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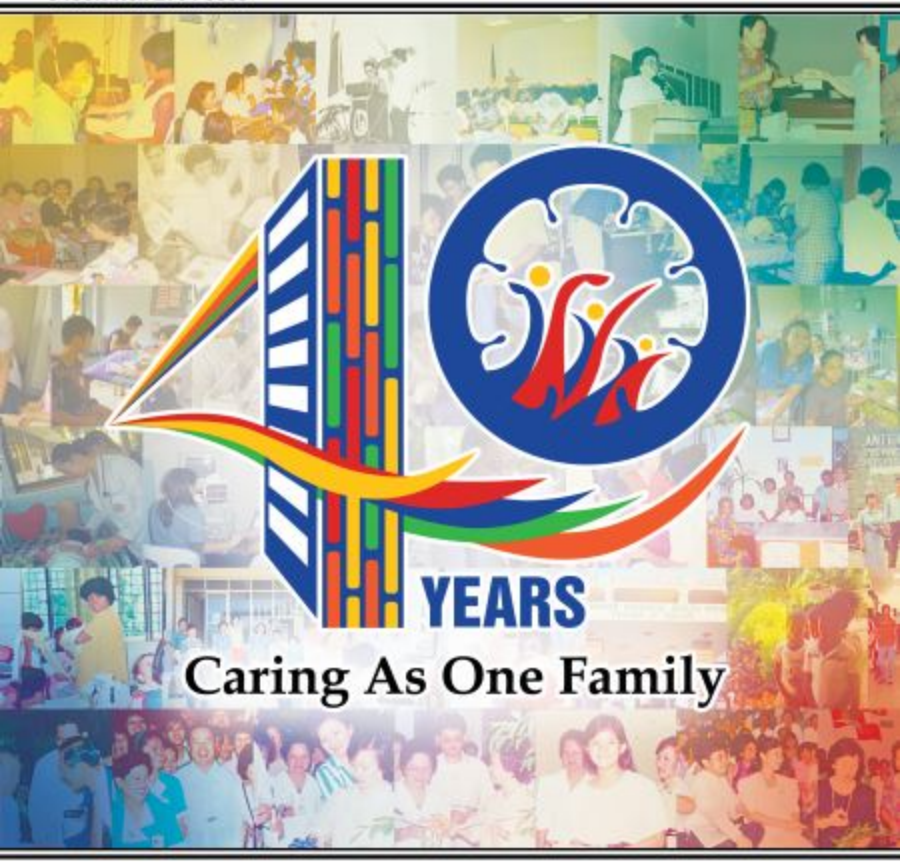

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As I write this, a lot has definitely happened, in our country and for this journal: the pandemic (of course), and the workshop on journal writing. This was held last August over Zoom, given by no less than the President of the Philippine Association of Medical Journal Editors (PAMJE), Dr. Jose Florencio Lapena. The latter would definitely not have happened without the former, as the shift to online learning has definitely made it a reality. Unfortunately though, the pandemic also disrupted the normal processes of coming out with the journal, which has resulted in this issue's delay. Be that as it may, we've decided to adapt Dr. Lapena's lessons and suggestions, which will certainly improve the quality of our journal.

This is also the third consecutive volume for which we've been able to come up with two issues a year. Hopefully that will facilitate our application for inclusion to the western Pacific Region Index Medicus (WPRIM), and result in higher visibility for our journal, and our authors. Here's to a better 2021 where we hopefully see the light at the end of the long dark tunnel!

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CONTENTS

UTILITY OF THE PEDIATRIC SHOCK INDEX AS A PREDICTOR OF OUTCOMES IN CASES OF DENGUE IN A PEDIATRIC TERTIARY CHILDREN'S HOSPITAL

SOCORRO MARIE V. BUENSALIDO, MELLINOR ASPURIA-ANG

ABSTRACT

BACKGROUND: Despite extensive studies on dengue fever, there is still limited knowledge about factors associated with poor outcomes in cases of dengue fever. The shock index (SI) is a bedside tool previously used in the adult population, adopted as a marker for poor outcomes in many shock states. There are limited studies applying the SI in children. There are also no known local studies applying an age-adjusted version as a marker or predictor of poor outcomes in severe acute illness, such as dengue.

OBJECTIVES: To determine the diagnostic ability of the age-adjusted pediatric shock index in predicting outcomes in cases of dengue admitted at a tertiary children's hospital.

METHODS: This is a prospective cohort study performed in a pediatric tertiary hospital over a period of 30 days. Admitting heart rate (HR) and systolic blood pressure (SBP) were taken to determine their shock index. This was then grouped according to age groups based on known literature and corresponding acceptable age-adjusted shock indices (ASI), and compared with outcomes such as final dengue classification (non-severe vs severe), use of inotropes, and mortality.

RESULTS: A total of 90 patients were identified for the study. Three were excluded due to exclusion criteria. 87 cases were followed up after admission from the ER. Unadjusted Shock Index (USI) was found not to be associated with both final dengue classification (as severe dengue) and use of inotropic support. In contrast, ASI was associated with both final dengue classification ($p < 0.001$) and use of inotropes ($p < 0.039$). The ASI had a fairly accurate capability of predicting poor outcomes for both final dengue classifications, with an area under the ROC curve of 0.7122, and eventual use of inotropes, with an area under the ROC curve of 0.6435.

CONCLUSIONS AND RECOMMENDATIONS: SI was found to be a helpful tool in predicting poor outcomes, but only when the Age-adjusted Shock Index (ASI) was used. A longer data collection period is recommended to be able to include mortality as an outcome. The predictive value of the tool can be tested against various other markers of poor outcome to widen the application of this non-invasive measure of hemodynamic status.

KEYWORDS: shock, shock index, dengue shock, dengue, critical care

INTRODUCTION

Since the first reported case of dengue in the Philippines in 1953[1], the disease had been observed in the country's history throughout several epidemics, with the 1998 epidemic being the most notable one, with a case fatality rate of 2 percent[2]. Seventy percent of affected individuals were children below the age of 15 years old[2]. Since then, the disease has been widely studied in terms of its pathogenesis, its transmission, and ultimately its management and prevention. Yet, much remains to be known about the disease, including the factors affecting its clinical manifestations in different individuals, and its varying severity and outcomes. Several studies have explored the relationships between disease's outcomes and patient factors such as the presence of certain signs and symptoms on presentation at a health institution, and certain laboratory results in patients already admitted for the disease[3]. The most severe form of the disease is known as the Dengue Shock Syndrome (DSS), of which the hallmark is the presence of symptoms attributable to plasma leakage and its related effects. In recent years, many studies have revolved around finding sound basis for predicting outcomes in patients who have acquired severe dengue, with some exploring immunological markers and markers of vascular integrity or damage[4]. Although some techniques have shown promise in predicting outcomes of the disease, they are expensive and impractical especially in resource-limited countries. Due to the economic implications of dengue, early predictors of disease outcome should identify those in need of closer monitoring and more aggressive management in the early phases of the disease.

The shock index (SI) is a bedside tool used in several disease entities and is derived from the formula: heart rate/systolic BP. It was originally described by Allgower and Buri in 1967 where they identified the normal range of SI in healthy adults to be between 0.5 and 0.7. Consequently, an elevated SI ($\geq$ 0.9) has been associated with different poor outcomes in different disease entities. Since then, its application has been studied in various settings and clinical conditions, primarily in predicting outcomes in cases of septic and hypovolemic shock, blunt trauma, and traumatic brain injury[5, 6, 7, 8], among others. Most of these showed a direct relationship between a higher SI and a greater risk for more complicated disease or for poorer outcomes. Following these observations, many researchers attempted to correlate the same tool with poor outcomes in the pediatric population, where findings showed similar results.

Given the wide range of normal values of both heart rate and blood pressure in the pediatric population, attempts have been made to adjust the pediatric shock index to different age groups to improve the sensitivity of the tool in identifying cases expected to have poorer outcomes. Most studies based their normal values for the basis for computation of SI on the normal vital signs per age group as suggested by Nelson's Textbook of Pediatrics[17]. Such tools are helpful in many ways, and have huge impacts both medically and economically, making them invaluable in practice. They may be especially helpful in

diseases encountered at health care facilities daily, and diseases with large impact on society such as dengue.

This study attempts to validate a low-cost tool that may improve the management of cases of dengue by identifying individuals who are more at risk for severe illness and poor outcomes, and to decrease mortality and complications by instituting more aggressive measures on patients expected to progress to more severe disease.

When left untreated or unrecognized, certain patients progress from the mild form of the disease to its more severe manifestations, of which one is profound shock. As recommended by the World Health Organization (WHO), the classification of dengue was revised to separate dengue without warning signs from dengue with warning signs, and severe dengue. Under the category of severe dengue are several mechanisms by which the nomenclature "severe" is considered: 1) severe plasma leakage leading to shock or fluid accumulation with respiratory distress, 2) severe bleeding, 3) severe organ involvement[13]. Furthermore, the WHO, in 2012, identified most deaths in dengue were due to shock. To date, no single identifying factor has been found to explain the occurrence of shock in one patient and the absence in another. Several studies have explored and have attempted to identify risk factors associated with poor outcomes in dengue such as demographic factors (i.e., population density, economic status), initial symptoms at presentation at the Emergency Department, age groups, etc. It is due to this that, despite many years of improving diagnostics and available management, the need to determine specific populations at risk for developing the severe manifestations of the disease is still relevant.

Shock is an acute process characterized by the body's inability to deliver adequate oxygen to meet the metabolic demands of vital organs and tissues[17]. Five categories of shock have been determined, depending on their underlying mechanisms and etiologies, of which the most associated with dengue is the hypovolemic type. In most types of shock, there is time for the body to activate compensatory mechanisms to preserve perfusion to the more vital parts of the body. Compensatory mechanisms include increase in heart rate, stroke volume, and vascular smooth muscle tone, all working to maintain perfusion and oxygen delivery to vital tissues. In the presence of these signs therefore, health practitioners can identify shock in its early stages delivering a window for intervention before profound shock sets in.

In 1967, Allgower and Buri first described the shock index as a simple and effective means of gauging the degree of hypovolemia in hemorrhagic and infectious shock states[16]. Since then, there have been numerous other studies exploring the utility of the shock index in predicting poor outcomes in different disease states, such as in septic shock, etc. Following these studies, which suggest that a higher SI relates to poorer outcomes, several researches were published, applying the same concept in the pediatric population. Disease states of interest in these published works included: sepsis and septic shock, traumatic brain

injury and blunt trauma. These reports had varying measurements and markers for poorer outcomes as hypothesized to be associated with an increased SI versus those with normal values for SI.

To our knowledge, no such studies have been published exploring the possible relationship and utility of the SI as a predictor of poor outcome in patients managed for dengue and its severe form – dengue shock.

OBJECTIVES OF THE STUDY

A. General Objective

To determine the diagnostic ability of the age-adjusted pediatric shock index in predicting outcomes in cases of dengue admitted at a tertiary children's hospital.

B. Specific Objectives

1. To determine the shock index of patients admitted from the emergency room with a diagnosis of dengue
2. To determine the association of an elevated pediatric shock index AND:
    a. age of patient
    b. sex of patient
    c. classification of dengue on admission (severe vs non-severe)
    d. use of inotropes
    e. mortality

METHODOLOGY

A prospective cohort was used in the study to determine the association and diagnostic ability of the shock index (both age-adjusted and non – age-adjusted) in predicting outcomes in patients admitted as dengue. Using Epi Info (CDC), and given a confidence interval of 95% and a power of 80% the sample size computed based on a similar study was 86 patients. This was the minimum number of samples required for this study.

All patients admitted from the Emergency Department, initially managed as dengue, whether by clinical diagnosis alone, or by laboratory confirmation were included in the study. Those who tested negative for either Dengue NS1 or dengue IgG/IgMwere excluded from the study upon follow-up. The patients were followed up on admission to the regular wards or to the PICU. Patients found to have other co-morbidities were excluded.

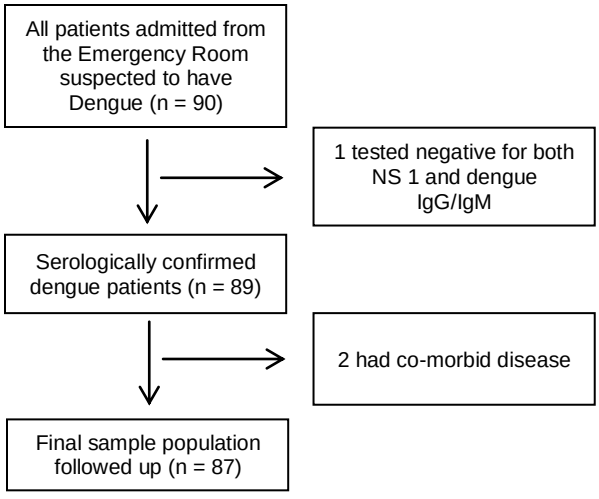

Figure 1. Flow diagram of the process of data collection

Upon approval from the Institutional Review Board, the study proceeded by case identification at the ER level. Patients admitted as dengue based on clinical signs, with or without serologic confirmation were included in the initial data gathering. Patients eventually serologically confirmed as not having dengue were dropped from the study. Data such as age and SI values were collected, and their course of management was followed until they were either discharged or had expired. Pertinent data pertaining to the outcome of management were collected, including dengue classification on admission, use of inotropes, final dengue classification and mortality.

For demographic data and general information of the samples, the admission sheet was used as the primary source. For uniformity, and to minimize bias, vital signs upon admission to the ER were taken solely from the ER form.

Data was analyzed using the STATA SE 14.2 software and processed from a table of collected data. Data were summarized as means and standard deviations for quantitative variables, and as frequencies and proportions for qualitative variable. Associations between variables were carried out first as a whole, without discrimination for age and corresponding normal SI values, then per age group. ROC analysis was conducted to determine the diagnostic ability and utility of the shock index in predicting poor outcomes among patients in the study. The sensitivity, specificity, PPV, NPV and accuracy to predict poor outcomes were determined and plotted in graph. Multiple regression analysis was used to determine the factors associated with poor outcomes.

Ethical considerations included issues regarding patient confidentiality as their patient records, specifically charts were the main source of data for the study. The study did not involve any additional intervention to the management of cases included in the study, nor did it involve withdrawal of any such intervention. Upon identification of cases included in the study, representatives of the patient (e.g., parent or legal guardian) were asked to give consent. A research assistant extracted information from patients' records from admission to discharge.

RESULTS

Two steps were employed to establish the association and diagnostic ability of the shock index as a tool in predicting outcomes in dengue. The statistical analyses were run involving first the unadjusted shock index (USI) used for the general population followed by analyses involving the age-adjusted shock index (ASI). The first involved determining the association of an elevated shock index and study outcomes, namely, final dengue classification and use of inotropes during admission. The second involved determining the diagnostic ability of the shock index as a tool for predicting the same outcomes. Mortality from dengue was originally a desired outcome for testing, however during the duration of the data collection for the study, only one patient expired, nullifying any statistical test involving this particular outcome.

A total of 90 patients were originally included in the study. Three patients were excluded from the final list of patients as they were sero-negative for dengue infection or were diagnosed to have co-morbids (Table 1). The remaining patients were followed up over 30days. The average age of subjects was 8 years old, with majority from the 4-11 y/o age group. There was an almost equal distribution between males and females. The average admitting heart rate (HR) was recorded at 112 bpm with a mean systolic BP (SBP) of 90mmHg. The average shock index was computed at 1.2. A total of 73 patients (83.91%) had an elevated shock index upon admission, based on the USI. However, when compared against the different shock indices acceptable for every age group, 53 patients (60.92%) had normal values while only 34 (39.08%) had elevated values. Fifty-nine patients (67.82%) were classified as non-severe upon discharge. Sixteen patients (18.39%) among those classified as severe utilized inotropes at some point during their admission. Only one patient (1.15%) died for the duration of the data collection.

Table 1. Demographic and clinical characteristics

Variables	**Value**
Age, years (mean, SD)	8.56 (4.02)
Age group (n, %)	
Less than 1 year	2 (2.30)
1 to 3 years	9 (10.34)
4 to 11 years	57 (65.52)
More than 12 years	19 (21.84)
Sex (n, %)	
Female	43 (49.43)
Male	44 (50.57)
Admitting heart rate, bpm (mean, SD)	111.68 (19.31)
Admittingsystolic blood pressure, mmHg (mean, SD)	92.18 (13.76)
Shock index (mean, SD)	1.20 (0.29)
Shock index classification (n, %)	53 (60.92)
Within normal range	34 (39.08)
Elevated	
Final classification (n, %)	
Non-severe	59 (67.82)
Severe	28 (32.18)
Use of inotropes (n, %)	
No	71 (81.61)
Yes	16 (18.39)
Mortality (n, %)	
No	86 (98.85)
Yes	1 (1.15)

One patient was excluded due to a negative dengue NS1 and dengue.

IgG/IgM; another 2 were excluded due to co-morbidities.

The mean shock index by age group and by sex are shown in table 2.

Table 2. Mean shock index by age group and sex

Variables	Mean shock index (mean, SD)
Age group	
Less than 1 year	1.54 (0.06)
1 to 3 years	1.39 (0.20)
4 to 11 years	1.16 (0.29)
More than 12 years	1.19 (0.30)
Sex	
Female	1.23 (0.29)
Male	1.170.30)

Both final dengue classification and use of inotropes were found not to be significantly associated with an elevated shock index when USI was used for reference (Table 3).

Table 3. Association of elevated Unadjusted Shock Index (USI) with outcomes

Outcomes of interest	Odds ratio (95% CI)	p-value
Outcome 1: Final dengue classification	7.63 (0.94 to 61.61)	0.057
Outcome 2: Use of inotropes	3.36 (0.41 to 27.78)	0.260

However, when the ASI was used, shock index was associated with both final classification of severe dengue ($p < 0.001$) and use of inotropes (p 0.039) (Table 4).

Table 4. Association of elevated Age-Adjusted Shock Index (ASI) with outcomes

Outcomes of interest	Odds ratio (95% CI)	p-value
Outcome 1: Final dengue classification	6.19 (2.31 to 16.60)	<0.001
Outcome 2: Use of inotropes	3.26 (1.06 to 10.06)	0.039

The odds of having severe dengue is 6.19 times higher (95% CI 2.31 to 16.60) among those with elevated ASI compared to those with normal ASI, while the odds of using inotropes during treatment is 3.26 times higher (95% CI 1.06 to 10.06) among those with elevated ASI compared to those with normal ASI.

The diagnostic ability of the shock index to predict outcomes was computed via the roctab command in STATA SE v 14. via Receiver Operating Characteristic (ROC) analysis. The USI was found to be a sensitive (96.43%) tool in determining patients who proceeded to be classified as having non-severe dengue after having been admitted as the same. The tool was however found to be poorly specific (22.03%), with only 45.98% of patients correctly classified as having severe dengue as a final diagnosis. Furthermore, with an area under the ROC

curve of 0.5923 (95% CI 0.5285 to 0.6561), the non-adjusted SI (USI) was an imprecise predictor of outcomes for final dengue classification (Figure 1).

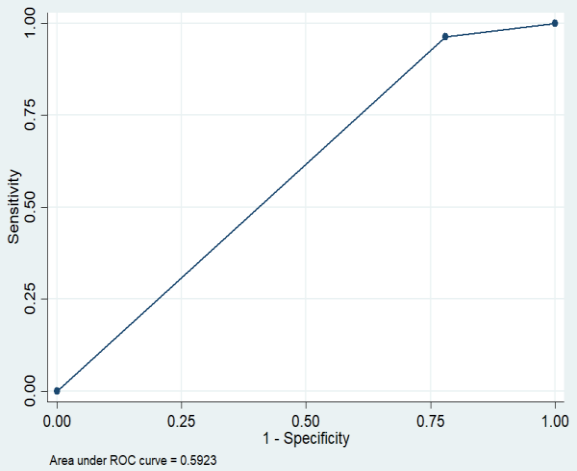

Figure 1. ROC Curve Graph for USI and final dengue classification

Similarly, in testing the tool as a predictor for the use of inotropes, the USI was found to be sensitive (93.75%). However, the tool was found to be poorly specific (18.31%), with only 32.18% of patients correctly predicted to have used inotropes during admission. With an area under the ROC curve of 0.5603 (95% CI 0.4841 to 0.6365), the non-adjusted SI (USI) was determined to be an imprecise predictor of outcomes for the use of inotropic support at any point within the duration of admission (Figure 2).

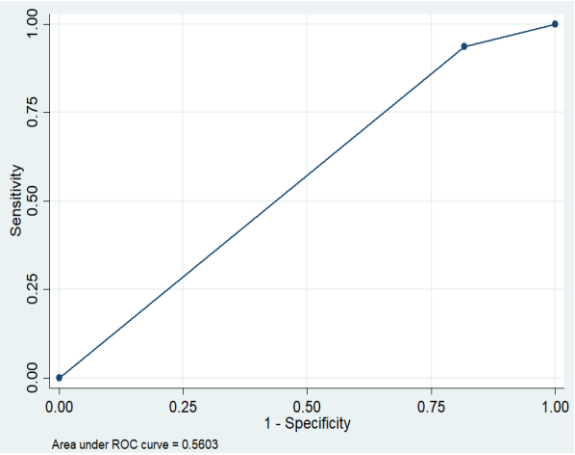

Figure 2. ROC Curve Graph for USI and use of inotropes

Pediatric Age-Adjusted Shock Index and Outcomes

On the other hand, ASI was found to be a more specific (74.58%) rather than a sensitive (67.86%) tool in predicting the final classification of patients, regardless of classification upon admission. The tool was also found to have a higher Negative Predictive Value (83.02%) than a Positive Predictive value (55.88%). Overall, the area under the ROC curve was 0.7122 (95% CI 0.6078 to 0.8166), demonstrating a much higher capability of accurately predicting those who will progress to severe dengue (Figure 3).

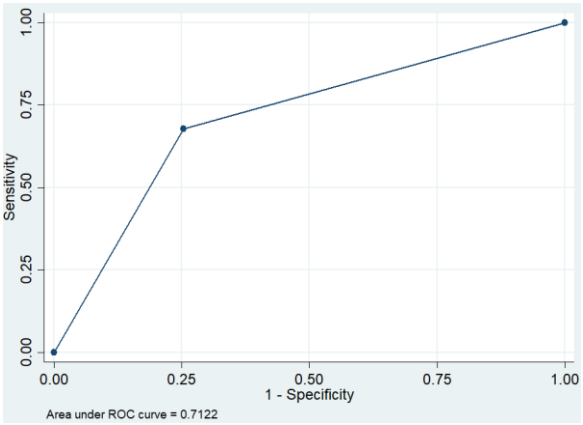

Figure 3. ROC Curve Graph for ASI and final dengue classification

In terms of the tool's ability to predict use of inotropes in patients, the ASI was found to be as equally specific (66.20%) as sensitive (62.5%). Its Negative Predictive Value (88.68%) is much higher than its Positive Predictive Value (29.41%). Overall, the area under the ROC curve showed was 0.6435 (95% CI 0.5090 to 0.7779), demonstrating a modest degree of accuracy in predicting who among those admitted will proceed to use inotropic support during their admission (Figure 4).

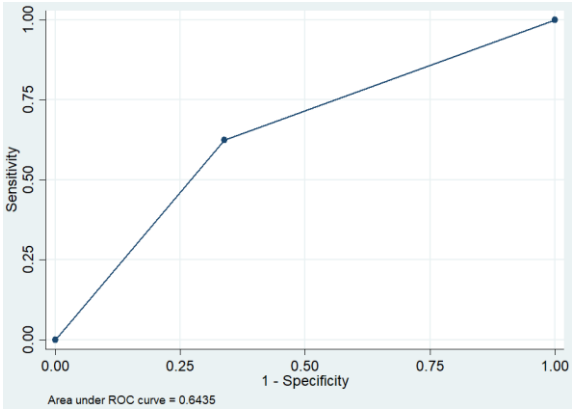

Figure 4. ROC Curve Graph for ASI and use of inotropes

DISCUSSION

The body's natural compensatory mechanism in states of shock includes an elevation in either stroke volume or cardiac rate to maintain a desired cardiac output (CO = SV x HR). Thus, a shock index that represents a widening of the difference between the heart rate and the systolic BP reflects a patient who is deteriorating in terms of a falling blood pressure, or one who is heavily compensating in terms of a rising heart rate. However, when applied to the pediatric population, defining a single SI value is challenging given the changes in vital signs as the child advances in age. This difference can be illustrated by comparing an adult with a baseline HR of 75 bpm and baseline systolic BP of 110, with a resulting SI of 0.68. If in trying to compensate during a shock state, the HR increases to 110, the resulting SI increases to 1, a value above the acceptable range of 0.5 – 0.7, and above the value identified in previous studies to be associated with worse outcomes. In contrast, if an infant whose baseline HR is at 130 bpm, assuming a heart rate increase like that of the adult example to 165 bpm (35 beats increase), with a systolic BP of 80, the SI changes from 1.6 to 2.0, which is a much higher value than that acceptable for the general population. This change of SI justifies the need for a pediatric age-adjusted SI.

Our results show a significant difference between the USI and ASI in the degree of association and accuracy of the tool in determining those who were classified as severe dengue as a final diagnosis, regardless of admitting classification. Using

the USI, neither the final dengue classification nor the use of inotropes was found to have been associated with the admitting SI. However, when adjusted for specific age-adjusted vital signs and SI (ASI), both the final dengue classification and the use of inotropes were found to be associated. This demonstrates the importance of taking into consideration the age group of the patient in drawing associations with the predetermined outcomes. Using the ASI, patients who ended up being assigned a final classification of "severe dengue" were 6.19 times more likely to have had an elevated SI upon admission versus those who had a normal SI. Similarly, those who ended up with inotropic support were around 3.26 times more likely to have had an elevated ASI upon admission.

To explore the predictive capability of the SI in terms of outcomes, anROC analysis was done, which revealed results similar to the above findings. USI was found to be poorly predictive of the patients' final dengue classification as well as eventual use of inotropes within the admission. However, when age-adjusted vital signs were considered, the tool had a fairly accurate prognostic capability in identifying both those who would progress to severe dengue, and those who would need inotropes.

Dengue is a very dynamic disease with its severe form characterized by many clinical features such as severe plasma leakage, severe bleeding, and evidence of severe organ involvement [13]. Consequently, severe dengue is not always accompanied by the expected compensatory mechanism of tachycardia. For example, in cases of compensated shock, defined as a narrow pulse pressure, there may or may not be accompanying tachycardia, which may result in relatively low SI values. Similarly, other characteristics of severe dengue may or may not be accompanied by an expected rise in heart rate, such as those diagnosed as dengue myocarditis, and other forms of severe dengue characterized by end organ damage (elevated liver transaminases, encephalopathy, etc.). Despite the differences in the clinical presentation of dengue severe, the shock index, specifically the ASI, may prove to be useful in identifying those patients who may need closer attention upon admission, as they are at more risk of developing into severe dengue. Furthermore, of those who were originally admitted as severe dengue or those admitted as dengue with warning signs but eventually progressed into severe dengue, the age-adjusted SI was helpful in predicting those who might need inotropes at one point in their admission.

The management of shock, regardless of etiology, is generally guided by the improvement of physiologic, hemodynamic and laboratory variables observable in patients. For example, in septic shock, an improvement in the heart rate, meaning a normalization of the heart rate signifies an immediate improvement of the current shock state. Similarly, an improvement of the blood pressure after a fluid bolus in a patient initially presenting with hypotension is as well a sign of immediate stabilization of the patient's state of shock. However, from practice, and based on various studies, not all patients who are stabilized shortly

after admission proceed to recover despite the normalization of their hemodynamic variables. Likewise, not all those who are successfully resuscitated at the ER present with favourable outcomes during their course of admission. A tool, therefore, that identifies those at most risk of developing a complicated course, and at the same time is non-invasive and cost-efficient is valuable in the management of shock at the ER level. The shock index, specifically when age-adjusted, as demonstrated above, appears to be one such tool.

This non-invasive bedside tool can guide clinicians in identifying those in most need of closer monitoring. Especially in resource-limited healthcare institutions, this tool may correctly identify those at-risk patients and may be useful in properly allocating both physical resources and human resources available, by recognizing patients who need to be prioritized in terms of admission to the intensive care unit. This may be especially helpful in times of surge of dengue cases during peak months. This study suggests further that an age-adjusted shock index may pinpoint patients in more need of closer monitoring more accurately than when based solely on other parameters of shock such as an increased heart rate or decreased blood pressure alone.

Limitations of the Study

A limitation of the study includes the differences in the measurement of a patient's vital signs upon entry at the ER, where a variety of modalities and equipment were used in the monitoring of vital signs. Equipment and resources at the Emergency Room provide for only manual measurement of vital signs, taken by the triage officer upon admission. Vital signs manually measured were the heart rate and blood pressure, using age-appropriate cuffs, completely dependent on the operator.

Another limitation of the study is the number of patients included in the study. The collected data within the data collection period only covered one mortality from dengue, rendering statistical analyses involving this parameter void. To better test for this outcome, a longer data collection period may be helpful.

CONCLUSION AND RECOMMENDATIONS

The pediatric age-adjusted shock was demonstrated in this study to be a useful marker and predictive tool in identifying children at risk of developing severe dengue and further needing inotropic support during their admission. This measure is an easily obtainable bedside tool that may help physicians and healthcare facilities allot their limited resources better upon admission and point of care at the Emergency Rooms. It may be a helpful addition to the vital signs monitoring in terms of being a marker for the physiologic status of patients of both the severe and non-severe types.

Further recommendations to improve the study include a longer duration for data collection, to allow for a more varied range of outcomes, especially in terms of mortalities. Other markers for poor outcomes may also be explored, as used in

many different studies, such as use of blood transfusion, use of hemodialysis, and total length of stay in the hospital. The tool may also be compared to other objective laboratory markers of severe dengue such as degree of metabolic acidosis on admission, or degree of end-organ damage observable for both renal and hepatic functions, among many available laboratory markers.

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EFFECT OF COLD VIBRATOR DEVICE ON PAIN PERCEPTION OF CHILDREN AGED 6-12 YEARS OLD UNDERGOING MANTOUX TEST AT PHILIPPINE CHILDREN'S MEDICAL CENTER OUT-PATIENT DEPARTMENT

MARIA CECILIA C. CARLOS, MARIA CLARISSA MANANGO-PELAYO, JESUS NAZARENO VELASCO

ABSTRACT

BACKGROUND: Painful procedures intensify hospital-related stress and anxiety leading to unpleasant experience that can adversely affect procedure outcomes and health seeking behaviors.

OBJECTIVE: To determine the effect of a cold vibrator device on pain perception of children aged 6-12 years old during Mantoux Test at the Out-Patient Department of the Philippine Children's Medical Center.

METHODOLOGY: This is a single blinded, randomized control trial where one-hundred four (104) subjects were randomly assigned to experimental (54 subjects) and control group (50 subjects) through fishbowl method. The experimental group received the cold vibrator prior to Mantoux test while the control group received the Mantoux test alone. Pre and post procedural heart rate, respiratory rate and oxygen saturation were obtained. The responses were evaluated using the Wong-Baker Faces Pain Scale.

RESULTS: Pain score was higher in the control group. Wilcoxon Rank-Sum Test showed mean rank of 67.5 with aggregated pain rank of 3645.00 compared to experimental group (with cold vibrator) of 36.3 with aggregated pain rank of 1815.00 with a p value 0.0000000046. There was no significant difference between the physiologic parameters (heart rate, respiratory rate, and oxygen saturation) before and after procedure between the two groups.

CONCLUSION AND RECOMMENDATION: The use of the cold vibrator was effective in reducing pain perception. It can be used as an adjunct to mitigate pain for needle-related procedures. Demographic data could also be correlated to the pain scores of the subjects.

KEYWORDS: Cold vibrator device, Mantoux Test

INTRODUCTION

Pain is one of the untoward manifestations of clinical events such as trauma, surgery, illness, or an adverse reaction following needle-related procedures like an immunization. Because of their young age, infants and children have their immature responses yet to pain, hence they experience it as despicable and should be avoided. This in turn upsets parents, relatives, and health care providers as well.

Pediatric procedural pain is often under evaluated or not assessed at all, leading to inadequate pain management. Stevens *et al*. reported that in only 28% of pediatric pain cases was pain documented and children receiving pain management associated with a painful procedure. (1)

Through time, there are several non-invasive techniques utilizing different sensation to decrease or even alleviate pain such as cold and vibration sense. A device combining cold and vibration called Buzzy ® was created by MMJ Labs Atlanta (2009) to alleviate or decrease procedural pain. It is in this light that this study is being carried out, to document the decrease in pain perception following Mantoux test, with the use of Buzzy ®, a device combining both cold and vibratory senses.

Pain management is extremely important for pediatric age group. A child's pain is quite different from that which is experienced by adults. Insufficient pain relief may cause long-term changes in pain understanding and perception and determines specific pain-related behavioral expressions. Procedural-pain-associated stress and discomfort have long-term negative effects on patients and their parents or caregivers. It may contribute to eating and sleeping disorders, provoke post-traumatic stress disorder, diminish social skills, or increase fears (3)

According to Lodhey, the gate control theory suggests that pain is transmitted from the peripheral nervous system to the central nervous system where it is modulated by a gating system in the dorsal horn of the spinal cord. The pain receptive nerves namely A-delta fibers responsible for acute pain and the C fibers for chronic pain are blocked by fast non-noxious motion nerves carried by A-beta. Prolonged cold stimulates the C fibers and, if preceding the pain, may further block the A-delta pain signal. Another mechanism by which the cold sensation is effective is triggering descending noxious inhibitory controls activating a supraspinal modulation raising the body's overall pain threshold (4)

On the other hand, vibration therapy is another intervention done to relieve mild to moderate pain where non-noxious stimuli such as touch, vibration, cold, activate nerve fibers inhibit the transmission of pain as stated in the gate control theory. In a study done by Berberich et al, as sited by Bahorski et al., vibration was used on the opposite arm from where an immunization was given in children 4-6years old. Observational pain score for children who received this vibration technique were significantly lower than those who did not (5)

Cold sensation is effective in triggering descending noxious inhibitory controls activating a supraspinal modulation raising the body's overall pain threshold. A local study done by Ausan MP, at Iloilo Doctors' Medical Center where ice was used as topical anesthetic for Purified Protein Derivative (PPD) Skin Test in children ages 8-12y/o. The study showed significantly lower scores among patients where ice was applied prior to PPD.(6)

Another local study done at University of Sto.Tomas Hospital on the

effectiveness of ice cube as topical anesthetic in reducing the pain of intramuscular injection among 4 to 6 years old children using the Wong Baker Faces pain scale for pain assessment. The subjects who were given ice compress prior to intramuscular injection experienced less pain with an average pain level of 5.14 compared to the control group where theaverage pain level was significantly higher at 7.18 [(7)]

In a study done by Baxter *et al*, the cold vibrator was compared to vapocoolant spray in 81 subjects, presenting at the Emergency Department for venipuncture. Before the procedure, the gadget was applied for 15-30 seconds where there was more pain relief (p=0.035) as well as increased venipuncture success rate in the Buzzy group [(9)]

In a study utilizing the vibratory device on foot and ankle injection, the gadget was applied 5-10cm proximal to the injection site over the anatomical location of the appropriate sensory nerve(s). The vibratory device was turned on for approximately 1 minute prior to and maintained during the injection [(11)].

Another study by Nemet *et al*, showed the use of "Buzzy" in a RCT during IV insertion in 48 children aged 4-12 at American University Medical Center. "Buzzy" was applied 5 to 10cm proximal to the dorsum of the hand site 15 to 60 seconds before and during the procedure while the other group underwent the usual procedure without any gadget or intervention applied. Pain scale was rated using the Wong Baker FACES Pain Rating Scale. The study showed lower pain score in the Buzzy group for the children and nurses. However,in this same study, gender, age, previous hospitalization, analgesics were all factors associated with children's pain score. On regression analysis they found out that Buzzy remained significant predictor of (lower) pain scores in children in this study.[(13)]

Across the globe there are different pain scales used in the pediatric age group such as the faces scales, numerical rating scales and visual analogue scales. In a review done by Baeyer, CL (2010), generally, children prefer faces scales with minimum age of 4[(11).] One of the widely used face scale, Wong-Baker Faces Pain Rating Scale (WBFPRS) has been preferred by children (any age), parents, and practitioners. In a study done by Tomlinson et al, concerning validity, WBFPRS has a high correlation with other self-reported pain scale used at the same time and shows differences ($p < 0.05$) in score between two comparable but different groups. Reliability has been proved using "test and retest" ($r > 0.5$) and by the concordance with simultaneous observational score ($r > 0.4$). WBFS has a significant ($p < 0.05$) responsiveness to pain-increasing (painful procedures) and pain-decreasing (analgesia) events [(14)]

Buzzy ® is a device created by MMJ Labs, Atlanta, GA which combined cold and vibration in a bee shaped device measuring 7.2cm x 4.8cm x 2.2cm, AAA+ battery-operated with removable ice gel wings, measuring 4.2 x 1.1 x 3.2 inches weighing

2.2 ounces. The device is pressed manually or secured by a rubber strap. Batteries will last at least at full strength for 20 hours as instructed in the manual. [16] Only vibratory, cold sensation, transient erythema and numbness were felt by the participants. There was no report of electrocuted subject using this gadget.

OBJECTIVES OF THE STUDY

General Objective:

To determine the effect of a cold vibrator device on pain perception of children aged 6-12 years old during Mantoux Test at the Out-Patient Department of the Philippine Children's Medical Center.

Specific Objectives:

To describe the demographic profile of children involved in the study as to age, gender, and school level.

Compare the following physiologic parameters before and after the procedure between the 2 groups, a) heart rate, b) oxygen saturation, b) respiratory rate

Determine the perceived pain among the 2 groups using the Wong Baker Faces Rating Scale for Pain

METHODOLOGY

This was a single blind randomized controlled study. The target population were children aged 6-12 years old, who were for Mantoux Test at Philippine Children's Medical Center Outpatient Department.

Excluded in the study were those with chronic and persistent pain disorder, with vision and hearing impairment, those with intellectual disability, patients with maintenance medication given as injection and patients with neurologic condition because of the possibility of altered sensation capacity. Those who could not recite back the instructions on how to answer or use the Wong Baker Face Scale after instruction was repeated three (3) times by the investigator or co-investigator were also excluded.

The participants were divided into control and experimental group. Each patient was randomized by drawing a piece of paper from a fishbowl given by the nurse where their respective group was written. The control subjects received Mantoux Test alone while the experimental group received the cold vibrator application 30 seconds prior and during the procedure.

A total of 104 subjects would achieve 80% power to detect a difference of 2.0 in pain score with a significance level of 0.05 using 2 tailed sided 2 sample t—test. This calculation assumed that the mean score for the controlled group is 7.2 with estimated group standard deviation of 3.6. [7] [44]

Patients and their caregivers coming in for Mantoux Test at PCMC OPD were oriented by the investigator or co-investigator regarding the study and invited to participate in the study. For those who joined, an Informed consent was obtained from the parents or guardian and assent for children 6-12y/o (appendix 5). The picture

of the gadget was shown and the Mantoux Test procedure was discussed to the participants and parents during the orientation prior to the procedure for them to have an idea of the procedure. Consenting participants were given a form for demographic data which they filled out. Instructions on how to answer the Wong Baker pain rating scale was discussed by the investigator or co-investigator after they filled out the form. Once the patient understood the process of answering the pain scale as evidenced by being able to recite and demonstrate on how to answer the scale, the following vital signs were obtained, namely: heart rate, respiratory rate, and oxygen saturation, by the investigator or co-investigator 1-2 minutes before the procedure. After obtaining baseline vital signs for 2 minutes, the participant was transferred to the adjacent procedure room. Fishbowl method was used by the subjects to identify their group. For the controlled group, the area was cleaned with cotton and 70% alcohol, after which Mantoux Test was be administered via intradermal injection on the volar aspect of the forearm. While in the experimental group, the cold vibrator was applied 5 to 10 cm proximal to the volar aspect of the forearm where the Mantoux Test would be done, 30 seconds prior and during the procedure. The cold vibrator device was secured using the rubber strap provided. It took 1 minute for drawing paper, 2 minutes to clean and strap the gadget, then 30 seconds in applying the gadget and another 30 seconds in injecting the Mantoux Test. After the procedure, the patient rated the experienced pain using the Wong-Baker Faces rating scale as oriented prior to the procedure. He was given 2 minutes to answer. After completion, the answer sheet was then folded, sealed, and placed by the participant in a collecting box beside the nurse. After the procedure, the patient returned to the holding room, where the investigator or co-investigator obtained the post-procedural vital signs: heart rate, respiratory rate, and oxygen saturation rate for another 2 minutes. The entire procedure took 10 minutes.

The investigator and co-investigator were blinded on the pain scale result of the patient since it was only the patient and parent who saw the pain score of the participant written on the paper which was then sealed and collected on the box. To ensure that uniformity of instructions given to the participants, a script was utilized by the investigator and co-investigator during the orientation of parents and patient.

The Wong Baker Faces Pain rating scale was used in this study. It is an instrument that measured the pain by an individual to certain stimuli which was recommended for ages 3 years old and above [(17)]. There were 6 faces in this rating scale. The first face represented a pain score of 0 "no hurt". The second face represented a pain score of 2, "hurts a little bit." The third face represented a pain score of 4 "hurts a little more". The fourth face represented a pain score of 6, "hurts even more". The fifth face represented a pain score of 8, "hurts a whole lot" while the sixth face had a pain score of 10, "hurts worst" [(18).]

The guardian or participant answered the data sheet containing the demographic data: age, birthday, gender, and date. The objective findings such as the heart rate, respiratory rate, and oxygen saturation pre- and post-procedure along with the Wong baker faces pain rating scale were obtained.

The test for the significant difference between the effect of cold vibrator in the pain perception during Mantoux test compared to those who did not receive the treatment was measured using Wilcoxon Rank-Sum Test. The WongBaker Pain Scale score was greater in the control group than in the experimental group,U = 540 with a p value < 0.05 (0.0000000046). T test was used for the evaluation of thepre- and post-procedural vital signs between and among groups. There was nosignificant difference between the physiologic parameters (heart rate, respiratory rate,and oxygen saturation) before and after procedure between the two groups with p value>0.5 for each vital sign.

This study was submitted and approved by the IRB-EC to ensure non-violation of patient's rights and safety. An Informed consent was obtained from the subjects' parents where simple explanation about the objective of the study was also explained. This study ensured the safety, privacy, and confidentiality for each patient. Each patient was given a chance to ask questions regarding the procedure to be taken. All data from this study was kept confidential.

RESULTS

There were 104 subjects aged 6-12 who participated in this study. Subjects were randomly assigned using the fishbowl method where in fifty (50) children belonged to the controlled group while fifty-four (54) on the experimental (with cold vibrator) group. All of which received Mantoux Test at the Out-Patient Department of the Philippine Children's Medical Center from October 1 to 18, 2019.

Table 1. Demographic profile of children as to age, gender, and school level.

Age in Years	N = 104	
Mean	9.01 ± 1.95	
Median	9.0	
Minimum	6	
Maximum	12	
	Frequency	Percent
Sex		
Female	50	48.1
Male	54	51.9
Educational Level		
GR 1	10	9.6
GR 2	12	11.5
GR 3	14	13.5
GR 4	23	22.1
GR 5	16	15.4
GR 6	13	12.5
GR 7	6	5.8
KINDER	10	9.6

Table 1 shows the demographic profile of children as to age, gender, and school level. The median age of the participants was 9 years old, the ages ranged from 6 years to 12 years old. As to gender, there were more

males than females wherein 54 (51.9%) were males and 50 were females (48.1%). All participants were also enrolled in school with the following grade level; grade 1, 10 participants (9.6%), grade 2, 12 participants (11.5%), grade 3, 14 (13.5%), grade 4, 23 (22.1%), grade 5, 16 (15.4%), grade 6, 13 (12.5%), grade 7, 6 (5.8%) and kinder with 10 students (9.6%).

Table 2. Comparison of Physiologic Parameters between the Experimental and Control Groups

Physiologic Parameters	Experimental Mean	Control Mean	p value
Pre procedure Heart Rate	101.92	102.87	0.732
Post procedure Heart Rate	98.48	99.02	0.848
Pre procedure Respiratory Rate	24.58	24.41	0.729
Post procedure Respiratory Rate	23.86	23.63	0.679
Pre procedure O2 Saturation	98.82	98.69	0.519
Post procedure O2 Saturation	98.84	99.0	0.613

Table 2 shows the comparison of the physiologic parameters between the experimental and control group. There was noted higher mean scores for the heart rate and respiratory rate for the pre procedural physiologic parameters for both the control and experimental group.

Table 3. Physiologic Parameters in the Control Group

Physiologic Parameter	Pre-Procedure Mean	Post Procedure Mean	p value
Heart Rate	103.17	99.21	0.008
Respiratory Rate	24.50	23.77	0.010
O2 Saturation	98.65	99.04	0.134

Table 3 shows the pre- and post-procedural physiologic parameters of the control group which showed higher heart rate and respiratory rate for the pre procedural heart rate and respiratory rate. The mean score of 102.87, 24.41, 98.69% compared to its post procedural physiologic parameters 99.02, 23.6, 99% for heart rate, respiratory rate, and oxygen saturation, respectively.

Table 4. Physiologic Parameters in the Experimental Group

Physiologic Parameter	Pre-Procedure Mean	Post Procedure Mean	p value
Heart Rate	101.85	98.15	0.008
Respiratory Rate	24.60	23.79	0.010
O2 Saturation	98.87	98.87	0.134

Table 4 shows the pre- and post-physiologic parameters for the experimental group. Like in the control group, the experimental group showed higher pre procedural mean score for heart rate and respiratory rate. There were 101.92, 24.5, 98.82 compared to its post procedural physiologic parameters of

98.48, 23.86, 98.84% heart rate, respiratory rate, and oxygen saturation respectively.

Table 5. Perceived pain among the 2 groups using the Wong Baker Faces Rating Scale for Pain using Mann-Whitney Test/Wilcoxon Rank-Sum Test

Group	N	Mean Rank	Sum of Ranks
1 – experimental	50	36.3	1815.00
2 - control	54	67.50	3645.00
Total	104		

Table 5 shows the perceived pain using Wong Baker Faces Rating Scale for Pain between the two groups. There was higher mean for the control group with mean rank of 67.5 with aggregated pain rank of 3645.00 compared to experimental group (with cold vibrator) of 36.3 with aggregated pain rank of 1815.00 with a p value < 0.05 (0.0000000046) using Wilcoxon Rank-Sum Test.

DISCUSSION

Vaccinations are one of the earliest and most commonly experienced painful procedure in healthy children, being reported as one of the most feared and painful medical experiences.[19] The pain of needle related procedure as well as adverse events, such as swelling and redness at the injection site, are key barriers to vaccination,[20] hindering coverage rates and, therefore, herd immunity. Furthermore, the distress felt by the child, and the parent during the procedure has been shown to influence hesitancy to vaccinate[21] which ultimately increases the likelihood for the vaccine preventable diseases. For this reason, the WHO continues to emphasize pain management as a fundamental right regardless of age, culture, race, ethnicity, and socio-economic status. [22] [23]

In our study, there was greater pain score experienced by the control group compared to the experimental or Buzzy group with a p value < 0.05 (0.0000000046) which makes the difference significant. In a similar study done by Susam V. *et al*[24] where cold vibrator was utilized during venipuncture stated that the mechanisms which could explain the impact of vibration and cryotherapy could be found through the gate-control theory [25]Based on gate control theory, mechanisms of pain relief induced by vibration can be reduced by simultaneous activation of nerve fibers that conduct no noxious stimuli. [26] [27] In another study, where vibration was applied as a counter stimulation to an anesthetic injection, it reached the brain before the pain sensation does. The brain can perceive only one sensation at a time. Therefore, the sensation that arrived at the brain first was the one that was felt. Hence as counter stimulation vibration reduces pain perception. [28] [29]

On the other hand, pain is subjective, complex and multidimensional construct that involves sensory, emotional, and cognitive processes [30] The primary outcome assessment was evaluated by self-report, which was considered as a primary source of evidence for pediatric pain intensity.[31] This could increase the magnitude of the detection bias as pain is a subjective measure.[32] However, some have argued that self-report assessment could be considered as equivalent to blinding of

outcome assessors considering that it is not associated with an overestimated intervention effects, as is the case in psychotherapy meta-analyses.[33] [34]

Previously published studies had reported that pain rating was influenced by demographic variables such as age, gender, and educational level of parents [35]. In a local study done by Acero AJ, analysis of the perceived injection pain among male and female groups showed no significant difference [36]. In a study conducted by Matthew T. Feldner and Hamid Hekmat (2001), it was investigated as to the extent of perceived control over anxiety-related events contributes to the experience of pain. It was discovered that pain tolerance and endurance, but not pain intensity or threshold, were predicted by perceived control over anxiety-related events [37]. In our study, correlation of demographics with regards to pain perception were beyond our scope and could be an avenue for future study.

In our study, there was no significant change between the vital signs (heart rate, respiratory rate, oxygen saturation) before and after the procedure between the two groups. Like in the study of Mohamed RA, on the effect of play intervention on anxiety and vital sign in children during preoperative period, vital signs had no statistically significant difference between the study and control group regarding vital signs one hour before transferring to operating room[38] However in our study, there was noted higher heart rate and respiratory rate among each group. This might be attributed to anxiety or fear felt by the subjects with the procedure. Fear can increase the secretion of cortisol and norepinephrine, which in turn affect the vital signs. This result was supported by a study done by Aranha, et al., (2017) about impact of multimodal preoperative preparation program on children undergoing surgery who found that multimodal preoperative preparation program is effective in stabilizing pulse, respiration, and blood pressure of children [39]

In the study of Hatfield and colleagues in 2008, it was explained that the long-term effects of unmanaged pain in human infants have been shown to include permanent impairment of elements of cognitive development, including learning, memory, and behavior and increased somatization in childhood [36]. The plasticity of the developing brain and the changes that occur in response to painful stimuli also contribute to altered perceptions of pain later in life [40]

CONCLUSION AND RECOMMENDATION/S

In this study, the use of the cold vibrator was shown to be efficacious in reducing pain perception felt by the children during Mantoux test. This gadget could also be applied to other needle related procedure as indicated on above mentioned studies. An inter-observer rating score could be utilized to assess and verify the pain experienced by the participants were congruent. Due to its vibratory mode potential use of this gadget as chest precursor to infants could also be explored.

Lastly, the demographic data could also be correlated to the pain scores of the subjects. While it may have a positive and significant effect, its measure and evidence were beyond the scope of this study but may be another avenue for a similar research along this topic.

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DEGREE OF FAMILY DISASTER PREPAREDNESS AND ASSOCIATION OF DEMOGRAPHIC CHARACTERISTICS OF ACTIVE CONSULTANTS OF A TERTIARY HOSPITAL FOR CHILDREN IN QUEZON CITY

PRISTINE ROSE D. FAJARDO, MICHAEL M. RESURRECION

ABSTRACT

BACKGROUND: Increasing incidence of natural and man-made disasters emphasize the need to assess home disaster preparedness of pediatricians.

OBJECTIVES: To determine degree of family disaster preparedness and association of demographic characteristics of active consultants of a tertiary hospital for children in Quezon City.

METHODS: Cross-sectional study where participants were selected using purposive type of sampling. Fifty-eight active consultants for children answered a self-administered questionnaire on home disaster preparedness. Data was analyzed using SPSS version 24.0.

RESULTS: Total of 36 (62.06%) participants scored 70 and above, indicating family disaster preparedness. A total of 22 (37.94%) participants scored below 70, indicating lack of home disaster preparedness. The age of participants 35 to 40 (OR 108.57), 41 to 45 (OR 36.01), 51 to 55 (OR 11.4) and 56 to 60 (OR 17.93) are more likely to be family disaster ready (p value <0.05). Male participants were 7 times more likely to have higher overall family disaster preparedness.

CONCLUSIONS: This study has shown that 36 consultants in a tertiary hospital for children in Quezon City are prepared for home disasters. Males and younger population are the demographic characteristics associated with an increased degree of family disaster preparedness.

RECOMMENDATIONS: Basics of home disaster management should be included in continuing medical education of the hospital staff. Health education management system should encourage participation of hospital staff in disaster management programs. Bigger sample size of the pediatric society is recommended. Determine association of other demographic variables on home disaster preparedness. Address issues to overcome response bias.

INTRODUCTION

Natural and man-made disasters are unpredictable events that can cause loss of life or damage to properties.[1] The 2018 World Risk Report stated that the Philippines is the third most vulnerable country to disasters and one of the most susceptible countries for climate change.[2] The Philippines experiences 20 to 25 typhoons yearly, with 22 known active volcanoes and an 80% probability for

earthquakes.[3] Metro Manila is one of the largest urban agglomerations in the Philippines and in the world. In comparison to the impact of climate change, Metro Manila is at risk for tropical cyclones and flooding.[3] The risk of man-made disasters in Metro Manila is also high owing to increased population and environmental degradation.

The need for disaster preparedness strategy for Metro Manila and for the entire Philippines has been widely emphasized. Emergencies occur anytime, and it is important for every community, family and individual to be prepared for any disaster to prevent further destruction of the consequences of such events.The National Disaster Risk Reduction and Management Council (NDRRMC) a working group of various government, nongovernment, civil and private sector organizations is responsible for ensuring the protection and welfare of the people during emergencies.[5] Throughout the country, local DRRM offices were established to create a local risk reduction and management plan according to the framework of the NDRRMC covering 4 aspects including disaster preparedness, response, prevention and mitigation, and rehabilitation and recovery.The Department of Health (DOH) through the Health Emergency Management Bureau (HEMB) is tasked for coordinating, integrating, supervising and implementing disaster related functions involving health concerns.[14] The DOH - HEMB is focused on disaster preparedness and response. Hospitals are required by NDRRMC through the DOH to have disaster plans and to practice them at least twice a year. These plans include the hospital's response to mass casualty incidents and internal disaster .[5]

Every pediatrician has a vital role in disaster preparedness, including personal preparedness through anticipatory guidance to their families and roles in the hospital and communities.[6]Families view pediatricians as their expert resource, and most of them anticipate that pediatricians are knowledgeable in disaster preparedness. A well-educated and equipped pediatrician who can lead his/her family in all phases of disaster in their home can be of immense service. The literature showed limited information on family disaster preparedness among healthcare professionals specifically pediatricians. This study will be conducted to answer the research question: What is the degree of family disaster preparedness and association of demographic characteristics of active consultants of a tertiary hospital for children in Quezon City?

Disasters could be man-made or natural environmental hazards of catastrophic consequences. These devastating events can overcome a community's ability to cope, causing serious harm to people's safety, health, and welfare. The government and non-government organizations have come up with various disaster preparedness plans.

The communities have the most crucial role since the ability of each member to be ready in times of disasters is more significant in reducing the damaging consequences. However, the key to having

an effective medical response during these events is ensuring that the healthcare system is well prepared in advance. This includes ensuring health care providers are prepared, by supporting them to develop household and business continuity plans, and to participate in health emergency management planning.[1,6]

According to Doctors of BC Council on Health Promotion, the personal preparedness among physicians is an important role in disaster preparedness to guide and empower their patients. Pediatricians have multitude of roles in emergency preparedness. This roles is not limited to general pediatricians but also applies to pediatric medical subspecialists and pediatric surgical specialists.[17]

Gausche - Hill et.al. and Mohamed Gad-el-Hak stated that general pediatricians and subspecialists' involvement may range from giving advice to families and children to being subject-matter experts for preparedness and critical resources in their communities. To fulfill these roles, it is essential that all pediatricians become educated regarding emergency preparedness.[7,8]

Gold, et.al and the American Academy of Pediatrics stated that it is necessary for all pediatricians to: institute office and home disaster plans; participate in the community or hospital disaster plan, exercises, and drills; provide medical assistance via established disaster medical delivery systems; provide guidance to patients and their families; make every effort to work in concert with the lead organization coordinating disaster relief when volunteering to assist during or after a disaster; serve a key role in identifying sentinel cases of illness after a chemical, biological, or radiologic release and include mental health preparedness in facing disasters and its consequences and after effects especially in vulnerable subjects - children.[10,12]

Mortelman et.al used a six-content assessment tool to evaluate the knowledge, estimated risk and capability for disasters of emergency pediatricians in specialized tertiary centers. It showed that 35% had disaster training and 53% felt that disaster education should be part of the curriculum of all healthcare professionals. The self-estimated capability ranged from 1.8 out of ten to 7.6 out of ten. It is said that physicians in general are willing to learn and adapt a curriculum on disaster preparedness but actual readiness is really limited.[11]

Chen et. al. conducted a national survey among 976 randomly selected Family Physicians. The study showed that only a quarter of family physicians were confident to respond to a bioterrorist event. The author concluded that physicians in general need more training in bioterrorism and other types of disasters.[9]

This study aimed to determine the degree of family disaster preparedness among Active consultants of a Tertiary Hospital for Children in Quezon City. The results of the study will be of importance to the following:

- Department of Health –The results of the study will guide officials and technical staff of DOH in planning strategies and formulating specific activities to generate awareness on disaster planning in community and family level.

- Philippine Medical Association and Subspecialty Societies – The result of the study will assist the medical community to come up with a statement/guidelines for and among its members on home disaster preparedness.

- Health Professionals – The results of this studywill strengthen the role of health professionals (ie pediatricians) in home disaster preparedness; enable pediatricians to improve their knowledge and skills in emergency preparedness.

STUDY OBJECTIVES

General Objective:

To determine the degree of family disaster preparedness and association of demographic characteristics of active consultants of a tertiary hospital for children in Quezon City.

Specific Objectives

1. Determine the degree of family disaster preparedness of pediatricians in a Tertiary Hospital for Children in Quezon City as to Home Disaster Plan, Home Disaster Supplies Kit and Disaster Preparedness Information.

2. Determine the association of degree of family disaster preparedness of pediatricians and demographic characteristic as to the participants age, sex, PPS membership status, type of practice and number of family members.

METHODOLOGY

This is a cross-sectional study conducted in a tertiary government hospital for children. The study invited Pediatricians of a tertiary government hospital for children in Quezon City. The following criteria was used in selecting the participants:

1. Diplomate, Fellow, Emeritus Fellow of the Philippine Pediatric Society, Inc.

2. Active consultant of a Tertiary Government Hospital for Children in Quezon City

3. Voluntary written informed consent to participate in the research study

STUDY PROCEDURE

The research protocol was submitted to the Institutional Review Board and Ethics Committee (IRB – EC) for review and approval. Data collection commenced onceapproved by the IRB – EC. Given that consultants arrived at different point in time, purposive sampling technique was applied to select participants. The study was done by

having the consultants, as they arrive, as respondents of the study if they satisfy the inclusion criteria until the required number of samples was achieved. The research assistant supervised/administered the questionnaire. The participants answered a self-administered questionnaire on home disaster preparedness. The Total Readiness Rating Score was used to evaluate the answers of theparticipants.

The answers on the self-administered questionnaire were encoded in Microsoft excel. Data was analyzed using SPSS version 24.0. Figure 1 outlines the study procedure.

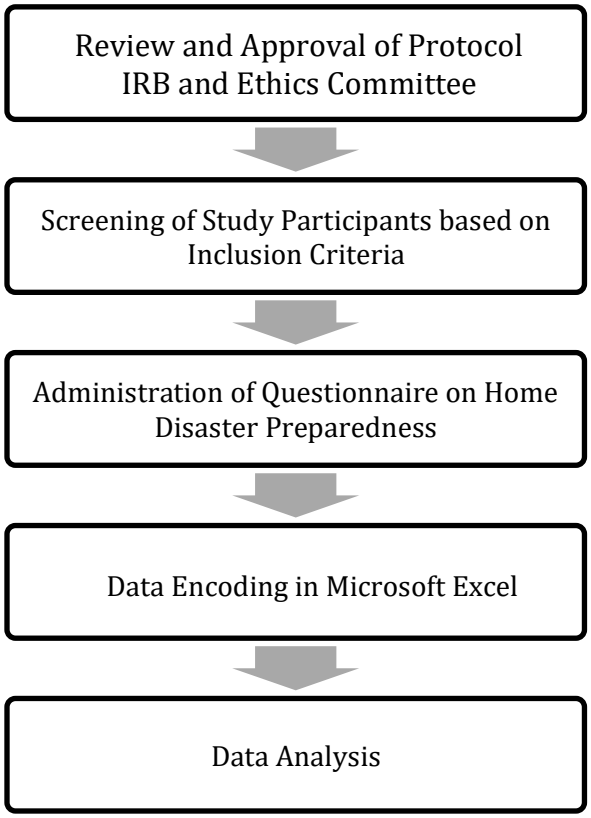

Figure 1. Study Procedure Flowchart

STUDY INSTRUMENT

The self-administered questionnaire was derived from Disaster Preparedness Event Too kit by The Philippine Pediatric Society, Committee on Accident Prevention, Disaster, Environmental Safety and Assistance. It is downloadable at www.redcross.org. Agunoy et al used the questionnaire in an earlier study. It was translated in Tagalog and validated by conducting a pre-test to 30 participants from the previous study.

The questionnaire is composed of four parts. The first part includes the demographics of the participants: age, sex, PPS member status, subspecialty and number of members in the family, The second part of the questionnaire includes three questions on home disaster plan: family's plan of a meeting place; identified an out of area phone contact and escape route in case of disaster. The third part of the questionnaire includes three questions on basic needs to put on the home disaster supplies kitthat comprised food, water, flashlight, batteries, radio, documents and materials for house pet. The fourth part of the questionnaire includes four questions on disaster information, it inquires on how well informed are the participants about disasters and its consequences. The total readiness rating score was used to evaluate the answers to the questions. The responses on the three domains were scored to determine the degree of disaster preparedness. The response to each item was given corresponding 10 points. A score of 90 to100 points is interpreted as excellent

readiness, a score of 80 points is interpreted as very good readiness, a score 70 points is interpreted as a solid foundation and a score of less than 70 points is interpreted as still more to do.

A total of 67 active consultants hold clinic in a Tertiary Hospital for Children in Quezon City. Samples were gathered using purposive sampling technique. Those consultants who met the inclusion criteria was considered until the required number of samples per type of practice was met (Table1).

Table 1: Frequency of Consultants and Sample Size Requirement per Type of Practice

Type of Practice	Total Number of Consultants per Type of Practice	Sample Size Requirement per Type of Practice
General Pediatrics	11	10
Adolescent Medicine	5	4
Cardiology	4	3
Clinical Genetics	1	1
Critical Care	4	3
Endocrinology	3	2
Gastroenterology	4	3
Hematology	6	5
Infectious Diseases	7	6
Neonatology	6	5
Nephrology	9	8
Neurology	1	1
Pulmonology	5	4
Total	67	55

Frequency, Percentage, Mean, Standard deviation, Median, and Interquartile Range were used to describe the demographic and clinical profile of the participants. Frequency and Percentage were used to determine the degree of family disaster preparedness of pediatricians in terms of home disaster plan, home disaster supplies kit, and disaster preparedness information in a Tertiary Hospital for Children in Quezon City. Ordinal logistic regression analysis was used to determine the association of degree of family disaster preparedness of pediatricians and demographic characteristic as age, sex, membership status, type of practice, and number of family members. SPSS version 24.0 was used for data analysis; Null hypothesis will be rejected at 0.05-alpha level of significance.

The research was guided by the Principles in the Declaration of Helsinki. The research protocol was submitted to the Institutional Review Board for review and approval. The principal investigator wrote a letter or request addressed to the Executive Director to conduct the study among pediatricians of the institution. The pediatricians were oriented in the nature, purpose and procedures of the study. The pediatricians were invited to participate in the study. Their approval in their involvement in the study was solicited. The informed consent process was conducted in English. Forms and questionnaires were coded. All information was secured. The members of the research team have completed the Good Clinical Practice training on the responsible conduct of research with human data. A trained

research assistant solicited the informed consent and administered the questionnaire. The structured research question was only administered once the informed consent was signed.

RESULTS

A total of 58 active consultants gave consent and completed the self-administered questionnaire. Table 2 outlines the socio-demographic profile of the study participants. Majority, fifty seven percent (57%) of the participants were51years old and above. There were more female (79.3%) consultants as compared with male (20.7%) consultants. Eighty five percent of the participants were fellows of the Philippine Pediatric Society (PPS). Majority, 24% of the consultants are General Pediatricians, 10% were Hematologists-Oncologists and 8.6% were Pulmonologists. Fifty percent of the participants have 5 or more family members.

Table 2: Frequency and Percentage Distribution of Sociodemographic Characteristics of the Participants

	N	Percentage
Age		
35-40	5	8.6%
41-45	11	19.0%
46-50	9	15.5%
51-55	12	20.7%
56-60	9	15.5%
60 and above	12	20.7%
Sex		
Male	12	20.7%
Female	46	79.3%
PPS Member Status		
Diplomate	9	15.5%
Fellow	49	84.5%
Emeritus Fellow	0	0.0%
Type of Practice		
General Pediatrics	14	24.1%
Adolescent Medicine	4	6.9%
Cardiology	4	6.9%
Genetics	1	1.7%
Critical Care	4	6.9%
Endocrinology	2	3.4%
Gastroenterology	2	3.4%
Hematology-Oncology	6	10.3%
Infectious Disease	4	6.9%
Neonatology	3	5.2%
Nephrology	5	8.6%
Neurology	4	6.9%
Pulmonology	5	8.6%
Number of FamilyMembers		
0-2	9	15.5%
3-4	20	34.5%
5 or more	29	50.0%

Analysis of pediatricians' home disaster plan showed that 31 (53.4%) have identified two places to meet after a disaster. The results showed that 12 (20.7%) of the participants have identified an out-of-area phone contact. Majority, 42 (72.4%) have identified escape routes out of their homes. Assessment of the pediatricians having a home disasters' supply kit showed that 26 (44.8%) have 3-day supply of food, water

and special items. There were 52 (89.7%) participants who verbalized to have flashlight, battery-powered radio and extra batteries. Forty-three (74.1%) affirmed to have a well stock first-aid kit. Inquiry on what to do in a disaster demonstrated that 52 (89.7%) of the participants know what type of disaster may occur in their area. Fifty-two (89.7%) of the participants learned the various methods to stay informed during a disaster. Fifty-one (87.9%) participants learned what to do in case of an earthquake and to evacuate safely or signal for help in case of fire. There were 46 (79.3%) participants who are certified in first aid and CPR. (Table 3)

Table 3: Frequency and Percentage Distribution of Family Disaster Preparedness of Pediatricians in terms of Home Disaster Plan, Home Disaster Supplies Kit, and Disaster Preparedness Information

	N	Percentage
Creating a Home Disaster Plan		
1. My family and I have identified two places to meet after a disaster.	31	53.4%
2. My family and I have identified an out-of-area phone contact.	12	20.7%
3. My family and I have identified escape routes out of our home.	42	72.4%
Developing a Home Disaster Supplies Kit		
1. I have a 3-day supply of food, water and special items	26	44.8%
2. I have a flashlight, battery-powered radio, and extra batteries.	52	89.7%
3. I have a well-stocked first aid kit	43	74.1%
Being Informed about what to do in a Disaster		
1. I have learned what disasters may occur in my area and how they might affect me and my loved ones.	52	89.7%
2. I have learned the various methods used to stay informed during a disaster.	52	89.7%
3. I have learned how to drop, cover and hold in case of an earthquake, to shelter-in-place if needed, and evacuate safely or signal for help if I am unable to exit in case of fire.	51	87.9%
4. I am currently certified in first aid and CPR.	46	79.3%

Analysis of the pediatricians' degree of home disaster preparedness showed that 12 (20.68%) have excellent readiness. There were 14 (24.13%) who have very good readiness and 10 (17.2%) have good readiness in home disasters. A total of 22 (37%) participants still have more to do to prepare for home disasters. Classification of the participants' disaster preparedness score demonstrated that 36 (62.06%) scored 70 and above which indicated family disaster preparedness. A total of 22 (37.94%) participants scored below 70, which indicated that they are not prepared in home

disasters. Analysis of family disaster preparedness of participants as to creating home disaster plan, developing home disasters' supplies kit and disaster preparedness information showed no association with demographic characteristics as age, sex, membership status, type of practice and number of family members.

Further analysis was done to determine the association of degree of overall family disaster preparedness and demographic characteristics as age, sex, membership status, type of practice and number of family members. The results revealed that the following age of participants 35 to 40 years old (OR 108.57), 41 to 45 years old (OR36.01), 51 to 55 years

old (OR 11.4) and 56 to 60 years old(OR 17.93)are more likely to be family disaster ready (p value <0.05) as compared to participants 60 years old and above.Study on the association of sex and overall home disaster preparedness showed that male participants were 7 times more likely to have higher overall family disaster preparedness compared to female participants. The results further revealed that PPS membership status, type of practice, and number of family members arenot associated with the overall degree of family disaster preparedness of the participants. (Table 4)

Table 4: The Association of Degree of Overall Family Disaster Preparedness Of Pediatricians And Demographic Characteristics

	Overall				**OR (95% CI)**	**P-value**
	Excellent	**Very Good**	**Solid Foundation**	**Still more to do**		
Age						
35-40	1 (8.3%)	3 (21.4%)	0 (0%)	1 (4.5%)	108.57 (3.28 - 3596.28)	0.009
41-45	3 (25%)	4 (28.6%)	1 (10%)	2 (9.1%)	36.01 (3.75 - 345.43)	0.002
46-50	2 (16.7%)	0(0%)	3 (30%)	5 (22.7%)	6.67 (0.75 - 59.34)	0.089
51-55	1 (8.3%)	5 (35.7%)	3 (30%)	3 (13.6%)	11.4 (1.33 - 98.14)	0.027
56-60	4 (33.3%)	1 (7.1%)	0 (0%)	4 (18.2%)	17.93 (2.06 - 155.71)	0.009
60 and above	1 (8.3%)	1 (7.1%)	3 (30%)	7 (31.8%)	0a	
Sex						
Male	10 (83.3%)	9 (64.3%)	8 (80%)	19 (86.4%)	7.48 (1.24 - 45.18)	0.028
Female	2 (16.7%)	5 (35.7%)	2 (20%)	3(13.6%)	0a	
PPS Member Status						
Diplomate	1 (8.3%)	5 (35.7%)	2(20%)	3 (13.6%)	4.71 (0.49 - 45)	0.178
Fellow	11 (91.7%)	9 (64.3%)	8 (80%)	19 (86.4%)	0a	

Emeritus Fellow						
Type of Practice						
Cardiology	0 (0%)	3 (21.4%)	0 (0%)	1 (4.5%)	4.9 (0.32 - 74.73)	0.253
Critical Care	1 (8.3%)	1 (7.1%)	1 (10%)	1 (4.5%)	1.57 (0.09 - 25.94)	0.753
Gastroeneterology	0 (0%)	1 (7.1%)	0 (0%)	1 (4.5%)	2.77 (0.16 - 48.13)	0.484
General Pediatrics	5 (41.7%)	3 (21.4%)	2 (20%)	4 (18.2%)	13.39 (0.28 - 636.95)	0.188
Genetics	0 (0%)	0 (0%)	0 (0%)	1 (4.5%)	3.1 (0.11 - 84.95)	0.502
Adolescent Medicine	1 (8.3%)	1 (7.1%)	2 (20%)	0 (0%)	8.15 (0.66 - 100.26)	0.101
Endorcrinology	1 (8.3%)	1 (7.1%)	0 (0%)	0 (0%)	0 (0 - 0)	
Hematology-Oncology	1 (8.3%)	1 (7.1%)	0 (0%)	4 (18.2%)	0.88 (0.06 - 13.46)	0.928
Infectious Disease	0 (0%)	1 (7.1%)	0 (0%)	3 (13.6%)	0.31 (0.02 - 6.35)	0.446
Neonatology	0 (0%)	0 (0%)	1 (10%)	2 (9.1%)	1.15 (0.04 - 36.74)	0.937
Nephrology	1 (8.3%)	1 (7.1%)	0 (0%)	3 (13.6%)	1.35 (0.07 - 27.38)	0.846
Neurology	1 (8.3%)	0 (0%)	3 (30%)	0 (0%)	6.6 (0.41 - 106.48)	0.184
Pulmonology	1 (8.3%)	1 (7.1%)	1 (10%)	2 (9.1%)	0a	
Number of Family Members						
0-2	2 (16.7%)	2 (14.3%)	0 (0%)	5 (22.7%)	0.58 (0.11 - 3.08)	0.526
3-4	4 (33.3%)	3 (21.4%)	6 (60%)	6 (27.3%)	0.89 (0.2 - 3.88)	0.878
5 or more	6 (50%)	9 (64.3%)	4 (40%)	11 (50%)		

DISCUSSION

The rising number of natural and man-made disasters around the world and specifically in the Philippines, the need for disaster preparedness is emphasized. Studies suggested that in disaster preparedness, pediatricians have a vital role in disaster preparedness as children are considered one of the most vulnerable population comprising 20% of the community.[11,15]This study revealed that the selected physicians in a tertiary hospital in Quezon City are generally prepared in terms of creating a home disaster plan, building a disaster supplies kit and being informed on what to do in a disaster.

Government efforts to increase awareness on disasters and programs on disaster preparedness in the hospital and community setting have contributed to the results of the present study. The increasing number and severity of natural and man-made disasters in the recent years have made the general population more vigilant in disaster preparedness. The development of newer information technology and its accessibility, have greatly educated the general population on basic information on disasters. These factors have led to the increased disaster preparedness of our participants.[16]

The results of this study are in contrast with that of Mortelman, et. al. and Chen et.

al, which showed that most physicians are under prepared for disasters and need to undergo specific training in pediatric disasters.[9, 11] Mortelman et al. conducted a six-content assessment tool to evaluate the knowledge, estimated risk and capability for disasters of emergency pediatricians in specialized tertiary centers. The results showed that 95% of respondents anticipated receiving pediatric patients after a mass casualty event; only half of the respondents had specific emphasis on the pediatric patient as part of their disaster plan.[11]

Analysis of the different demographic characteristics and degree of disaster preparedness showed an association with age and sex. Being a male pediatrician, with age of less than 60 is associated with increased degree of home disaster preparedness. This is affirmed in the study of Makama et.al, which showed an association between male, ages 46 to 50 years old and increased home disaster preparedness. [18] This is in contrast to the study by Najafi, et.al, which stated that gender is not associated with degree of home disaster preparedness. Other factors associated with home disaster preparedness are monthly income, previous disaster experience, residential district and occupation (physicians). [19]

Men as head of the family have a greater responsibility both within their households and as volunteers and rescue workers in their community. Younger population plays various roles in disaster preparedness. They are flexible and can easily adapt to situations. As such, they can guide the community in their risks and protective factors or may hold leadership within programs on disaster preparedness. The youth can also act as medium to disperse information on home disaster preparedness and act as change makers. With a higher access to technology and media exposure, the younger population can come up with resourceful plans to disaster preparedness efforts.

Children and adults, ages 60 and above are the most vulnerable during and after disasters. Older adults are more likely than others in a community to be socially isolated. They have multiple chronic conditions, limitations in daily activities, declining vision, hearing, physical and cognitive disabilities that can hamper their ability to communicate about, prepare for, and respond to a natural disaster deeming them less prepared for it.

The present study revealed that there is no association between PPS membership status and number of family members, type of practice and home disaster preparedness. This is similar to the result of the study by Najafi et.al, which concluded that there is no association between number of household members and degree of home disaster preparedness.[19]

This study is limited to the active staff of a tertiary pediatric hospital in Quezon City. The result is not reflective of the home disaster preparedness of the membership of the specialty society. This is a survey type of study that could be associated with factors that can influence response.

CONCLUSIONS AND RECOMMENDATIONS

This study concluded that 62% of the consultants in a tertiary hospital for children in Quezon City are generally prepared for home disasters in terms of creating a home disaster plan, building a disaster supplies kit and being informed on what to do in a disaster. Gender and age are the demographic characteristics associated with an increased degree of family disaster preparedness. PPS membership status, type of practice and number of family members were not significant factors.

It is recommended that basics of home disaster management should be included in the continuing medical education of the hospital staff. The health education management system should encourage participation of hospital staff in disaster management programs and activities. The researcher recommends that for future study a bigger sample size involving a representative sample of the general membership of the pediatric society. Determine association of other demographic variables such as monthly income, previous disaster experience and residential district on home disaster preparedness. Address issues to overcome response bias.

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USE OF THE PATIENT FALL PREVENTION REMINDER CHECKLIST TO INCREASEHEALTH CARE PROVIDER AWARENESS AT THE PHILIPPINE CHILDREN'S MEDICAL CENTER

JACQUELINE G. MARQUEZ, MARIA EVA I. JOPSON

ABSTRACT

BACKGROUND: Falls in the hospital are preventable. Prevention of fall requires cooperation from the health care provider, caregivers, as well as the hospital administration. This study was done to utilize standard reminders for fall to increase the awareness of health care providers of a tertiary hospital for children.

OBJECTIVES: To determine the effectiveness of the Patient Fall Prevention Reminder Checklist in increasing the awareness of health care providers of patients admitted at the Philippine Children's Medical Center.

METHODOLOGY: After obtaining permission to use an established Patient Fall Prevention Reminder checklist from the Intermountain Health Care (USA), participants were recruited after giving their informed consent. A pre-test was conducted to gauge the awareness and practices of the participants in preventing falls in the hospital. After the pre-test, the tool was introduced and discussed by the author to the participants. After 7 days, the participantswere followed up to take the post-test. Data collected were encoded then analyzed throughdescriptive statistics.

RESULTS: There were one hundred twenty-one (121) respondents with 42 males and 79 females. There is an increase in awareness in fall prevention amongthe residents and nurses, based on their pre and post-test examination results. The midwives had previous awareness in preventing falls even prior to the study.

CONCLUSIONS AND RECOMMENDATIONS: The checklist served as an effective tool in increasing the awareness of most study participants. We recommend the establishment of an institutionalized Fall Prevention Reminder Checklist at the Philippine Children's Medical Center for use by health care personnel.

KEYWORDS: Fall Prevention, Fall Prevention Checklist, Health Care Provider

INTRODUCTION

Falls can lead to potential injury and other negative outcomes such as increased length of hospital stay and costs. The health care provider has a responsibility in keeping every admitted child safe.

Falls, which may occur in the hospital or at home, continue to be a heavy burden in the continuum of care of all medical professionals. Fall is one of the most common injuries requiring medical care and the most common non-fatal injury requiring hospitalization. Available data states that 2.8 million children are treated at the emergency department due to fall-related injuries; most of whom are children under five years of age probably due to curiosity and development of motor skills.[1]Falls are the most frequent cause of any injury during infancy with an estimated ratio of 35.1 per 1000 infant-years.[1]A retrospective chart review done by Schaffer, et. al last 2011 on 100 identified fallers and 100 non-fallers noted that most falls occur 81% of the time at pediatric in-patient units, 87% in the child's room, and 22% when the child is going to the bathroom.[10]In Philippine Children's Medical Center (PCMC), there is an increasing incidence of fall from the year 2013 to 2017, with an average number of 24 fall incident per year.

There are several reasons why children of all ages are at an increased risk for fall especially in the hospital setting. One of the identified reasons is that the child is in an unfamiliar place and people, rendering his/her movement to be erratic. An infant or toddler is also still developing strength and coordination. In addition, the child may be taking certain medications during the admission that may cause numbness, dizziness or cause the child to make him/her weak, confused, or impair the senses. Another factor would be contraption-related injuries such as that sustained during use of wheelchairs, having tube drains, equipment monitors, and intravenous pumps or tubing, all of which contribute to difficulty in ambulation and predisposing the child to an increased risk for fall.

In the hospital setting, considering these factors, a fall prevention checklist was developed by the Intermountain Health Care of Utah.[2] It aims to ensure that patient safety is a priority of every health care team member. In this light, even a seemingly mild fall can result to serious bleeding or injury and therefore needs to be prevented.

Until better screening tools are developed to assess risk for falls in the pediatric population, nurses should monitor their patients frequently. Accomplishing a complete fall risk screen for documentation, improving the screens in practice, documenting the risk scores in the chart, noting assessment, and implementing preventive fall measures are warranted.[3]In addition these activities should include reassessment and notation of changes in physiologic, motor, sensory, or cognitive status of the patients. These strategies will eventually lead to critical improvements in fall prevention screening.[3]

There are only a few studies on pediatric falls but what is known is that it occurs less often and estimated at 0.56 to 2.19 falls per 1,000 patient days versus 1.4 to 17.9 for adults.[3]But every medical practitioner must consider that children are still at risk for injuries, from minor bruises to serious head injuries.[3]

This study aims to increase the awareness of health care providers of children admitted at hospitals using the fall prevention reminder checklist. This study also aims to measure the efficacy of the tool when applied to a high-volume tertiary pediatric hospital.

It has been stated that children who are at increased risk for falls are those who are still developing motor skills and curiosity. A study done in Singapore by Yee, et. al in year 2013, concluded that the presence of caregivers in the room does not prevent falls among children in the hospitals because they tend to be distracted, less attentive and less vigilant in a new environment due to stress and anxiety.[9] Although fall occurrences may be high for the infant or toddler patients, adolescents must also be monitored since incidences of falls in the toilet have been documented. Every medical personnel must have an increased knowledge or awareness of the measures that should be employed to prevent falls in children given any setting. Therefore, formulating a checklist on fall prevention while admitted in the hospital may be an effective intervention to decrease its incidence during confinement. The use of educational resources, such as written materials appropriate to language and reading level, can augment but not replace instruction.[7]

At the Philippine Children's Medical Center (PCMC), a pediatric tertiary specialty hospital located in Quezon City, when a patient is admitted, the nurse assigned would remind the parent or guardian on precautionary measures to prevent falls while in the hospital ward. These reminders are only verbally explained and are referred to as the "Fall Safety Orientation" for the purpose of this study. The content of the reminders may vary from one nurse to another. Once the precautions are explained, the nurse would document on the nurses' notes, the verbal interaction that transpired, and have the parent /guardian sign in a designated sheet in the patient chart. Since there is no existing checklist or guide, the instructions given to the caregivers are not standardized.

The results of the study will benefit the children admitted by instituting an intervention to prevent in-patient injury occurrences, which could result in long-term developmental effects or disabilities. This will also help the management to adopt an intervention that will decrease fall incidents which is an issue of patient safety.

According to Murphy, pediatric patients have dynamic changes and the need for an individualized plan for fall prevention is not "one size fits all".[4]Normal developmental changes could increase the risk of fall related injuries in children, such as learning to walk, learning to use the toilet, and impulsivity related to development can raise

the chances for fall.[4] Young children may have the tendency to run through halls or bounce on beds, while adolescents, who generally desire privacy, are at greater risk because they often resist the requirements that someone remain with them while they use the toilet or shower and are reluctant to ask for help.[4]Children can also become hypoglycemic or dehydrated quickly, an important factor in patients who may spend hours without eating or drinking prior to a procedure.[4]

In a study conducted in Ohio, USA, by Schaffer, et. al in the year 2011, 26 (83.9%) out of 31 falls involved children who were developmentally appropriate for age. Only 2 (6.5%) children were disoriented, 22 (71%) were reported to be independent and unassisted in their mobility. In addition,13 of the falls occurred in children younger than 3 years old and 40 occurred in children older than 3 years old.[10]

A study on the effects of brain injuries secondary to a trauma or fall in childhood can lead to a widespread deficit in a range of functions and the effects may be long-term. Most of the deficits occurred in higher learning skills such as organization, planning, and reasoning, which are centered in the frontal area of the brain where most brain injuries occur.[8]

There are four types of fall, namely: 1) Accidental, which includes environmental hazards like tripping or slipping or falls from bed surfaces; 2) Developmental, mainly comprised of infants or toddlers as they are learning to walk or run; 3) Anticipated Physiological, wherein the patient's diagnosis or characteristics may predict their likelihood of falling (e.g. procedural sedation, post procedure recovery, unsteady gait); 4) Unanticipated Physiological,with no obvious risk factors identified on assessment or falls related to conditions not anticipated such as first-time seizure, adverse reactions to medications.[5]

Many risk assessment tools have been developed, and one of the most popular is the Humpty Dumpty Fall Scale.[3] Although the sensitivity is 65%, the specificity of the said tool is only 26% meaning there is a 74% false positive rate.[3]Another tool used was the Little Schmidy.[4]While it performed as well as or better than other tools, some elements were not helpful in identifying patients at risk for falls, such as evaluating mental activity or cognitive impairment – an important fall predictor in adults, but less so in children.[4]

At least two factors make the development of scientific assessment tools for pediatric falls difficult. First, falls are a low-incident event in children's hospitals, and the development of valid and reliable screening tools for rare events is difficult. Second, many of the institutions where fall prevention tools are being developed and evaluated already have fall prevention programs thereby leading to a spuriously large number of false positives which overestimates the effectiveness of the checklists.

The Royal Children's Hospital Melbourne has specifically cited thatthe

following factors could influence the risk for fall[6]:

- Environmental Issues: Common cause of falls, some examples include inappropriate use of cot side or side rails, equipment clutter, wet floors, nurse call buttons out of patient reach or the use of faulty equipment.

- Age: Incidence data identified the adolescent group (10-17 years) have the highest risk of falls in hospital closely followed by the toddler group (1 -2 years). The developmental stage and ambulation capabilities are key potential fall risk factors.

- Medical Diagnosis: Various medical conditions may increase a child's risk of falling. Some high-risk diagnosis includes drop seizures, severe ataxia, epilepsy surgery or patients who have had a craniectomy.

- Mental State: Altered mental state is the most commonly identified risk factor for falling and is perhaps the most difficult to manage in terms of minimizing the risk of falling.

- Mobility: Impaired mobility and orthopedic restrictions are key potential fall risk factors.

- Elimination: Special toileting needs are a factor for increased risk of falling.

- Bedrest: Majority of falls occur at the patient's bedside due to inappropriate bed positioning, defective brake locks, and defective or inappropriately used bed rails.

- Medications: Use of medications such as barbiturates, phenothiazines, sedatives, hypnotics, antidepressants, laxatives and diuretics may increase the risk of falls.

- Length of Stay: Incident data showed that most of the patients had a fall injury in the first 5 days of admission and have had previous admissions in the hospital.

- History of Falls: Patients who have a history of falls in hospital or at home have an increased risk of falling again.

While normal developmental growth may explain why younger children have the highest incidence of hospital falls, the cognitive and motor impairments commonly seen in hospitalized adolescents who have experienced traumatic brain injury or neurological impairment may explain why this age group is reported to have the second highest incidence of falls.[7]

A study on fall prevention in the presence of caregivers was done in Singapore by Yee, et. al in 2013showed a reduction of in-patient fall incidents with the use of posters and reminders list.[9]The experience gained from this project led to improvement in communication among staff members and caregivers which ledto a

positive change in practice.[9]This study therefore aims to employ a similar strategy to increase the knowledge of the medical professionals as an initial step towards fall prevention.

A medical practitioner must bear in mind that hospitalization of children provides an opportunity to reinforce information and education among caregivers regarding normal psychological and motor development of small children which is related to risk of fall thereby decreasing incidence of fall inside and outside the hospital.[6]

OBJECTIVES OF THE STUDY

General Objective

To determine the effectiveness of the Patient Fall Prevention Reminder Checklist in increasing the awareness of caregivers of patients admitted at the Philippine Children's Medical Center.

Specific Objectives

1. To describe the demographic profile of healthcare provider participants in this study.

2. To determine if the use of the Fall Prevention Reminder checklist increased the awareness of health care professionals

METHODOLOGY

This research useda descriptive paired sample study design.Convenience sampling was used.Doctors, nurses, and midwives of PCMC were recruited to participate in the study from September 19 to October 19, 2019.

Inclusion Criteria

All resident physicians, nurses, and midwives at the Emergency Room, Intensive Care Units, Pay and Service wards.

Exclusion Criteria

Nurses, midwives, and physicianson leave for 3 or more days during the 7-day study period.

Study Procedure

The following identified clinical areas of PCMC were utilized in this study: 1) Service wards, 2) Pay wards, 3) Short Stay Unit at the Emergency Room, 4) Intensive Care Units.Before implementation, the principal investigator secured a license from the Intermountain Health Care from Salt Lake City of Utahfor reproduction and internal distribution of the adapted checklist at PCMC valid for a year.The checklist, pre-test and post-test examinations underwent tool validation and appropriate revisions were made prior to data collection.

Informed consent was obtained from the study participants. A pre-tested 10-item questionnairewhich used a 5-point Likert Scale was administered, followed by the

provision of the fall prevention reminder checklist. A short explanation of the checklist was given to the participants in the ward. In the interim, monitoring of any incidences of fall injuries was done. The investigator inquired for the subject's schedule on the following days for the follow-up. After seven days from the pre-test date, the same study participantsunderwent a post-test using the same pre-test questionnaire. The post-test also has a portion for comments and suggestions by the participants for the purpose of systems improvement.Results of the pre-test and post-test were evaluated through a scoring system and analyzed using of t-test to determine any change in score after introduction of the intervention. Each participant took 2 minutes and less to answer the pre and post-test questionnaires.

This study underwent review by the Institutional Review and Ethics Committee (IR-EC). Data collection only commenced upon approval of the board. All subjects signed an informed consent form and queries were addressed before proceeding to the study proper.

Participation in this studywas entirely voluntary and they could withdraw anytime without giving any explanation. The principal investigator ensured confidentiality among the subjectsas well as reassurance that their answersand scores were to be used solely for this study. There was no monetary compensation provided.

The data gathered were encoded using the Microsoft Excel. Prior to encoding, completeness, accuracy, and consistency were checked. Control numbers represented each subject response. Each column represented the questions asked and their respective answers during the pre-test and post-test represented by nominal numbers.

Descriptive statistics such as mean and standard deviation were used to summarize the pre-test and post-test scores of the respondents. Wilcoxon signed rank test was used to determine if there was significance change in their scores from pre-test to post-test. All statistical tests were two-tailed. Shapiro-Wilk was used to test the normality of the continuous variables. Null hypothesis was rejected at 0.05α-level of significance. STATA 13.1 was used for data analysis.

RESULTS

There were 132 respondents recruited initially in the study. However, only 121 respondents were included and 11dropped out and were lost to follow up.Of the 121 respondents, 49 were pediatric residents in training (40.5%), 67 were nurses (55.4%), and 5 were midwives (4.1%). Forty-two (42) were males, and 79 were females.

Table 1 shows the comparison of the pre-test and post-test results of the participants of the study. There was statistical improvement of post-test scores among the residents and nurses across all items in the questionnaire based on a significant P-value of < 0.05. As for the midwives, there was already an observed high score during the pre-test, and this was maintained during the post-test examination.

Table 1. Comparison of pretest and post-test results

	Pre test	Post test	P-value
	Mean ± SD		
Overall (n=121)	3.90 ± 0.68	4.35 ± 0.66	<0.001
Resident (n=49)	3.36 ± 0.56	3.9 ± 0.66	<0.001
Midwife (n=5)	4.1 ± 0.26	4.58 ± 0.35	0.087
Nurse (n=67)	4.29 ± 0.48	4.66 ± 0.48	<0.001
Item 1: Brakes of beds and stretchers are locked	4.40 ± 0.85	4.66 ± 0.64	<0.001
Resident	3.84 ± 0.96	4.37 ± 0.73	<0.001
Midwife	5	5	-
Nurse	4.76 ± 0.50	4.85 ± 0.50	0.083
Item 2: Side rails are up and functional	4.50 ± 0.67	4.69 ± 0.55	0.001
Resident	4.18 ± 0.73	4.45 ± 0.61	0.018
Midwife	4.4 ± 0.89	5	0.208
Nurse	4.75 ± 0.50	4.85 ± 0.43	0.019
Item 3: Help is made available to patients while sitting up and walking to the bathroom	3.45 ± 0.90	4.06 ± 0.99	<0.001
Resident	2.98 ± 0.85	3.61 ± 0.98	<0.001
Midwife	3	4 ± 0.71	0.034
Nurse	3.82 ± 0.80	4.39 ± 0.89	<0.001
Item 4: Room has enough light	3.98 ± 1.0	4.43 ± 0.85	<0.001
Resident	3.29 ± 0.89	3.88 ± 0.93	<0.001
Midwife	4.2 ± 0.84	4.8 ± 0.45	0.071
Nurse	4.48 ± 0.77	4.81 ± 0.53	<0.001
Item 5: Talked to caregivers to prevent falls	4.28 ± 0.99	4.64 ± 0.65	<0.001
Resident	3.65 ± 1.11	4.29 ± 0.79	<0.001
Midwife	4.8 ± 0.45	5	0.374
Nurse	4.70 ± 0.63	4.87 ± 0.39	0.004

Item 6: Hourly checking of patients	3.46 ± 1.18	3.97 ± 1.12	<0.001
Resident	2.55 ± 0.911	3.18 ± 1.11	<0.001
Midwife	3.4 ± 0.55	4.2 ± 0.84	0.099
Nurse	4.13 ± 0.92	4.52 ± 0.75	<0.001
Item 7: Removal of unused equipment in patient's room	3.68 ± 1.22	4.17 ± 1.06	<0.001
Resident	2.69 ± 1.04	3.33 ± 1.07	<0.001
Midwife	4.8 ± 0.45	4.8 ± 0.45	1.000
Nurse	4.31 ± 0.82	4.75 ± 0.56	<0.001
Item 8: Door is always kept open	3.96 ± 1.15	4.31 ± 0.96	<0.001
Resident	3.67 ± 0.99	4.08 ± 0.86	0.001
Midwife	4.4 ± 0.89	4.4 ± 0.89	1.000
Nurse	4.13 ± 1.24	4.46 ± 1.02	0.021
Item 9: Bed is kept in lowest position	3.79 ± 1.02	4.40 ± 0.86	<0.001
Resident	3.33 ± 0.97	3.96 ± 0.96	<0.001
Midwife	4.4 ± 0.55	4.6 ± 0.55	0.621
Nurse	4.09 ± 0.97	4.72 ± 0.65	<0.001
Item 10: High risk patients are placed close to the nurses' station	3.54 ± 1.09	4.17 ± 1.02	<0.001
Resident	3.37 ± 0.97	3.86 ± 1	<0.001
Midwife	2.6 ± 1.14	4 ± 1.73	0.052
Nurse	3.73 ± 1.12	4.40 ± .0.92	<0.001

The investigator also included additional questions in the post-test examination. The first question is, "Did the Fall Prevention Reminder Checklist helped you increase your awareness to prevent fall?' which is answerable by yes or no. All 121 respondents answered yes.

The second question was, "Do you have comments or suggestions to prevent incidences of fall in the hospital?' which was optional for the participants to fill in. Most of the responses pertain to changing of the busted hospital beds and stretchers as well as adding more beds to increase occupancy therefore preventing 5 children in 1 bed. This is most true at the Emergency Room. Others commented on adding more hospital staff to be able to monitor patients more closely. While others commented on agreeing with the development of the checklist, some also suggested putting the

checklist on the walls of the hospital premises. There were also concerns about permitting another watcher at the bedside so that they will be able to take turns in taking care of the patient especially when they feel sleepy and exhausted. Previously reported cases of fall were children sleeping on the lap of the watchers who also fell asleep. There was one respondent who suggested to tag patients who are at increased risk for fall to alert other medical staff.

In summary, most of the concerns were included in the checklist hence, positive feedbacks from the respondents were gained.

DISCUSSION

Fall in an already hospitalized child is an event that every healthcare provider must prevent.In a study conducted by the American Academy of Sleep Medicine, 40% of in-hospital pediatric accidents result from fall.[11]Not only does it increase hospital stay, but the fear of a serious sequelae that it could do to a growing child's brain and bones are the greatest consideration.

Fall is one of the most preventable events in a pediatric hospital. With proper education and reminders to the caregivers of these patients, incidences of fall may be reduced. However, for this to happen, increased awareness of health care providers is needed to deliver appropriate education to caregivers and patients. Also, prevention of fall should always be a joint effort with the hospital administration in order to address external factors including replacement of defective beds and stretchers, standardization of a fall prevention program, and proper dissemination of information to all health care providers in an institution.

Checklists are effective tools in reinforcing standard of care. A study conducted in Australia using checklist and reminders in clinical pathways to improve hospital in-patient care revealed significant improvements in the quality of patient care.[12]Another study conducted by Ethics consultants aiming to improve quality of ethics consultation by providing reminders about process steps that are important for most patient-centered ethics consultations and consistency, showed improvement in overall quality of the subjects.[13]

An article by Physician-Patient Alliance for Health and Safety discussing the benefits of adopting patient safety checklists stated that these tools provide a sense of confidence that you have taken all the right steps, are effective at reducing medical mistakes therefore reducing litigation costs, provide technical solutions for technical problems and are free.[14] Checklists are gaining popularities not only in the in-hospital patient care but as well as the out-patient care. Health care professionals should continue to explore and device checklists in improving health care system.

Data analysis of the scores of the pre-test and post-test in each question showed a statistically significant increase in awareness in both the residents and nurses ($p < 0.05$).

This study was conducted to develop an institutionalized fall prevention checklist that is applicablefor health care providers in a tertiary pediatric hospital in a developing country with increasing incidence of fall. Installation of call lights in each room in the wards may be made part of the priority equipment to be procured by the hospital. Replacement of beds and stretchers with busted side rails and locks is warranted. Moving patients at risk for fall close to the nurse station is not always applicable given the setting of this institution. The treatment room, which is closest to the nurse station, is where patients who are critically ill are placed. However, this room can only contain 1 to 2 patients.

CONCLUSION

We were able to administer the Fall Prevention Reminder Checklist to 121 participants after administering a pre-test examination. The pre-test examination assessed the baseline awareness of the participants seen through pre-test scores which notably increased in the post-test examination done after 7 days from the time of the administration of the checklist.Results showed that a fall prevention reminder checklist significantly increased the awareness of health care providers which would help in preventing the occurrence of fall. In addition, educating caregivers about ways to prevent fall would become more effective if the health care providers are more knowledgeable on fall prevention practices.

Development of a standardized Fall Prevention Reminder Checklist for PCMC is recommended based on the findings of this study. This will promote uniformity and standardization of fall prevention reminders. In addition, educating caregivers about ways to prevent fall would become more effective if the health care providers are more knowledgeable on fall prevention practices.

Were commend research that directly involves the caregivers, as in the use of a fall prevention checklist written in vernacular, or reminders in illustration, whichever is most effective.Use of Risk Assessment Tools for Fall which can be effective in identifying patients who should be closely monitored may also be used in future studies.

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CLINICAL FEATURES, OUTCOMES AND RISK FACTORS FOR THE DEVELOPMENT OF *ACINETOBACTER BAUMANNII* INFECTION AMONG NEWBORNS IN PHILIPPINE CHILDREN'S MEDICAL CENTER

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ABSTRACT

OBJECTIVES: To determine the risk factors, clinical features, and outcomes of newborns in a tertiary care hospital who developed *Acinetobacter baumannii* infection.

METHODOLOGY: A retrospective case control study was performed, comparing each case of newborn infected with *Acinetobacter baumannii* to two uninfected controls.

RESULTS: Ninety charts were reviewed, comprising 30 cases and 60 controls. Risk factors (use of total parenteral nutrition, prior antibiotic use, presence of a central line, mechanical ventilation and intubation, blood transfusion, surgical procedure, intensive care unit admission and presence of a co-morbidity) were noted to be significantly associated with the development of *A. baumannii* infection (p value <0.001). *A. baumannii* infection manifests more commonly as fever, respiratory distress, leukocytosis, and thrombocytopenia.

CONCLUSIONS: *Acinetobacter baumannii* is associated with certain risk factors that increase the likelihood for its perpetuation and acquisition. The increasing number of multi-drug resistant strains of *A. baumanni* signifies the need to focus on certain issues as infection control and the conscientious use of antibiotics in newborns.

KEYWORDS: *Acinetobacter baumannii*, sepsis, newborns

INTRODUCTION

Each year, nearly 3.3 million babies are stillborn, and more than 4 million die within the neonatal period, or the first 28 days of life, according to the World Health Organization.[1] While there has been a drop in infant mortality rates in recent years, this is still significant: approximately 3.9 of the 10.8 million annual deaths in under-fives are neonatal and found mostly in rural areas, 50-70% of them occurring during the first week of life.[3] Bacterial infections remain to be the primary cause of death in term infants, pneumonia accounting for 19%, neonatal tetanus for 14%, sepsis/meningitis for 7% and diarrhea for 2%.[2] In the Philippines alone, according to the 2017 National Demographic and Health Survey, neonatal mortality is 14 deaths per 1,000 live births, post-neonatal mortality is 7 deaths per 1,000 live births and infant mortality is 21 deaths per 1,000 live births.[4]

In 2011, a multicenter surveillance and chart review was conducted for 6

months in five hospitals in the Philippines, and in this study, Gram-negative bacteria were found to be the dominant bacteria in culture isolates in these hospitals.[3] Gram-negative infections are now increasingly being recognized for their associated morbidity and mortality and increasing rate of multi-drug resistance. It is therefore timely and appropriate to delve into the factors involved in the development of Gram-negative infections, especially those associated with multi-drug resistance and neonatal outbreaks. This study focuses on one of the top five bacterial isolates enumerated associated with nosocomial infections and outbreaks: *Acinetobacter baumannii*.[8]

As the incidence of Gram-negative infections increases, so does the need to determine the possible factors involved in its transfer and perpetuation, especially in neonatal intensive care units. Newborns are especially at risk due to their immature immune system. They are particularly susceptible to transmission of infectious agents due to deficiencies in certain immune components and response, which include limited reserves of neutrophils needed in response to severe infections, limited number of functioning T-cells, and slow maturation of immunoglobulins (IgG).[5]

The *Acinetobacter* species, once thought of as organisms of low virulence, are gaining importance as a cause of neonatal septicemia due to its frequent isolation, multidrug resistance and being a leading cause of mortality.[6] *Acinetobacter baumannii* is difficult to control and treat due to its propensity to develop resistance at an extremely rapid pace, and resistance is often multiple, making its treatment a challenge to medical practitioners.[7] While carbapenems are usually the antibiotics of choice for these organisms, carbapenem-resistant *Acinetobacter baumannii* (CRAB) strains have been rising steadily over the past few years. There is, therefore, a need to not only determine the risk factors for *Acinetobacter baumannii* infection, but also examine its antibiotic susceptibility pattern. As of today, no study in Philippine Children's Medical Center has focused on *Acinetobacter baumannii* alone, its risk factors, signs, outcomes, and antibiotic susceptibility patterns.

Acinetobacter, ubiquitous free-living saprophytes in soil and water, are Gram-negative coccobacilli that are strictly aerobic. They are oxidase-negative, catalase-positive, non-motile, non-fermenting and pigment-lacking. Infections can present as pneumonia, bacteremia, meningitis and urinary tract infections.[9] Most outbreaks from *A. baumannii* were traced to environmental sources, such as air conditioners, mechanical ventilation equipment and even patient mattresses.[9] Now, *Acinetobacter baumannii* has become established as an "alert" pathogen in intensive care units (ICU) owing to its multi-resistant strains even to carbapenems.[10] Mortality from *Acinetobacter* species can be as high as 23-73%.[11]

In a prospective study of *Acinetobacter* septicemia admitted to NICUs, 26 *Acinetobacter* species were

isolated from blood specimens of 26 septicemia neonates, with *A. baumannii* comprising 84.6% of the isolates, while 15.4% were identified as *A. iwoffi*. Multidrug-resistant strains were only found in the *A. baumannii* strains.[8] Risk factors that had significant findings were hospital birth, birth weight <1500 grams, hospitalization of >7 days, and mechanical ventilation. Other variables were not proven to have statistical difference from controls.

A similar prospective case-control study was done in a NICU of a University hospital in Brazil in response to an outbreak of *A. baumannii* septicemia.[9] The study yielded significant results on the same risk factors, with the addition of age</= 7 days, prior carbapenem and antibiotic use and use of a central venous catheter. An unusual aspect in this study is that the index patient was a neonate with suspicion of meningitis transferred from a nearby city, with no prior antibiotic use before infection. Environmental and hand cultures of health workers also tested negative for *A. baumannii;* however, the risk for lapses in infection-control cannot be discounted and was still noted to be the primary reason for the outbreak. Among the isolates, 6 out of 11 were extended spectrum beta-lactamase producers, and all isolates were resistant to third- and fourth generation cephalosporins. This study is, however, limited by its small sample population for cases.

In a similar case-case-control study by Thatrimontrichai, et al, involving carbapenem-resistant and carbapenem-susceptible cases and uninfected controls, the use of a central venous line and inadequate antimicrobial therapy, described therewith as the absence of a prescribed antimicrobial agent directed against the specific class of recovered microorganisms and/or administration of antimicrobial agents to which the microorganism responsible for the infection was resistant, were important risk factors. The importance of strict adherence to infection control for central venous line placement and maintenance and antimicrobial stewardship were emphasized to help reduce bacteremia.[12]

General Objective:

To determine the risk factors, clinical features and outcomes of newborns admitted in Philippine Children's Medical Center who developed *Acinetobacter baumannii* infection

Specific Objectives:

1. To describe the clinico-demographic profile of neonates and mothers of neonates infected with *A. baumanni* in the Newborn Section and Neonatal Intensive Care Unit of Philippine Children's Medical Center (PCMC)
2. To determine the risk factors (catheter placement, duration and kind of nutrition, intubation, use of empiric antibiotics, and more) in the development of *A. baumannii* infection among newborns
3. To determine the clinical features of newborns infected with *A. baumannii* in Philippine Children's Medical Center

4. To determine the outcomes, whether discharged or expired, of newborns infected with *A. baumannii* in Philippine Children's Medical Center
5. To determine the antibiotic susceptibility/resistance pattern of *A. baumannii* isolates in cultures of infected patients

METHODOLOGY

A retrospective case control study was performed in a tertiary care hospital, Philippine Children's Medical Center, after approval from the Institutional Ethics Committee. This was performed by comparing each case of *A. baumannii* to 2 uninfected controls.

This study included newborns admitted at the Newborn Section (NBS) and Neonatal Intensive Care Unit (NICU) of Philippine Children's Medical Center (PCMC) between January 2009 to October 2019. Cases included admitted newborns within the last 10 years who tested positive to *A. baumannii*, whether cultures in blood, urine, tracheal aspirate, cerebrospinal fluid (CSF) or other body fluids. Controls included patients who were admitted at the same sections of the hospital during the last ten years, managed as a case of sepsis who tested negative for *A. baumannii* in any of their cultures. Two controls were randomly assigned for each case. Two controls were matched with a case within the month and year the case was admitted. Randomization was done by assigning numbers to each control and selection is by fishbowl method.

The sample size was computed for an unmatched case control-study involving comparison of cases and controls (sample sizes for 95.40 divided by exposure in controls). Computation of the sample size was made through Epi Info, and consideration of the risk factors in a similar study was considered. The variable with the greatest number of sample size was used (the age in days). With confidence of 95% and power of 80%, exposure of 62.39% and odds ratio of 0.08 (based on the variable age in days), the minimum sample size is 60, or 30 for cases and 30 for controls.

The medical records, NICU logbook and ICC data of the past ten years (2009-2019) were obtained to determine the patients who tested positive in cultures of blood, urine, tracheal aspirate, stool, and cerebrospinal fluid in the Newborn Section (NBS) and Neonatal Intensive Care Unit (NICU) of Philippine Children's Medical Center. Obtained data pertaining to demographics, risk factors, clinical features and outcomes were reviewed, and cultures confirmed through records of the Microbiology department of the Pathology section. The antibiotic susceptibility pattern of the cultures was also obtained.

Demographic data included: age, sex, birth weight, weeks of gestation, mode of delivery, place of birth, duration of hospitalization prior to a positive culture, and dates of admission and discharge. Medical records were reviewed for presence of underlying or chronic illnesses, admission diagnoses and presence of surgical procedures done within one week before the

acquisition of *Acinetobacter baumannii*. Maternal factors included maternal age, premature rupture of membranes, intrapartum pyrexia, presence of co-morbidity, and intrapartum infection. Neonatal factors, on the other hand, included prematurity, low birth weight, intake of breastmilk (feeding), prior antibiotic use for at least 3 days, utilization of a central line, history of blood transfusion, mechanical ventilation and intubation, admission to the neonatal intensive care unit (NICU), surgical procedure done within seven days of a positive culture and presence of co-morbidities as intraventricular hemorrhage (IVH), necrotizing enterocolitis (NEC), bronchopulmonary dysplasia (BPD) and others. Clinical presentation, laboratory tests (leukopenia, or leukocytosis, thrombocytopenia), the source of the culture isolate, the patient's outcomes (whether discharged or expired), and the antibiotic susceptibility of the culture isolate will also be recorded. All factors were considered for both the case and control group. An individual record was filled out, and all data tabulated through Microsoft Excel. Statistical analysis was used to determine if variables comparing control and case group were significant.

Descriptive statistics was used to summarize the demographic and clinical characteristics of the patients. Frequency and proportion were used for categorical variables, median and interquartile range for non-normally distributed continuous variables and mean and SD for normally distributed continuous variables. Independent Sample T-test, Mann-Whitney U test and Fisher's Exact/Chi-square test were used to determine the differences of mean, rank, and frequency, respectively, between case and control patients. Odds ratio and corresponding 95% confidence intervals from binary logistic regression was computed to determine significant factors for *A. baumannii* infection. All statistical tests were two tailed tests. Shapiro-Wilk was used to test the normality of the continuous variables. Missing variables was neither replaced nor estimated. Null hypotheses were rejected at 0.05 α-level of significance. STATA 13.1 was used for data analysis.

RESULTS

This study compared thirty cases of *Acinetobacter baumannii* bacteremia in neonates hospitalized in the newborn section (NBS) and neonatal intensive care unit (NICU) of Philippine Children's Medical Center with sixty neonates admitted during the same period between January 2009 to October 2019 who were managed as a case of sepsis but tested negative for growth of *Acinetobacter baumannii* or any other isolate in their cultures. The demographic characteristics of the cases and the controls are summarized in **Table 1** and **2**. **Table 1** shows that the characteristics of the cases and controls were homogenous, but there is a significant difference in the number of days of life when the patient was admitted, the place of birth and the duration of hospital stay. Most of the *A. baumannii*-infected cases were outborn (76.67%), while most of the uninfected controls were inborn (70%). Using univariate analysis, outborn

patients have a 7.67 odds of developing *A. baumannii* infection.

In this study, there is no significant difference in the risk for acquiring *A. baumannii* infection for male and female neonates (p-value of 0.171) and for those with less than 1.5 kilograms and those >/= 1.5 kilograms in weight (p-value of 0.446). With p-value of 0.139, the gestational age (term status) was also found to be not an important factor in this study. For every score increase in 1-minute APGAR, the odds of developing *A. baumannii* infection decreases by 24%. Neonates who were delivered at lying-in clinics and local health centers had 2.88 odds of developing *A. baumannii* infection compared with neonates who were delivered at the hospital. In terms of duration of hospital stay, *A. baumannii* cases were found present in those with more prolonged hospital stay compared to the controls, who are mostly inborns that were discharged in less than 7 days. For every day increase in hospital stay, the odds of developing *A. baumannii* infection increases by 24%.

Table 2 compares the maternal profile between the cases and the controls and shows that the characteristics of the two groups are homogenous. Neonates with mothers with co-morbidity were 65% less likely to have *A. baumannii* infection by univariate analysis. Most of the controls were inborn patients, born to mothers with co-morbid conditions.

The risk factors associated with *Acinetobacter baumannii* bacteremia acquisition were shown in **Table 3**. After the univariate analysis, risk factors independently associated with *A. baumannii* infection were use of a total parenteral nutrition (TPN), history of prior antibiotic use, presence of a central line, mechanical ventilation (without intubation) and mechanical intubation, history of blood transfusion, surgical procedure or intervention within the past seven days, admission to an intensive care unit and the presence of a co-morbidity. Newborns who were started on total parenteral nutrition had 11.77 the odds of developing *A. baumannii* infection. Those with a central line, whether through an umbilical vein, intrajugular or femoral, had 9.04 the odds of acquiring *A. baumannii* infection. Those who were mechanically ventilated but not intubated had 9.75, while those who were intubated had 44.33 the odds of being infected with *A. baumannii*. The other risk factors also showed a greater likelihood of developing *A. baumannii:* those who had blood transfusion (37.86), admitted in NICU (37.92) and with co-morbidities (29.57). The co-morbidities present among the 23 neonates were conditions requiring surgical intervention (30% of all cases), comprising of gastroschisis (16.67%), omphalocele (6.67%), congenital diaphragmatic hernia (3.33%) and Hirschsprung disease (3.33%). Other co-morbidities present in the *A. baumannii*-infected newborns were Chiari II Malformation (16.67%), congenital heart diseases (16.67%), hypoxic ischemic encephalopathy (3.33%), bronchopulmonary disease (3.33%) and other congenital

anomalies as laryngomalacia, cleft lip and palate (6.67%).

The clinical presentation and outcomes associated with *A. baumannii* infection are presented in **Table 4**. Clinically significant features associated with *A. baumannii* infection included fever and respiratory symptoms such as cough and colds, difficulty of breathing and desaturations. The other listed features, such as jaundice, neurologic symptoms (seizure, irritability, changes in sensorium), poor suck, cardiovascular or blood volume changes (hypotension and mottling), have no significant differences with the controls. By univariate analysis, neonates with fever were 25.29 more likely to have *A. baumannii* infection. Neonates with respiratory symptoms, on the other hand, were 8.5 more likely to have *A. baumannii* bacteremia. In terms of laboratory results, there is no significant difference between the two groups. Newborns with leukocytosis are 9.5 more likely, and those with thrombocytopenia 6 more likely to have a positive culture. Neonates who had other clinical features were 3.78 more likely to have *A. baumannii* infection. The other clinical features noted in the cases include abdominal distention, discharge on wound sites and a coffee-ground output. The outcomes between the infected cases and uninfected controls were also significant. In terms of outcome, eight of the thirty *A. baumannii* cases, (26.7%) expired, while no mortality was observed in the control group.

Table 5 shows all the significant factors associated with the development of *A. baumannii* infection in neonates by univariate and multivariate analysis. Using multivariate analysis, it showed that for every day increase in hospital stay, the odds of developing *A. baumannii* infection increases by 12% after adjusting for mechanical intubation use and blood transfusion given. The patients who were mechanically intubated had 12.54 the odds of developing *A. baumannii* infection after adjusting for duration of hospital stay use and blood transfusion given. Those who received blood transfusion had 10.6 the odds of developing *A. baumannii* infection after adjusting for mechanical intubation use and duration of hospital stay.

Most of the culture specimens from both the case and control groups were obtained from blood specimens. In the case group, *A. baumannii* specimens were more commonly isolated from blood (56.67%), tracheal aspirate (23.33%) and wound sites (16.67%). Only six specimens (20%) were found to be carbapenem-susceptible, while most cases (23 of 30 or 76.77%) were found to be carbapenem-resistant. Of these, all were multi-drug resistant (MDR) strains. One of the cases was a pan-drug resistant (PDR) strain, resistant to all antibiotic classes. The individual antibiotic susceptibility pattern shows that 90% of cases were susceptible to amikacin, an aminoglycoside. A. baumannii infections in our institution are resistant to most forms of antibiotics including beta-lactams, cephalosporins, and carbapenems.

DISCUSSION

Most studies evaluating CRAB bacteremia performed in adult populations identify the following as risk factors for its acquisition: presence of a central venous line (CVL), respiratory infection, diabetes mellitus or hematologic malignancy as co-morbidities, previous use of cephalosporins and carbapenems and total parenteral nutrition. Risk factors among the pediatric population, on the other hand, according to Thatrimontrichai, et al, revealed that low birth weight, previous surgical procedures, prolonged tracheal intubation and mechanical ventilation, previous use of aminoglycosides or carbapenems, prolonged stay at the intensive care unit are significantly associated with CRAB infections.[12]

In this investigation, birth weight and prematurity were not statistically important factors in the development of *A. baumanniii* infection. In most studies, however, prematurity is a significant risk factor, with a 3-10 fold higher incidence of infection than full term infants because they are more likely to need a more prolonged intravenous access, endotracheal intubation or other invasive procedures that may provide as portals of entry for severe infection.[6,11,13] Preterm infants also have a more immature immune system, and low levels of transplacentally-acquired antibodies.[17] The study by Mishra, et al, however, yielded similar results as this investigation, showing that other contributing factors may be required for *A. baumannii* infection to develop.[16] A higher APGAR score is also shown to have a decreased predisposition, showing that the first few minutes of life in newborns may be protective. Outborn deliveries, or neonates delivered from other institutions, have a higher predisposition to acquiring *Acinetobacter baumannii* infection. The time from delivery to the time the patient was admitted to our institution cannot be discounted and may have also exposed the newborns to gram-negative infections. Six of the 26 newborn cases (26%), whether institutional or non-institutional deliveries, were noted to have a positive culture within one to two weeks that the patients were admitted. De Brito, et al, have pointed that the dissemination of *Acinetobacter baumannii* may be facilitated by its prolonged survival on inanimate surfaces, high colonization rates and frequent contamination of health workers' hands.[9] Sultan et al, in a similar study, reported that previous stay at another hospital is associated with an increased risk of acquisition of carbapenem-resistant *A. baumannii* (CRAB) isolates.[18] Another important risk factor is prolonged hospital stay. Of the cases, only two cases (6%) were found to have positive cultures in less than 7 days of hospitalization, both were outborn deliveries. Most of the cases were hospitalized for at least one week before a positive culture was noted.

In terms of maternal factors, the presence of a co-morbidity in the mother seem to be a protective factor. Since this institution is primarily a pediatric facility with a perinatal center for care of high-risk mothers, this may explain why most of the controls were inborn patients and how

maternal co-morbidity presents as a significant difference between the two groups. The decrease in likelihood of developing *A. baumannii* infection in mothers with co-morbidities may also be due to increased monitoring and surveillance during the prenatal period for these high-risk mothers.

We showed that most of the factors listed were found to be statistically significant in the acquisition of *Acinetobacter baumannii* infections. The use of total parenteral nutrition in neonates has been listed in studies as an independent risk factor for hospital-acquired infections, blood-stream infections, and sepsis. Total parenteral nutrition, especially with lipids, have been shown to promote the growth of a wide spectrum of microorganisms, which is even further increased by human serum.[17] Other reasons include the contamination of infusates and the possibility of infection of the catheter at any time while the patient is on TPN. A previous study by Yin, et al, reported that the administration of TPN for >/= 2 weeks was associated with a higher incidence of nosocomial *A. baumannii* infection.[19] The presence of a central venous line was also found to be significant. Central venous lines are usually used because they last longer, and hence, prevents the unnecessary insertion of intravenous peripheral lines for neonates, especially the preterm infants. They are used to deliver total parenteral nutrition, intravenous fluids, antibiotics, and other medications. A prolonged central line, however, increases the risk for gram-negative infections because they present as portals of entry for infection. Strict aseptic techniques are important and must be applied in handling central venous lines.

Prior antibiotic use for at least 3 days is a consistent risk factor cited in different studies, especially in the development of carbapenem-resistant strains. All the newborns in the case group received at least two classes of antibiotics prior to the development of a positive culture (mostly ampicillin or oxacillin with gentamycin or cefotaxime). Among the 30 cases, six patients or 20% were already given carbapenems, and these isolates were found to be all carbapenem-resistant. Baran, et al, in their study of risk factors for nosocomial CRAB infections, found that the previous use of carbapenems was associated with imipenem resistance. The risk for imipenem resistance was increased by five- to ten-fold in patients who received antibiotic therapy.[7] Scerpella, et al, noted that third generation cephalosporins were associated with acquisition of MDR strains of *A. baumannii* in a nosocomial outbreak, while the administration of imipenem as monotherapy, according to del Mar Tomas, et al, was a risk factor for colonization with CRAB strains in an outbreak. Prior exposure to imipenem or third generation cephalosporins were risk factors for nosocomial occurrence of CRAB.[7]

Newborns admitted to the intensive care unit and with presence of co-morbidities have increased propensity to develop CRAB and CSAB infections. Most cases were surgical abdominal cases that require surgical intervention such as gastroschisis,

omphalocele, Hirschsprung disease and congenital diaphragmatic hernia. A great number of cases (16.67%) were newborns with Chiari II malformation, and who were brought in due to leaking lumbosacral meningocele. The presence of congenital heart diseases and congenital anomalies also increase the risk for these newborns to develop severe gram-negative infections.

In this study, among the thirty cases of neonates with *A. baumannii* infection, only six or twenty percent of cases were susceptible to carbapenems. Eighty percent of cases were all carbapenem-resistant strains (twenty-six cases) and were found to be multi-drug resistant. Among these twenty-six cases, twenty-three or 88.4% were found to be sensitive only to one drug, which is amikacin. One case (3.8%) was resistant to all antibiotics. This signifies that carbapenem-resistant strains of *Acinetobacter baumannii* are steadily increasing over the past ten years. The growing multiple resistance poses as a therapeutic dilemma to all medical practitioners.

Carbapenems are usually the antibiotics of choice for treating serious infections caused by *A. baumannii*. Since their introduction in 1985, they have been the most important agents for the treatment of multi-drug resistant strains of nosocomial pathogens. Studies, however, have shown that the percentage of carbapenem-resistant strains, especially to *Acinetobacter baumannii*, have gradually increased over the last ten years in Europe, North America, and Latin America.[13]

We showed that *Acinetobacter baumannii* can possibly become resistant to all antibiotics; hence, it deserves special attention and emphasis, especially on issues of infection control and the conscientious use of antibiotics in newborns.

In the case group, eight of the 30 cases (26.67%) expired during their hospitalization. It is important to note that among these, only two cases expired within two weeks of a positive culture to *A. baumannii*. The rate of mortality in this study is lower than the reported rate of mortality in the studies conducted by Thatrimonthrichai, et al (49.2%) and Seifert, et al (44%) but higher than that of Shete, et al (11.3%). Multiple factors have been implicated for *A. baumannii*-associated mortality which include a severe, rapidly fatal underlying disease, septic shock at onset of infection, pneumonia as the primary source of infection, mechanical ventilation, thrombocytopenia, and the presence of multiple artificial devices.[14] In this study, mortality was associated with mechanical ventilation, presence of a central line, surgical procedure or intervention and co-morbidity, and prior antibiotic use.

There are some limitations of this study. The small sample size may limit our capacity to detect additional risk factors associated with *Acinetobacter baumannii* infection among neonates. The present study's findings may also be limited by the retrospective, single-center design, with risks of bias. Since this institution is primarily a pediatric hospital, the characteristics of both the cases and controls

were homogenous, including birth weight and age of gestation, which in most studies were found to be significant risk factors in the development of *Acinetobacter baumannii* infection. This study did not explore the possible sources of infection in the newborn section and neonatal intensive care unit in our institution. Culture of possible sources of infection such as medical devices, incubators and blankets used for neonates may be useful in an outbreak.

CONCLUSION AND RECOMMENDATION

This is the first study in this institution to evaluate *Acinetobacter baumannii* bacteremia and its risk factors, clinical features and outcomes using a case-control study. In summary, the findings in this study showed that the following risk factors: use of a total parenteral nutrition (TPN), history of prior antibiotic use, presence of a central line, mechanical ventilation and mechanical intubation, history of blood transfusion, surgical procedure or intervention prior to a positive culture of *A. baumannii*, admission to an intensive care unit and the presence of a co-morbidity, were all significantly associated with *Acinetobacter baumannii* infection among neonates. Clinical features common to *A. baumannii* infection included fever, respiratory symptoms, leukocytosis, and thrombocytopenia. There was a mortality rate of 26% among the cases, but only 2 of these cases expired within two weeks of *Acinetobacter* infection. Other factors such as the presence of an underlying illness, presence of a surgical procedure and mechanical ventilation may have also contributed to the outcome. This study also shows that there has been a steady increase in the number of carbapenem-resistant strains and multi-drug resistant strains of *Acinetobacter baumannii* in the last ten years. This study recommends a more conscientious use of antibiotics, especially carbapenems, in our institution to prevent antibiotic resistance.

A similar study with the same objectives is recommended in other institutions. A prospective study may also be done to remove confounding variables and determine what factor independently increases the risk for the development of *Acinetobacter baumannii* over time.

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TABLE 1. DEMOGRAPHIC PROFILE OF THE NEWBORNS IN THE CASE AND CONTROL GROUPS ADMITTED AT PHILIPPINE CHILDREN'S MEDICAL CENTER (PCMC) ON JANUARY 2009 TO OCTOBER 2019

	Total (n=90)	**Case (n=30)**	**Control (n=60)**	**P-value**
	Frequency (%); Median (IQR)			
Day of life	1 (1 to 44)	1.5 (1 to 44)	1 (1 to 5)	**<0.001**
Sex				0.171
Male	54 (60)	15 (50)	39 (65)	
Female	36 (40)	15 (50)	21 (35)	
Birth weight				0.446
< 1.5 kgs	17 (18.89)	7 (23.33)	10 (16.67)	
≥ 1.5 kgs	73 (81.11)	23 (76.67)	50 (83.33)	
Term status				0.139
Extremely preterm (<28 weeks)	1 (1.11)	1 (3.33)	0	
Very preterm (28-33 weeks)	10 (11.11)	5 (16.67)	5 (8.33)	
Late preterm (34-36 weeks)	29 (32.22)	6 (20)	23 (38.33)	
Term (37-42 weeks)	50 (55.56)	18 (60)	32 (53.33)	
APGAR score				
1 minute (n=70)	8 (6 to 8)	7 (5 to 8)	8 (7 to 8)	0.054
3 minutes (n=70)	9 (8 to 9)	9 (6 to 9)	9	0.105
5 minutes (n=14)	8 (8 to 9)	8 (7 to 9)	8 (8 to 9)	0.618
7 minutes (n=2)	8.5 (8 to 9)	8	9	0.317
GA				0.200
SGA	8 (8.89)	4 (13.33)	4 (6.67)	
AGA	81 (90)	25 (83.33)	56 (93.33)	
LGA	1 (1.11)	1 (3.33)	0	
Mode of delivery				0.290
NSD	55 (61.11)	21 (70)	34 (56.67)	
CS	32 (35.56)	9 (30)	23 (38.33)	
OFE	3 (3.33)	0	3 (5)	
Place of birth				**<0.001**
Inborn	49 (54.44)	7 (23.33)	42 (70)	
Outborn	41 (45.56)	23 (76.67)	18 (30)	
Institution				0.079
Hospital	62 (68.89)	16 (53.33)	46 (76.67)	
LIC/LHC	24 (26.67)	12 (40)	12 (20)	
Home	4 (4.44)	2 (6.67)	2 (3.33)	
Duration of hospital stay	2 (1 to 10)	19.5 (7 to 31)	1 (1 to 2)	**<0.001**

TABLE 2. MATERNAL PROFILE OF THE NEWBORNS IN THE CASE AND CONTROL GROUPS ADMITTED AT PHILIPPINE CHILDREN'S MEDICAL CENTER (PCMC) ON JANUARY 2009 TO OCTOBER 2019

	Total (n=90)	**Case (n=30)**	**Control (n=60)**	**P-value**
	Frequency (%); Mean ± SD; Median (IQR)			
Age of mother	28.53 ± 7.27	29 ± 6.63	28.29 ± 7.61	0.665
Gravidity	2 (1 to 7)	2 (1 to 7)	2 (1 to 6)	0.196
Parity	2 (1 to 7)	2 (1 to 7)	2 (1 to 6)	0.199
PROM	37 (41.11)	12 (40)	25 (41.67)	0.880
Intrapartum pyrexia	5 (5.56)	0	5 (8.33)	0.104
Co-morbidity	35 (38.89)	7 (23.33)	28 (46.67)	**0.040**
Prolonged labor	4 (4.44)	1 (3.33)	3 (50)	1.000
Intrapartum Infection on the 3rd trimester	35 (38.89)	11 (36.67)	24 (40)	0.760

TABLE 3. RICK FACTORS FOR *ACINETOBACTER BAUMANNII* INFECTION AMONG NEWBORNS IN THE CASE AND CONTROL GROUPS ADMITTED AT PHILIPPINE CHILDREN'S MEDICAL CENTER (PCMC) ON JANUARY 2009 TO OCTOBER 2019

	Total (n=90)	**Case (n=30)**	**Control (n=60)**	**P-value**
	Frequency (%)			
Feeding				0.548
DBF/EBM	87 (96.67)	30 (100)	57 (95)	
Formula	0	0	0	
Mixed	3 (3.33)	0	3 (5)	
Use of TPN (Total Parenteral Nutrition)	53 (58.89)	27 (90)	26 (43.33)	**<0.001**
Prior Antibiotic Use (at least 3 days)	38 (42.22)	30 (100)	8 (13.33)	**<0.001**
Presence of Central Line	39 (43.33)	23 (76.67)	16 (26.67)	**<0.001**
Mechanical Ventilation	50 (55.56)	26 (86.67)	24 (40)	**<0.001**
Mechanical Intubation	24 (26.67)	21 (70)	3 (5)	**<0.001**
Blood transfusion given	32 (35.56)	25 (83.33)	7 (11.67)	**<0.001**
Surgical Procedure/ Intervention (within seven days of a positive culture)	13 (14.44)	13 (43.33)	0	**<0.001**
Admission to NICU	55 (61.11)	29 (96.67)	26 (43.33)	**<0.001**
Neonatal comorbidity	29 (32.22)	23 (76.67)	6 (10)	**<0.001**

TABLE 4. CLINICAL FEATURES AND OUTCOMES OF THE NEWBORNS IN THE CASE AND CONTROL GROUPS ADMITTED AT PHILIPPINE CHILDREN'S MEDICAL CENTER (PCMC) ON JANUARY 2009 TO OCTOBER 2019

	Total (n=90)	**Case (n=30)**	**Control (n=60)**	**P-value**
	Frequency (%)			
Fever	10 (11.11)	9 (30)	1 (1.67)	**<0.001**
Cough/Colds/DOB/desaturations	25 (27.78)	17 (56.67)	8 (13.33)	**<0.001**
Jaundice	14 (15.56)	2 (6.67)	12 (20)	0.129
Neurologic symptoms (seizure, irritability or changes in sensorium)	1 (1.11)	0	1 (1.67)	1.000
Poor suck	4 (4.44)	1 (3.33)	3 (5)	1.000
Hypotension/Mottling	3 (3.33)	2 (6.67)	1 (1.67)	0.257
Laboratory Features				
Leukocytosis (WBC>/= 25 x 10^9/L)	13 (14.44)	10 (33.33)	3 (5)	**0.001**
Leukopenia (WBC <5 x 10^9/L)	3 (3.33)	3 (10)	0	**0.0035**
Thrombocytopenia (Platelets<150 x 10^9/L)	18 (20)	12 (40)	6 (10)	**0.002**
With other clinical features	21 (23.33)	12 (40)	9 (15)	**0.016**
Outcome				**<0.001**
Alive	88 (91.11)	22 (73.33)	60 (100)	
Expired	8 (8.88)	8 (26.67)	0	

TABLE 5. FACTORS ASSOCIATED WITH THE DEVELOPMENT OF *ACINETOBACTER BAUMANNII* INFECTIONAMONG NEWBORNS AT PHILIPPINE CHILDREN'S MEDICAL CENTER (PCMC) ON JANUARY 2009 TO OCTOBER 2019 BY UNIVARIAT E AND MULTIVARIATE ANALYSIS

	Univariate		Multivariate	
	Odds ratio (95% CI)	**P-value**	**Odds ratio (95% CI)**	**P-value**
Outborn	7.67 (2.79 to 21.06)	**<0.001**	-	-
1 minute APGAR score	0.76 (0.57 to 0.99)	**0.049**	-	-
Institution			-	-
Hospital	(reference)	-		
LIC/LHC	2.88 (1.08 to 7.67)	**0.035**		
Home	2.88 (0.37 to 22.13)	0.310		
Duration of hospital stay	1.24 (1.12 to 1.37)	**<0.001**	1.12 (1.02 to 1.23)	**0.023**
Maternal comorbidity	0.35 (0.13 to 0.93)	**0.036**	-	-
Use of TPN	11.77 (3.22 to 43.08)	**<0.001**	-	-
Presence of Central Line	9.04 (3.25 to 25.09)	**<0.001**	-	-
Mechanical Ventilation	9.75 (3.02 to 31.49)	**<0.001**	-	-
Mechanical Intubation	44.33 (10.94 to 179)	**<0.001**	12.54 (2.1 to 54)	**0.005**
Blood transfusion given	37.86 (10.93 to 131)	**<0.001**	10.6 (2 to 78)	**0.007**
Admission to NICU	37.92 (4.84 to 296)	**<0.001**	-	-
Neonatal comorbidity	29.57 (8.95 to 97.66)	**<0.001**	-	-
Fever	25.29 (3.02 to 211)	**0.003**	-	-
Cough/Colds/DOB/desaturations	8.5 (3 to 23.98)	**<0.001**	-	-
Leukocytosis	9.50 (2.37 to 38)	**0.001**	-	-
Thrombocytopenia	6 (1.97 to 18.31)	**0.002**	-	-
With other clinical features	3.78 (01.37 to 10.45)	**0.010**	-	-

THE UTILIZATION OF NEUTROPHIL LYMPHOCYTE COUNT RATIO AS PREDICTOR OF NEONATAL SEPSIS: A SYSTEMATIC REVIEW AND META-ANALYSIS

ERIKA LOREN U. REYES, MARIA EVA I. JOPSON

ABSTRACT

BACKGROUND: Neonatal sepsis remains to be an important cause of neonatal morbidity and mortality and its diagnosis is difficult due to non-specific signs and symptoms that may mimic other infectious conditions. Blood culture, the gold standard in the diagnosis of sepsis, is limited by it being time-consuming and with high probability of false negative results.

OBJECTIVE: To investigate the usefulness of the NLR as a predictor in the diagnosis of neonatal sepsis and early - onset neonatal sepsis (EOS).

METHODS: Relevant publications from 2009 to 2019 that fulfilled the inclusion criteria were identified through electronic database search. Studies were analyzed and a meta- analysis was performed. The effect of NLR was calculated as a predictive factor for EOS.

RESULTS: Four observational studies were included with a total of 392 patients. Two studies were analyzed for EOS which included 242 patients. There is significant association between NLR and neonatal sepsis. The sensitivity and specificity of NLR to predict sepsis were 84.5% and 91%. The sensitivity and specificity of NLR to predict EOS were 71% and 66%.

CONCLUSION: NLR is an acceptable tool in predicting neonatal sepsis and EOS but its usefulness is limited due to the presence of bias and heterogeneity in the studies included.

RECOMMENDATIONS: Further studies, preferably local studies, to investigate and validate the usefulness of the NLR as a predictor of neonatal sepsis and EOS is recommended.

KEYWORDS: "neonatal sepsis", "early – onset neonatal sepsis", "neutrophil – lymphocyte ratio", "meta – analysis"

INTRODUCTION

Statement of the Problem

Infection remains to be an important cause of neonatal morbidity and mortality.[1] In 2018, the World Health Organization (WHO) recorded approximately five million neonatal deaths each year due to sepsis with 34 in 1000 births mortality rate.[2] In addition, almost 95% of the cases identified were from developing countries.[3]Especially in the neonatal population, delays in the diagnosis and initiation of appropriate antibiotics are critical because such delays can significantly worsen outcomes.[4]

The diagnosis of neonatal sepsis is difficult due to non-specific signs and symptoms that may mimic other infectious conditions.[1]Routine laboratory testing is done in any newborn with identifiable risk factors or signs and symptoms concerning sepsis. The gold standard in the diagnosis of neonatal sepsis is a positive culture from a normally sterile site and it would usually take 2 to 5 days for culture results to come out thereby delaying the diagnosis of sepsis. In addition, not all neonates with signs and symptoms of neonatal sepsis had positive cultures.[3] In a study done by Ruslie *et. al*, in neonates suspected to have sepsis, only 55.3% showed positive culture results.[3]

The neutrophil-lymphocyte ratio (NLR) is a novel parameter and is assumed to be a prognosticating factor in diseases such as inflammatory diseases like Kawasaki Disease and Systemic Lupus Erythematosus, cardiovascular diseases, cancer, and infections.[5] It is easily obtained and calculated from the complete blood count test. Several studies have found that the neutrophil – lymphocyte ratio outperforms other acute phase reactants such as the white cell count (WBC), neutrophil count and C-reactive protein (CRP) in the emergency room department.[5,6] Recent studies were also done with regards to the use of the NLR in the diagnosis of neonatal sepsis. The present study aimed to determine the usefulness of NLR as a predictor neonatal sepsis and early-onset sepsis in neonates.

Neonatal sepsis is a clinical syndrome characterized by signs and symptoms of infection with or without proven bacteremia in the first month of life.[8] It can be divided into two major categories depending on the onset of symptoms. Early-onset sepsis presents within the first 72 hours of life.[8] It develops after delivery from organisms acquired before or during birth. On the other hand, late-onset sepsis presents after the 72nd hour of life. The source of infection is either hospital-acquired or community-acquired. [1,8]

The clinical manifestations of newborn infections vary and include subclinical infection, and mild to severe manifestations of focal or systemic infection.[1]According to the World Health Organization (WHO), neonatal sepsis can be diagnosed by the presence of at least two clinical symptoms and at least two laboratory signs in the presence of or because of suspected or proven infection. The clinical symptoms include temperature instability (hypothermia or hyperthermia), cardiovascular instability (bradycardia or tachycardia), presence of skin and subcutaneous lesions, respiratory instability (apnea or tachypnea), gastrointestinal symptoms (feeding intolerance, poor suck, or abdominal distention) and other non-specific signs and symptoms such as irritability, lethargy and hypotonia. Laboratory signs include WBC count of less than 4,000 x 109 cells/L or 20,000x109 cells/L, immature to neutrophil ratio of greater than 0.2, platelet count of <100,000 x 109 cells/L, CRP of >15mg/L, procalcitonin of >2ng/ml, hyperglycemia >180mg/dl or hypoglycemia <45mg/dl, and metabolic acidosis. However, in resource-limited settings with limited access to laboratory evaluations, this definition may not be applicable.[2]

The diagnosis of neonatal sepsis is complicated by its nonspecific clinical

symptomatology.[3] The gold standard in the diagnosis of sepsis is blood culture and should be done in all cases of suspected sepsis prior to starting of antibiotics. However, blood culture can time making it an unreliable tool in determining if treatment is needed in critical hours once the disease has begun.[7] Positive results can be influenced by several factors such as specimen collection and methods in culturing blood. Cultures may be negative in those who have received antibiotics previously or antenatally.[3]

Complete blood count is a common laboratory test done to screen for possible infection. Markers of infection that can be derived from the CBC include total leukocyte count, absolute neutrophil count and the immature to total neutrophil count. However, the absolute neutrophil count and the immature to total neutrophil count vary considerably during the neonatal period.[3,4,8] In addition, Poyoa *et al*. and Sierra et al. reported leukocyte level had low diagnostic value for neonatal sepsis. [9,10] In this study, leukocyte count was higher in confirmed sepsis than in suspected sepsis, but was not statistically significant.[3]In addition, according to the study done by Hornik, *et. al*, these markers have low sensitivities, making it a poor diagnostic marker to rule out early onset sepsis. [11]

A high index of suspicion is needed for early diagnosis of neonatal sepsis and treatment should be initiated without delay to prevent adverse outcomes of sepsis in the neonate. At present, starting empiric treatment with broad-spectrum antibiotics after a sepsis work-up in patients with clinical signs became a routine practice in neonatal care while awaiting results of the blood cultures sent.[3] Thus, a rapid diagnostic test that can differentiate neonates with and without sepsis will have a significant impact on neonatal care management.

Neutrophils and lymphocytes are important components of the immune system.[7] The NLR has been recently investigated as a biomarker for inflammation. It was found to be comparable with Erythrocyte Sedimentation Rate (ESR), CRP and WBC count as an indicator of systemic inflammation. The NLR has been used as a guide to prognosticate community-acquired pneumonia, ischemic heart disease, intravenous immunoglobulin (IVIG) resistant Kawasaki Disease, and cancer. [6]In general, neutrophils serve as a marker of ongoing non-specific inflammation, while lymphocytes act as a marker of the immune regulatory response. The NLR thus, represents the balance between inflammation and immune regulation, and is a biomarker of surgical stress, systemic inflammation, and sepsis, as the severity and clinical courses of such conditions correlate with neutrophilia and lymphocytopenia. In addition, in a study by Liu et al., it was reported that a high NLR is associated with more severe sepsis and higher mortality rate.[3]

OBJECTIVES OF THE STUDY

The general objective of this study was to investigate the usefulness of the neutrophil to lymphocyte ratio (NLR) as a predictor in the diagnosis of neonatal sepsis.

The study also aimed to determine the sensitivity and specificity of NLR using available studies on the utility of NLR in predicting early-onset neonatal sepsis.

METHODOLOGY

A systematic review and meta-analysis were done to synthesize the evidence for NLR as a predictor of early onset sepsis in neonates. Literature search used the following databases: PubMed, MEDLINE, EMBASE, CINAHL, HERDIN, Google Scholar, and the Cochrane Database of Systematic Reviews to look for relevant studies included in the study. The literature search used search terms containing "neutrophil-lymphocyte ratio", "early onset sepsis" and "neonatal sepsis". Combination

of terms was done using Boolean operators. Organizations, training hospitals, and professional societies were contacted for any additional published trials and unpublished data that may be included in this study.

All studies that met the following criteria were included in the study: (1) Retrospective or prospective case control, cross sectional, cohort study design investigating neonatal sepsis and early-onset neonatal sepsis from 2009 to 2019 according to the criteria set by the WHO, (2) Studies involving neonates ages 0 to 7 days old diagnosed to have neonatal sepsis and early-onset neonatal sepsis, and (3) Studies involving NLR as predictor of neonatal sepsis and early-onset neonatal sepsis.

Studies were excluded if (1) The effect of the outcome of interest is not assessed (2) Data is insufficient to provide or calculate pooled estimates (3) Studies or trials on animals other than humans, studies with different population and population with other alternative diagnoses.

Full text articles of the studies were obtained and assessed for eligibility for the study based on the set inclusion and exclusion criteria. The author extracted data onto a data extraction form, which included the following: (1) General Information: Study authors, published/unpublished, publication year, and journal, (2) Study design, (3) Study participants-age and sex, (4) Initial CBC parameters such as WBC, neutrophil and lymphocyte counts, (5) NLR and cut off value for patients diagnosed with early-onset neonatal sepsis as compared to those without neonatal sepsis, and (6) Sensitivity, specificity, p value, odds ratio and cut off ratio.

The following key terms were used: (“Neutrophils” AND lymphocyte ratio), (“neutrophil to lymphocyte ratio (NLR)” AND SEPSIS), (“neutrophil to lymphocyte ratio (NLR)” AND MORTALITY). Medical subject headings (MeSH) were also used to search the databases: (("neutrophils"[MeSH Terms] OR "neutrophils"[All Fields] OR "neutrophil"[All Fields]) AND ("lymphocytes"[MeSH Terms] OR "lymphocytes"[All Fields] OR "lymphocyte"[All Fields]) AND ("Ratio (Oxf)"[Journal] OR "ratio"[All Fields])) AND ("neonatal sepsis"[MeSH Terms] OR ("neonatal"[All Fields] AND "sepsis"[All Fields]) OR "neonatal sepsis"[All Fields]).

The review also included grey literature from the following databases: New York Academy of Medicine: Grey Literature, Sociological Abstracts, Science.gov, ProQuest Dissertations and Thesis, and WorldCat. Search for registered proposals and RCTs was done using websites such as www.clinicalTrials.gov. Cross-referencing of journals was also done. Data search also included searches from Google Scholar and the World Wide Web. Journals and articles published from 2009 to 2019 will be included in the study.

A Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) flow diagram was used to document the search process and the inclusion and exclusion of studies.

Studies included were appraised to assess risk of bias. However, due to the limited number of studies included in the study, a formal testing for publication bias was not feasible. The present study used the Newcastle – Ottawa Scale (NOS) in assessing the risk of bias. The NOS was developed to assess the quality of non-randomized studies with its design, content and ease of use directed to the task of incorporating the quality assessments in the interpretation of meta-analytic results. The scale uses a 'star system' in which a study is judged on three broad perspectives: the selection of the study groups; the comparability of the groups; and the ascertainment of either the exposure or outcome of interest for case-control or cohort studies respectively.[21]

The effect of heterogeneity of the studies was assessed by means of I^2. The predefined heterogeneity criteria were set as follows: low and not significant if the I^2 value is <40%; moderate with I^2 values of 40 to 60%; substantial heterogeneity at I^2 values 60 to 90% and considerable heterogeneity at 75% to 100%.[17] Due to the limited number of studies included in the analysis, possible sources of heterogeneity were not explored. The data was analyzed in the form of sensitivity, specificity and false-positive rates, odds ratio with their 95% confidence intervals (CIs). Meta-analysis was performed using the Review Manager 5.3 (Cochrane Collaboration, UK). To describe the percentage of total variation across the studies included in the study, heterogeneity was quantified using the I^2 test. Subgroup analysis was performed and methodological differences between studies were identified if heterogeneity was seen by visual inspection of the forest plot or a high I^2 value.

RESULTS

A systematic search was conducted to retrieve studies that will be included in the study. Search for grey literature was also done, however, there was no available study for review. A total of 20 studies were identified during the initial search. Eight studies that were not relevant to the present study were removed. Upon review of the titles and abstracts, eight studies that did not meet the inclusion criteria were excluded. A total of four studies were included in this meta-analysis. Flow chart of study selection is shown in Figure 1.

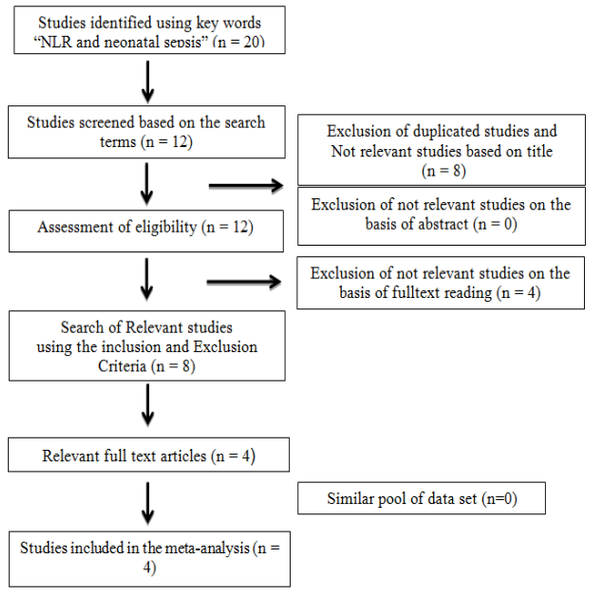

Figure 1. Systematic Review Process

Study Characteristics

The systematic search resulted in studies with different study designs, thus, upon careful consideration; the studies were confined to cross-sectional study designs. For this meta-analysis, studies included were those with reported use of NLR and early onset neonatal sepsis. The review included data from four (4) cross-sectional studies published during the period 2015 to 2019.

A total of four studies were included in the analysis. A total of 382 neonates were included in the analysis: 112 from the study of Can *et al* (2018), 120 from Wilar (2019), 70 from the study of Omran *et al* (2017), and 80 from Fang *et al* (2015). A summary of characteristics of the studies included are presented in Table 1 found on the next page.

Table 2 shows the summary of the results between the patients with neonatal sepsis and those without sepsis.

Table 2. Summary of Results Between Non – Neonatal Sepsis Group and Neonatal Sepsis Group

Study Author Year Country	**Non – Sepsis Group**	**Neonatal Sepsis Group**			
	Neutrophil – Lymphocyte Ratio (Mean and Standard Deviation)	**Neutrophil – Lymphocyte Ratio (Mean and Standard Deviation)**	**Sensitivity**	**Specificity**	**Cut – Off Point**
Can 2018 Turkey	0.21±0.12	2.88±0.16	97.4%	100%	6.76
Wilar 2019 Korea	0.82±0.32	2.82±2.29	83.3%	93.3%	1.245
Omran 2017 Egypt	1.6 ± 0.4	2.9 ± 1.7	80%	57.1%	2.7
Fang 2015 China	2.1 ± 0.6	11.45± 6.68	75%	84.2%.	12.64

TABLE 1: CHARACTERISTICS OF INCLUDED STUDIES				
First Author Surname Year Country	Study Title	Study Design	Population	Parameters Assessed and Findings
Fang 2015 China	Ratios of CD64 Expressed on Neutrophils, Monocytes, and Lymphocytes May Be a Novel Method for Diagnosis of Neonatal Sepsis	Prospective observational study design	80 neonates with neonatal sepsis (21 culture positive, 59 negative) were included	Ratios were calculated with these levels of CD64 expression. Blood culture and other laboratory CD4 ratios were calculated including the NLR, neutrophil to monocyte ratio, neutrophil - lymphocyte ratio to neutrophil monocyte ratio. Cut-off for NLR ratio is 12.64 with sensitivity of 75% and specificity of 84.2%.
Omran 2017 Egypt	Salivary C-Reactive Protein, Mean Platelet Volume and Neutrophil Lymphocyte Ratio as Diagnostic Markers for Neonatal Sepsis	Cross sectional study	70 full-term neonates were included, 35 were septic and 35 were non-septic	Mean platelet volume and neutrophil-lymphocyte ratio showed significant difference between septic neonates and controls. At a cut-off point of 2.7, neutrophil-lymphocyte ratio presented 80% sensitivity and 57.1% specificity
Can 2018 Turkey	The Value of Neutrophil to Lymphocyte Ratio and Platelet to Lymphocyte Ratio for Detecting Early-onset Neonatal Sepsis	Prospective observational study design	A total of 122 term neonates were included, 78 EOS group, 44 non - EOS	EOS group had significantly higher neutrophil counts, axillary temperature, neutrophil lymphocyte count ratio, platelet lymphocyte count ratio, C-reactive protein and procalcitonin levels compared with the control group. An NLR of 6.76 was determined as the predictive cutoff value of neonate EOS (sensitivity 97.4%; specificity 100%).
Wilar 2019 Korea	Diagnostic value of eosinopenia and neutrophil to lymphocyte ratio on early onset neonatal sepsis	Cross sectional study	120 neonates who met the inclusion criteria, 90 in the EOS group and 30 in the non-EOS group.	EOS group had higher NLR level and greater eosinopenia than the non – EOS group. The diagnostic value of NLR in the EONS group (cutoff point, 1.24) showed83.3% sensitivity and 93.3% specificity.

Figure 2 shows the Risk of Bias analysis using the Newcastle-Ottawa Quality Assessment Scale. The studies included in the analysis exhibited low risk for bias. There are different parameters for the assessment such as Representativeness of Samples, Sample Size, Non-Respondents and Ascertain Risk of Exposure. A total of 10 stars can be obtained in the assessment with 10 being the highest. Each study included in the analysis garnered 8 stars which indicates low risk of bias.

	Representativeness	Sample size	Non-respondents	Ascertainment of exposure	Control of confounding	Assessment of outcome	Statistical test	Total
Wilar 2019	★	★	★	★★	--	★★	★	8
Omran 2018	★	★	★	★★	--	★★	★	8
Can 2017	★	★	★	★★	--	★★	★	8
Fang 2015	★	★	★	★★	--	★★	★	8

Figure 2. Risk of Bias Assessment Using Modified Newcastle-Ottawa

Neutrophil – Lymphocyte Count in Neonatal Sepsis

The pooled estimate for sensitivity and specificity of the four (4) studies on neonatal sepsis is shown in Figure 3. The NLR as a predictor of neonatal sepsis has high sensitivity at 0.86 (95% CI 0.70 – 0.94) and high specificity at 0.94 (95% CI0.47 – 1.0).

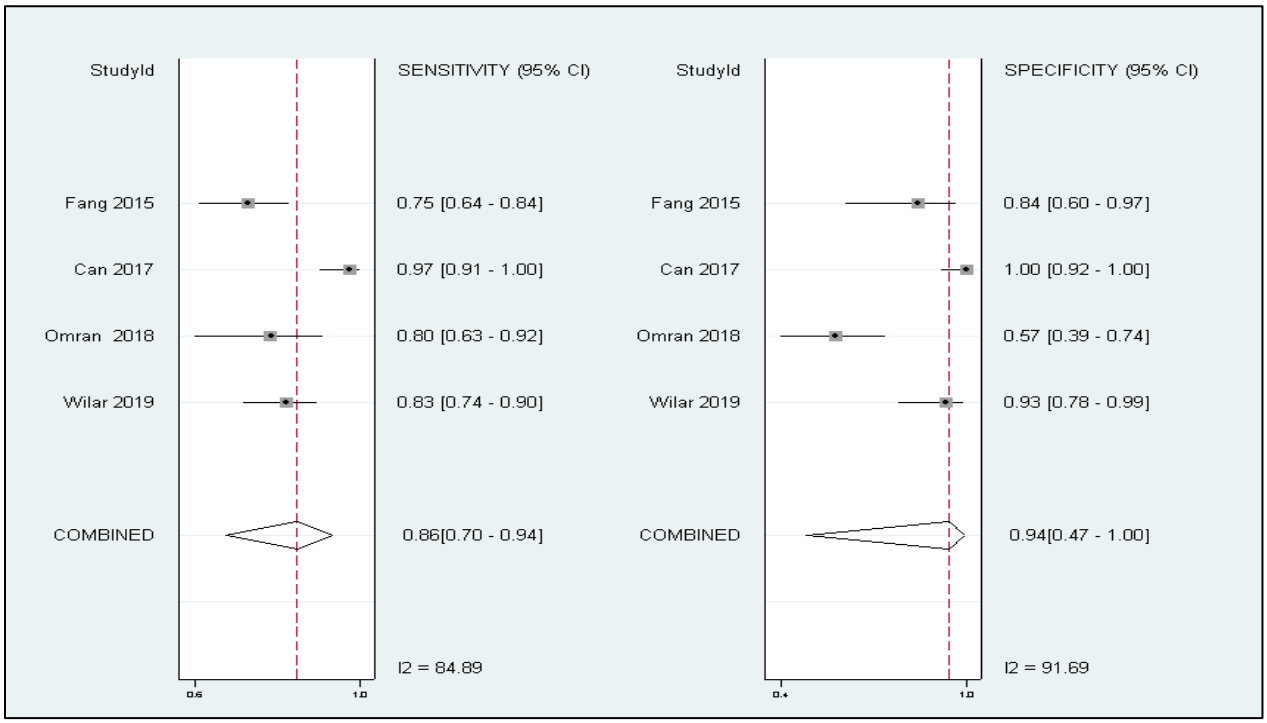

Figure 3: Forest Plot for Diagnostic Accuracy of NLR in Predicting Early Onset

Neonatal Sepsis

The area under the curve (Figure 4) shows high accuracy (AUC=0.93), suggesting that the NLR can be used as an acceptable diagnostic marker in the diagnosis of neonatal sepsis. All 4 studies have considerable heterogeneity at 84.9-91.7%.

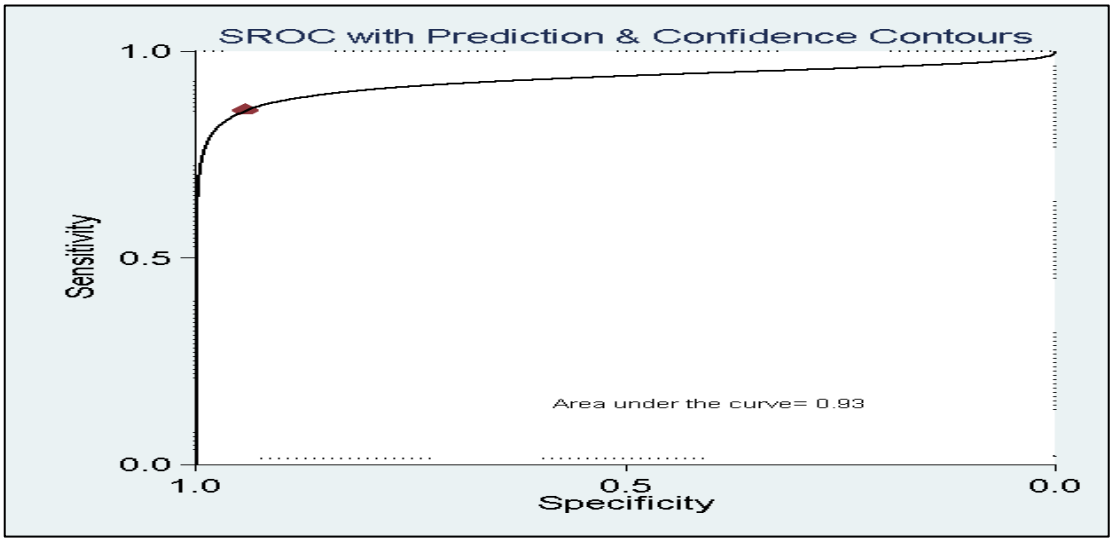

Figure 4: ROC Curve on the Diagnostic Accuracy of NLR in Predicting Neonatal Sepsis

The pooled estimate for sensitivity and specificity of two studies on early onset neonatal sepsis is shown in Figure 5. NLR in the diagnosis of early onset neonatal sepsis has a high combined sensitivity at 0.89 (95% CI 0.79 – 0.94) and high combined specificity at 0.97 (95% CI 87 – 1.0).

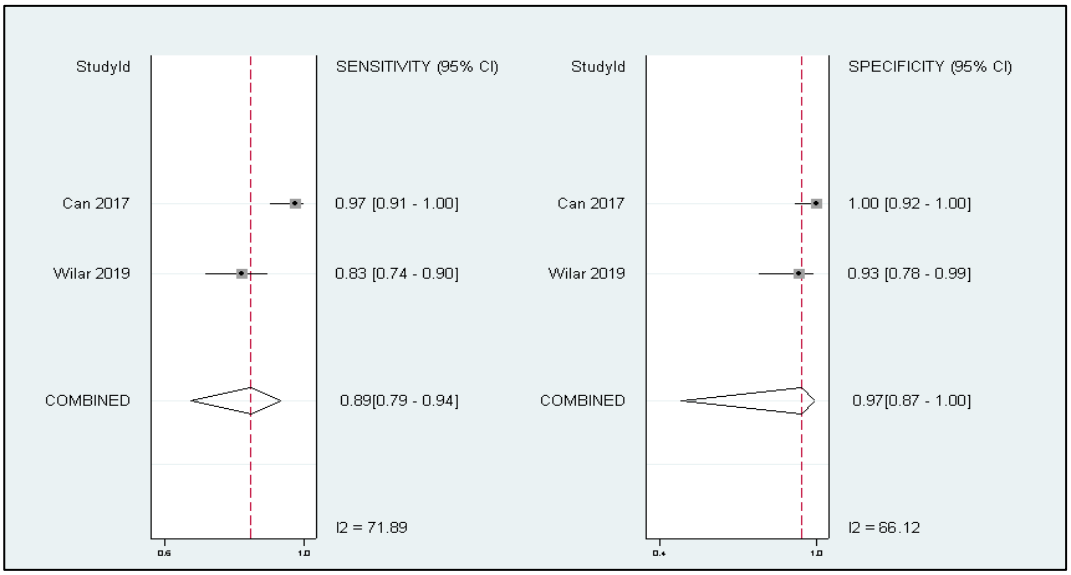

Figure 5: Forest Plot for Diagnostic Accuracy of NLR in Predicting Early Onset Neonatal Sepsis

The area under the curve shown in Figure 6 shows high accuracy (AUC=0.95). The 2 studies have substantial heterogeneity (71.9-86.1%).

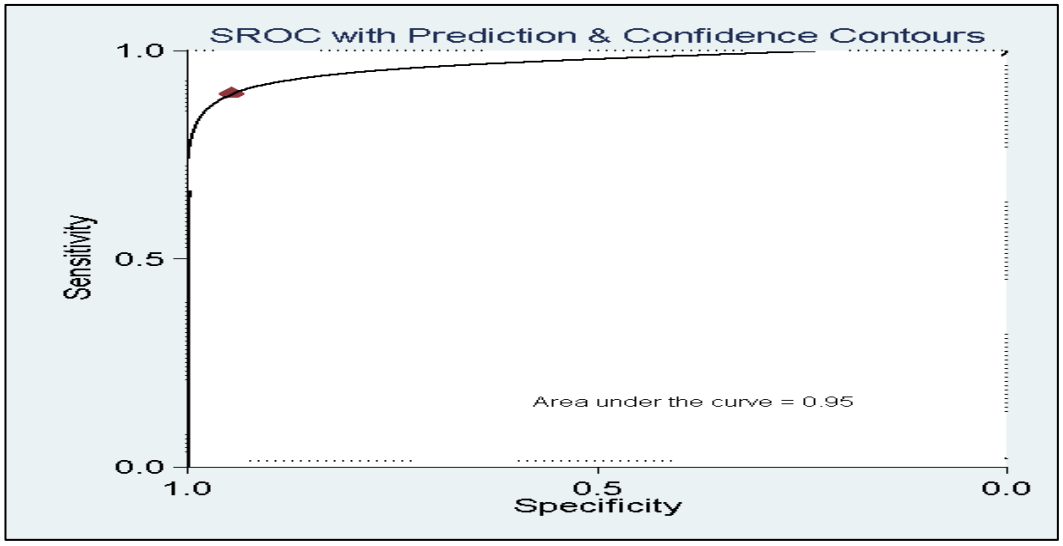

Figure 6: ROC Curve on the Diagnostic Accuracy of NLR in Predicting Early Onset Neonatal Sepsis

DISCUSSION

The diagnosis of early-onset neonatal sepsis remains to be a challenge to physicians due to its variable clinical presentation and can lead to substantial morbidity and mortality during the newborn period. Blood culture, which is the gold standard in the diagnosis of neonatal sepsis, is limited by being time-consuming and high probability of false negative results. Although several biochemical markers have been studied and proposed as potential markers for neonatal sepsis, the sensitivity and specificity of the tests were inadequate, and some results were inconclusive. Also these markers are expensive and not always readily available. Hence, it is necessary to find an immediate, cost-effective, and readily available marker for neonatal sepsis. The present study utilized parameters derived from the complete blood count (neutrophil count and lymphocyte count), which is a standard, routine and readily available test done in patients suspected to have infections, in the early diagnosis of early-onset neonatal sepsis.

There is growing evidence that NLR can be a promising predictor of conditions such as inflammatory conditions, cardiovascular diseases, cancer, and infections. The NLR is a simple and inexpensive marker of subclinical inflammation, which can be easily calculated from the differential white blood cell counts.[12]The present study combines current knowledge on the role of the NLR in the diagnosis of neonatal sepsis and early-onset neonatal sepsis and is the first systematic review and meta-analysis done investigating the predictive value of the NLR in the diagnosis of neonatal sepsis and early – onset neonatal sepsis.

The results of the present study showed significant association between neutrophil – lymphocyte count and early onset sepsis. The sensitivity and specificity of NLR to predict sepsis marker was 84.5% and 91%, respectively. Furthermore, the sensitivity and specificity of NLR to predict early-onset of sepsis was 71% and 66%. NLR are seen in early phase of sepsis and thus maybe of help in making a good diagnosis, especially when microbiological culture poses limitation in terms of time and low-positive rate.

The present study has some limitations such as the limited number of studies available for review. Hence, a funnel plot for asymmetry was not done which can lead to high risk of publication bias. The studies included in the analysis were observational in nature and risk of bias assessment and confounders might be present. Heterogeneity was also evident among the study categories and variables- both clinical and statistical. The possible sources of heterogeneity were ideally to be explored, however this was not possible due to the limited number of studies included in the analysis. The high heterogeneity results in this analysis may be partly due to differences in focused clinical outcomes of the studies. In addition, due to the lack of clinical data, the cut off value for the neutrophil to lymphocyte count ratio in the studies were different and the lack of raw data thereof for a computation of a new

cut off score from the analysis was not feasible.

CONCLUSION

Based on the present study, the NLR is a good diagnostic marker for the early diagnosis of neonatal sepsis given its high sensitivity and specificity. The NLR is higher among patients with early onset neonatal sepsis than those without neonatal sepsis. However, the heterogeneity of the studies included may pose limitations in the usefulness of NLR as a valid and accepted marker for early onset neonatal sepsis.

We recommend that prospective further studies be done to validate the usefulness of the NLR as a predictor for early – onset neonatal sepsis. Studies combining the effectiveness of the NLR with other markers of infection can also be done to increase the sensitivity and specificity of these markers combined in the diagnosis of early-onset neonatal sepsis.

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