

# Review of pressure ulcers management in pediatrics: assessment, prevention, and intervention

## Abstract

**Objective:** This study did a thorough review of the literature and investigated the current evidence-based guidelines and information available for the incidence and prevalence, the identification of risk factors, which risk scales are valid and reliable, and examined the effectiveness and applicability of the different intervention and prevention options for the management of Pressure Ulcers (PUs) and skin breakdown in pediatric population in comparison to those found in adults literature.

**Results:** PUs in the pediatric population has been poorly documented and has not received adequate attention in the literature compared to those in the adult population. The chronically ill children and the pediatric patient population with chronic conditions and severe neurological and sensory motor impairments such as cerebral palsy, spine bifida and Spinal Cord Injury (SCI), are at significant risk for the development of PUs. A comprehensive and thorough pediatric skin care program should emphasize the need for accurate, continuous assessment, including specific and detailed documentation of tissue damage. Early assessment and detection are essential because early stage PUs is far easier and less costly to treat. Currently, there are 10 published pediatric pressure ulcer risk assessment scales. Of these scales, only the Braden Q Scale, the Neonatal Skin Risk Assessment Scale (NSRAS), and the Glamorgan Scale have been tested for sensitivity and specificity.

**Conclusion:** Most of the current evidence-based guidelines for prevention and management of pediatric PUs have been relatively limited and are largely modifications of adult practice guidelines. Healthcare professionals should keep in mind that pediatric patients are not just small adults, but deserve unique consideration in their medical and surgical care. Therefore, further future research studies and well designed randomized clinical trials (RCTs) are needed to examine the efficacy, effectiveness, the applicability, and safety of the available prevention and treatment options for the management of PUs and skin breakdown in pediatric population.

**Keywords:** pressure ulcer, pediatric, assessment, management, prevention, intervention

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**Hassan Izzeddin Sarsak**

Department of Occupational Therapy, Batterjee Medical College, Saudi Arabia

**Correspondence:** Hassan Izzeddin Sarsak, PhD, OT, Department of Occupational Therapy, Batterjee Medical College, Jeddah, KSA, Saudi Arabia, Email h.sarsac@ju.edu.jo, hassan.sarsac@bmc.edu.sa, sarsachassan@gmail.com

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## Introduction

A Pressure Ulcer (PU) is defined by the National Pressure Ulcer Advisory Panel (NPUAP) as a “localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction.<sup>1</sup> Pus represent a significant healthcare problem and play a critical role in the patients’ quality of life and their treatments affect the patients’ lives emotionally, mentally, physically and socially.<sup>2</sup> The staging system of PU was defined by Shea in 1975 and provides a name to the amount of anatomical tissue loss. The original definitions were confusing to many clinicians and lead to inaccurate staging of ulcers associated or due to perineal dermatitis and those due to deep tissue injury. In 2007, the proposed definitions were refined by the NPUAP and described in details with input from an on-line evaluation of their face validity, accuracy clarity, succinctness, utility, and discrimination.<sup>1,3</sup>

## Method

The following electronic databases were searched to identify literature relevant to this study: PubMed, Ovid (MEDLINE, Psych INFO, and Global Health), and Cumulative Index of Nursing and Allied Health Literature (CINAHL). Search terms (keywords) used were pediatric, pressure ulcers, skin integrity, risk factors, assessment, incidence and prevalence, physical disabilities, assistive technology,

adaptive seating interventions, and prevention. Seventy four potential relevant research studies were identified and screened for the literature review. Research studies were selected and included in the literature review if they were written in the English language and published between 1976 and 2013 in peer-reviewed journals. Based on these criteria, 55 studies out of the 74 were identified and reviewed and 19 studies were excluded. Furthermore, studies were screened again for more detailed evaluation and were included if they involved methods of pressure ulcers assessments, prevention, and intervention in different populations (pediatrics, adult, geriatrics). Studies were excluded if they included only one pressure ulcers measurement method and did not compare between different methods. This yielded a total of 32 studies that were included in the literature review and 23 studies were excluded.

## Results

PUs in pediatrics has not received adequate attention compared to other populations. The anatomical sites of PU differ between the adult and pediatric population. While the sacrum is the most common site for PU in adults, the occipital region in children less than 36 months, the sacral region, and the calcaneous are the primary sites identified in the research.<sup>4,5</sup> PUs occurs less frequently in the pediatrics than adults.<sup>6-9</sup> In 2004, a survey of 513 adult and pediatric inpatients at a tertiary care hospital, PU prevalence was found to be 29.2% in

adult patients and 13.1% in pediatric patients.<sup>10</sup> The lower incidence and prevalence of PUs in children compared with adults may have shown that PUs are not a significant problem in children. PUs is often considered significant complications in pediatrics with severe illnesses or with neurological and sensory motor dysfunctions such as cerebral palsy, spina bifida, and SCI. There is a big misconception that children are not at risk for developing of PUs which unfortunately becomes a major risk factor itself and therefore may lead to inappropriate regular skin inspection and prevention methods.<sup>11</sup>

Unfortunately, most of the current evidence-based guidelines and information available for identification of risk factors and assessment and intervention of pediatric PUs have been limited and are largely modifications of adult guidelines. Because of the anatomical and physiological differences between pediatrics and adults, PU management protocols adopted from adults may not be applicable for children. There is limited information available in terms of risk factors identification related to PU in pediatrics when compared with those found in the adult literature. Most of those factors were derived from adult's population.<sup>5</sup> Prolonged pressure over bony prominences, friction, and shear forces are common extrinsic risk factors. Besides, any external condition that limits mobility increases the chance of PU development, such as prolonged surgical operations, intubation, casts, and splints.<sup>4,10,11</sup> Furthermore, there are many physical conditions that may cause limitation in mobility, such as decreased sensation, impaired cognition, hypotension, edema, trauma, and other neurological conditions associated with Traumatic Brain Injury (TBI), spina bifida, cerebral palsy, pediatric stroke, and SCI. For instance, children with high level SCI are at a very high risk of developing PUs because most often they are paralyzed, and therefore their ability to pressure relief is limited or absent. Moreover, the sensory loss that results from the SCI makes the child unaware of the existing injuries due to lack of pressure relief. Additionally, in children with SCI, the blood flow to the tissues would be inadequate due to dysregulations in the metabolic mechanisms.<sup>12</sup> Decreased oxygenation, infection, anemia, and hypovolemia are all other PUs risk factors identified in adults. Although they may seem self-evident in children, they need more investigation in terms of the vulnerability for skin breakdown due to history of spinal surgeries and other spinal deformities.<sup>6</sup> In addition, there are many other factors that may cause PUs, such as but not limited to physical characteristics (i.e., obesity, kyphoscoliosis, and large head circumference), demographic variables (i.e., age and race), and other abnormalities (i.e., edema and incontinence). It is reported that most pediatric PUs are related to the use of devices and located at the contact points with these objects such as wheelchairs, casts, blood pressure cuffs, continuous positive airway pressure (CPAP), orthotics and prosthetics.<sup>13</sup>

When assessing PUs, proper evaluation of the risk of ulceration and accurate staging and documentation are considered vital prerequisites for adequate management after ulcer detection.<sup>3</sup> Numerous PU risk assessment scales have been suggested for use in pediatrics. Currently, there are ten published pediatric pressure ulcer risk assessment scales. Of these scales, only the Braden Q Scale, the Neonatal Skin Risk Assessment Scale (NSRAS), and the Glamorgan Scale have been tested for sensitivity and specificity.<sup>11</sup> The Braden Q Scale is based on the Braden Scale used to predict pressure ulcer risk in adults. The Braden Q scale and its brief version were documented as comparable to that of the Braden Scale.<sup>14</sup> The Neonatal Skin Risk Assessment Scale (NSRAS) was also developed and adopted from the

Braden scale and tested.<sup>4</sup> The Glamorgan Scale is another pediatric PU risk assessment scale with tested psychometric properties.<sup>15,16</sup>

## Discussion

Management of PUs begins with proper and adequate assessment and prevention. Management may include controlling factors for PU development such as, pressure, shear, friction, moisture, and blood flow dysregulation. Ulcers' healing through adequate nutrition and fluid support and edema management is also applied. Maintenance of ulcers' environment helps manage infection, maintain a suitable level of moisture, cleanse the ulcer, eliminate scars, control odor, and minimize pain.<sup>3</sup> In 1999 the Canadian Association of Wound Care (CAWC) developed 12 recommendations of PU management forming best clinical practices in patient care which include a completion of patient's medical history & determination of risk factors that may delay healing, modifications of situations where pressure may be increased (e.g. when seated or lying down), maximization of nutritional status, activity and mobility, reducing friction and shear,<sup>17</sup> development of a patient-centered plan & interdisciplinary team with flexibility to meet the patient's needs, staging and treating the wound to provide an optimal wound environment (debridement, infection & incontinence control, moisture balance), considering surgical treatment for deep non healing ulcers, and educating patient, caregiver, and healthcare professional on the prevention and intervention of PUs.<sup>2,18</sup> A variety of techniques and technologies could be performed to prevent and/or treat PUs in children. The child should be assessed on regular basis to determine comfort with the bed, chair, or object is being used. Any object that may cause pressure on the skin should be adjusted and monitored carefully. In neonates, respiratory devices that are in contact with sensitive facial skin, must be closely monitored to prevent formation of PUs. In addition, preterm neonates should be repositioned at least twice in an 8-hour shift.<sup>10</sup> Children with SCIs are at a high risk of developing ulcers on their buttocks and sacrum due to lack of sensation.

Therefore, regular position's change that relieves pressure and prevents prolonged ischemia is recommended. The use of specialized support surfaces, such as mattresses, beds, and cushions reduce the pressure applied on the patient's skin.<sup>18</sup> An alternating pressure mattress was developed and proved to be useful and effective in children.<sup>20</sup> In 2001, a study revealed that the use of appropriate pressure-relief cushions for elderly wheelchair users at nursing homes who are at high risk for developing pressure ulcers led to a lower incidence rate of pressure ulcers, a greater number of days until ulceration, and lower peak interface pressures compared with the use of regular foam cushions over one year.<sup>21</sup> A ROHO cushion for wheelchair users as well as push-up exercises may minimize the risk of PU development.<sup>22</sup> A comprehensive assessment of nutrition plays an important role in the prevention and management of PU. A comprehensive assessment of nutritional status and risk factors conducted by an interdisciplinary team and an individualized nutritional care planning for each child must be implemented. Once implemented, the plan should be assessed on regular basis according to the patient's developmental stages and growth and change in health status.<sup>16</sup> Patients and care givers education is important in the management of PUs. They should learn the signs and symptoms of pressure ulcers, basic principles of pressure relief, how to report associated pain, how to apply basic dressing changes, and become familiar with patient's care guidelines. Healthcare professionals such as nurses and therapists could learn a lot from their

patients' experiences, could provide useful information about realistic time expectations for recovery, and could provide preventative interventions and a better understanding of the importance of comfort and positioning for patients.<sup>2</sup> However, education of children may not always be applicable due to age-related inability to communicate efficiently and follow directions adequately.<sup>5</sup>

A study suggested that the Negative Pressure Therapy (NPT) which has been approved as an effective method for wound closure in adults can be used to manage wounds in children. The system has been proven to accelerate wound healing, decrease tissue edema, lower wound bacterial load, and provide a healing environment. However, further future studies are needed to determine appropriate modifications that could be applicable to the child to ensure the benefits of this technology.<sup>23</sup> Moreover, it was found that the application of a lotion containing hexachlorophene, squalene, and allantoin was superior when compared to a simple moisturizing lotion, and therefore could act as a bactericidal agent and might stimulate cell proliferation and tissue growth.<sup>18</sup> Topical management of PUs is a vital component of ulcer healing. Providing the suitable wound dressing is an important step in preserving a healing ulcer environment (Wu, et al., 2009). Applying the TIME approach may be appropriate in choosing a dressing to enhance ulcer healing. The TIME approach addresses the following factors:

- a) Tissue type
- b) Infection
- c) Moisture balance of an ulcer
- d) Edge of ulcer

There is a variety of available types of dressings that have been used to promote PU healing in children and are intended to add moisture to a wound bed, such as hydro gels, transparent films, hydro cellular foam, and silver antimicrobial dressings.<sup>3</sup> Prescription of seating devices for children who use wheelchairs for mobility usually considers posture, comfort, function, and pressure management. Power wheelchairs with multiple seating functions, such as tilt-in-space, backrest recline, and seat elevator, are usually prescribed to facilitate posture, accommodate deformity, increase comfort, and assist in functional activities of daily living (ADL) for children with severe types of cerebral palsy or with a high-level SCI with impaired sensation who are unable to adjust their body position independently or for those with neuro motor dysfunctions that a standard manual wheelchair does not meet their needs. The appropriate use of multiple power seat functions may lead to PU prevention. Researchers found that tilt-in-space significantly minimized seating pressure, and that combining tilt-in-space with backrest recline reduced pressure more than tilt-in-space alone. In addition, many previous studies suggested that persons use large tilt-in space and recline angles to effectively manage pressure to minimize the risk of PU.<sup>24</sup> A study found that the biggest reduction in maximum pressure at the ischial tuberosities was found at 45° of tilt-in space and 120° of backrest recline and that an effective weight shift could be achieved only when tilt-in-space is >15°. <sup>25</sup> The International Classification of Functioning, Disability and Health (ICF) address the area of adaptive seating for children with severe and chronic conditions. The ICF is a comprehensive framework that focuses on function and health rather than disease-based models of disability, and puts the individual at the center of the health care process. The ICF model not only gives a holistic basis for therapists to evaluate their own activity, but also encourages more adequate

communication with other healthcare professionals and provides a means of interactive and meaningful discussions with children and their families.<sup>26-32</sup>

## Conclusion

In conclusion, PUs in the pediatrics has been poorly documented and have not had adequate attention compared to other adults. Most of the PU risk factors such as immobility, neurological impairment, and decreased oxygenation are primarily defined in the adult research. It can be proposed that these risk factors also apply to pediatrics. The anatomical sites of PU differ between the adult and pediatric population (whereas the sacrum is the most common site for PU in adults, the occipital region in children less than 36 months, the sacral region, and the calcaneus are the primary sites identified in the research). Children with chronic conditions and severe neurological and sensory motor dysfunctions such as cerebral palsy, spine bifida and SCI are at significant risk for PU development. A thorough pediatric skin care program should emphasize the need for comprehensive, accurate, continuous assessment, including specific documentation of tissue damage. Early assessment and detection are crucial as PUs at earlier stages is usually much easier and cost effective. Currently, there are 10 published pediatric pressure ulcer risk assessment scales. Of these scales, only the Braden Q Scale, the Neonatal Skin Risk Assessment Scale (NSRAS), and the Glamorgan Scale have been tested for sensitivity and specificity. Most of the current available clinical applications for prevention and intervention of PUs in pediatrics are limited and are adopted from the adult practice guidelines. Healthcare professionals should keep in mind that children deserve unique consideration in their healthcare. Therefore, guidelines and evidence from clinical and research studies for prevention and intervention of PUs specifically targeting pediatrics are required. Future research studies and well designed RCTs are needed to further examine the efficacy, effectiveness, the applicability, and safety of the available prevention and intervention options for skin breakdown and PU management in pediatric population.

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## Conflict of interests

Author declares that there is no conflict of interest.

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