Smith AL](#), [Dunbar SB](#). [Biobehavioral factors and heart failure medication adherence](#). *Circulation*, 2007;116: 486.
27. * [Gary RA](#), Cress EM, Hayes DM, Moore TL. Performance of the Domains of Physical Activities of Daily Living among New York Heart Association Class II and III Heart Failure Patients. *Journal of Cardiac Failure*, 2007; Volume 13, Issue 6, Supplement 2, Page S174.
28. * [Gary RA](#), Lee SYS. [Sleep patterns, quality of life and physical function in older women with diastolic heart failure: Effects of a progressive walking program](#). *Journal of Cardiac Failure*, 2005;11:S93.
29. * Schumacher AM, [Gary RA](#), [Dunbar SB](#). [Heart rate variability and sudden death risk in women with heart failure](#). *Journal of Cardiac Failure*, 2005;11: S201.
30. * [Gary RA](#), Dougherty MC, Rosenberg B, Cheek DJ, Preisser JS, Neelon VJ, McMurray RG, Sueta CA. [Low to moderate intensity home-based exercise improves exercise tolerance and quality of life in women with diastolic heart failure](#). *Circulation*, 2003;108:503.
31. * [Gary R](#), Dougherty M, Sueta C, Rosenberg B, Cheek D, Preisser J, Neelon V, McMurray R. [The six-minute walk test as an outcome measure for exercise intervention effectiveness in older women with diastolic heart failure](#). *Gerontologist*, 2003; 43:496.

SCHOLARSHIP: PRESENTATIONS (# invited presentations denoted, ^podium presentation)

International Presentations (*data-based; +corresponding or senior author; authors underlined are students or mentees; # invited presentations denoted, ^podium presentation)

1. *^**Gary RA**, Dunbar SB, Higgins MK, Hepburn K, Miller A, Corwin E and Bauer-W S. Physical and psychosocial characteristics of family givers of persons with heart failure Sigma Theta Tau International's 24th International Nursing Research Congress, Prague, Czech Republic. July; 2013
2. *^Dunbar, SB, Clark PC, **Gary RA**, Higgins M, McCarty F, Reilly, C, Robinson, J, Smith AL., Family focused Interventions improve HF Family members knowledge and supportive communication, European Society of Cardiology, August 2009, Barcelona, Spain, August; 2009.
3. *^Dunbar, SB, Clark PC, **Gary RA**, Higgins M, McCarty F, Reilly, C, Robinson, J, Smith AL., Family focused Interventions improve HF Family members knowledge and supportive communication, oral abstract presentation, European Society of Cardiology, Barcelona, Spain. August; 2009

4. # Murray J, **Gary, R.A.**, Dunbar, S. Research Workshop, Addis Ababa University, School of Nursing Faculty, Addis Ababa Ethiopia. Funded by the Institute of Developing Nations, Emory University. December; 2009
5. *^Dunbar SB, **Gary RA**, Clark PC, McCarty F, Smith A, Reilly CM, Quinn, C. Family functioning, self- management, and outcomes in patients with heart failure, presented at the European Society of Cardiology. Munich, Germany, European Heart Journal, vol29. September 2008.
6. *^**Gary RA**, Dougherty M, Rosenberg B, Cheek DA, Preisser J, Neelon V, McMurray R, Sueta CA. The effectiveness of home-based exercise in women with diastolic heart failure. Sigma Theta Tau, 37th Biennial Convention. Toronto, Canada. November; 2003.
7. *^**Gary RA**, Dougherty M, Rosenberg B, Cheek DA, Preisser J, Neelon V, McMurray R. & Sueta CA. The effectiveness of home-based exercise in diastolic heart failure women. Sigma Theta Tau, Fourteenth International Research Congress on Evidenced Based Practice. St. Thomas Virgin Islands. July; 2003.

National Presentations (*data-based; +corresponding or senior author; authors underlined are students or mentees; # invited presentations; ^podium presentation)

1. #^**Gary RA**.Frailty: What do physical function measures tell us? American Heart Association ScientificSessions, November 2019.
2. *^**Gary RA**,Waldrop-Valverde D, Butts B, Corwin E, Paul S. Exercise and Cognitive Re-Training as aStrategy to improve neurocognitive outcomes in Heart Failure. American Heart Association Scientific Sessions, November 2017.
3. *^Higgins MK, Reilly CM, **Gary RA**, Dunbar SB, Butts B and Butler J. Characterizing Quality of Life Responses and Physical Functioning Improvements to an Integrated Self-care Intervention for Persons with Co-morbid Heart Failure and Diabetes. *Circulation: Cardiovascular Quality and Outcomes*. 2017;10: A224, American Heart Association, March 2017.
4. *+^Butts B, Butler J, Dunbar SB, Corwin EJ, **Gary RA**. Interleukin1 β and Methylation of Apoptosis Associated Speck-Like Protein Containing a Caspase Recruitment Domain Are Associated with Aerobic Capacity in Heart Failure. American Heart Association Scientific Sessions, New Orleans, LA. November; 2016
5. ***Gary RA**, Waldrop-Valverde D, Paul S, Corwin EJ, Hepburn K, Williams B. Exercise and Cognitivetraining to Improve neurocognitive outcomes in persons with heart failure. NINR Advancing Science, Bethesda, MD. May; 2017.
6. *+^Butts B, Dunbar SB, Butler J, **Gary RA**. Effects of an exercise intervention on ASC methylation and IL-1 cytokines in persons with heart failure. Rapid Fire Abstract Presentation, Heart Failure Society of America, Orlando, FL. September; 2016.
7. *+^**Gary RA**, Dunbar SB,Butts B, Higgins MK, Hepburn K, Corwin EJ, Miller AH. Improvingphysical function and reducing cardiovascular disease risk among family caregivers of persons with heart failure. Council Academy of Nursing Science (CANS), Washington DC, September; 2016.

8. #^**Gary RA**, Waldrop-Valverde D and Paul S. Exercise to improve cognitive outcomes in cardiovascular disease. American Heart Association Scientific Sessions, November; 2016.
9. *^**Dunbar SB**, Corwin E. **Gary RA**, Higgins MK, Smith A, Butler J. Novel Correlates of Depressive Symptoms in Family Caregivers of Heart Failure Patients. American Heart Association Scientific Sessions. November; 2016
10. *+**Gary RA**, Butts B, Waldrop-Valverde D, McElroy R, Relli-Moniz P, Kim JH, Brunn K. Exercise and Cognitive Retraining in Persons with Heart Failure (EXCITE-HF): Preliminary Findings. Poster presented at the 2015 NINR Center Directors Meeting, Bethesda, MD, May 5, 2015.
11. *+^**Gary RA**, Dunbar SB, Butts B, Higgins MK, Hepburn K, Corwin E and Miller A. Improving Physical Function and Reducing Cardiovascular Disease Risk Among Family Caregivers of Persons with Heart Failure. American Heart Association Scientific Sessions, November; 2015.
12. *+**Gary, RA**, Dunbar SB, Butts B, Higgins MK, Corwin E, Hepburn K, and Miller AH. Improving physical function and reducing cardiovascular disease risk among family caregivers of persons with heart failure. Advancing Science, Improving Lives, NINR's 30th Anniversary Scientific Symposium and Poster Session, NIH, Bethesda, MD. October; 2015
13. *+^Butts B, **Gary RA**, Dunbar SB, Butler J. ASC methylation and outcomes in heart failure. E-Abstract Oral Presentation, American Heart Association Scientific Sessions, Orlando, FL. November; 2015
14. *+^Butts B, **Gary RA**, Dunbar SB, Butler, J. ASC Methylation and Expression are Associated with Depressive Symptoms, Anxiety, and Quality of Life in Heart Failure. Oral Presentation, Heart Failure Society of America, National Harbor, MD. September; 2015.
15. *^**Dunbar SB**, **Gary RA**, Corwin EJ, Miller AH, Hepburn K, Higgins MK, Butler J. Effects of a Heart Failure Family Caregiver Intervention on Caregiver Strain and Outcomes, American Heart Association, Chicago, IL. November; 2014.
16. *^**Dunbar SB**, **Gary, RA**, Clark, PC, McCarty, F, Smith, A, Reilly, C, Quinn, C Family functioning, self-management, and outcomes in patients with heart failure. Council for the Advancement of Nursing Science (CANS) Washington DC, October; 2008
17. *^**Dunbar SB**, Reilly CM, **Gary RA** Higgins MK, Culler S, Butler J. An Integrated Self Care Education and Counseling Intervention for Persons with Heart Failure and Diabetes Improves Quality of Life and Physical Functioning, Heart Failure Society of America, Las Vegas, NV. September; 2014.
18. *^**Butts B**, **Gary RA**, Reilly CM, Higgins MK, Butler J, Dunbar SB. Effects of an integrated self-care intervention on frailty risk in persons with heart failure and type 2 diabetes mellitus. American Heart Association Scientific Sessions, Chicago, IL. November; 2014.
19. ***Butts B**, **Gary RA**, Dunbar SB, Higgins MK, Miller AH, Corwin E. Caregiver stress and cardiovascular disease risk among female family caregivers of persons with heart failure. Poster presentation, Preventive Cardiovascular Nurses Association, Atlanta, GA. April; 2014
20. *^**Routledge FS**, **Gary RA**, Rogers AE, Paul S, Dunbar SB. Association of Sleep Medication with Cardiorespiratory Fitness in Normotensives, Pre-hypertensives and Hypertensives. American Heart Association, November 2014.
21. *+^**Gary RA**, Higgins MK, Cress ME, Smith AL, Dunbar, SB. Improved physical function confers greater quality of life benefits for NYHA class III then NYHA Class II patients. Heart Failure Society of America. Seattle, WA. September; 2012

22. *^Cress ME, **Gary RA**& Higgins M K Clinically important effects of exercise on functional performance in patients with heart failure. Gerontological Society of America. San Diego, CA. November; 2012
23. *^Grossniklaus DA, Tohill BC, Frediani J, Higgins MK, **Gary RA**, Dunbar SB. Depressive symptoms are important correlates of dietary energy density in overweight adults. Preventive Cardiovascular Nurses Association 15th Annual Symposium, Dallas, TX. April; 2009
24. *^Grossniklaus DA, Frediani J, Higgins MK, **Gary RA**, Dunbar SB. Depressive symptoms and dietary patterns associated with cardio metabolic risk in overweight adults. American Heart Association Quality of Care and Outcomes Research in Cardiovascular Disease and Stroke, Washington D.C. March; 2009.
25. *^Dunbar, SB, Clark PC, **Gary RA**, Quinn C, Reilly CM, Smith A, Higgins M. Heart Failure Family Caregiver Outcomes and Associated Factors, *Journal of Cardiac Failure*, 15 (6, S1), S108.Heart Failure Society of America, Boston, September; 2009
26. *+^**Gary RA**, Cress ME, Smith AL, Higgins MK, Dunbar SB. Combined aerobic and resistance training improves functional performance and muscle strength in patients with HF. American Heart Association Scientific Sessions. Orlando FL. November; 2009
27. *^Dunbar SB, Clark PC, **Gary RA**, Smith AL, Reilly CM, McCarty F, Robison, J. Family Partnership and Education Interventions Reduce Dietary Sodium Intake by Patients with Heart Failure, American Heart Association Scientific Sessions, November; 2009
28. *+^**Gary RA**, Dunbar SB, Musselman DL, Cress ME, Higgins, MK. The multidimensional domain of fatigue in patients with heart failure and depression. Council for the Advancement of Nursing Science. Washington, DC. October; 2008
29. *+^**Gary RA**, Musselman DL, Dunbar SB, Cress ME, Cotsonis GA. Exercise and cognitive behavioral therapy improves depression and clinical outcomes in heart failure patients. Council for the Advancement of Nursing Science (CANS). Washington, DC. October; 2008
30. +^**Gary RA**, Dunbar SB, Musselman DL, Cress ME, Higgins, MK. Use of the Symptom Interactional Framework to examine multidimensional domains of fatigue and depression in heart failure patients. Heart Failure Society of America. Toronto, ON. September; 2008
31. *Dunbar SB, Clark PC, **Gary RA**, Reilly CM, Quinn, C, Smith A, Butler J. A Comparison of Self-Care Behaviors and Outcomes in HF Patients with and without Diabetes, poster presented at Heart Failure Society of America, Toronto, September; 2008
32. *+^**Gary RA**, Musselman DL, Dunbar SB, Cress ME, Cotsonis, G.A. Combined exercise and cognitive behavioral therapy improves outcomes in heart failure patients. American Heart Association: Quality of Care and Outcomes Conference. Baltimore, MD. April; 2008
33. *+^**Gary RA**, Robinson, JM, Clark PC, Smith AL, Dunbar SB Bio-behavioral predictors of medication adherence in heart failure patients, American Heart Association, Orlando Florida, November; 2007
34. *+^**Gary RA**, Dunbar SB, Clark PC, Cotsonis GA. Gender is not associated with Depression in heart failure. Poster presentation: *Journal Cardiac Failure*, 319, S166. September; 2007
35. *+^**Gary RA**, Cress ME, Hayes DM, Moore TL. Performance of physical activities of daily living among New York heart Association Class II and III heart failure patients. Heart Failure Society of America. Washington, DC. September; 2007

36. *^Cress ME, Hayes DM, Moore TL, **Gary RA**. Physical Functional Performance in Patients with Class II and III Chronic Heart Failure. *Medicine and Science in Sports and Exercise*, 39(5), S287. American College of Sports Medicine. May;2007
37. #^Bittner V, Deckerlegand JL, **Gary RA**. How to set up a home-based exercise program for heart failure patients. Heart Failure Society of America. Seattle, WA. September 2006.
38. *+^**Gary RA**.& Lee SY. Sleep patterns, quality of life and physical function in older women with diastolic heart failure: effects of a progressive walking program. Heart Failure Society of America. Boca Raton, Florida. September; 2005.
39. *+^**Gary RA**, Dougherty M, Rosenberg B, Cheek DA, Preisser J, Neelon V, McMurray R, Sueta CA (2005). Low to moderate intensity exercise improves exercise tolerance and quality of life in women with diastolic heart failure. *Circulation*, 108, 503, American Heart Association. November; 2005
40. *+^**Gary RA**, Dougherty M, Sueta, CA. The Six-Minute Walk Test As An Outcome Measure for Exercise Intervention Effectiveness In Older Women With Diastolic Heart Failure. Gerontological Society of America. San Diego. November; 2003
41. *+^**Gary RA**, Dougherty M, Rosenberg B, Cheek DA, Preisser J, Neelon, V, McMurray R, Sueta, C.A. Home-based exercise improves functional performance and quality of life in women with diastolic heart failure. Heart Failure Society of America. Las Vegas, Nevada. September; 2003

State/Regional Presentations (*data-based; +corresponding or senior author; authors underlined are students or mentees; # invited presentations; ^podium presentation)

1. *+^ Irwin C, Murden RJ, Waldrop-Valverde D &**Gary RA**. Predictors of exercise adherence in older persons living with HIV (OPLWH). Podium presentation: Southern Nursing Research Society, March 2019.
2. *+ Irwin C, Murden RJ, Waldrop-Valverde D. **Gary RA**. Walk for life: Predictors of exercise adherence in older persons living with HIV (OPLWH). Poster Presentation at Southern Nursing Research Society; March 2019; Orlando, FL.
3. *+ Irwin C, Murden RJ, Waldrop-Valverde D. **Gary RA**. Walk for life: Predictors of exercise adherence in older persons living with HIV (OPLWH). Poster presentation at Scholars Day, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta GA; April 2019
4. ^**Gary RA**. Developing a career trajectory, managing time and work life balance in the pre-doc and post-doc phases. T-32 roundtable. November 2018.
5. *^ **Gary RA**, Waldrop-Valverde D, Paul S, Corwin EJ, Hepburn K, Williams B. Exercise and Cognitive training to Improve neurocognitive outcomes in persons with heart failure. Blue Bag Seminar, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta GA. Spring 2017
6. *+^**Gary RA**, Waldrop-Valverde D, Corwin E., Butts B, Paul S. Exercise and Cognitive Re-training as a Strategy to Improve Cognitive Outcomes in Heart Failure: Preliminary Data. Blue Bag Seminar. Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta GA., February; 2016.

7. *+Butts B , **Gary RA**. Factors Associated with Performance on A Symptom Limited Exercise Treadmill Test in Persons with Heart Failure. Poster Discussion Presentation, Southern Nursing Research Society, Dallas, TX. February; 2017
8. *Butts B, Reilly CM, **Gary RA** Higgins MK, Dunbar SB. Factors affecting heart failure knowledge and retention after an integrated self-care intervention in persons with heart failure and diabetes. Poster Presentation, Southern Nursing Research Society Annual Conference, Williamsburg, VA. February; 2016.
9. *^Dunbar SB, **Gary RA**, Corwin E, Miller A, Hepburn K, Higgins MK Butler J, Bauer-Wu S. Family Caregiver Intervention Improves Psychological Symptoms in Family Caregivers of Persons with Heart Failure, Southern Nurses Research Society, Tampa Fla. February; 2015.
10. *+^Butts B, **Gary RA**, Dunbar S, Butler, J. Patterns of ASC Methylation are Associated with Ejection Fraction, Quality of Life and Depression in Persons with Heart Failure. Southern Nursing Research Society; February 2015; Tampa, FL.
11. *Higgins MK, Dunbar SB, **Gary RA**, Reilly CM, Butts, B. Modified scoring and analysis approach of the CHAMPS physical activity questionnaire and its relationship to six-minute walk physical functioning. Poster Presentation, Southern Nursing Research Society Annual Conference, Tampa, FL. February 2015.
12. *Butts B, **Gary RA**, Dunbar SB, Higgins MK. Barriers to Exercise in Persons with Heart Failure and Type 2 Diabetes Mellitus. Southern Nursing Research Society. San Antonio, Texas. February; 2014.
13. *+McGee B, Donovan M, Heath A, Hitro E, Rowland A, Serieno J, Scullin R, **Gary R**. Post-Traumatic Stress Disorder Symptoms following Acute Myocardial Infarction as a Predictor of Future Health Outcomes. Southern Nursing Research Society. February 2014; San Antonio, Texas.
14. *+Tomaso S, **Gary RA**, Higgins MK. The influence of exercise on physical and psychological function of family caregivers of persons with heart failure. Poster: Southern Nursing Research Society. San Antonio, Texas. February 2014; Best Student Poster.
15. *Butts B, **Gary RA**, Reilly CM, Culler S, Butler J, Dunbar, SB. Effect of an integrated heart failure and diabetes self-care intervention on quality of life and self-care behaviors. Poster presentation, Southern Nursing Research Society Annual Conference, Little Rock, AR. February; 2013.
17. *Ferranti E, Butler J, Reilly C, **Gary RA**, Culler S. Higgins MK, Dunbar SB. Self-Management of both Heart Failure and Diabetes: Perspectives from Patients and their Family Caregivers. Poster presentation at the Southern Nursing Research Society, Jacksonville, FL, Feb 2011 and the Nell Hodgson Woodruff School of Nursing Research Day, April, 2011.
18. *^Grossniklaus DA, Tohill BC, Frediani J, Lee J, Higgins MK, &**Gary RA**. Depressive symptoms are important correlates of dietary energy density in overweight adults. Southern Nurses Research Society Annual Conference, Baltimore, MD. February; 2010.
19. *^**Gary RA**, Dunbar SB, Clark PC, Cotsonsis GA.. Gender is not associated with depressive symptoms in heart failure. Southern Nursing Research Society. Birmingham, AL. February; 2008
20. *^ **Gary RA**, Dunbar SB, Clark PC, Reilly CM. Depression, physical function and quality of life in heart failure patients. Southern Nursing Research Society. Birmingham, AL. February; 2008.
21. *^Clark PC, Quinn C, **Gary RA**, McCarty F, Kaslow NJ, Smith AL, Dunbar SB. Influence of Perceived Support from Health Care Providers and Family on Depressive

Symptoms in Patients with Heart Failure. Southern Nursing Research Society. Birmingham, AL. February; 2008.

22. *^Reilly CM, Clark PC, **Gary RA** Grossniklaus D, Lindsley K, Smith AL, Dunbar SB. Biobehavioral Correlates of Dietary Sodium Intake in Heart Failure Patients. Southern Nursing Research Society. Birmingham, AL. February; 2008.

23. *^Dunbar SB, Clark PC, Jacobson KL, McCarty F, Smith AL, Kovalchick L, **Gary RA**. Health Literacy in HF Patients and Family Caregivers. Southern Nursing Research Society. Birmingham, AL. February; 2008.

24. *^Dunbar SB, Clark PC, Quinn C, McCarty, F, **Gary R**, Kaslow N, Dashiff, C, Family Functioning and Heart Failure Caregiver Outcomes, oral presentation, Southern Nursing Research Society. Birmingham, AL. February; 2008.

25. *^**Gary, RA**. The psychometric testing of two fatigue instruments in heart failure patients. Nursing Research Conference, Emory University. Atlanta, GA. June; 2006.

26. *#^**Gary RA**. Depression and HF: preliminary findings. Boston Scientific/Guidant Corporation. Minneapolis MN. May; 2006

27. *#^**Gary RA**. Exercise and cognitive behavioral therapy as an intervention for depression in heart failure patients: preliminary findings. EPICORE, Emory University. Atlanta, GA. March; 2006

28. ***Gary RA**, Dougherty MA pilot study comparing bio-impedance and anthropometric measurements in rural frail elders. Southern Nursing Research Society. Fort Worth, Texas. February 1997.

TEACHING ACTIVITIES

Courses Taught

01/2019	NRSG 505: Research and Evidence Based Practice	Coordinator
08/2019	NRSG 710: Health Outcomes Research	Coordinator
01/2018	NRSG 505: Research and Evidence Based Practice	Coordinator
08/2017	NRSG 710: Health Outcomes Research	Coordinator
01/2016	NRSG 505: Research and Evidence Based Practice	Coordinator
08/2015	NRSG 710: Health Outcomes Research	Coordinator
01/2015	NRSG 505: Research and Evidence Based Practice	Coordinator
08/2014	NRSG 710: Health Outcomes Research	Coordinator
01/2014	NRSG 507: Theory and Research Applications	Coordinator
08/2013	NRSG 440: Core Concepts II	Coordinator
01/2013	NRSG 507: Theory and Research Applications	Coordinator
08/2012	NRSG 440: Core Concepts II	Coordinator
08/2012	NRSG 763: Research Seminar and Residency	Coordinator
01/2012	NRSG 340: Core Concepts I	Coordinator
01/2012	NRSG 507: Theory and Research Application	Coordinator
08/2011	NRSG 763: Research Seminar and Residency	Coordinator
08/2011	NRSG 440: Core Concept II	Coordinator
05/2011	NRSG 507: Theory and Research Applications	Coordinator
01/2011	NRSG 471: Professional Development IV:	Leader/Mentor

	Health Policy	
01/2011	NRSG 340: Core Concepts I	Coordinator
05/2010	NRSG 507: Theory & Research: Applications	Coordinator
01/2010	NRSG 507: Theory & Research: Applications	Coordinator
01/2010	NRSG 340: Core Concepts I	Coordinator
08/2009	NRSG 440: Core Concepts II	Coordinator
08/2009	NRSG 370: Professional Development I: Foundations of Professionalism	Mentor Group Leader Coordinator
01/2009	NRSG 474: Research Honors	Coordinator
01/2009	NRSG 340: Core Concepts I	Coordinator
08/2008	NRSG 473: Research Honors	Coordinator
01/2008	NRSG 763: Research Seminar & Residency I	Coordinator
01/2008	NRSG 474: Research Seniors Honors	Coordinator
01/2008	NRSG 371H: Research Junior Honors	Coordinator
08/2007	NRSG 762: Research Seminar & Residency I	Coordinator
08/2007	NRSG 473H: Research Senior Honors	Coordinator
08/2007	NRSG 370: Professional Development I: Professionalism	Mentor Group Leader
08/2007	NRSG 440: Core Concepts II	PBL Leader
01/2007	NRSG 371H: Research Junior Honors	Coordinator
08/2006	NRSG 762: Research Seminar & Residency I	Coordinator
05/2006	NRSG 560B: Cardiovascular Topics: Independent Study Course	Coordinator
01/2006	Tenure Track Research Sabbatical	
08/2005	Tenure Track Sabbatical	
05/2005	NRSG 507: Theory & Research: Applications	Coordinator
01/2005	NRSG 371: Professional Development II: Research	Coordinator
08/2004	NRSG 460M: Clinical Nursing III: Maturing & Aging Adults and Family	Coordinator

Doctor of Philosophy Nursing Advisement

2015-2019 Fekadu Aga (Emory, Addis Ababa University) Dissertation Co-Chair
 Title: Correlates of Type 2 Diabetes Self-Care Behaviors in the Context of Comorbid Heart
 Failure Fogarty Global Health Post-Doctoral Award

2018-present Lemlem Beza (Emory, Addis Ababa University) Dissertation Chair Title:
 Knowledge, attitudes and beliefs surrounding treatment seeking behaviors for persons with acute
 coronary syndrome in Addis Ababa, Ethiopia.

2018-present Semarya Berhe (Emory, Addis Ababa University) Dissertation Chair Title:
 Cervical Cancer Screening Intention among Health care professionals at College of Health
 Sciences in Addis Ababa University; Using Psychometrically Tested Health Belief Model Clued
 by Trans-Theoretical Model: 2020

2013-2016 Brittany Butts (BSN-PhD) Dissertation Co-Chair Title: Effects of Exercise on Epigenetic Regulation of Inflammatory pathways in Persons with Heart Failure

2015-2016 Mary Katherine (MK) Findley Dissertation Chair Title: Risk Factors of Recurrent Hospital Admission for Young Adults Presenting with Hyperglycemic Emergencies at an Inner-City Hospital

2016-present Emebet B. Woldaramian (Emory, Addis Ababa University) Dissertation Chair Title: Feasibility and predictability of the Braden scale for Pressure Injury Risk Assessment by Nurses Working in Government owned Hospitals in Addis Ababa, Ethiopia

2015-present Daniel Mengistu (Emory, Addis Ababa University) Dissertation Chair Title: Knowledge and risk perceptions of cardiovascular disease and risk reduction behaviors among adult hypertensive patients in Addis Ababa, Ethiopia.

2014-2018 Blake McGee (BSN-PhD) Dissertation Chair Title: How does prescription drug spending affect medication adherence, acute care use, and health care costs in heart failure?

2011-2016 Tingting Liu (BSN-PhD) Dissertation Chair Title: Comparison of Biological, Physical, and Psychological Risk Factors for Cardiovascular Disease in Overweight/Obese Individuals with and Without Prediabetes

2004-2009 Daurice Grossniklaus Dissertation Member Title: Factors associated with Energy Dense Food Intake in Overweight Adults

2003-2006 Amy Valderrama Dissertation Reader
Title: Multidimensional factors associated with fatigue in persons with permanent atrial fibrillation

PROFESSIONAL AND UNIVERSITY SERVICE ACTIVITIES

Membership in Professional Organizations		Member
2019-Present	International Network for Doctoral Education in Nursing	
2005-Present	Council for the Advancement of Nursing Science	Member
2005-2011	Gerontological Society of America	Member
2002-Present	Heart Failure Society of America	Member
2002-Present	American Heart Association	Member
1979-Present	Sigma Theta Tau	Member
1985-Present	American Nurses Association, Georgia Nurses Association	Member

Editorships and Editorial Boards

2016-Present	Journal of Geriatric Cardiology	Editorial Board
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Manuscript reviewer

2013-Present	Archives in Physical Medicine and Rehabilitation	Reviewer
2012-Present	Heart	Reviewer

2008-Present	Journal of Cardiac Failure	Reviewer
2008-Present	Western Journal of Nursing Research	Reviewer
2005-Present	Heart Lung: Journal of Acute and Critical Care	Reviewer
2004-Present	Journal of Cardiovascular Nursing	Reviewer

National and International Scientific Review

2018-Present	NIH: Clinical Management of Patients in Community-based settings (CMPC)	
2009-2013	Greater Southeast Affiliate Research Committee, American Heart Association (AHA)	

National Committee Appointments

		Co-Chair
2018-Present	Cardiovascular and Stroke Nursing Council Mentorship	Committee Abstract Reviewer
2012-2018	Scientific Sessions, American Heart Association	Reviewer
2014-2018	AHA, Cardiovascular Disease in Older Populations Committee	Member
2009-2015	Cardiovascular Nursing Council Committee	Awards Committee
2008-2011	Cardiovascular Nursing Council Care of the Complex Patient	Member

Emory University Service

2012-Present	Scientific Advisory Council	Member ADHOC
2012-Present	Atlanta Clinical Translational Science Institute	Member
2012-2015	University Senate and Faculty Council	Member Board
2012-2015	Center for Faculty Development and Excellence	Member,
2006-2012	Scientific Advisory Council	Member
2006-2012	Atlanta Clinical Translational Science Institute formerly General Clinical Research Committee	Reviewer

Nell Hodgson Woodruff School of Nursing Service

	Emory-Addis Ababa University	PhD in Nursing	Program Director
2016-Present	Research Committee		Chair
2016-2018	Ad hoc BSN Curriculum Committee		Member
2014-2016	Student Success and Monitoring Committee		Chair
2013-Present	T-32 Executive Search Committee		Board Member
2013-Present	PhD Executive Committee		Board Member
2012-Present	PhD Curriculum Committee		Member
2012-2014	PhD Admission Committee		Member

2012-2014	Admission Committee	Chair
2012-2014	Woodruff Scholar	Selection Committee
2012-2014	FULD Scholar	Selection Committee
2012-2013	PhD SACS	Review Committee
2011-Present	FACPT Committee	Member
2011-2012	Admission Committee	Co-Chair
2009-2011	Curriculum Committee	Chair
2007-2009	Curriculum Committee	Member

ROSE LEE WYNNE MURPHREE, DNP, MSN, RN, CWOCN, CFCN

Assistant Professor, Clinical Track Nell Hodgson Woodruff School of Nursing

Emory University

Telephone: (404) 772-3007

Email: Rose.Murphree@emory.edu

EDUCATION

Degrees

2012-2014	Georgia Regents University Augusta, GA	DNP
2008-2011	Emory University Nell Hodgson Woodruff School of Nursing Atlanta, GA	MSN
1981-1983	Mobile College Mobile, AL	BSN
1978-1980	Mobile Infirmary - Mobile College Division of Nursing Mobile, AL	ADN

Non-Degree Programs

2015	Supervisor Development Program Emory University
1996	Parish Nursing Program Saint Joseph's Hospital, Atlanta, GA
1987	Enterostomal Therapy Nursing Education Program Emory University

LICENSES AND CERTIFICATIONS

1986 – Present	Registered Nurse, Georgia	RN080337
2004 – Present	Wound, Ostomy and Continence Nursing Certification Board: CWOCN, CFCN CWCN: Certified Wound Care Nurse COCN: Certified Ostomy Care Nurse CCCN: Certified Continence Care Nurse CFCN: Certified Foot Care Nurse	

HONORS AND AWARDS

2017	Team Excellence Award, Nell Hodgson Woodruff School of Nursing, Atlanta, GA
2016	Academic Education Finalist March of Dimes Nurse of the Year, Georgia
2016	#LivingOurValues winner (August) Nell Hodgson Woodruff School of Nursing, Atlanta, GA
2014	Who's Who Among University Students Georgia Regents University
2014	Phi Kappa Phi Inductee Chapter 324, Georgia Regents University
2009	Sigma Theta Tau International Inductee Alpha Epsilon Chapter, Emory University
2004	Outstanding Employee of the Month North Fulton Regional Hospital

PROFESSIONAL POSITIONS (WORK HISTORY)

2015-Present	Lead Nurse Planner	Emory Nursing Professional Development Center Accredited Provider Unit (ENPDC) Atlanta, GA
2015-Present	Assistant Professor, Clinical Track	Emory University's Nell Hodgson Woodruff School of Nursing Atlanta, GA
2014-2019	WOCNEC Program Director	Emory University's Nell Hodgson Woodruff School of Nursing's Wound, Ostomy, and Continence Nursing Education Center (WOCNEC) Atlanta, GA
2012-2014	WOCNEC Assistant Director	Emory University's Nell Hodgson Woodruff School of Nursing's Wound, Ostomy, and Continence Nursing Education Center (WOCNEC) Atlanta, GA
2008-Present	Legal Nurse Consultant	Legal Nurse Consultant, Alpharetta, GA

2006-2012	WOCNEC Instructor	Emory University's Nell Hodgson Woodruff School of Nursing's Wound, Ostomy, and Continence Nursing Education Center (WOCNEC) Atlanta, GA
2006-2014	WOC Nurse Clinical Consultant	The Emory Clinic in collaboration with WOCNEC Atlanta, GA
2004-2006	WOC Nurse	North Fulton Regional Hospital Roswell, GA
2002-2004	Rehab Unit charge nurse	North Fulton Regional Hospital Roswell, GA
2001-2004	Rehab Unit staff nurse	North Fulton Regional Hospital Roswell, GA
1999-2002	Paraprofessional	Northwestern Middle School Alpharetta, GA
1997-2010	Volunteer Office Manager	International Commodity Trading, Inc. Alpharetta, GA
1996-1997	Parish Nurse	Saint Joseph's Hospital of Atlanta Saint Anne's Episcopal Church Atlanta, GA
1995-1996	WOC Nurse	Visiting Nurse Health System Atlanta, GA
1992-1995	1994-1995 Oncology staff nurse; 1992-1994 WOC Nurse	Saint Joseph's Hospital of Atlanta Atlanta, GA
1987-1991	ET Nurse	Cobb Hospital and Medical Center Austell, GA
1986-1988	ICU staff nurse	Henrietta Egleston Hospital for Children Atlanta, GA
1985-1986 01-03, 1983	Nursing Supervisor	Jackson Hospital Marianna, FL
1984-1985 08-11, 1983	Staff Nurse-ICU, Emergency Room; RN Consultant	King Fahad Hospital, S.A.N.G. Riyadh, The Kingdom of Saudi

Arabia

1980-1983	1981-1983 ICU Charge nurse; 1980-1981 Graduate Medical Tech; 05-09, 1980 Temporary RN	Doctor's Hospital Mobile, AL
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SCHOLARSHIP: GRANTS AND OTHER FUNDING

External Program Grants

Emory Nursing Academic-Practice Partnership in Primary Care [CAPACITY]. (Kimble, L. P., Project Director), **Murphree, R.** (Co-investigator, 10% effort). Division of Nursing, Health Resources and Services Administration (HRSA). Nurse Education, Practice Quality and Retention Grant. Total Costs: \$2,731,285. Proposed Funding Period. July 1, 2018-June 30, 2022.

SCHOLARSHIP: PUBLICATIONS

Original Articles in Peer-Reviewed Journals data based publications denoted with a *, senior or first author publications with +, student or faculty mentee with an underline.

***+Murphree, R. W.** (2017). Impairments in skin integrity. *Nursing Clinics of North America*, 52, 405-417. PMID: 28779822. doi: 10.1016/j.cnur.2017.04.008

***+Murphree, R. W.** (2009). Allogenic acellular dermal matrix in the management of an enterocutaneous fistula: WOC nurse challenges. *Journal of Wound, Ostomy, and Continence Nursing* 36, 674-678.

***Doughty, D., Hays, S., & Wynne, R. L.** (1990). Charging for services: efficiently, effectively, and easily. *Journal of Enterostomal Therapy*, 17, 10-13

Non Peer-Reviewed Publications

Murphree, R. W. (2004-2006). WOC nursing corner: monthly article in the Housewide Notes, a facility publication for North Fulton Regional Hospital.

Book Chapter

Murphree, R. W., & Jaszarowski, K. A. (2020, pending publication). Professional practice for the wound care nurse. Wound, Ostomy and Continence Nurses Society® Core Curriculum: Wound Management (2nd Ed. McNichol, L. and Yates, S., eds.) LWW, Philadelphia, PA. ISBN pending.

Murphree, R. W., & Jaszarowski, K. A. (2020, pending publication). Professional practice for the Ostomy care nurse in Wound, Ostomy and Continence Nurses Society® Core Curriculum: Ostomy Management (2nd Ed. Goldberg, M. ed.) LWW, Philadelphia, PA. ISBN pending.

Murphree, R. W., & Jaszarowski, K. A. (2020, pending publication). Professional practice for the continence care nurse in Wound, Ostomy and Continence Nurses Society® Core Curriculum: Wound Management (2nd Ed. Ermer-Sultan, J., eds.) LWW, Philadelphia, PA. ISBN pending.

Murphree, R. W., & Jaszarowski, K. A. (2020, pending approval). Wound cleansing and dressing selection in Wound, Ostomy and Continence Nurses Society® Core Curriculum: Wound Management (2nd Ed. McNichol, L. and Yates, S., eds.) LWW, Philadelphia, PA. ISBN pending.

Jaszarowski, K. A., & **Murphree, R. W.** (2016). Wound cleansing and dressing selection in Wound, Ostomy and Continence Nurses Society® Core Curriculum: Wound Management (1st Ed. Doughty, D. and McNichol, L., eds.) LWW, Philadelphia, PA. ISBN-10: 1451194404 ISBN-13: 978-1451194401

Research Abstracts and Proceedings

Murphree, R. W. & Jaszarowski, K. (2020). Innovations in peristomal health restoration: case study exploration. Abstract pending approval. 2020 World Council of Enterostomal Therapists International Congress. Glasgow, Scotland.

Murphree, R. W. & Dees, J. (2009). Ostomy-psychosocial and quality of life aspects: 3252: Fistula care-not just containment of effluent. *Journal of Wound Ostomy Continence Nursing*. 36(3S). Supplement: S21. Abstract. Poster at 2009 WOCN Society National Conference.

Timms, C., **Murphree, R. W.** (2007). Complex wound closure using negative pressure therapy to facilitate granulation and provide a surface for pouching a compromised colostomy site. *Journal of Wound Ostomy Continence Nursing*. 34(3S) Supplement: S11-S12. Abstract. Poster at 2007 WOCN Society National Conference.

Instructional Booklet

Emory WOCNEC Faculty Team. (2010-2019). Pocket pals for WOC nurses. Annual Updates. Emory University, Atlanta, GA.

Emory WOCNEC Faculty Team. (2006-2019) Course lecture notes for WOC nurses. Annual Updates. Emory University, Atlanta, GA.

SCHOLARSHIP: PRESENTATIONS (Note: # denotes Keynote Speaker, ^ denotes podium presentations, and ‡ denotes invited expert presentation)

International Presentations

- ‡Murphree, R. W. (March, 2016). *Current wound care concepts for the nurses of the Bahamas*. Presented to nurses in Nassau and Eleuthera for the Bahamas Ministry of Health in Nassau and Eleuthera, Bahamas.
- ‡Murphree, R. W. (September, 2014). *Complete and holistic WOC education program*. Presented to doctors and nurses of Asian countries at the Inaugural International Colorectal Research Summit 2014 in Seoul, Korea.

National Presentations

- ‡Murphree, R. W. (June, 2014). *Music to the advance practice nurse's ears: Pharmacology made easy—ostomy component*. Presented to WOC nurses and other healthcare professionals at the WOCN® 46th Annual Conference in Nashville, TN.
- ‡Murphree, R. W. (June, 2009). *Just a Spoonful of Sugar*. Presented during Nightmares on ET street segment to WOC nurses and other healthcare professionals at the 41st WOCN® Society National Conference in St. Louis, MO.
- ‡Wynne, R. W. (October, 1987). *ICU psychosis and the pediatric patient*. Presented to attendees at the American Association of Critical Care Nurses (AACN) Symposium in Atlanta, GA.

Local, State, and Regional Presentations

- ‡Murphree, R. W. (October, 2019). *Wound care*. Presented principles and challenges of wounds to healthcare providers attending the 2019 Unity Conference: Leading Change through Collaborative Influence in Atlanta, GA.
- ‡Murphree, R. W. (October, 2019). *Wound management*. Presented management options for wounds to healthcare providers attending the 2019 Unity Conference: Leading Change through Collaborative Influence in Atlanta, GA.
- ‡Murphree, R. W. (October, 2019). *Bringing our ostomy heritage into today's healthcare*. Presented to healthcare providers and WOC nurses who attended the 2019 Southeast Region Wound, Ostomy and Continence Nursing Society 43rd Annual Conference: Enhancing WOC Nursing – Bridging Our Past to Our Future in Columbus, GA.
- ‡Murphree, R. W. (February, 2018). *Have you fallen down the rabbit hole?* Professional considerations about WOC nursing presented to the attendees at the 2018 Florida Association of Enterostomal Therapists Annual Conference: Alice in Wonderland in Orlando, FL.
- ‡Murphree, R. W. (November, 2016). *Beyond the classroom: Wound care in theory and in practice*. Georgia Family Physicians' 2016 Hospital Acquired Conditions Conference, Atlanta, GA
- ‡Murphree, R. W. (2016-2018). *Nurse planner education*. Presented to Emory Healthcare and Nell Hodgson Woodruff School of Nursing nurses multiple times in Atlanta, GA.
- ‡Murphree, R. W. (November, 2014). *Current wound care management*. Presented to physicians and other healthcare providers attending the 2014 Georgia Family Physicians Annual Scientific Assembly of Georgia Association of Family Physicians in Atlanta, GA.

- ‡Murphree, R. W. (2015, 2016). *Current wound care management*. Presented multiple times to the salesforce and nurses attending the Monlycke Sales Team Updates in Atlanta, GA
- ‡Murphree, R. W. and Srinivasan, J. (September, 2012). *Bariatric ostomy surgical care: Pre-op, intra-op, and post-op considerations*. Presented to WOC nurses and other attendees at the 2012 Southeast Region WOCN Conference: WOC Nurses Embracing Change with Southern Grace in Savannah, GA.
- ‡Murphree, R. W. (2004-2006). *What can I do for this wound?* Presented to the healthcare staff of North Fulton Regional Hospital in Alpharetta, GA.
- ‡Murphree, R. W. (September, 1993). Changing times: The future of wound care in America. Presented to multiple persons from industry, nursing, and other facets of health care as one of four panelists for discussion at National Institute for Health and Clinical Excellence/Medtrade Exposition in Atlanta, GA.
- ‡Murphree, R. W. (April, 1993) Orthotrophic bladders: Something new. Presented to Emory ETNEP staff. Atlanta, GA.
- ‡Wynne, R. L. (May, 1991). *What can I do for this wound?* Presented to the healthcare staff of Georgia Physical Therapy, Inc. in Austell, GA.
- ‡Wynne, R. L. (January, 1989). *Skin, wound, and ostomy care seminar*. Presented to the nursing staff at the ABC Home Health Services, Inc. in Atlanta, GA.
- ‡Wynne, R. L. (March, 1987). Multiple trauma patient: The ICU nurse's responsibility. Presented to nurses, interns, and physicians at Henrietta Egleston Hospital for Children, Inc. in Atlanta, GA.

TEACHING ACTIVITIES

Courses Taught at NHWSN

Dates	Name of Course	Role in course
2019-Summer	N554 Advanced Neonatal and Pediatric Health Assessment	Guest Lecturer: Skin Concerns for NNPs
2019-Summer	N405 Alternative Spring Break: Moultrie Migrant Farm Workers Group	Guest Lecturer: Approaches to Foot Care and Wound Care
2019-Summer	N405 Alternative Spring Break: CAPACITY ABSN group	Guest Lecturer: Approaches to Wound Care
2017-Spring	N405 Alternative Spring Break: Moultrie Migrant Farm Workers Group	Guest Lecturer: Approaches to Foot Care
2016-Fall	N480 Alternative Winter Break: Kingston, Jamaica Group	Guest Lecturer: Wound Care with Limited Resources
2016-Present	N683 Human Sexuality in Health and Illness	Guest Lecturer: Sexual Concerns with Ostomy Surgery
2016-Spring	N480 Alternative Spring Break: Eleuthera, Bahamas Group	Guest Lecturer: Wound Care with Limited Resources
2015-Spring	N480 Alternative Spring Break: Dominican Republic Group	Guest Lecturer: Wound Care with Limited Resources
2014 -Present	N645 Advanced Ostomy Management—online every semester	Course Coordinator

2014- Present	N644 Advanced Continence Management—online every semester	Course Coordinator
2014- Present	N646 Advanced Wound Management—online every semester	Course Coordinator
2014-Spring	N544 Advanced Health Assessment—ENP Course	Guest Lecturer: Foot Care and Burn Care
2010-Present	N683 Human Sexuality in Health and Illness (across multiple semesters)	Guest Lecturer: Sexual Concerns with Ostomy Surgery
2008-Present	N360 Nursing Fundamentals (across multiple semesters)	Guest Lecturer: Advanced Wound Care Concerns
2006-2019	WOCNEC	Instructor and Course Coordinator

Courses Taught at Emory School of Medicine

Dates	Name of Course	Role in course
2019 -Fall	DPT810 Adult Neurorehabilitation	Guest Lecturer: Bowel and bladder management in neurologic populations

Doctor of Philosophy in Nursing Advisement

2016-Present	Dissertation Committee Co-Advisor for Emebet Berhane. Testing the Braden scale for Pressure Injury Risk Assessment by Nurses in Ethiopia: Feasibility Study.
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Doctor in Nursing Practice Advisement

2018-Present	DNP Quality Improvement Project Committee Chair for Elizabeth Woods. Implementation of a Pressure Injury Prevention Bundle in a Medical Intensive Care Unit.
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PROFESSIONAL AND UNIVERSITY SERVICE ACTIVITIES

Membership in Professional Organizations

Dates	Name of organization	Role(s)
1987-Present	Wound, Ostomy and Continence Nurse Society™ (WOCN®)	Member; 2016-2018 Secretary; 2014-2016 WOC Nursing Education Program Director Liaison; 1993-1996 Region 4 Director
1987-Present	Southeast Region WOCN®	Member; 1992 Fundraising Committee Chairperson 1989-1991 Policy & Procedure/By-Laws Chairperson; 1992 United Ostomy Associates Youth Rally Committee Chairperson; 1991 National Conference Planning Committee Liaison; 1990-1992 Director

2000-Present	World Council of Enterostomal Therapists	Member; 2019-Present USA International Delegate
2008-Present	Sigma Theta Tau, International	2017-2018 Alzheimer's Walk Coordinator; 2016-present Finance Committee Chairperson; 2011-2016 Treasurer; 2010-2011 Policy and Procedure/By-Laws Manual Chairperson; 2009-2010 Policy and Procedure/By-Laws Manual Committee
2014-Present	American Nurses Association	Member
2014-Present	Georgia Nurses Association	Member
2014-Present	Phi Kappa Phi	Member
Manuscript Reviewer		
2018-2019	Peer Reviewer, manuscript submissions to JWOCN®	
2016	Peer Reviewer, WOCN® Society's 1026 Guideline for Prevention and Management of Pressure Ulcers	
2008	Reviewer/Content Validation, WOCN® Society's Pressure Ulcer Evaluation and Documentation Clinical Document Task Force	
Poster Judge		
2019	Poster Judge, 2019 New Directions Conference	
2015-Present	Poster Judge, WOCN® Society's National Conference Poster Session	
Emory University Service		
2019-Present	Learning Outcomes Assessment Committee	Member
2020	Emory Joint Accreditation Task Force	ENPDC/NHWSN representative
Nell Hodgson Woodruff School of Nursing Service		
2020	Education Technology Committee	Member
2020	National League of Nursing Center of Excellence Task Force	Member; Criterion 4 author
2019-Present	School Life Committee	Co-Chair
2019	Curriculum Committee: MN Program Task Force	Member
2019	Curriculum Committee: MN Sub Task Force, Semester 2	Co-Chair
2017-Present	Curriculum Committee	Member
2016	Alternative Winter Break Clinical Experience: Kingston, Jamaica (December)	Clinical Instructor
	Alternative Spring Break Clinical Experience: The	Clinical Instructor

2015-2016	Bahamas (March) Emory Nursing Professional Development Accreditation Task Force	Chair
2014-2017	Dean's Education Council	Member
Other Community Service		
2018	Eternal Hope in Haiti Cap Haitien, Haiti (June)	Medical Team Volunteer
2017	Eternal Hope in Haiti Cap Haitien, Haiti (December)	Medical Team Volunteer
2015-Present	Mercy Care Atlanta, Atlanta, GA	Medical Team Volunteer
2009-Present	Lazarus Ministries' Annual Health Day for Homeless, Atlanta, GA	Wound/Foot Team Coordinator
2006-2019	Atlanta Area WOC Nurse Consortium Atlanta, GA	Journal Club Coordinator
1987-Present	Muscular Dystrophy Association Atlanta, GA	1987-Present Medical Team Coordinator/Summer Camp Nurse, Camp Twin Lakes, Rutledge, GA 2002-2010 Key Volunteer Coordinator, Labor Day Telethon 1990-2001 Phone Room Supervisor, Labor Day Telethon 1988-1990 Green Room Volunteer, Labor Day Telethon 2009-Present ALS Night of Hope Gala Volunteer 2012-2014 Nominations Chairperson 2008-2012 Vice President 2006-2008 Communications Coordinator
2006-2014	United Methodist Women Atlanta Roswell District, Atlanta, GA	PTA member; Band Booster; 2001-2004 Band Camp Nurse
1999-2004	Milton High School Parent Volunteer Alpharetta, GA	
1996-Present	American Cancer Society, South Cobb Unit, Austell, GA	Volunteer
1989	Community Cholesterol and BP Screening for Cobb County	Volunteer
1988-1990	Community Outreach Program, Cobb Hospital Austell, GA	CPR Course; 09/1989 Diabetic Support Group Panelist for Diabetic Care; 02/1990, 08/1990 Diabetic Foot Care Presentation

Curriculum vitae (Wondwossen Amogne Degu)

Academic rank: Associate Professor in Internal Medicine & Infectious Diseases, Addis Ababa University, School of Medicine (MD, PhD)

Date of birth: March 13, 1966

Marital status: Married, father of three children.

Nationality: Ethiopian

Address: Addis Ababa, Addis Ketema subcity, Kebele 17, House number 021

P.O. Box 25311, Addis Ababa, Ethiopia (Private)

Tel. 2511-12-761287(home), 2519-11-406179(mobile)

E-mail address wonamogne@yahoo.com, wondwossen@hotmail.com

Fax : 2511-11-5513099

1. EDUCATION

- Africa union Elementary and Junior secondary school, A.A (1972-1979)
- Medhane Alem Comprehensive Secondary School, A.A (1980-1983)
- Addis Ababa University, School of Medicine, College of Health Sciences
 - Doctorate degree in Medicine (1983/84-1990)
 - Specialty training in internal Medicine (1994-1996)
 - Sub-specialty training in Infectious Diseases (2010-2012)
- Certificate in clinical research methods (Addis Ababa University, School of Medicine in collaboration with the University of California, San Diego). June 2011- June 2013
- Karolinska Institute, Stockholm, Sweden, PhD (Infectious Diseases). Dec 2007-Dec 2015

2. AWARDED ACADEMIC CREDENTIALS

- 2.1. Very great distinction, Ethiopian School Leaving Certificate Examination, 1983
- 2.2. Degree of Doctor of Medicine, MD (March, 1990)
- 2.3. Specialty certificate in Internal Medicine (April, 1996)
- 2.4. Sub-specialty certificate in Infectious diseases (March 2012)
- 2.5. Certificate in clinical research methods (2013)
- 2.6. Associate Professor in internal medicine (December 2013)
- 2.7. PhD in Infectious Diseases (Dec 2015)
- 2.8. The best scientific paper at the 51st Ethiopian Medical Association Annual meeting, Feb 2015 (given certificate and money award)
- 2.9. The best scientific paper (gold medal, certificate and money award), 52nd Ethiopian Medical Association meeting, Feb 2016
- 2.10. Selected as their best instructor by the graduating residents in internal medicine, 2018

3. COURSES, NATIONAL AND INTERNATIONAL WORKSHOPS & MEETINGS ATTENDED

- 3.1. Optimal use of antiretroviral drugs (June-September, 2002) at National Institute for Infectious diseases, Lazzaro Spallanzani, Rome, Italy.
- 3.2. Training Course on Antiretroviral therapy, organized by Ministry of Health (MOH), Drug Administration and Control Authority (DACA) and HIV/AIDS Prevention & Control Office (HAPCO), September 01-05, 2003
- 3.3. HIV/ AIDS management program: Training of the Trainer, The John Hopkins University School of Medicine, AIDS Service, February – March, 2004
- 3.5. Pan-African HIV experts meeting, Cape Town, September 8-11, 2005
- 3.6. Coartem regional meeting, Mombasa, Kenya (Novartis), October 7-9, 2005.

- 3.7. Pan-African HIV experts meeting, Nairobi, Kenya, June 15-18, 2006
- 3.8. Certificate of Participation, Advanced ARV Treatment Workshop PharmAccess Foundation, Issued Nov 9th 2005, Nairobi, Kenya
- 3.9. Certificate of Completion in distance-based learning on Disease Management-Immune System and Infection, Issued 18th July 2005.
- 3.10. Certification of Completion, Training of Trainers on ART for Physicians organized by ITECH- Ethiopia, Supported by HIV/AIDS Prevention & Control Office (HAPCO)/MOH, Columbia University & John Hopkins University, January 24-28, 2006
- 3.11. WHO- First MDR-TB Training Course for the African Region, October 16-20, 2006, Dar es Salaam, Tanzania.
- 3.12. HIV/AIDS Care and Management of Anti-retroviral Therapy for Doctors in Africa, December 11th – December 15th, 2006, Infectious Disease Institute, Kampala, Uganda
- 3.13. New Strategies in the treatment of HIV infected patients Portugal, Lisbon, April 27th – 29th, 2007
- 3.14. Care 5 Meeting, 5th HIV/AIDS Management exchange workshop, April 2nd-3rd 2008, Kampala, Uganda.
- 3.15. The 53rd Annual Philip A. Tumulty Topics in Clinical Medicine at Johns Hopkins University, Baltimore Maryland (May 5-9, 2008)
- 3.16. 18th Annual Conference for Clinical Care of the Patient with HIV Infection Johns Hopkins University, Baltimore, Maryland, USA (May 15-16, 2008)
- 3.17. Pharmacogenetics of Drug Metabolism, 22-26 June 2009, Nairobi, Kenya, Organized by African Institute of Biomedical Science & Technology and University of Nairobi
- 3.18. Human subject protection & Research Procedural Training, November 10-11, 2007, Organized by Ethiopian Science & Technology Agency (ESTA) and JHU-TSEHAI
- 3.19. Course in Good Clinical Practices (GCP), 24-25 January 2009, jointly organized by Karolinska Institute and Addis Ababa University, Medical Faculty

- 3.20. Training on Systematic reviews of Evidence organized by the WHO Health Organization in Collaboration with the University of Gent, Belgium, September 7-18, 2009
- 3.21. Eighth International Conference on the Pathogenesis of Mycobacterial Infections. June 30-July 3, 2011, Stockholm, Sweden
- 3.22. Certificate of attendance: IAS 2011, 17-20 July, Rome, Italy
- 3.23. 19th Conference on Retroviruses and Opportunistic Infections (CROI), Seattle, WA, March 5-8, 2012.
- 3.24. Grant writing workshop, organized by EMORY University at the School of Medicine, AAU, July 1-5, 2013
- 3.25. The 11th congress of World Federation of Societies of Intensive and Critical care Medicine, WFSICCM Durban, South Africa, 28th August until 1st September 2013
- 3.26. The International Liver Congress 2014, EASL, London April 9-10, 2014
- 3.27. Emergency preparedness and response for the Ebola virus disease outbreak, World Health Organization, Brazzaville, Congo, 26-28 August 2014
- 3.28. Collaborative Institutional Training Initiative (CITI), biomedical research-basic/refresher Curriculum completion report, 09/05/2014
- 3.29. Glasgow HIV conference, 2-6 November 2014, Glasgow, Scotland
- 3.30. The 12th congress of the World Federation of Societies of Intensive and Critical Care Medicine, WFSICCM Seoul 2015, 29 August-1st September 2015
- 3.31. 2015 ARV consolidated Guidelines, Clinical Guideline Development Group (Geneva, Switzerland), member of the WHO HIV guideline development group. 1-5 June, 2015
- 3.32. Global Health Diagnostic Course July 6-10, 2015, McGill Global Health Program, Montreal, Canada
- 3.33. 5th Advanced TB Diagnostic Research Course July 13-17, 2015, McGill Global Health Program, Montreal, Canada
- 3.34. Certificate of attendance: IAS 2015, July 19-22, Vancouver, Canada
- 3.35. The 7th MSD Infectious Diseases Update, Johannesburg, South Africa, 30th October 2015-1st November 2015.

- 3.36. Gilead sponsored African viral hepatitis submit, 18-20 January 2016, Dakar, Senegal
- 3.37. 4th PFIZER African and Middle East FOCUS on community acquired respiratory tract Infections, February 19-20, Casablanca, Morocco.
- 3.38. 6th Infection Control Africa Network Congress (205) 2016, South Africa, Johannesburg: 25- 28 September 2016.
- 3.39. African Antifungal strategic advisory board meeting 2017, South Africa, Johannesburg: 20-21 July 2017 (organized by GILEAD Sciences)
- 3.40. Federation of Infectious Disease Societies of Southern Africa (FIDSSA) congress in South Africa: 9-12 November 2017
- 3.41. 10th MSD Infectious Disease Update, Johannesburg, South Africa, 20-22 July, 2018
- 3.42. Second International conference on (206) emerging infectious diseases. Addis Ababa, Ethiopia. 13-15 March 2019.
- 3.43. Expert input forum HIV in South East Africa, Johannesburg, South Africa, 25-26 October 2019

4. WORKING EXPERIENCE

- 4.1. General practitioner at the Armed Forces General Hospital, A.A. (1990-1993)
- 4.2. Chief Resident in Internal Medicine, 1996
- 4.3 Medical Director and head department of internal medicine at Gondar Armed Forces Hospital (1996-1998)
- 4.4 Consultant Physician in Internal Medicine and Infectious diseases at Addis Ababa University, School of Medicine, since 1999 (with academic rank of Associate Professor since 2011).
- 4.5. Head Hematology Unit, Addis Ababa University Medical Faculty, Internal Medicine department, 2003- June 2005
- 4.6. External examiner in Internal Medicine at the Jimma Institute of Health Sciences for final year medical students, 2001
- 4.7. Head of Division of Infectious diseases and HIV medicine, Department of Internal

medicine, School of medicine, AAU since June 2006.

4.8. Senior advisor for adult ART Program at John Hopkins University, Tsehai project Addis Ababa March 2006- December 2013

4.9. External examiner for:

4.9.1. MPh thesis entitled Assessment of the Prevalence of adverse drug reaction among HIV infected adults on antiretroviral therapy and factors associated with it at Zewditu Memorial Hospital, Assegid Tassew Mengistu, MD, February 2007, Department of community health, Addis Ababa University, School of Medicine.

4.9.2. MSc thesis entitled Effect of antiretroviral therapy on immunological response to Hepatitis B vaccine in HIV infected children in Addis Ababa, Ethiopia.

4.9.3. MSc thesis entitled evaluation of ceftriaxone utilization in medical and emergency wards of Tikur Anbessa Hospital”

4.9.4. MSc thesis entitled antimicrobial prophylaxis in surgical patients in Tikur Anbessa Specialized Referral Hospital.

4.9.5. PhD thesis entitled Effects of HIV/AIDS on the education sector and the responses to mitigate the epidemic in Addis Ababa, Ethiopia. Addis Ababa University, College of Health Sciences, School of Public health, October 2015.

4.9.6. PhD thesis entitled Hospital Acquired Infections and Infection Prevention Practices in Teaching Hospitals in the Amhara Regional State in Ethiopia. Addis Ababa University, College of health sciences, School of Public Health, May 2017.

4.9.7. PhD thesis entitled Depression among people with Tuberculosis: Determinants, Course, and its impact on treatment outcome of Tuberculosis in Ethiopia. Addis Ababa University, College of Health Sciences, School of Medicine, Department of Psychiatry, August 23, 2017

4.9.8. PhD thesis entitled Human Immunodeficiency Virus Type-1 Infection in South Omo of Southern Ethiopia: Studies on genetic diversity, drug resistance mutations and treatment outcomes. Aklillu Lemma Institute of

Pathobiology, School of Graduate Studies, Tropical and Infectious Diseases.

- 4.10. Has served at various committees giving technical assistance for the National HIV/AIDS Programs Coordinating Office (HAPCO) and Ethiopian Ministry of Health since 2007.
- 4.11. Member of the scientific advisory committee, ICASSA 2011, FMOH
- 4.12. Member of the WHO HIV treatment guideline group 2015
- 4.13. Tikur Anbessa Specialized Referral Hospital, Infection Prevention and Control Committee, Chairman, 2016-
- 4.14. External examiner for final year internal medicine residents of Mekelle University, College of Health Sciences, August 20, 2018
- 4.15. Editorial board of the Journal of Clinical Tuberculosis and other Mycobacterial Diseases, Assigned on September 2018.
- 4.16. External examiner for final year internal medicine residents of St. Paul's Millennium Medical College, October 2018
- 4.17. Director Research and Technology Transfer, College of Health Sciences, Addis Ababa University, January 2019

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Appendix F: Declaration

Letter for Declaration of the Dissertation

I, the undersigned, declared that this dissertation work is my original work and has never been presented to any other institution or university for the award of any Degree, Diploma, or Certificate. All resources of information, material, and contributions from others have been duly acknowledged and referenced. I take full responsibility for the content and findings of the dissertation work.

Name: Emebet Berhane Woldemariam

Signature:  Date: 15/ 08/ 2025

Place: Addis Ababa University, College of Health Science, School of Nursing and Midwifery
Addis Ababa, Ethiopia.

This dissertation has been submitted for examination with my approval as University supervisor:

Name: **Dr. Rose W Murphree**, (CWO CN, DNP, RN), Assistant professor, **Primary Advisor**

Signature:  Date: 08/30/2025

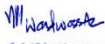
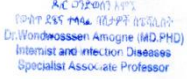
Place: Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, USA

Name: **Dr. Rebecca A. Gary (RN, PhD, FAHA, FAAN)**, Professor

Signature:  Date: 08/22/2025

Place: Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, USA

Name: **Dr. Wondwossen Amogne Degu** (MD, PhD), Associate professor

Signature: 
 Date: 08/26/2025

Place: Addis Ababa University, College of Health Science, School of Medicine, Addis Ababa, Ethiopia.

Name: **Dr. Melinda K Higgins**, (PhD, Research track, Biostatistics and Data Core Director), Professor

Signature:  Date: 09/08/2025

Place: Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, USA

Appendix G: Granted Permission for the Braden Scale (Checklist)



Date: July 17, 2019

To: ~~Emebet Berhane, PhD Nursing Student – Addis Ababa & Emory University~~

From: Barbara Braden, PhD, RN, FAAN, Nancy Bergstrom, PhD, RN, FAAN

RE: Permission to use the Braden Scale*

As holders of the official copyright for the Braden Scale, we hereby grant permission for the use of the scale in your dissertation research testing the acceptability and feasibility of using the Braden Scale in ICU nurses.

*It is understood that the tool must be printed as it appears on the Braden Scale website (www.bradenscale.com) and that no changes will be made to the following: The title, "The Braden Scale for Predicting Pressure Sore Risk," the wording and scoring of the tool including the subscales, and the attribution and copyright information with the acknowledgement, "Copyright, Barbara Braden and Nancy Bergstrom, 1988. ~~Reprinted with permission. All rights reserved.~~"

**Permission is granted for this purpose only. Additional permission is required for other uses. We are in the process of a business transition. As such, any additional permission might be considered and granted by a new owner.

Handwritten signatures of Barbara Braden and Nancy Bergstrom in black ink.

Standardized pressure ulcer risk assessment scale

Overview of pressure injury

Pressure injury: is known as pressure ulcer, pressure sore, bedsore, or decubitus ulcer. It is defined as a local injury to skin and underlying tissue resulting from prolonged pressure on the skin; usually affect people confined to bed or who sits on chair/wheelchair for prolonged time; and occur over bony prominent areas such as the heels, ankles, hips and sacral area.

Bundle of Best Practices to prevent Pressure Injury

- Pressure injury prevention practices checklist includes:
 - ☐ Standardized pressure injury risk assessment practice
 - ☐ Comprehensive skin assessment practice
 - ☐ Care planning and implementation to address areas of risk

Standardized pressure ulcer risk assessment e.g. Braden Scale

- Braden Scale: - is an evidence-based assessment tool used to predict/forecast the risk of pressure injury/ulcer development. Braden scale is developed by Barbara Braden and Nancy Bergstrom in 1987.
- Purpose: helps health professionals such as, nurses to assess a patient's risk for developing pressure injury that helps to prioritize pressure ulcer preventive care.
- The Braden scale assesses risk factors in six categories:
 - Sensory perception: ability to respond meaningfully to pressure related discomfort
 - Moisture: degree to which skin is exposed to moisture
 - Activity: degree of physical activity
 - Mobility: ability to change and control body position
 - Nutrition: useful food intake pattern
 - Friction & shear: degree of problems
- Braden Subscales: each subscale is scored from 1 to 4, except friction/shear that scores 1 to 3; the total score ranging from 6 to 23.

Interpretation of the Braden scale score based on the total sum of the scale and the risk level is classified as follow:

Classification

- **Very high-risk:** refer to the score 9 or less.
- **High risk:** refers to the score 10 to 12
- **Moderate risk:** refers to the score 13 to 14
- **Mild risk:** refers to the score 15 to 18
- **No risk:** refers to the score 19 or greater.

Braden Scale Checklist

Risk factors	1.	2.	3.	4.	Score
Sensory perception ability to respond meaningfully to pressure related discomfort	1. Completely limited Unresponsive (does not moan to pinch or grasp) to painful stimuli, due to diminished Level of Consciousness or sedation or limited ability to feel pain over most of the body surface)	2. Very limited Responds only for painful stimuli, cannot communicate discomfort, except by moaning or restlessness. Or has sensory impairment which limits the ability to feel pain or discomfort over ½ of the body.	3. Slight limited Responds to verbal commands, but not always capable to communicate discomfort or need to be turned. Or has some sensory impairment which limits ability to feel pain or discomfort over 1 or 2 extremities	4. No impairment Responds to verbal commands. No sensory deficit which would limit ability to feel or voice pain or discomfort.	
Moisture degree to which skin is exposed to moisture	1. Constantly moist Skin is kept moist almost constantly by perspiration, urine, etc. Dampness detected every time when pt. is moved or turned	2. Very moist Skin is often, but not always moist. Linen must be changed at least once a shift	3. Occasionally moist Skin is occasionally moist Requires extra linen change once a day	4. Rarely moist Skin usually dry, linen only requires changing at routine interval	
Activity degree of physical activity	1. Bed fast Bed ridden	2. Chair fast Ability to walk severely limited Cannot bear own weight and must be assisted into chair/wheelchair	3. Walks occasionally Walks occasionally very short distance with or without assistant. Spent majority of shift in bed or chair	4. Walks frequently Walks outside room at least twice a day and inside room at least once every 2 hours during waking hour	
Mobility ability to change and control body position	1. Completely immobile Patient does not make even slight changes in body or extremity position without assistance	2. Very limited Makes occasionally slight change in body or extremity position but unable to make frequent and significant changes independently	3. Slightly limited Makes frequent though slight change in body or extremity position independently	4. No limitation Makes frequent and major changes without assistance	
Nutrition usual food intake pattern	1. Very poor Never eats complete meal. Rarely eats more than 1/3 of any food offered. Eats two serving or less of protein (animal proteins) per day. Takes fluid poorly. Does not take fluid supplement. Or NPO and/or maintained clear liquids, or IV fluid infusion for more than 5days.	2. Inadequate Rarely eats a complete meal and generally eat about ½ of any food offered. Protein intake includes only 3 serving of meat or dairy products per day. Occasionally will take a dietary supplement. - Or Receives less than optimum amount of liquid diet or tube feeding.	3. Adequate Eats over half of most meals. Eats a total of 4 serving proteins (meat, dairy product per day). Occasionally will refuse a meal, but usually will take supplement when offered. OR Being on tube feeding or TPN regimen which probably meets most nutritional needs.	4. Excellent Eats most of every meal. Never refuse a meal. Usually eats a total of 4 or more serving of animal protein. Occasionally eats between meals. Does not require supplementation	
Shear and friction	1. Problem Require moderate to maximum assistance in moving. Complete lifting without slide against sheet is impossible. Frequently slides down in bed or chair. Requires frequent repositioning with maximum assistance. Spasticity, contractures or agitations leads to almost constant friction.	2. Potential problem Moves feebly or requires minimum assistance. During move skin slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	3. No Apparent problem Moves in bed and in chair independently. Sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair		
Total score					



Comparing Knowledge and Attitudes Toward the Braden Scale for Pressure Injury Risk Assessment by Nurses: Before and After the Educational Intervention

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Abstract

Pressure injuries are considered an adverse quality care indicator among hospitalized patients. Despite the importance of routine assessment and pressure injury prevention strategies, nurses may often neglect them. In Ethiopia, pressure injury risk assessment tool such as the Braden Scale has not been reported or implemented in hospital settings. To examine the feasibility of the Braden Scale by assessing the knowledge and attitude of nurses before and after an educational intervention, and testing three delivery methods: printed, oral, or a combination. A quasi-experimental cluster study, on a sample of 145 nurses was conducted. The participants were selected from units with patients often bedridden and more likely to develop a pressure injury during their hospital stay. Data was collected using structured self-administered questionnaires. A Wilcoxon signed-rank test and independent group test (one-way ANOVA and Kruskal-Wallis test) were used to analyze the data. 68.3% of nurses were female, with a mean age of 29.4 ± 4.9 years and 66.7% had no prior information about the Braden Scale. The overall mean scores change of the pre-to-post educational intervention for knowledge and attitude was statistically significant, $p < .001$, with a large effect size, 1.95 and 0.81, respectively. Nurses attending a brief educational program are feasible and, as a result, are more knowledgeable and have a more positive attitude about utilizing the Braden Scale. Future research is needed on how educational programs such as the ones provided increase the acceptability and implementation of the Braden Scale in practice settings.

Plain language summary

Study using before and after educational intervention to assess the knowledge and attitudes of nurses toward the Braden scale pressure injury risk assessment, in public hospitals, Addis Ababa, Ethiopia

Understanding the Braden Scale helps involve nurses in patient assessments to identify pressure injury high-risk individuals and prioritize preventive measures. Effective pressure injury prevention strategies include routine risk and skin assessments; however, most nurses may often neglect them. In Ethiopia, the Braden Scale has not been reported or implemented in hospital settings. The researchers studied the knowledge and attitude of the nurses about the Braden Scale before and after education intervention and tested the effectiveness of the three education delivery methods (reading printed, oral presentation, or combining both approaches). The study was conducted on a sample of 145 nurses, selected from units with patients often bedridden and more likely to develop a pressure injury, to assess the

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participants were female, with an average age of 29.4 ± 4.9 years, the majority 65.5% ($n = 95$) were between the ages of 23 and 29, and 66.7% ($n = 67$) had no prior information about the Braden Scale. The overall average scores change in knowledge and attitude before and after the educational intervention was found significant, with a large effect size ($d = 1.95$ and 0.81), respectively. This study has identified nurses who attend a brief educational program about Braden Scales are more knowledgeable, and have a more positive attitude about utilizing the pressure injury risk assessment tool, feasible for resulting significant change. Future research is needed on how educational programs such as the ones provided increase the acceptability and implementation of the Braden Scale in practice settings. In-service training for nurses, focusing on pressure injury risk assessments, is essential to update their knowledge, and improve patient outcomes, experts should also consider integrating a pressure injury risk assessment score in the nursing process format.

Keywords

braden scale, pressure injury, nurse, knowledge, attitude, quasiexperimental, educational intervention

Introduction

Pressure injuries are a common occurrence in patients who are immobile and remain a global health concern with various levels of severity and prevalence rates across different healthcare settings (F. Coyer et al., 2017; Eberlein-Gonska et al., 2013; Kröger et al., 2009). The global prevalence of pressure injury is 12.8%, which indicates the significance of this adverse health occurrence (Z. Li et al., 2020). The pressure injury prevalence increases with age (Zhang et al., 2021) and is highest in low to middle-income countries, where prevalence rates approach 31.3% (Kaddourah et al., 2016). Pressure injury is considered an adverse health occurrence, a negative quality care indicator, and a patient safety risk during hospitalization; thus, it is referred to as hospital-acquired pressure injury (Latimer et al., 2016; Razmus & Bergquist-Beringer, 2017). The incidence of hospital-acquired pressure injury ranges from 0.63% to 8.4% worldwide (Amir et al., 2017; Eberlein-Gonska et al., 2013; Jenkins & O'Neal, 2010; Jiang et al., 2014; Z. Li et al., 2015; Samuriwo & Dowding, 2014) and is also easy to use (2020). It is more commonly associated with various medical devices such as endotracheal and nasogastric tubes (F. M. Coyer et al., 2014), which may reflect a greater illness severity. Pressure injuries cause a considerable burden as they contribute to greater patient suffering, which may result in life-threatening infections, pain, poor quality of life, impaired recovery, higher mortality rates, and increased healthcare costs (F. M. Coyer et al., 2014). The cost of pressure injury treatment in the United States is estimated to be \$11 billion annually (Kane et al., 2017), accounting for a substantial portion of the annual healthcare budget in most countries (Bennett et al., 2004; CEC, 2017; 2014). Nurses play a key role in preventing and managing pressure injury. In addition, they are directly involved in risk assessment and preventative strategies before they occur and applying appropriate preventive strategies (Gage, 2015; Guy et al., 2013).

The presence of pressure injury is a sensitive quality indicator of nursing care. Nurses are responsible for assessing and identifying patients at high-pressure injury risk (Hunter et al., 2014) and implementing appropriate evidence-based prevention strategies (Latimer et al., 2016; Sving et al., 2014). Studies have shown that the involvement of nurses in pressure injury prevention and quality improvement projects results in a significant reduction of hospital-acquired pressure injuries (Elliott et al., 2008; Fabbuzzo-Cota et al., 2016).

Research suggests that nurses use clinically validated pressure injury risk assessment tools for accurate pressure injury risk prediction. Many pressure injury risk assessment tools have been developed, including the Braden Scale. The Braden Scale is a consistent and precise predictor of pressure injury occurrence in high-risk hospitalized patients (Elliott et al., 2008). Additionally, in many hospitals, the Braden Scale is administered by nurses and integrated into nursing assessment (Mwebaza et al., 2014; Qaseem et al., 2015; Samuriwo & Dowding, 2014) and is also easy to use for pressure injury risk person identification (Kumar et al., 2012). All pressure injury risk assessment tools are based on the most common predisposing factors, such as low sensory perception, physical activity, mobility, nutritional status, high skin moisture, and pressure/shear. These factors have been identified as prominent factors which place the person at higher risk for pressure injury development (Hommel & Santy-Tomlinson, 2018).

The presence or absence of a pressure injury is one metric used to measure the quality of nursing care (Mwebaza et al., 2015; Samuriwo & Dowding, 2014). Nurses should perform a pressure injury risk assessment and skin inspection during or soon after hospital admission and repeat on a routine basis among patients at higher risk, such as those

who are immobilized or if their clinical status deteriorates not currently being used in practice settings in Ethiopia. The objective of this study is to evaluate the impact of including systematic and ongoing skin assessment, combined educational interventions on Ethiopian staff nurses' with the implementation of evidence-based pressure injury knowledge and attitudes regarding the use of the Braden preventive measures that include skin care, support surface, Scale for assessing pressure injury risk. Additionally, the study aims to identify the most effective method of delivering educational interventions (oral, written, or a combination of both) to improve Ethiopian staff nurses' pressure injury knowledge and attitudes toward the Braden Scale and showed a significant (.73%) reduction in pressure injury pressure injury risk assessment.

prevalence in cardio-thoracic ICU after the intervention of quality improvement programs for the front-line healthcare staff including nurses (Gupta et al., 2020).

Despite the availability of risk assessment tools and prevention strategies, optimal reductions in the prevalence rates of pressure injury are often not achieved. Reasons include poor knowledge regarding pressure injuries and poor performance by nurses in assessing, planning, and implementing pressure injury prevention strategies (Latimer et al., 2016). There is also a poorly documented skin assessment by nurses about pressure injury characteristics, staging, and intervention planning (D. Li, 2016). Utilization of evidence-based assessment tools is often not performed but relies on outdated knowledge and experience to make decisions about pressure injury intervention care (Samuriwo & Dowding, 2014). Many nurses are unwilling to adopt evidence-based methods for identifying or managing pressure injuries (Kallman & Suserud, 2009). In Ethiopia, there is a lack of literature discussing the Braden scale, a tool used for PI risk assessment. Limited published resources have highlighted gaps in knowledge and practices related to pressure injury prevention (Ebi et al., 2019; Muhammed et al., 2020; Nuru et al., 2015). A study conducted in a particular region of Ethiopia revealed that about 91.5% of nurses displayed inadequate knowledge of PI prevention, which is frequently linked to insufficient training (Ebi et al., 2019).

Research suggests that the quality of nursing care is highly correlated with a positive attitude toward pressure injury prevention strategies, which is influenced by knowledge and personal behavior (Beeckman, Defloor, Schoonhoven, & Vanderwee, 2010; Demarre'et al., 2012; Nuru et al., 2015; Qaddumi & Khawaldeh, 2014). In Ethiopia, one study reported that over 50% of bedside nurses had adequate knowledge, favorable attitudes, and were optimistic regarding pressure injury prevention practices (Dilie & Mengistu, 2015). This contrasts with another report in northwest Ethiopia, where nurses demonstrated inadequate knowledge and poor practice regarding pressure injury prevention strategies (Nuru et al., 2015).

Despite the availability of multiple evidence-based validated pressure injury risk assessment scales, they are

Methods

Study Design and Setting

A quasi-experimental cluster design was conducted in three government-owned hospitals in Addis Ababa, Ethiopia. All three were teaching and referral hospitals and had similar specific units/wards where higher-risk patients for pressure injuries are admitted, including adult general ICU (both medical and surgical), orthopedic, internal medicine, general surgery, and neurology.

Study Population

Participant recruitment took place in specific units after IRB approval and after the purpose of the study was explained. Inclusion criteria included nurses working in medical or surgical ICU, orthopedic, internal medicine, general surgery, or neurology units and directly involved in patient care. Participants had to be working full-time as nursing staff or as a supervisor. The participants also received printed information explaining the purpose of the study and, if there were no questions, were asked to provide their written informed consent for study participation.

Sample Size and Sampling Methods

The sample size was calculated using the G-power software program, using the *F*-test family repeated measures with the values: Power (1 - β error probability) = 80%, Effect size $f(V) = 0.25$, the α error probability = .05, number of groups = 3, number of measures = 2, non-sphericity correction $\epsilon = 1$ were considered. The final calculated total sample size (159) was proportionally allotted for each hospital: Tikur Anbessa Specialty Hospital = 59, Saint Paul's Hospital Millennium Medical College = 63, and Menelik-II Referral Hospital = 37; and was based on a total number of nurse staff. The nurse participants were selected randomly from the specific units using simple random sampling technique. In order to choose the participants, a list of names of all nurses from each chosen unit was created, and then random samples were selected.

Data Collection

Data Collection Instruments. The data were collected using self-administered structured questionnaires adapted from the literatures (Abed, 2016; Ahmed Ahmed Qalawa & Ata, 2016; Beeckman, Defloor, Demarre, et al., 2010; Edward et al., 2022). The instrument contained three sections: socio-demographic data and knowledge and attitude questions regarding the Braden Scale.

Socio-demographic characteristics included age, gender, education level, monthly income, years of work experience, bedside work experience, experience with pressure injury care, the workload nurse-to-patient ratio, special training, and access to reading material about pressure injuries.

Knowledge questions regarding the total Braden Scale and sub-scales were adapted from the literatures with a Cronbach alpha coefficient of .83 (Abed, 2016; Ahmed Ahmed Qalawa & Ata, 2016; Braden & Maklebust, 2005; Brown, 2004; Edward et al., 2022). This instrument contained 12 multiple-choice items with response rates recorded as correct, incorrect, or do not know. Knowledge questions consisted of the definition of the Braden Scale, the reason for use, and assessment components (sensory perception, mobility, activity, moisture, nutrition, and friction/shear) and their rating score. Correct responses were scored as “1” and incorrect as “0,” ranging from 0 to 17 points. We used the total sum of the correct answers and converted them into percentages ranging from 0 to 100. Using Bloom’s cut-off points, the knowledge level was classified into three categories: high = 80 to 100%, moderate = 60 to 79%, and low = less than 59%. Higher scores reflected better knowledge of the Braden Scale (Khaled et al., 2020).

A modified 11 items Likert-type scale of the attitude instrument is produced. The content part adapted from Beeckman, Defloor, Demarre, et al. (2010), Beeckman, Defloor, Schoonhoven, and Vanderwee (2010), Attitude toward Pressure ulcer Prevention instrument with the three nursing shifts were provided with the intervention Cronbach alpha = .79, and from Moore and Price (2004) the five points scale has been adapted (Moore & Price, 2004). The original Attitude questions had 13 items covering 5 domains (personal competency, items 1, 2, 3; priority, items 4, 5, 6; impact, items 7, 8, 9; and responsibility, items 10, 11; and confidence, items 12, 13) with each item scored as 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. For the modified scale used in this study, only the first 11 items of the attitude questions were used (the 2 confidence items were removed) as they were not in line with the objective and each five-point scale refers to: strongly disagree = “1”, disagree = “2”, neither disagree nor agree = “3”, agree = “4”, and strongly agree = “5”; and reverse rating for negative questions (items 3, 4, 5, 7, 8, 10), total sum measure

ranges from 11 to 55 points with a higher score reflecting more positive attitude. We measured with a total mean score of the Likert scale items (11 items), which had been previously validated for PI prevention (Beeckman, Defloor, Demarre, et al., 2010; Beeckman, Defloor, Schoonhoven, & Vanderwee, 2010). Using Bloom’s cut-off point of the total sum, the attitude was grouped into three categories (positive attitude = 44–55, Neutral = 33–43.5, negative attitude = \33 points; Ünver et al., 2017).

Data Collection Procedure. Data collection was carried out similarly for each of the three hospitals. Questionnaires were distributed to participating nurses before the educational intervention session. After a 2-week time frame, the educational program was provided. After the educational intervention, the second questionnaire was distributed within 1 month to the same nurses who completed the pretest.

Education Intervention. Among the three participating hospitals, each received a randomly selected mode of educational intervention delivery. The researcher implemented the educational intervention using three distinct strategies: distributing reading material, delivering an oral presentation with poster support, and combining both approaches. One hospital received written materials for the intervention; another received an oral presentation; the remaining hospital received a combination of written and oral presentations. The nurses in that hospital all received the same intervention on using the Braden Scale for pressure injury risk assessment. This helped to avoid contamination of interventions across units. The principal investigator provided the education intervention at each of the three hospitals. The intervention was conducted in a quiet place near the nurses’ station. All over 1 week for the selected units at each hospital. The educational session for those assigned to the written information group was provided with a print-out in the form of a brochure. Nurses who received the oral presentation were provided verbal instruction on the Braden Scale. Those who received the combination intervention received a verbal presentation. Each method of delivery had the same content and was delivered in the same manner for all sessions. The two groups’ oral presentations took approximately 45 min to receive this intervention component. For the written material, the Principal Investigator stayed for about 15 min to answer any questions raised about the Braden Scale. After the educational sessions, the post-intervention survey was conducted. The post-test included the same question as the pretest.

Data Management and Analysis. Descriptive and inferential statistical analyses were conducted. Data were entered into the Epi.info version 4.6, software and transported to SPSS version 26. Data were checked for normal distribution, outliers, and missing data before analysis. The data on inspection and testing using the Kolmogorov-Smirnov test showed an abnormal distribution requiring a non-parametric test. Independent sample *t*-tests were used to compare knowledge and attitude scores concerning socio-demographic characteristics. A paired sample *t*-test and one-way ANOVA were used to compare the knowledge and attitude score changes from before and after education interventions and to compare the three educational delivery methods. The Wilcoxon rank test, Mann-Whitney *U*-test, and the Kruskal Wallis test were used for non-parametric analysis. For the groups that met the assumptions of normality and homogeneity of variance ($p < .05$), paired *t*-test was utilized. Statistical significance was determined with a *p*-value less than .05.

Ethical Approval and Consent to Participants

Ethical Approval was obtained from IRB of the College of Health Science, Saint Paul's Hospital Millennium Medical College, and Addis Ababa city health office, with Protocol No: 040/20/Nursing, Ref. No.pm23/27 and Ref. No. A/A/A 281/227, respectively. All methods were carried out in accordance with relevant guidelines and regulations or declarations of Helsinki. Thus, all participants received printed information explaining the purpose of the study and, provided their written informed consent for study participation.

Results

A total of 159 questionnaires were distributed to three government-owned hospitals: Tikur Anbessa Specialty Hospital (59), Saint Paul Millennium Medical College Hospital (63), and Menelik-II Referral Hospital (37). The completed questionnaires were collected from each hospital: Tikur Anbessa Specialty Hospital (58), Saint Paul Millennium Medical College Hospital (62), and Menelik-II referral Hospital (25). With 145 (91.2%) completed questionnaires returning. Fourteen (8.8%) were excluded due to a lack of participation at both time points (pre-post-education sessions; Figure 1).

Nurse Participants' Socio-Demographic Characteristics

Of the sampled 145 nurse participants, 68.3% were female, with a mean age of 29.4 ± 4.9 years. Most 65.5% ($n = 95$) were between the ages of 23 and 29. Their mean (*sd*) work experience duration was 6.3 ± 4.88 years. The nurses had similar bedside care experience, with a mean

(*sd*) of 5.27 ± 3.9 years. The majority of participants, 89% ($n = 129$), were bachelor's prepared, while 4.1% ($n = 6$) and 6.9% ($n = 10$) participants were diploma and master's prepared, respectively. Their average monthly income was 6,504 $\pm$ 1,711birr, equal to 108 $\pm$ 29 US dollars (\$), and approximately half, 50.3% ($n = 70$), were married. Most nurses, 67.2% ($n = 98$), had pressure injury care experience, but 94.5% ($n = 137$) had not received special training within the last 6 months. More than half, 51.1% ($n = 74$) of the nurses had a workload of 1:5 nurse-to-patient ratio. Regarding the respondents' awareness of the Braden scale, 66.7% ($n = 97$) of the nurses had no information about it, even though 65.5% ($n = 95$) had access to reading material, or the internet.

Knowledge Score Between Before and After the Educational Intervention

Most nurses were unaware of the Braden Scale; 66.9% ($n = 97$) and 70.3% ($n = 102$) did not know the correct definition of the Braden Scale. Less than half, 44.1% ($n = 64$), understood the importance of the Braden scale for pressure injury risk assessment, while only 17.2% ($n = 25$) of nurses correctly identified the number of Braden parameters. In addition, 64.8% of the participants did not correctly answer the correct elements of the Braden Scale. Scores improved on the post-test, with 65.5% ($n = 95$) of nurses responding correctly to the Braden Scale definition to predict pressure injury risk. The importance of the Braden Scale also improved, with 80.7% ($n = 117$) identifying the correct answer that the Braden Scale is important to assess and predict pressure injury risk. A majority of participants, 63.4% ($n = 92$), also correctly identified the six Braden sub-scales, and 73.3% correctly stated the elements of the Braden Scale (i.e., sensory perception, mobility, activity, moisture, nutrition, and friction/shear). A similar percentage of nurses (13.8%, 24.1%, and 13.1%) had identified the correct pressure injury risk category expressed by very high risk, moderate risk, and no risk, respectively (Table 1). In their overall knowledge scores, the pretest results showed 91.7% ($n = 133$) nurses scored less than 60%, indicated a low knowledge level, while 60% ($n = 87$) of them scored significantly greater than 80%, a high knowledge level on the post-test evaluation. Based on their score the nurses' knowledge level is categorized to high (80%–100%), moderate (60%–79%), and low (less than 59%) knowledge level.

Nurses' Attitude Towards the Braden Scale

A description of the nurses' attitude toward the Braden Scale before and after the educational intervention in both time points is presented in table below. The

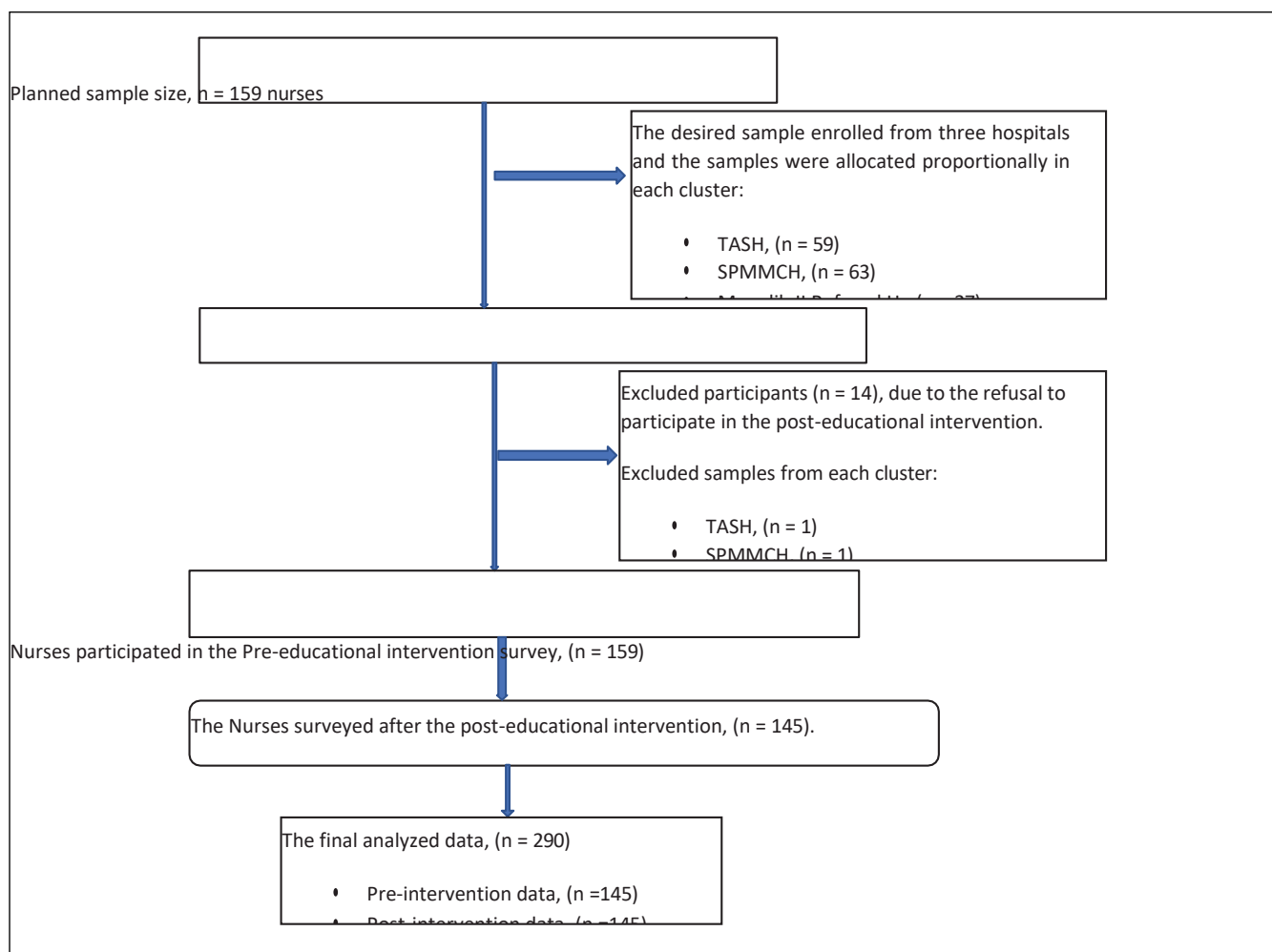


Figure 1. Flow chart for participant inclusion for analysis.

participants' attitudes improved from pre- to post-test, indicating great confidence in using the Braden Scale, and they were more optimistic about implementing it in clinical practice. Although a significant number, 62.1% ($n = 90$) of nurses strongly disagreed with being responsible for pressure injury risk assessment using the Braden Scale after the educational intervention (Table 2).

The attitude scores of nurses after the education session were higher (median = 36) than before-educational intervention scores (Median = 31). According to Bloom's cut-off point, the overall attitude score of the nurses is categorized to positive (44–55), neutral (33–43.5), and negative attitudes (less than 33) points. The pre-intervention attitude indicated a negative attitude, while the post-intervention became more neutral or positive.

Comparison of the Baseline Knowledge and Attitude Scores by Nurse's Characteristics

There were no statistically significant differences in baseline (pre-educational intervention) knowledge or attitude

scores when comparing nurse characteristics including gender, age, nursing education level, total work experience in years, bedside care experience in years, pressure injury care experience, having special training, workload (nurse-to-patient ratio), and have access of reading material.

Mean Comparison of the Knowledge and Attitude Score in Pre- To- Post-Education Intervention

The mean comparison of the participant's knowledge and attitude score before and after receiving the educational intervention, there were significant improvements in knowledge and attitude scores from pre- to- post-test evaluation, $p \leq .001$, with a large effect size, 1.95, and 0.81, respectively (Table 3).

The Knowledge and Attitude Score Among the Three Education Delivery Methods

The knowledge and attitude differences were compared by education mode of delivery for printed material, oral

Table 1. Nurses' Knowledge Assessment Questions Regarding the Braden Scale in Pre- and Post-Educational Intervention, 2021.

S. No.	Questions	Response	Pretest		Posttest	
			N	%	N	%
Q1	Ever heard about Braden Scale	Yes	48	33.1	124	85.5
		No	97	66.9	21	14.5
Q2	What is the Braden scale?	The assessment tool used to guide PI prevention	26	17.9	32	22.1
		The assessment tool used to predict PI risk (Correct Answer)	43	29.7	95	65.5
		The assessment tool used to guide nurses to treat PI	21	14.5	13	9.0
		Don't know	61	42.1	6	4.1
Q3	What is the importance of Braden Scale for the patient?	Use to move body parts	11	7.6	12	8.3
		Use to hasten wound healing	14	9.7	12	8.3
		Use to assess and predict the PI risk (Correct Answer)	64	44.1	117	80.7
		Don't know	61	42.1	6	4.1
Q4	What is the number of sub-scales in the Braden scale?	Four sub-scales	21	14.5	21	14.5
		Five sub-scales	10	6.9	15	10.3
		Six sub-scales (Correct Answer)	25	17.2	92	63.4
		Ten sub-scales	9	6.2	6	4.1
		Don't know	80	55.2	11	7.6
Q5	Which elements of the Braden scale are used in PI risk assessment? (Multiple responses)	Sensory perception (Correct Answer)	28	19.3	107	73.8
		Mobility (Correct Answer)	51	35.2	116	80.0
		Activity (Correct Answer)	38	26.2	111	76.6
		Moisture (Correct Answer)	35	24.1	109	75.2
		Nutritional status (Correct Answer)	29	20.0	102	70.3
		Friction/shear (Correct Answer)	38	26.2	102	70.3
		Don't know	19	13.1	17	11.7
Q6	Which element of Braden Scale doesn't take the same rating scale?	Sensory perception	18	12.4	11	7.6
		Mobility	19	13.1	17	11.7
		Nutrition	15	10.3	15	10.3
		Friction/shear (Correct Answer)	15	10.3	94	64.8
		Don't know	82	56.6	19	13.1
Q7	A Braden scale total score falling between 13 and 14 means	Sever risk	31	21.4	12	8.3
		Moderate risk (Correct Answer)	35	24.1	121	83.4
		No risk	6	4.1	4	2.8
		Don't know	74	51	8	5.5
Q8	Excessive and persistent moisture to the skin is rated as	One (Correct Answer)	15	10.3	91	62.8
		Two	23	15.9	26	17.9
		Three	17	11.7	10	6.9
		Four	19	13.1	7	4.8
		Don't know	71	49.0	11	7.6
Q9	In nutritional status assessment, eating a small portion or half of the served meal is rated with	One	15	10.3	11	7.6
		Two (Correct Answer)	24	16.6	107	73.8
		Three	15	10.3	16	11
		Four	15	10.3	4	2.8
		Don't know	76	52.4	7	4.8
Q10	Which sub-scale examines patient's ability to change position?	Physical Activity	26	17.9	16	11.0
		Mobility (Correct Answer)	60	41.4	116	80.0
		Sensory perception	12	8.3	7	4.8
		Don't know	96	66.2	139	95.9
Q11	The total score of the Braden scale equal to or less than nine indicates	Very high risk (Correct Answer)	20	13.8	117	80.7
		High risk	15	10.3	11	7.6
		Moderate risk	25	17.2	8	5.5
		No risk	10	6.9	3	2.1
		Don't know	76	52.4	6	4.1
Q12	The high point (19–23) total sum of Braden's score indicates	Very high risk	27	18.6	8	5.5
		High risk	17	11.7	7	4.8
		Moderate risk	6	4.1	6	4.1
		No risk (Correct Answer)	19	13.1	117	80.7
		Don't know	76	52.4	7	4.8

Note. The bold refers to correct answer.

Table 2. Description of the nurses' attitude score toward the Braden Scale between pre- and post-educational intervention, 2021.

Item	Pre-intervention						Post-intervention					
	SD	D	N	A	SA	Mean (sd)	SD	D	N	A	SA	Mean (sd)
Q1 [+] I feel confident in my ability to use Braden Scale												
2 Count	50	38	31	20	6	2.27 6 1.19	23	31	41	38	12	2.9 6 1.2
2 Percent (%)	34.5	26.2	21.4	13.4	4.1		15.9	21.4	28.3	26.2	8.3	
Q2 [+] I am well-trained to use BS												
2 Count	89	19	24	6	7	1.78 6 1.16	57	32	24	24	8	2.27 6 1.29
2 Percent (%)	61.4	13.1	16.6	21.4	4.8		39.3	22.1	16.6	16.6	5.5	
Q3 [2] Implementing Braden Scale is too difficult for me												
2 Count	50	36	21	16	22	3.52 6 1.44	49	48	24	15	9	3.78 6 1.19
2 Percent (%)	34.5	24.8	14.5	11.0	15.2		33.8	33.1	16.6	10.2	6.2	
Q4 [2] Too much attention goes to implement Braden Scale												
2 Count	43	36	38	14	14	2.45 6 1.27	20	38	32	34	21	2.99 6 1.28
2 Percent (%)	29.4	24.8	26.2	9.7	9.7		13.8	26.2	22.1	23.4	14.5	
Q5 [2] Implementing Braden Scale for pressure injury prevention is not that important												
2 Count	75	37	12	6	15	4.04 6 1.30	85	39	12	5	4	4.35 6 0.97
2 Percent (%)	51.7	25.5	8.3	4.1	10.3		58.6	26.9	8.3	3.4	2.8	
Q6 [+] Pressure Injury risk assessment is a priority												
2 Count	35	22	42	20	26	2.86 6 1.40	14	17	38	41	35	3.46 6 1.25
2 Percent (%)	24.1	15.2	29.0	13.8	17.9	9.7		11.7		28.3	24.1	
Q7 [2] Pressure injury rarely causes discomfort for a patient.												
2 Count	60	30	27	8	20	3.7 6 1.40	76	25	20	15	9	3.99 6 1.28
2 Percent (%)	41.4	20.7	18.6	5.5	13.8		52.4	17.2	13.8	10.3	6.2	
Q8 [2] Financial impact of pressure injury on patients should be exaggerated												
2 Count	51	49	28	14	3	2.10 6 1.06	40	53	23	24	5	2.43 6 1.24
2 Percent (%)	35.2	33.8	19.3	9.7	2.1		27.6	36.6	15.9	16.6	3.4	
Q9 [+] Financial impact of pressure injury on society is high												
2 Count	40	43	32	19	11	2.40 6 1.24	26	31	34	39	15	2.90 6 1.27
2 Percent (%)	27.6	29.7	22.1	13.1	7.6		17.9	21.4	23.4	26.9	10.3	
Q10 [2] I am not responsible to assess patient using Braden Scale												
2 Count	71	33	18	6	17	3.93 6 1.36	90	25	18	7	5	4.30 6 1.08
2 Percent (%)	49.0	22.8	12.4	4.1	11.7		62.1	17.2	12.4	4.8	3.4	
Q11 [+] I have an important task in implementing the Braden Scale												
2 Count	45	26	41	20	13	2.52 6 1.30	25	18	28	43	31	3.26 6 1.38
2 Percent (%)	31.0	17.9	28.3	13.8	9.0		17.2	12.4	19.3	29.7	21.4	
Total Attitude score						31.26 6 6.06						36.3 6 6.44

Note. SD = strongly disagree, D = disagree, N = neither disagree nor agree, A = agree, SA = strongly agree; sd = standard deviation.

Table 3. Summary of the Nurse's Knowledge and Attitude Scores Toward the Braden Scale Before and After Educational Intervention, 2021.

Groups	Before education		After education		Paired difference			Effect size (D)	Wilcoxon signed-rank test
	Mean (sd)	Median	Mean (sd)	Median	Mean (sd)	Std. error			
Knowledge	23.23 6 22.58	18.75	73.88 6 28.98	87.5	50.65 6 33.68	2.797	1.948	$p = .001$	
Attitude	31.26 6 6.06	31	36.3 6 6.44	36	5.04 6 7.736	0.642	0.806	$p \searrow .001$	

Note: . Cohen's D: effect size. sd = standard deviation; Std error = standard error; IQR = inter-quartile range.

presentation, or a combination of both after education intervention. The nurses' knowledge and attitude scores were higher after the education intervention, but there were no differences in how the information was presented (Table 4).

Discussion

This study tested knowledge and attitudes among Ethiopian staff nurses employed at three hospitals about the information on a pressure injury risk assessment tool, the Braden Scale, before and after an educational

Table 4. Summary of the Nurse's Knowledge and Attitude Scores Toward the Braden Scale Among the Three Education Delivery Methods, 2021.

Oral presentation (n = 26)	Combined both reading Reading material (n = 61) and oral presentation (n = 58)								ANOVA		
	Groups	Mean (sd)	Std. error	Mean (sd)	Std. error	Mean (sd)	Std. error				
Knowledge		74.2788	6.29.9649	5.877	75.3074	6.29.4575	3.772	72.198	6.28.441	3.735	p = .694
Attitude		36.54	6.7.511	1.473	35.07	6.5.879	0.753	37.5	6.6.369	0.836	p = .117

Note: . sd = standard deviation; Std error = standard error; IQR = inter-quartile range.

intervention using three delivery methods. Based on the results, approximately two-thirds of the participants were unaware of the Braden Scale. With the educational intervention, the participant nurses have improved their knowledge and awareness of monitoring pressure injuries. Scores improved in knowledge and attitude from pre- to post-test, with no difference observed in how the information was delivered. In addition, we found no differences in knowledge and attitude scores based on nurse characteristics.

Similar to our study, across most studies conducted on the Braden Scale or pressure injury risk assessment, there were changes in knowledge scores that occurred from pre- to post-education interventions (Gaballah & Salah El-Deen, 2021; Kaur et al., 2021; Mohamed & Weheida, 2015; Sarkar, 2018; Suma et al., 2021; Sutherland-Fraser et al., 2012). In India, a study evaluated the effectiveness of structured teaching programs on knowledge score change in the Braden Scale and observed significant changes from pre- to post-test. Other studies show similar findings on nursing students and nurses working in specialized areas such as perioperative and international settings (EL-Khadry et al., 2020). Notably, most of the literature and evidence on using the Braden scale for pressure injury risk assessment has come from high to middle-income countries, with little to no research conducted in low and middle-income countries and is an area for further research investigation.

Regarding knowledge of the Braden Scale, our study report is similar to prior studies conducted in Japan (38%), South East Nigeria (36.3%), India (Vijayapur; 40%), and district Hisar (India; 38.3%; Agorye et al., 2015; Kaur et al., 2021; Kohta et al., 2017; Nadagaddi et al., 2018). Furthermore, unlike ours, in a study report from the Hirsan district, more than 1/3 of the sample (38.3% of nurses) had previous experience with using Braden Scale for pressure injury risk assessment (Kaur et al., 2021). It may reflect differences in the educational system or training.

In prior studies, most nurses showed poor knowledge of the Braden Scale (Khong et al., 2020; Nuru et al.,

2015; Qaddumi & Khawaldeh, 2014). For example, in Singapore, the highest proportion (85.6%) of the nurses scored less than 60% on knowledge of the Braden Scale, which is similar to our results. Another study conducted by Sarkar (2018) that examined pre- and post-test changes using an observational checklist revealed that a significant number of nurses (63%) had inadequate knowledge of the Braden Scale assessment, particularly during the pretest (Sarkar, 2018). A study conducted in Gondor, Ethiopia, less than 50% of nurses scored as having poor knowledge on the Braden Scale and PI risk assessment. In contrast to our findings, some reports from India have shown that a lower proportion, 16%, and 20.7%, of staff nurses, had inadequate knowledge of the Braden scale (Clady et al., 2019; Suma et al., 2021). Kaur et al. (2021) reported that no nurse in their study had poor knowledge of the Braden Scale, including during the pretest assessment (Kaur et al., 2021). This wide variation likely reflects differences in nursing education and training or resources available for implementing the Braden Scale.

Training on pressure injury prevention was low in the current study. In contrast to our findings, other studies in Nigeria, India, and Australia have shown that a significant number of nurses (ranging from 20% to 40%) received training on either Braden Scale risk assessment or general pressure injury prevention (Agorye et al., 2015; Nadagaddi et al., 2018; Sutherland-Fraser et al., 2012). Nurses reportedly received formal and specialized training on the pressure injury and risk assessment scales: in Nigeria (37.4%) and Australia (20%) in the last 2 years. We found no difference in knowledge of the Braden Scale when considering nurses' socio-demographic characteristics, work-related experience, and history and years of nursing. This is consistent with prior studies conducted in Belgium, India, and Nigeria (Demarre' et al., 2012; Edward et al., 2022; Suma et al., 2021). Even though the comparisons were among different categories of nurses, between nurses and nurse assistants, among nurse students, and among staff nurses (before and after the structured teaching program), their characteristics

did not change the overall knowledge score on pressure injury risk assessment. However, other studies from India and Indonesia have shown significant knowledge differences due to nurse age, education, and additional training on pressure injury risk assessment (Kaur et al., 2021; Pandhare & Dhudum, 2018; Sari et al., 2021).

Although many studies, including ours, had shown a difference in knowledge score from pre- to post-intervention, no significant differences were reported utilizing different education methods (printed material, oral presentation, and combination of both; McEvoy et al., 2021). A randomized controlled trial conducted by Farshbaf-Khalili et al. (2021) on surgical nurses compared knowledge scores regarding pain management using two education-delivering methods. Nurses in the electronic learning group scored significantly higher in knowledge than those in the lecture format (Farshbaf-Khalili et al., 2021). Providing education in cost-effective ways is essential for nurses to utilize evidence-based practice, such as pressure injury risk assessment, and is an area for further research.

In the current study, we showed significant differences in attitude scores on the Braden Scale between pre- and post-educational intervention. Similar to knowledge, however, there were no attitude differences that occurred due to nurse characteristics or mode of educational delivery. Few studies have been conducted on nurse attitudes related to the Braden Scale or pressure injury risk assessment. Aslan and Yavuz Van Giersbergen (2016) conducted a study in Turkey to assess nurses' attitudes toward pressure injury prevention. They reported no significant variations in attitude scores based on characteristics except for the last training received. Al-Busaidi et al. (2019) reported that attitude has a significant positive correlation with working experiences in implementing evidence-based practice by nurses (Al-Busaidi et al., 2019). A study by Farshbaf-Khalili et al. (2021) had also shown a significant change in attitude scores after using different education methods, with higher attitude scores toward pain management in the e-learning group than in the lecture group (Farshbaf-Khalili et al., 2021). Several studies have reported that attitude positively correlates with knowledge of pressure injury prevention and recommends continuing education to improve attitude (Demarre et al., 2012; Gresham et al., 2021).

Strengths and Limitations of the Study

- This study is one of the first studies in Ethiopia to examine nurse knowledge and attitudes on the Braden Scale to identify pressure injury risk. Findings from this study indicate that a simple education intervention can change both

knowledge and attitudes and serves as a director for future interventions.

- The study had several strengths including the use of a quasi-experimental cluster design, utilizing nurses working in three referral hospitals. Because the cluster design was used we were able to avoid contamination between the different educational delivery groups.

- The nurses were also very similar across all three hospitals, with no significant differences in work experience or socio-demographics which strengthen our findings.

- The study also had limitations such as not being able to be generalized to all nurses working in other types of hospitals in Ethiopia such as private, smaller, or rural hospitals.

Conclusion and Recommendations

The educational intervention provided was successful in positively changing the knowledge and attitude of nurses, regarding the Braden Scale and its potential use in clinical settings for identifying pressure injury-risk patients. All educational delivery methods were equally effective, indicating that further research is required to identify the most cost-effective one feasible in resource-limited countries such as Ethiopia. It is suggested that in-service training for nurses, focusing on pressure injury risk assessments is essential to enhance their knowledge and improve patient outcomes. Health institutions should consider adopting international pressure injury prevention guidelines, including the Braden Scale, to ensure effective prevention practices. Nurse experts should also consider integrating Braden Scale scoring into the nursing process format as a unified entity.

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Ethical Considerations

Approval was obtained from IRB of College of Health Science (CHS), Saint Paul's Hospital Millennium Medical College (SPHMMC), and Addis Ababa city health office, with Protocol No: 040/20/Nursing, Ref. No. pm23/27 and Ref. No. A/A/A281/227, respectively.

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Data Availability Statement

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Evaluation of the Predictive Capacity of the Braden Scale for Pressure Injury Development among Hospitalized Patients in Addis Ababa, Ethiopia

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Abstract

Background: Effective prevention of pressure injuries relies on accurately predicting patient risk. International pressure injury prevention guidelines advocate the use of risk assessment tools like the Braden Scale. While the Braden Scale's predictive ability varies across studies, its effectiveness in the Ethiopian healthcare setting remains unexamined.

Objective: The study aimed to investigate the predictive ability of the Braden in forecasting pressure injuries in hospitalized patients.

Method: This prospective study enrolled 238 patients from critical care units in three public hospitals in Addis Ababa, Ethiopia, using convenience sampling. Data were collected using structured questionnaires and analyzed with SPSS version 25. Binary logistic regression assessed variable relationships, and ROC analysis evaluated the Braden Scale's predictive ability for pressure injuries.

Results The study analyzed 229 participants, predominantly male (59.8%), with a median age of 39 years. The mean score on the Braden Scale was 13.2 ± 2.95 on a scale of 6 – 23. Pressure injuries developed in 21.83% of participants. The Braden Scale score, age, and body temperature were significant predictors of pressure injury risk. A one-unit increase in the Braden Scale score reduced injury odds by 24.5%, while age and body temperature increased the odds by 2% and 2.27 times, respectively. ROC analysis revealed a sensitivity of 64% and specificity of 59.2% at a cut-off point of 13.5. The AUC value was 0.682 (95% CI: 0.611, 0.761), reflecting a statistically significant, yet insufficient capacity to predict the risk of pressure injuries ($p < 0.001$).

Conclusion: The Braden Scale score, body temperature, and age are significant predictors of pressure injuries. However, the results indicate that the Braden Scale has limited predictive ability in identifying hospitalized patients at risk of developing pressure injuries. Further research with a larger sample size in specific clinical settings is needed to fully evaluate its effectiveness. [*Ethiop. J. Health Dev.* 2025; 39(1)]

Keywords: Braden Scale, Pressure Injury, ROC analysis, AUC, Sensitivity, Specificity

Introduction Background

Pressure injuries (PIs) are devastating complications for hospitalized patients and commonly occur in severely ill and highly care-dependent patients (1). Reports from various different regions, note a hospital-acquired pressure injury (HAPI) incidence ranges from 0.63% to 10% (2-6). The primary risk factors for PIs include friction/shear, immobility, moisture, poor sensory perception (7-9), and older age and hyperthermia (4, 10-13). PIs lead to numerous suffering such as pain, sepsis, prolonged hospital stays, and increased treatment costs. A recent systematic review found that the PI treatment cost is higher than the prevention cost (14). It is important to note, however, that PI prevention practices are not necessarily less expensive, as they often require significant human and material resources (15, 16). Therefore, it is crucial to identify individuals at higher risk for PIs to implement appropriate prevention interventions (17). Furthermore, the PI risk assessment using an evidence-based assessment tool is acknowledged as the first step in initiating prevention strategies for PIs. Numerous globally validated PI risk assessment scales have been developed using specific risk factors and are defined as point scales (18). These scales help identify a patient's vulnerability level to PI development. Additionally, they are valuable tools for

nurses in creating more effective prevention plans for potential PI development (13, 19).

The Braden Scale for predicting PI risk utilizes six distinct sub-scales to evaluate the factors involved in pressure ulcer risks (20). These sub-scales are categorized based on two main determinants: the amount and duration of pressure applied, and the tissue's ability to tolerate it (20-22). The sub-scales for sensory perception, activity, and mobility functions are employed to assess the intensity and duration of pressure. In contrast, the sub-scales for moisture, nutrition, and friction/shears assess their impact on tissue tolerance. The Braden Scale rates each sub-scale from 1 to 4 points, except for friction/shear, which is rated from 1 to 3 points. The overall score ranges from 6 to 23, with lower scores indicating a higher risk of developing PIs. Numerous studies have provided evidence that a cut-off score of 18 or below signifies a high risk for the development of PI (20, 23). The risk level is determined based on the total score as follows: a score of 19 – 23 signifies no risk, 15 – 18 indicates mild risk, 13 – 14 suggests moderate risk, 10 – 12 signifies high risk, and a score below 9 indicates very high risk (23, 24).

The Braden Scale is a widely used tool and well-validated for assessing the risk of developing PIs. Research consistently shows its accuracy in predicting

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the development of PIs in at-risk individuals (7, 22, 25). Many studies have analyzed the ability of the Braden Scale to predict the risk of developing PIs, showed satisfactory sensitivity and specificity values at different cut-off points ranging from 11 to 17 (19, 26). The accuracy is also demonstrated with varying area under the curve (AUC) values ranging from 0.6 to 0.9, indicating poor to excellent prediction (27-29). Additionally, it is recommended to utilize a combination of the Braden Scale score and nursing clinical judgment in a comprehensive preventive intervention program (24).

The 2019 International pressure injury Prevention Guideline (IPIPG) provides detailed guidance on planning and implementing effective strategies to prevent PIs (30). Consistent risk assessment and documentation ensure the PIs prevention. Therefore, accurately identifying at-risk individuals is crucial to delivering appropriate preventive care for those in need, as stated in the newly developed IPIPG (23, 30). In Ethiopia, there is a deficiency of specific guideline documents addressing the prevention of PIs, which includes the utilization of the Braden Scale for assessing the risk of PIs.

This study primarily aims to determine the incidence rate of pressure injuries (PIs) among adult hospitalized patients. The secondary objectives are to identify risk factors associated with the occurrence of PIs and to evaluate the effectiveness of the Braden Scale in predicting PI development among patients admitted to the three selected hospitals in Addis Ababa. The overarching goal of the study is to encourage and facilitate nursing to utilize the Braden Scale for patient assessment, determine the level of PI risk, and prioritize appropriate preventive intervention measures.

Methods

Study Design, Setting, and Population

A prospective study design with a convenience sampling technique was conducted in three public hospitals located in Addis Ababa, Ethiopia. All three were teaching and referral hospitals and had similar specific units/wards where higher-risk patients for PI development were admitted. Participant selection took place in specific units within February to April 2021, patients admitted to ICU, orthopedic, internal medicine, general surgery, and neurology units were included in the study. Patients admitted within 24 hours who were 18 years or older with a total Braden Scale score of 18 or less were included in the study. Patients with existing pressure injuries or other skin lesions or scars at the time of admission, or those discharged (due to transfer or deceased) before day five were excluded from study participation.

Sample size and sampling methods

The sample size was calculated using a single population proportion. Using a prevalence rate of PI = 17%, power = 80%, with a 95% confidence interval and precision value = 5%, and add 10% non-response. The final calculated total sample size of **238** was proportionally allotted for each hospital based on the total number of beds. Ninety-four patients were

selected from Tikur Anbessa Specialty Hospital (TASH), 88 from St. Paul's Hospital Millennium Medical College (SPHMMC), and 56 patients from Minelik-II Referral Hospital. Before data collection, the eligibility of the participants was determined by assessing their risk using the Braden Scale. We included patients who were at mild to high risk for PI development.

Data Collection

Data collectors were nurses with BSN or MSN qualifications and patient care experience. Eight nurses were enrolled for the data collection. Before the data collection, they received training about the PI and the Braden Scale including exercises of the Braden Scale scoring, skin assessment for signs of PIs, and staging of PI. The principal investigator held a training session for one day at each hospital before data collection. The training was delivered through oral presentations and practical patient assessments including PI risk and skin condition assessments. The principal investigator supervised the data collectors while performing patient assessments in the hospital.

Measures

A structured questionnaire was utilized for data collection. The questionnaire had three sections: the patient's demographic and clinical characteristics, a Braden Scale checklist, and a skin assessment checklist (30, 31). The socio-demographic characteristics encompassed age (in years), sex, body mass index (BMI), blood pressure (in mmHg), body temperature (in degrees Celsius), unit/ward where admitted, and current medical diagnosis and reasons for admission.

The Braden Scale checklist was adopted from the original authors Braden and Bergstrom (31). The checklist consists of six sub-scales. Each sub-scale was rated with a 4-point Likert scale, except friction/shear rated with 3 points. The total sum score of the checklist was ranged from 6 to 23 points.

The skin assessment checklist was adopted from the National/European Pressure Ulcer Advisory Panel (NPUAP/EPUAP) guidelines (30). It includes an examination for the presence of PIs with yes/no response, documentation of the number of PIs, their specific location, stage, and date of assessment. The grading of PIs was performed based on the NPUAP/EPUAP. Six stages of PI classification system, which include: Stage-I (intact skin with non-bleachable redness or colour different from the surrounding), Stage-II (partial thickness skin loss with intact or ruptured blister presenting as red wound bed), Stage-III (full-thickness skin loss with visible subcutaneous layer), Stage-IV (full-thickness tissue loss), Unstageable (intact epidermis but affected area appears with purple or blood-filled blister over dark wound bed), and suspected deep tissue injury (sDTI) (full thickness skin and tissue injury, but the depth of the ulcer is obscured by necrotic tissue) (30).

The information was collected by nurses who were not part of the hospital staff being studied. The data collectors conducted patient examinations within 24
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hours of admission. Then, they continued reassessments every other day until the patient developed a PI or left the unit after a two-week stay. The data collector also initially assessed the patient eligibility status of a score of 18 or below using the Braden Scale.

Ethical approval and consent to participants

Ethical Approval was obtained from several relevant authorities, including the IRB of the College of Health Science, Saint Paul's Hospital Millennium Medical College, as well as Addis Ababa city health office, with specified Protocol and reference numbers: No. 040/20/Nursing, Ref. No. pm23/27 and Ref. No. A/A/A281/227, respectively. Additionally, the study emphasizes adherence to established guidelines, specifically the Declaration of Helsinki. All participants or their relatives were adequately informed about the study's purpose and that consent was obtained verbally, indicating a commitment to ethical standards in research practices.

Data management and analysis

The collected data were checked, coded, and entered into epi-data, version 4.6 software, and exported to SPSS, version 26.0, for analysis. Frequency, percentage, mean, and standard deviation (SD) or median of different variables were calculated to describe and summarize the demographic and health-related characteristics of the participants. The Pearson chi-square test and student t-test were performed to compare the significance of the predictor variables in pressure injury development. Binary logistic regression analyses were calculated to examine the relationship between the predictive factors and the development of PIs. The statistical significance of the predictor

variables value of .05 was used at a 95% confidence interval (CI). A ROC analysis was performed to determine the Braden Scale's predictive ability. Using the AUC, sensitivity, and specificity test values determined the diagnostic accuracy of the tests. The value for AUC can range from 0 to 1. A test value of 0.5 or less indicates (no discrimination), 0.6 - 0.7 (poor discrimination), 0.7 - 0.8 (acceptable discrimination), 0.8 - 0.9 (excellent discrimination), and 1.0 (perfect discrimination) (32-34).

Results

A total of 238 patients were assessed, of which 229 patients completed the questionnaire with a response rate of 96.2%. Participants' demographic and clinical characteristics, at admission 229 patients had no PI. More than half of the samples 59.8% (137) were male, with ages ranging from 18-98 years. The median age was 39.0 years. The majority, 110 (48.03%) were admitted to the ICU, and the mean body-mass index (BMI) was $21.52 \pm 3.58 \text{ Kg/m}^2$. All cases were evaluated for the risk of PI development using the Braden Scale score. The mean (SD) of the total Braden Scale score was 13.2 ± 2.95 points, indicating a moderate risk for PI development. The sensory perception sub-scale had the highest average score (3.07 ± 1.04), while the degree of activity and friction/shear sub-scales had lower scores of 1.59 ± 0.754 and 1.62 ± 0.68 , respectively. Detailed data description is presented in Table 1. Among the admitted patients, 64 (27.9%) were diagnosed with traumatic injury, and 59 (25.8%) of them had multiple disease diagnoses. Details are depicted in Figure 1.

Table 1: Demographic and Clinical characteristics of participants admitted to selected public hospitals in Addis Ababa, Ethiopia, from February to April 2021 (n = 229)

Variables	Total	Frequency (n, %)		Statistics	P value
		Mean $\pm$ SD		X ² /t-test	
		No PI	PI		
Gender				X ² (1) = .001	.977
- Male	137 (59.8 %)	107 (46.7%)	30 (13.1%)		
- Female	92 (40.2 %)	72 (31.4%)	20 (8.7%)		
Age in years	42.14 $\pm$ 17.01	40.91 $\pm$ 16.64	46.56 $\pm$ 17.75	t (227) = -2.092	.038*
Body mass index (in Kg/M ²)	21.52 $\pm$ 3.58	21.57 $\pm$ 3.54	21.35 $\pm$ 3.75	t (227) = .387	.699
Systolic Blood pressure in mmHg	118.07 $\pm$ 19.75	117.49 $\pm$ 19.40	120.19 $\pm$ 20.99	t (227) = -.846	.398
Diastolic Blood pressure in mmHg	73.76 $\pm$ 12.19	73.50 $\pm$ 11.83	74.66 $\pm$ 13.80	t (227) = -.593	.554
Body temperature in °C	36.70 $\pm$ 0.87	36.59 $\pm$.75	37.07 $\pm$ 1.13	t (227) = -3.474	.001**
Total Braden Scales score	13.20 $\pm$ 2.95	13.59 $\pm$ 2.93	11.80 $\pm$ 2.58	t (227) = 3.911	<.001**
Braden sub-scales					
- Sensory perception	3.07 $\pm$ 1.04	3.15 $\pm$ 1.001	2.80 $\pm$ 1.125	t(227) = 1.964	.037*
- Skin Moisture	2.75 $\pm$ 0.728	1.66 $\pm$.712	1.32 $\pm$.760	t(227) = 2.038	.037*
- Activity	1.59 $\pm$ 0.754	2.80 $\pm$.780	2.56 $\pm$.587	t(227) = 3.345	.005*
- Mobility	2.004 $\pm$ 0.814	2.07 $\pm$.814	1.76 $\pm$.771	t(227) = 2.504	.016*
- Nutrition	2.19 $\pm$ 0.74	2.25 $\pm$.725	1.96 $\pm$.755	t(227) = 2.489	.016*
- Friction and shear	1.62 $\pm$ 0.68	1.68 $\pm$.675	1.40 $\pm$.639	t(227) = 2.666	.010*
PI risk category				X ² (3) = 19.917	< .001*
- Very high risk	32 (14.0 %)	19 (8.3%)	13 (5.7%)		
- High risk	54 (23.6 %)	41 (17.9%)	13 (5.7%)		
- Moderate risk	49 (21.4 %)	33 (14.4%)	16 (7.0%)		
- Low risk	94 (41.0 %)	86 (37.6%)	8 (3.5%)		
Admission ward				X ² (4) = 4.95	.292

Evaluation of the Predictive Capacity of the Braden Scale for Pressure Injury

- ICU	110 (48.03 %)	82 (35.8%)	28 (12.2%)		
- Medical	44 (19.2%)	34 (14.8%)	10 (4.5%)		
- Orthopedic	35 (15.3%)	27 (11.8%)	8 (3.5%)		
- Neurology	30 (13.1%)	28 (12.2%)	2 (0.9%)		
- Surgical	10 (4.4%)	8 (3.5%)	2 (0.9%)		
Number of diseases				$\chi^2(1) = 2.268$	.145
- Single disease	170 (74.2 %)	137 (59.8%)	33 (14.4%)		
- Multiple diseases	59 (25.8 %)	42 (18.3%)	17 (7.4%)		

Footnote: (**) refers correlation is significant at the .01 level, (*) correlation is significant at .05 level

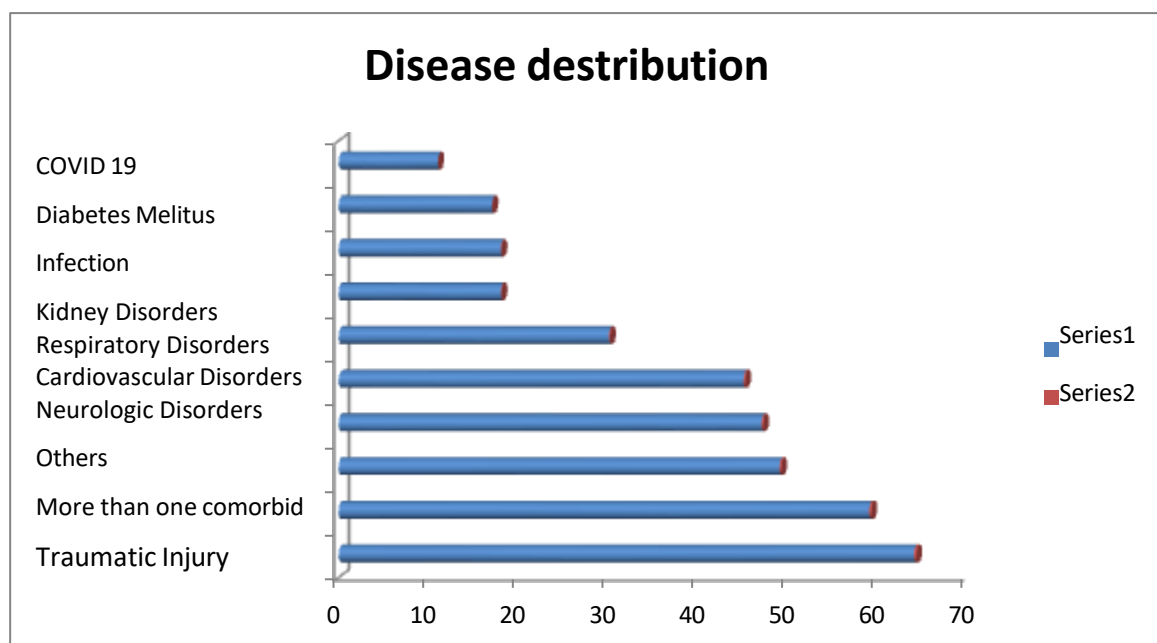


Figure 1 Graphic presentation of the distribution of disease diagnosis among the study participants admitted to three public hospitals in Addis Ababa, Ethiopia, from February to April 2021(n= 229)

Among the admitted patients, 50 (21.8%) developed a new PI at various sites after hospital admission, and of them, 30/50 (60%) were male. Most of the PIs 48/52 (92.3%) were classified as stages I and II, primarily located in the sacral area. The incidence of PIs varied considerably among the three hospitals: TASH had 28

cases (12.2%), while SPHMMC and Minelik II Referral Hospital each reported 11 cases (4.8%). This difference was statistically significant ($\chi^2 = 7.616$, $p = .022$). The PI development began after the 2nd day of admission. The larger number of PIs was recorded within ten days; details are shown in [Table 2](#).

Table 2 The Pressure Injury among Participants admitted to selected public hospitals in Addis Ababa, Ethiopia, from February to April 2021(n =229)

Variable	Frequency (percentage)
Pressure injury (n = 229)	
- No	179 (78.2%)
- Yes	50 (21.8%)
PI cases among three Hospitals	
- TASH	28 (12.2%)
- SPHMMC	11 (4.8%)
- Minelik II Referral Hospital	11 (4.8%)
Location of PI (n=52)	
- Sacral area	28 (53.8%)
- Hip	14 (26.9%)
- Shoulder	5 (9.6%)
- Elbow	2 (3.8%)

Evaluation of the Predictive Capacity of the Braden Scale for Pressure Injury

Heel & ankle	2 (3.8%)
Ear	1 (1.9%)
Stages of the PI (n = 52)	
Stage-I and II	48 (92.3 %)
Stage-III	2 (3.85 %)
Stage-IV and sDTI	0 (0.0 %)
Unstageable	2 (3.85 %)
The onset of Pressure Injury in days (mean ±SD)	10.52 ± 2.62

Significant associations were observed between PI development and demographic and clinical characteristics such as age, body temperature, and Braden Scale score. These variables also showed significance in multiple binary logistic regression analysis, as age increased by one year, the odds of developing a PI increased by 2%, $p = .030$. For every one-degree Celsius ($^{\circ}\text{C}$) increase in body temperature,

the likelihood of developing a PI increases by 2.27 times. Conversely, a one-point increase in the Braden Scale score is associated with a 24.5% decrease in the likelihood of PI development. Based on the PI risk categories, the risk of PI development was found to be more likely in the very high-risk category with $p < .001$ as shown in [Table 3](#).

Table 3 Statistically significant predictor variables on pressure injury development among Participants admitted to selected public hospitals in Addis Ababa, Ethiopia, February to April 2021 (n =229)

Independent Variable	Dependent Variable		COR	AOR	P value	95% CI	
	No PI (n)	PI (n)				lower	upper
Age in years (mean±SD)	40.91±17.75	46.56 ±16.63	1.019	1.021	.030*	1.002	1.041
Body temp. in $^{\circ}\text{C}$ (mean±SD)	36.599±.752	37.072±1.138	1.823	2.270	.000**	1.537	3.351
Braden Scale score (Mean±SD)	13.59±2.937	11.80±2.587	0.813	0.755	.000**	.728	.908
PI risk category							
• Very High risk	86	8	7.355	11.274	.000**	3.773	33.685
• High risk	41	13	3.409	3.767	.009**	1.384	10.255
• Moderate risk	33	16	5.212	6.484	.000**	2.389	17.602
• Low risk	19	13	1	1	1		

ROC analysis: The ability of the Braden Scale to identify PI development was determined using the receiver operating characteristics (ROC) analysis. The optimal cut-off point for the best balance of sensitivity and specificity was 13.5, providing 64% and 59.2%, respectively. The area under the curve (AUC) was calculated as 0.682 with a 95% CI (0.611, 0.761), $p <$

.001. The area under the ROC curve (AUC) provides a measure of the test's overall ability to discriminate between true positive and true negative cases. A graphic illustration of the ROC curve with the plot of sensitivity versus 1-specificity (FPR) at various cut-off points is presented in [Figure 2](#).

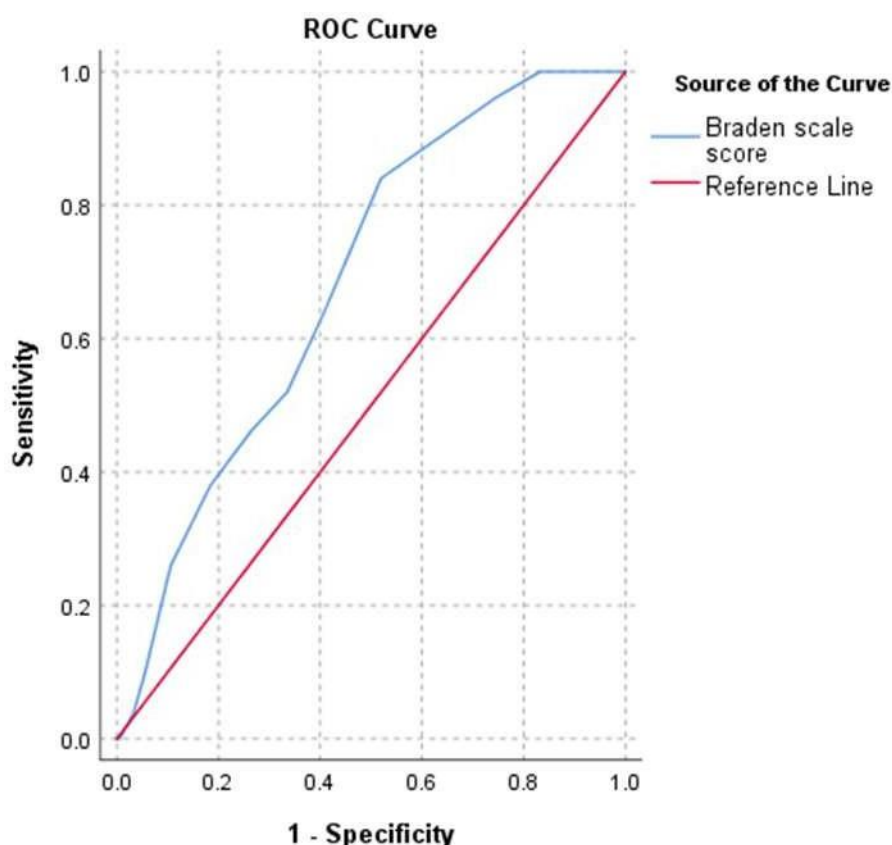


Figure 2 Illustration of the AUC-ROC curve of the Braden Scale with pressure injury development. The ROC curve plots the true positive rate (sensitivity) against the false positive rate (1 - specificity) at various thresholds.

Discussion

Hospitalized patients who develop PIs are at risk for poor health outcomes and often reflect the quality of care provided. Preventing PIs is a top priority among critically ill patients, and one way to do so is by identifying individuals who are at risk using validated risk assessment tools like the Braden Scale. The results of our study indicated that the Braden Scale had poor ability to discriminate the PI development, as AUC = .686 values, with 64% sensitivity and 59.2% specificity. In addition, more than 20% of the newly admitted patients developed PIs, with the majority being classified as stage I and II. The average total Braden Scale score suggested a moderate risk for PI development among the study sample. Additionally, in the binary logistic regression analysis, our study found that age and body temperature had a statistically significant relationship with PI development.

However, this pioneering Ethiopian study was not without limitations. The restriction to urban tertiary care centers, brief training, lack of inter-rater reliability assessment, and omission of hospital-specific factors, potentially compromising accuracy and generalizability were some of the limitations of the study. On the other hand, the fact that the study was conducted prospectively, evaluated patients timely and was conducted in more than one hospital among patients

with different lengths of hospital stay could be cited as its strength.

Contrary to our findings, several studies have indicated that the Braden Scale effectively predicts the occurrence of PIs at different threshold levels (27, 28, 35-37). For example, a retrospective cohort study conducted in an ICU in the US demonstrated satisfactory performance of the Braden Scale in predicting PI development, with an AUC of 0.737(28). Another study carried out among acutely ill veterans in the US found that the Braden Scale had moderate accuracy in predicting PI development, with sensitivity, specificity, and AUC values of 65%, 70%, and 0.70, respectively (27). Numerous meta-analysis studies conducted in different settings (ICU, long-term care facility, nursing home) also showed moderate predictive accuracy of the Braden Scale, with the summary ROC-AUC values ranging from 0.7 to .84 (35-37). However, it is important to note that while our study found similar results, studies also reported inadequate accuracy of the Braden Scale in predicting PI development with the value of AUC falling on .672 and .648 at optimal cut-off points 13 and 16, in several hospitals (38, 39). This discrepancy may be due to differences in the study areas and the participants' demographic and clinical characteristics as the risk assessment tool is more appropriate for geriatric and ICU-admitted patients.

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The current study identified a PI incidence rate of approximately 22% among critically ill hospitalized patients. In contrast to our findings, prior studies reported higher rates of HAPI (40-43). Other studies reported rates lower than ours, and additional investigations similarly noted reduced rates of HAPI (5, 6, 28, 38, 44, 45). Notably, the majority of studies, including the current one, found that HAPIs occurred within an average of 10 days, ranging from the 2nd to the 13th day, regardless of prevention strategies (6, 40, 46). A notable exception was a single study that reported a shorter onset period of 6-8 hours (44), consistent with a systematic review examining various studies (47). However, this lower incidence rate is inconsistent with our findings. These discrepancies highlight the need for further research to understand the factors contributing to varying PI incidence rates and to develop more effective prevention strategies.

In addition to the factors included in the Braden Scale, numerous risk factors played a role in developing PI among hospitalized patients. In our study, we evaluated gender, BMI, age, body temperature, blood pressure, and comorbid illnesses as independent variables to determine their significance in predicting the development of PI. However, only age and body temperature were significant predictors, indicating that they are intrinsic factors contributing to decreased tissue tolerance as suggested by Braden and Bergstrom (21). On the contrary, numerous studies have documented risk factors for PI development (18, 48). These include advanced age, high BMI, elevated lactate, use of vasopressors and antifungals, male gender, diabetes, isolation, and prolonged ventilation (28, 46). In addition, the use of vasopressor drugs, low blood pressure, and an extended stay in ICU have also been significantly associated with the development of PI (40). The study found only age and body temperature as significant predictors, whereas other studies have found numerous other contributors. This difference arises from variations in study methods and design, and the range of variables investigated. Therefore, further research is needed.

The current study did not find a statistically significant association between BMI and PI development. However, past studies have identified low BMI as a significant predictor of PI development (18, 49). It's important to note that variations in findings may arise from differences in study methods, particularly study population. Further research using similar instruments may assist in obtaining better insights into these risk factors.

Conclusion and Recommendation

The study revealed a concerning incidence rate of 21.8% for hospital-acquired pressure injuries (HAPIs), underscoring the crucial need for improved patient care and health outcomes in healthcare settings. The Braden Scale, a widely used tool for assessing risk, yielded an average score of 13.2, indicating that many patients are at moderate risk for developing pressure injuries. Notably, age and body temperature emerged as significant predictors of this risk, highlighting the importance of monitoring these factors. However, in

this study, the Braden Scale showed limited ability to predict patients' risk of developing PIs. This suggests that the Braden Model may not be sufficient on its own for effective risk assessment.

Therefore, further research involving larger sample sizes and a focus on specific hospital units to generate more precise data is essential. Additionally, testing inter-rater reliability will be crucial for ensuring consistent application of the Braden Scale. Overall, these steps are vital for enhancing PI risk assessment effectiveness and ultimately reducing the incidence of hospital-acquired pressure injuries.

Conflict of Interest Regarding Funding:

The authors hereby declare that they have no conflicts of interest about funding, as no external funding has been received for this project.

Authors' contribution

EBW was responsible for conceptualizing the project and conducting investigations through the collection and organization of data. Additionally, EBW prepared the initial draft of the manuscript. MKH played a key role in the formal analysis and interpretation of the data. RWM, WAD, and RAG contributed by validating the manuscript and participating in its review and editing process. All authors have reviewed the final version of the manuscript and have given their approval for its publication.

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The AI writing percentage should not be the sole basis to determine whether misconduct has occurred. The reviewer/instructor should use the percentage as a means to start a formative conversation with their student and/or use it to examine the submitted assignment in accordance with their school's policies.

What does 'qualifying text' mean?

Our model only processes qualifying text in the form of long-form writing. Long-form writing means individual sentences contained in paragraphs that make up a longer piece of written work, such as an essay, a dissertation, or an article, etc. Qualifying text that has been determined to be likely AI-generated will be highlighted in cyan in the submission, and likely AI-generated and then likely AI-paraphrased will be highlighted purple.

Non-qualifying text, such as bullet points, annotated bibliographies, etc., will not be processed and can create disparity between the submission highlights and the percentage shown.



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by Emebet Berhane

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