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A comparison of the performance of the Braden Q and the Glamorgan paediatric pressure ulcer risk assessment scales in general and intensive care paediatric and neonatal units

Jane Willock[i], Laila Habiballah[ii], Deborah Long[iii], Kelli Palmer[iv] and Denis Anthony[v] ' [vi]

Abstract

Aims

To compare the predictive ability of two risk assessment scales used in children.

Background

There are several risk assessment scales (RASs) employed in paediatric settings but most have been modified from adult scales such as the Braden Q whereas the Glamorgan was an example of a scale designed for children.

Methods

Using incidence data from 513 paediatric hospital admissions, receiver operating characteristic (ROC) was employed to compare the two scales. The area under the curve (AUC) was the outcome of interest.

Results

The two scales were similar in this population in terms of area under the curve. Neonatal and paediatric intensive care were similar in terms of AUC for both scales but in general paediatric wards the Braden Q may be superior in predicting risk.

Conclusion

Either scale could be used if the predictive ability was the outcome of interest. The scales appear to work well with neonatal, paediatric intensive care and general children's wards. However the Glamorgan scale is probably preferred by childrens' nurses as it is easy to use and designed for use in children. There is some suggestion that while the two scales are similar in intensive care, for general paediatrics the Braden Q may be the better scale.

Aims

To compare the Glamorgan and Braden Q scales in general paediatric, PICUs and NICUs.

Background

Pressure ulcers affect the paediatric population, especially in those who are critically ill or with debilitating conditions (1). However, there is a paucity of empirical evidence upon which new guidelines for this area can be established (2). Children and neonates have unique characteristics, depending on their developmental maturity, that are different to adults, and this necessitates specific protocols for skin care. In order to have effective prevention and intervention procedures, there should be an accurate and practical assessment, hence assessment is the preliminary step toward suitable prevention (3, 4), however, there is little validated evidence for pressure ulcer risk assessments in children (2).

Pressure ulcers in children, as in adults, have many devastating effects; such as pain, and increased hospital stay (3, 5). They can also cause disfigurement or permanent alopecia, which may affect the child's body image (5-7). Any breaks in child's skin by invasive medical devices, incontinence lesions, or other wounds may cause them to be susceptible to infection (8), and in severe cases infected pressure ulcers can lead to osteomyelitis (7, 9). Pressure ulcers impose a financial burden both on health organizations and on individual patients (5). Given the breadth of consequences on children, families and communities, practice aimed at pressure ulcer prevention is more favourable than treatment (10).

Incidence and prevalence studies are necessary to establish benchmarking data about the size of the pressure ulcer problem (11, 12), and using prospective incidence studies can help in exploring the performance of the RASs in certain populations (13). . Most studies of prevalence and incidence are low quality, however when including only higher quality papers there was a prevalence (excluding grade I ulcers) of 0.8% (14) in paediatric populations though much higher incidence and prevalence figures were found in paediatric intensive care units (PICUs) than the general paediatric population. In a multicentre study of 412 children in 14 clinics there was a prevalence of 35%, although these were mostly minor (15) there were three grade III and two grade IV pressure ulcers. A previous study by the same team (16) found similar results and noted that two pressure ulcers were still apparent after six months - the higher prevalence found in these studies are largely due to reporting of minor ulcers (grade I). Thus pressure ulcers occur in children, can be severe and cause serious problems. There are at least twelve paediatric RASs but of these only the Braden Q, Glamorgan and the Neonatal Risk Assessment Scale have been validated (17).

The early development of the Braden Q scale was based on modifications to the adult Braden Risk assessment scale (10, 18). It was created for use in paediatric critical care, and is thought to be useful because of its diverse range of sub-items; items which the original authors believed to be the major causes of pressure ulcer development (10). The items derived from Braden and Bergstrom's conceptual model divided risk factors into two groups related to skin tolerance and to the intensity and duration of the pressure (19). The Braden Q Scale is composed of seven sub-items; mobility, activity, moisture, tissue perfusion & oxygenation, friction and shear, sensory perception, and nutrition. Each sub-item is scored from one to four, with four representing the lowest level of risk and one indicating the highest risk. The total score for any child should range from seven (the

highest risk) to 28 (lowest risk) (10). These sub-items are the same as those found in the adult Braden scale, but with the addition of the seventh sub-item, '*tissue perfusion and oxygenation'*. This item was added to reflect the unique paediatric developmental characteristics, and to optimise the benefits of using data that are commonly available in PICUs. This sub-item was also included in the original conceptual model used to develop the adult Braden Scale (10). The Braden Q scale has been tested for validity in infants and children aged from 21 days old to eight years (11) and found to show good diagnostic accuracy in 3-8 year olds (20). Validity studies have shown that children considered at low risk of pressure injury score an average of 25, moderate risk score an average of 21, and high risk score an average of 16 on the Braden Q scale. In a sample of 322 PICU patients (pressure injury incidence 62%), the Braden Q scale, using a cut off score of 16 has demonstrated high sensitivity of 0.88 and moderate specificity of 0.58 (AUC 0.83, CI 0.76 – 0.91) (21). Validation data from the Braden Q scale authors have only sampled critically ill children in PICUs, not patients from general paediatric wards. No inter-rater reliability data are available for the Braden Q scale.

The Glamorgan scale was developed using detailed data collected on 336 paediatric inpatients from 11 hospitals in the United Kingdom, and included prevalence and incidence data. Sixty one children had pressure ulcers and 175 had no observed pressure ulcers. (22). A comparison of children with and without pressure ulcers was undertaken to determine the variables which contributed the most significantly to the scale. Eleven out of the seventeen variables identified were included in the scale as sub-items. A reliability study was undertaken, and after additional modifications, the final scale included nine sub-items (23). The risk scores were adjusted so that patients with higher scores would be those at higher risk of developing pressure ulcers. Potential total scores can range from 0 to 42, with higher scores indicating a higher risk of pressure injury development (≥ 10 at risk; ≥ 15 high risk; ≥ 20 very high risk). The Glamorgan scale has also undergone validation in independent populations (24) showing in that case to be superior to the Braden Q scale. However inter-rater reliability has been questioned. In this sample there was little variability in items of the Glaorgan scale and thus while there was high absolute agreement there was a low intraclass correlation coefficients though the Glamorgan scale had higher inter-rater reliability than a visual analogue scale **(25, 26)**.

The items relating to mobility and devices or objects pressing on the skin were allocated higher scores than the other 7 items (22) based on expert opinion. Using a cut off score of 15, the Glamorgan Scale has demonstrated very high sensitivity of 0.98 and moderate specificity of 0.67 (AUC 0.91) when tested with the data used to develop it (27).

In summary pressure ulcers occur in children and there is a need to assess the risk of pressure ulcers. Few studies have been conducted to evaluate paediatric RASs but none had considered neonatal intensive care units (NICUs).

Methods

Study design

Prospective study

Setting

Paediatric inpatients in all clinical areas (Brisbane) and critical care units (Irbid)

Participants

Incidence data were collected in two geographical areas using identical data collection tools. The areas were the King Abdullah University Hospital (KAUH) in Irbid, Jordan, and the Royal Children's Hospital in Brisbane (RCHB), Australia. In KAUH data were only collected on children admitted to critical care areas. In KAUH there was one data collector (an experienced tissue viability nurse and PhD student), who was familiar with the Braden Q and Glamorgan scales, and the identification of pressure ulcers. The sample was obtained by means of consecutive non-probability sampling (28). Between November 2011 and May 2012 all paediatric patients who were admitted to the critical care units, and who were eligible to participate (no pre-existing pressure ulcers, and parental consent), were recruited, to obtain a target sample size of over 200 individuals. The critical care areas were PICUs, NICUs, and general intermediate care (GIMU, though only one child was recruited from GIMU).

In KAUH participants had a stay of over 72 hours so that at least one follow-up skin assessment could be carried out after the initial assessment. Pressure ulcer risk assessments using both the Glamorgan and the Braden Q tools were performed three times a week (every 2 to 3 days) for the first two weeks of admission, then once a week until participants were discharged, died, or the study period ended.

In Brisbane, data were collected on children in all clinical areas. Data collection commenced early in 2010 to include all children admitted to the hospital with no pre-existing pressure ulcers, to obtain a sample of over 300 complete data sets. All children aged less than 18 years were included. Education was given to clinical nursing staff working in in-patient areas regarding the use of both the Braden Q (previously used in the clinical area) and Glamorgan scales tools. Further education was provided where gaps in knowledge and practice were identified. The education provided:

- Theoretical information on paediatric pressure injuries and the risk assessment tools.
- Feedback to in-patient areas on their uptake of the pressure ulcer risk assessment tools.
- A discussion forum for nurses to communicate their concerns about pressure injury risk management.
- In both areas, participants had skin and pressure ulcer risk assessments (using both the Glamorgan and Braden Q tools) within 24 hours of admission. Only individuals with no pre-existing skin damage were included in the sample.

In RCHB the data collection phase commenced one month after rolling out the Glamorgan and Braden Q scales. Data were collected on all paediatric inpatients that had a length of stay of two nights or more. The data were collected as part of normal patient care and clinical assessment.

Variables

Nurses were asked to collect pressure injury risk assessments on each child using both the Braden Q and Glamorgan scales on a daily basis. Data collection sheets were collated by ward reception staff and collected weekly by the Project Officer.

The EUPAP & NPUAP (29) pressure ulcer categorisation scale was used at both sites.

Bias

By including all patients in the relevant areas (Brisbane) and from whom consent was obtained (Irbid) any selection bias was reduced.

Study size

212 paediatric admissions in KAUH, and on 301 paediatric admissions at RCHB

Statistical methods

ROC analysis was used to compute the AUC for the two scales. An AUC value significantly greater than 0.5 indicates the scale is performing better than randomly and the AUC provides a comparative value for the RASs under consideration.

Ethical considerations

Research Ethics committee approval was obtained for the studies in both areas. Information about the projects was given to parents and young people (where appropriate) prior to obtaining consent in Jordan (in Brisbane consent was waivered) to participate.

Results

Participants

Data were collected on 212 paediatric admissions in KAUH, and on 301 paediatric admissions at RCHB.

Descriptive data

The sample size, gender, proportion of critical care (PICU, NICU and GIMU) and pressure ulcers are shown in Table 1.

Table 1: Sample details

	Sample size	Male gender	Critical care admissions	Developed one or more pressure ulcers
KAUH	212	124 (59%)	212 (100%)	19 (9%)
RCHB	301	150 (49%)	50 (16%)	16 (5%)
Total	513	274 (53%)	263 (51%)	35 (7%)

Most pressure ulcers were category I or II (Table 2) according to the EPUAP and NPUAP (29) descriptors. The category III ulcers identified in the KAUH sample were found on the occiput (two ulcers), and heel (one ulcer). Twelve children in this sample had device-related ulcers.

Table 2: Total pressure ulcers and categories

	Pressure ulcer	Total number of pressure	Category I	Category	Category

	incidence	ulcers (in number of children)	(in number of children)	II (in number of children)	III (in number of children)
KAUH	9% (n=19)	29 (19)	12 (8)	14 (8)	3 (3)
RBCH	5% (n=16)	25 (16)	19 (10)	5 (5)	1(1)
Total	6.8% (n=35)	54 (35)	31 (18)	19 (13)	4 (4)

Main results

The AUC (see Figure 1 and Table 3) was higher for Braden Q than Glamorgan but the 95% confidence intervals overlapped considerably so it is not likely that there is a statistically significant difference between the two AUCs.

Figure 1. ROC curve for the Glamorgan and Braden Q scales

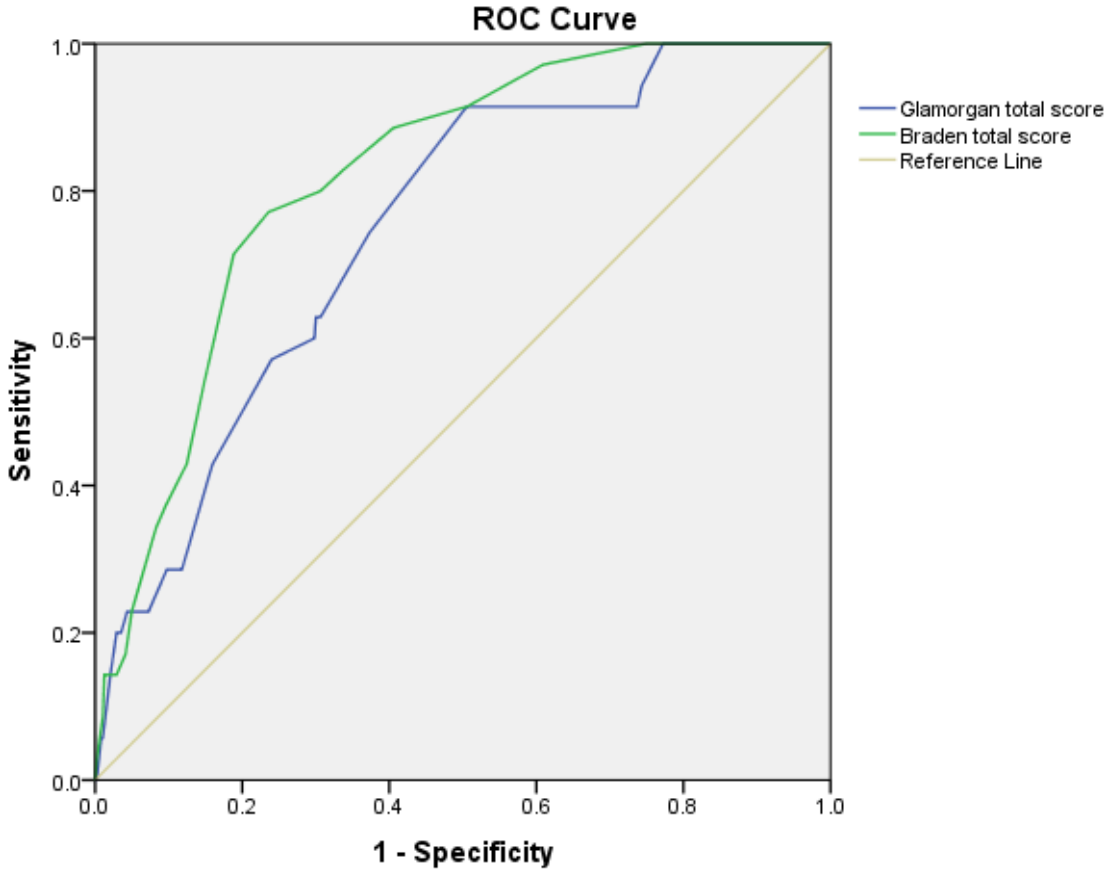

Table 3 AUC all children

	Area	P value	95% Confidence Interval
Glamorgan score	0.748	<0.001	0.673, 0.822
Braden Q score	0.820	<0.001	0.760, 0.880

Focussing on specific clinical areas, the two scales were virtually identical with respect to AUC in intensive care but for general paediatrics the Braden Q performed better (see Table 4). Unfortunately the numbers are small to start with (35 patients with ulcers) and drop further when broken down by specialty (11 for PICU, 15 for NICU and only 9 for general paediatrics).

Table 4 AUC for PICU, NICU and general paediatrics

		Area	P value	95% Confidence Interval
PICU (n=93)	Glamorgan score	0.76	0.006	0.61, 0.91
	Braden Q score	0.74	0.010	0.58, 0.90
NICU (n=169)	Glamorgan score	0.82	<0.001	0.73, 0.91
	Braden Q score	0.82	<0.001	0.73, 0.92
General (n=251)	Glamorgan score	0.57	0.478	0.37,0.77
	Braden Q score	0.83	<0.001	0.73,0.92

Finally as grade I ulcers are considered less serious, an analysis of grades II/III (there were no grade IV ulcers) showed very similar results with the Braden Q higher but again having overlapping confidence intervals (see Table 5).

Table 5 AUC Excluding grade I ulcers

	Area	P value	95% Confidence Interval
Glamorgan score	0.77	<0.001	0.67, 0.87
Braden Q score	0.85	<0.001	0.77, 0.93

Finally AUCs were computed for each site, see Table 6. The broadly similar AUCs (though with wide Cis) suggest it was appropriate to pool data.

Table 6 AUC by site

		Area	P value	95% Confidence Interval
Brisbane	Glamorgan total score	.676	0.018	0.53, 0.82
	Braden total score	.827	<0.001	0.74, 0.91
Irbid	Glamorgan total score	.788	<0.001	0.71, 0.87
	Braden total score	.801	<0.001	0.72, 0.89

Discussion

The incidence of pressure ulcers in this study is higher than the figure given by Kottner et al for general paediatric units and lower than Schluer et al's figures for PICUs. Given this dataset is from both settings the incidence is thus in line with previous studies. This is a large dataset from general paediatric wards, PICUs and NICUs. There are few studies identified that focus on NICUs though the Neonatal Skin Risk Assessment Scale (NSRAS) has been shown to be reliable and have predictive power (30, 31). This study demonstrates that it is acceptable to use the Braden Q or the Glamorgan scale for this population. Similarly both scales appear to work similarly on a PICU sample. For general paediatric units in this sample the Braden Q appeared superior.

Historically, the Children's Health Service in Brisbane (RBCH) has used the Braden Q scale for pressure injury risk assessment. The service has found poor compliance with the Braden Q scale across acute care areas. The complexity of the Braden Q scale has been given as a reason for its low level of compliance, use and acceptability according to feedback to the authors from clinicians. The Glamorgan scale has been positively received in Scotland (where it has been included in the Scottish National toolkit), Northern Ireland (where it has been implemented as the scale to be used across the province), the Republic of Ireland, Wales England, Germany, Spain, New Zealand, England, and Australia. Since the Glamorgan scale is thought by paediatric nurses to be more suitable and easier to use than Braden Q it probably should be the first choice for PICUs and NICUs. While Braden Q may be a better scale in general paediatrics it is premature to make such a claim on one study with few cases. It is also questionable whether two different scales should be in use in the same hospital where both PICU and NICU exist.

There have been few studies comparing paediatric RASs. Most studies are concerned with predictive validity and/or inter-rater reliability of one scale. Figures on different RASs used in different populations are not comparable. There is one other study comparing the Braden Q and Glamorgan (24) which showed the Glamorgan superior to Braden Q while this study does not support this result. Of the many other paediatric RASs the most widely validated is the NSRAS and thus probably one of these three RASs should be considered for implementation in the absence of further studies.

Testing the available paediatric pressure ulcer RASs can give an indication of their predictive ability (validity), however, there in adults no study has shown using even a valid and reliable risk assessment tool reduces the pressure ulcer incidence rate in clinical practice (32, 33). However even if they do not reduce incidence of pressure ulcers (and the work has not been done in children so we have no idea if they do or not) they are useful for audit and research purposes. They are useful for audit since they show the number of patients who are high, medium and low risk which might be useful information to (say) adjust staffing levels. They could be used in cases where hospitals are sued over pressure ulcers to show whether the patient was high risk and what was done about it if so. They have been used in research to (e.g.) match patients at various risk levels who either do or do not have pressure ulcers and then consider (e.g.) lengths of stay (34).

Strengths and limitations

This is the first study to consider NICU (n=169) patients employing these two scales. The sample size is large (n=513) but as pressure ulcers are relatively uncommon in children the number of ulcers is small (n=35 children with ulcers) and the number of more serious ulcers smaller (n=16). The results

from the overall sample are probably robust but splitting analyses into the three clinical areas may give results that are not generalizable especially for general paediatrics where the number of ulcers was in single figures. The numbers with serious ulcers is too small to effect a sub-analysis by clinical area. The small numbers of pressure ulcers potentially may make the model unstable as generally it is advised to have ten subjects

Using both scales at the same time by identical raters may contaminate both scorings. As with all similar studies, clinical staff may have instituted preventive measures on high risk children which would have the effect of reducing the sensitivity of the scales. This problem has been discussed in DeFloor & Grypdonck (35) who state in many studies the preventive measure are not described or categorised as standard care. However as this is true for both scales a comparison between them is valid and it would be unethical not to conduct a comparison study.

Conclusion

The Braden Q and Glamorgan scales probably have similar validity in paediatric critical care areas and for more serious pressure ulcers. The Braden Q may be a better scale in general paediatric wards but with such a small number of ulcers in this group it is premature to draw a firm conclusion on this.

Conflict of interest statement

There are no conflicts of interest

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[i] University of South Wales, willock@tesco.net
[ii] Irbid National University, Jordan, lailahabeeb2007@yahoo.com
[iii] Griffith University, Debbie.Long2@health.qld.gov.au
[iv] Royal Children's Hospital, Brisbane, Kelli.Palmer@health.qld.gov.au
[v] University of Leeds, d.anthony@leeds.ac.uk
[vi] Harris Manchester College, University of Oxford