The Egyptian Journal of Hospital Medicine (July 2023) Vol. 92, Page 6472- 6479

# Shock Index as a Predictor Outcome of Pediatric Abdominal Trauma in Mansoura Emergency Hospital

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## ABSTRACT
**Background:** The most frequent cause of morbidity and mortality in children is trauma. HR divided by the SBP results in the SI. It has been investigated in patients who are either at risk for shock or are already in it due to a number of different conditions such trauma, hge, and sepsis.
**Objective:** This study aimed to assess the shock index of pediatric abdominal (SIPA) trauma as a predictor of short-term outcome of pediatric abdominal trauma.
**Patients and Methods:** This was a prospective study on 123 paediatric patients under the age of eighteen who had either isolated or combined abdominal trauma. The patients were gathered from Mansoura Emergency Hospital between January 2022 and January 2023.
**Results:** Comparing cases with high shock index (SI) to those with normal shock index, blood transfusions were significantly more common in cases with high SI. With sensitivity and specificity values of 80.6% and 79.5% respectively, SI had the validity to predict ICU admission. SI had an accuracy of 87.5 percent and a specificity of 80.6% in predicting the requirement for inotropic administration. SI had a sensitivity and specificity of 75% and 82.9% respectively, for predicting death (P=0.076).
**Conclusion:** In pediatric trauma patients, elevated SI may be used as a precise and accurate predictor of morbidity and mortality. It enables quick evaluation of these individuals and is a useful tool that can be used to direct decisions about therapeutic care and resuscitation.
**Keywords:** Shock index, Pediatric age-adjusted, Abdominal injury, ABCDE approach, Blood transfusion.

## INTRODUCTION

Trauma is the number one cause of illness and mortality among children. Following the head and extremities as the most often injured anatomical areas in children, the abdomen can be involved in twenty-five percent of serious trauma cases. In traumatized children, abdominal damage is the most frequent site of initially-unrecognized lethal injury with a death rate as high as 8.5% [(1)]. Compared to adults, children are more likely to sustain intra-abdominal injuries for a variety of causes. Since they are lighter and receive less force, it is distributed across a smaller surface. Due to their lower levels of fat and weaker muscles, their organs are also less protected. Because of their greater pliability, their ribs provide less protection [(1)].

Vital signs, such as heart rate (HR) and systolic blood pressure (SBP), are accessible when caring for an emergency trauma patient and are regarded as immediate and accurate clinical indications of shock. In children who are in shock, tachycardia has been proven to indicate a higher mortality risk. One of the more effective predictors of in-hospital death in pediatric trauma patients is low SBP in the emergency department [(2)].

HR divided by SBP in millimeters of mercury is known as the shock index (SI). Due to age-related variations in children HR and SBP, SI application within the pediatric trauma group is challenging. Pediatric age-adjusted SI (SIPA) values have been established by **Acker *et al.*** [(3)] based on vital signs across recognized age groups, and this model has been verified as a predictor for injury severity in blunt trauma. The SIPA, is calculated by dividing the highest normal heart rate by the lowest normal SBP by the patient's age [(3)]**.** SIPA has been found to be helpful in identifying severe head injuries, severe isolated blunt liver/spleen injuries, the need to activate the trauma team, and the requirement for abdominal CT following blunt trauma injury, according to further study [(4)].

A high SI has been linked to increased mortality and transfusion risk. A rising SI is linked to a higher risk of mortality in children with septic shock. SI improved when pediatric shock patients received advanced life support quickly [(5)].

The goal of the current study was to determine if the SIPA could be used to predict the short-term prognosis of pediatric abdominal trauma.

## PATIENTS AND METHODS

This was a prospective-research on young patients who had experienced abdominal trauma who were gathered from the Mansoura Emergency Hospital, Faculty of Medicine, Mansoura University between January 2022 and January 2023.



Received: 09/03/2023
Accepted: 08/05/2023

**Inclusion criteria:**

Cases of abdominal trauma in patients under the age of 18 who were either isolated or a result of multiple trauma.

**Exclusion criteria:**

Patients who refused to participate in the study or who had missing information regarding their presentation (HR, SBP, GCS), those who had underlying illnesses that might have an impact on their vital signs or outcome (such as cardiac disease, liver disease, sepsis), those who were transferred from another hospital, and those who had received blood products or intravenous fluids.

***Methods***

According to the ABCDE strategy, which comprised maintaining the airway and immobilizing the cervical spine, assessing breathing and ventilation, controlling the circulation and stopping any bleeding, determining any disabilities, and controlling exposure and environmental factors, all patients were evaluated and given CPR.

In the secondary survey, a thorough history was taken, including information on age, sex, and previous surgical or medical issues. The injury's mechanism, date, and any accompanying symptoms or complaints were all mentioned in the history. The physical examination comprised a vital sign assessment, a thorough abdominal exam, and any necessary examinations of other body systems. Blood pressure, HR, respiration rate, and body temperature were all vital signs. They can offer crucial details regarding future medical issues or complications and were frequently used as a first assessment of a person overall health state.

We first determined the shock index by dividing the heart rate by the systolic blood pressure after the triage nurse and assigned physician evaluated and documented all vital signs of the patients upon arrival. Vital signs are a crucial component of the early evaluation in the case of pediatric abdominal trauma and can be used to spot any indications of shock or other problems. To guarantee the best prognosis for the child, any anomalies in vital signs should be treated very away. The doctor checked the patient abdomen for any indications of injury, such as discomfort, bruising, or swelling. They check for symptoms of peritonitis, inflammation of the lining of the abdominal cavity, and listen for bowel noises. Guarding, rigidity, rebound discomfort, and pain with movement were all indicators of peritonitis. To check for any indications of rectal bleeding or damage, the doctor did a rectal examination.

***Investigations***

Laboratory testing included coagulation profile, CBC, LFT, KFT, and ABG. Focused Assessment with Sonography for Trauma (FAST), chest and pelvic x-rays, and CT were among the radiological examinations performed.

***Outcomes***

The need for blood transfusions, assisted ventilation, (ICU) stays, overall hospital stays, inotropic support needs, operating room needs, infectious complications, and in-hospital mortality were all used to evaluate the result.

**Ethical approval:**

The Ethics Committee of Faculty of Medicine, Mansoura University granted the study approval. All participants signed informed consents after a thorough explanation of the goals of the study. The Helsinki Declaration was followed throughout the study's conduct.

**Statistical Analysis**

SPSS version 20.0 was used to tabulate and statistically analyse the gathered data. For numerical parametric data, descriptive statistics were performed using the mean ± SD (standard deviation) and minimum and maximum of the range. For numerical non-parametric data were performed using the median and first and third interquartile ranges, and for categorical data were performed using the number and percentage. For quantitative variables, inferential analyses were performed using the independent t-test when there were two independent groups and parametric data, and the Mann Whitney U when there were two independent groups and non-parametric data. Chi square test for independent groups was used for inferential analyses of qualitative data. P value ≤ 0.05 was considered significant.

**RESULTS**

The initial number of patients examined was 757 patients who were admitted to Mansoura Emergency Hospital. We excluded 532 patients who were above included age. We also excluded 12 patients who arrived arrested and 23 patients transferred from other hospitals, 67 patients who refused or unable to give consent to be included in the study, leaving 123 patients met the inclusion criteria.

Table (1) demonstrated the sociodemographic characteristics and type of trauma among studied cases. The percentages of ages (1-3), (4-6), (7-12) and >12 was 8.1, 25.2, 33.3, 33.3% respectively. Male/female ratio was 69.9/30.1. Most traumas were blunt (95.1%), while only 4.9% of which were penetrating. The table also illustrated vital signs and laboratory findings among studied cases. The median values of GCS, HR, SBP, DBP, RR, WBCS, RBCS, HB, Hematocrit, Platelet count, AST, ALT, Bilirubin and Serum creatinine were 15, 110.28 ± 18.23, 103.29

± 17.90, 63.98 ± 12.71, 24.44 ± 4.13, 12, 4.35, 11.28, 35.01, 299.69, 46, 46, 0.310 and 0.65 respectively.

**Table (1):** Sociodemographic characteristics, type of trauma vital signs and laboratory findings among studied cases

| | N=123 | % |
|---|---|---|
| **Age/ years** | | |
| One-three years | 10 | 8.1 |
| Four-six years | 31 | 25.2 |
| Seven-twelve years | 41 | 33.3 |
| >twelve years | 41 | 33.3 |
| **Sex** | | |
| Male | 86 | 69.9 |
| Female | 37 | 30.1 |
| **Type of trauma** | | |
| Blunt | 117 | 95.1 |
| Penetrating | 6 | 4.9 |
| **Vital Signs** | | |
| GCS | 15(5-15) | |
| Heart rate | 110.28±18.23 | |
| Systolic blood pressure | 103.29±17.90 | |
| Diastolic blood pressure | 63.98±12.71 | |
| Respiratory rate | 24.44±4.13 | |
| **Laboratory Findings** | | |
| WBCS (Range) | 12(4.5-39) | |
| RBCS (±SD) | 4.35±0.43 | |
| HB (gm/dl) (±SD) | 11.28±1.89 | |
| Hematocrit % (±SD) | 35.01±5.36 | |
| Platelet count (±SD) | 299.69±70.09 | |
| AST (Range) | 46(11-1400) | |
| ALT (Range) | 46(11-1273) | |
| Bilirubin (mg/dl) (Range) | 0.310(0.02-2.54) | |
| Serum creatinine (mg/dl) (Range) | 0.65(0.20-1.24) | |

Parameters described as median (min-max) and mean ±SD

Table (2) demonstrated complications of the studied cases. The percentage of liver injury, splenic injury, renal injury, pancreatic injury, intestinal injury, blood transfusion, assisted ventilation, surgical intervention, ICU admission, inotropic support, infection complications and Mortality were 22, 22, 8.1, 4.9, 7.3, 35.8, 8.9, 21.1, 46.3, 10.6, 17.1, 6.5 and 9% respectively. The median duration of ICU stay duration and total hospital stay were 9 and 12 respectively.

**Table (2):** Complications of the studied cases

| | N =123 | % |
|---|---|---|
| Liver injury | 27 | 22.0 |
| Splenic injury | 27 | 22.0 |
| Renal injury | 10 | 8.1 |
| Pancreatic injury | 6 | 4.9 |
| Intestinal injury | 9 | 7.3 |
| Blood transfusion | 44 | 35.8 |
| Assisted ventilation | 11 | 8.9 |
| Surgical intervention | 26 | 21.1 |
| ICU admission | 57 | 46.3 |
| Inotropic support | 13 | 10.6 |
| Infection complications | 21 | 17.1 |
| Mortality | 8 | 6.5 |
| ICU stay duration(days)<br>Median (min-max) | 9(3-70) | |
| Total hospital stay (days)<br>Median (min-max) | 12(3-83) | |

Table (3) displayed the comparison of socio-demographic characteristics of the studied cases between normal and high shock index. There was a statistically significant increase in age among cases with high shock index compared to cases with normal SI (P<0.05). However, no significant differences were recorded between both groups as regards sex and mechanism of trauma (P>0.05).

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**Table (3):** Comparison of socio-demographic characteristics of the studied cases between normal and high shock index

| | Normal shock index N=63(%) | High shock index N=60(%) | Test of significance |
|---|---|---|---|
| **Age/ years**<br>Mean ±SD | 8.16±4.65 | 11.33±4.53 | t=3.83<br>P=0.001* |
| 1-3 years | 5(7.9) | 5(8.3) | MC=11.34<br>P=0.01* |
| 4-6 years | 23(36.5) | 8(13.3) | |
| 7-12 years | 21(33.3) | 20(33.3) | |
| >12 years | 14(22.2) | 27(45.0) | |
| **Sex** | | | |
| Male | 45(71.4) | 41(68.3) | χ2=0.140<br>P=0.708 |
| Female | 18(28.6) | 19(31.7) | |
| **Mechanism of trauma** | | | |
| Blunt | 58(92.1) | 59(98.3) | FET=2.74<br>P=0.254 |
| Penetrating | 5(7.9) | 1(1.7) | |

t: Student t test, MC: Monte Carlo test, FET: Fischer exact test, $\chi^2$: Chi-Square test

Table (4) demonstrated comparison of vital signs between cases with normal and high shock index. Normal SI group was associated with significant increases in GCS, SBP, DBP and significant decreases in HR and RR compared to cases with high SI group (P<0.01). Regarding laboratory findings between cases with normal and high shock index, cases with high shock index were associated with significant increases in WBCS, AST and ALT and significant decreases in both HB and Hematocrit compared to subjects with normal SI. Regarding complications, cases with high shock index were associated with significant increases in liver injury, splenic injury, renal injury, blood transfusion, surgical intervention, ICU admission, inotropic support and infection complications compared to cases with normal shock index. However, no significant differences were recorded as regards pancreatic injury, intestinal injury and assisted ventilation.

**Table (4):** Comparison of vital signs, laboratory findings and complications between cases with normal and high shock index

| | **Normal shock index N=63** | **High shock index N=60** | **Test of significance** |
|---|---|---|---|
| **Vital Signs** | | | |
| GCS | 14.52±1.96 | 13.53±2.73 | t=2.32 P=0.02* |
| Heart rate | 100.35±12.25 | 120.7±17.72 | t=7.44 P<0.001* |
| Systolic blood pressure | 114.53±13.16 | 91.50±14.30 | t=9.29 P<0.001* |
| Diastolic blood pressure | 71.11±10.02 | 56.50±10.83 | t=7.77 P<0.001* |
| Respiratory rate | 23.87±4.33 | 25.95±3.64 | t=2.87 P=0.005* |
| **Laboratory Findings** | | | |
| WBCS | 10.24±2.43 | 14.42±3.58 | t=4.47 P=0.001* |
| RBCS | 4.41±0.37 | 4.28±0.48 | t=1.70 P=0.092 |
| HB (gm/dl) | 11.74±1.46 | 10.1±2.16 | t=2.84 P=0.005* |
| Hematocrit % | 36.76±4.01 | 33.16±5.98 | t=3.94 P=0.001* |
| Platelet count | 298.33±62.14 | 301.12±74.32 | t=0.219 P=0.827 |
| Serum creatinine (mg/dl) | 0.619±0.145 | 0.689±0.171 | t=1.82 P=0.071 |
| AST | 32(11-510) | 116.5(13-1400) | z=3.82 P<0.001* |
| ALT | 34(11-362) | 73(14-1273) | z=3.19 P=0.001* |
| Bilirubin (mg/dl) | 0.3(0.1-1.6) | 0.37(0.02-2.54) | z=1.39 P=0.163 |
| **Complications** | | | |
| Liver injury | 5(7.9) | 22(36.7) | χ2=14.81 P<0.001* |
| Splenic injury | 2(3.2) | 25(41.7) | χ2=26.58 P<0.001* |
| Renal injury | 2(3.2) | 8(13.3) | χ2=4.25 P=0.039* |
| Pancreatic injury | 3(4.8) | 3(5.0) | FET=0.004 P=1.0 |
| Intestinal injury | 4(6.3) | 5(8.3) | χ2=0.178 P=0.673 |
| Blood transfusion | 3(4.8) | 41(68.3) | χ2=54.06 P<0.001* |
| Assisted ventilation | 3(4.8) | 8(13.3) | FET=2.77 P=0.096 |
| Surgical intervention | 7(11.1) | 19(31.7) | χ2=7.79 P=0.005* |
| ICU admission | 10(15.9) | 47(78.3) | χ2=48.22 P<0.001* |
| Inotropic support | 2(3.2) | 11(18.3) | χ2=7.47 P=0.006* |
| Infection complications | 4(6.3) | 17(28.3) | χ2=10.49 P=0.001* |
| Mortality | 2(3.2) | 6(10.0) | χ2=2.35 P=0.125 |

t: Student t test, z: Mann Whitney U test; FET: Fischer exact test; $\chi^2$: Chi-Square test;
*Statistically significant; Median, min-max: non-parametric test

Table **(5)** demonstrated analysis of factors predicting mortality among studied cases. Heart rate, systolic blood pressure, respiratory rate, pancreatic injury and shock index could be used as significant predictors for mortality only. While analysis of factors predicting ICU admission among studied cases were age, GCS, heart rate, systolic blood pressure, respiratory rate, liver injury, splenic injury and shock index that could be used as significant predictors for ICU admission only.

**Table (5):** Analysis of factors predicting mortality and ICU admission among studied cases.

| | **β** | **P value** | **AOR (95%CI)** | **β** | **P value** | **AOR (95%CI)** |
|---|---|---|---|---|---|---|
| | **Factors predicting mortality** | | | **Factors predicting ICU admission** | | |
| **Age/ years** | 0.036 | 0.632 | 1.03(0.836-1.27) | 0.257 | 0.001* | 1.29(1.11-1.51) |
| **Sex**<br>**Male (r)**<br>**Female** | 0.835 | 0.258 | 2.30(0.543-9.77) | 0.161 | 0.743 | 1.18(0.448-3.08) |
| **GCS** | -1.41 | 0.179 | 0.245(0.032-1.90) | -0.743 | 0.025* | 0.475(0.249-0.909) |
| **Heart rate** | -0.12 | 0.04* | 0.880(0.786-0.986) | 0.122 | 0.01* | 1.13(1.06-1.20) |
| **Systolic blood pressure** | -0.261 | 0.03* | 0.851(0.489-0.984) | -0.099 | 0.007* | 0.906(0.844-0.973) |
| **Diastolic blood pressure** | -0.124 | 0.568 | 0.884(0.577-1.35) | 0.015 | 0.767 | 1.02(0.919-1.12) |
| **Respiratory rate** | 0.367 | 0.006* | 1.44(1.11-1.88) | 0.162 | 0.046* | 1.18(1.003-1.38) |
| **Liver injury** | 1.39 | .0.063 | 4.0(.930-17.21) | 2.32 | .002* | 10.18(2.42-42.89) |
| **Splenic injury** | 2.165 | .124 | 8.71(0.552-137.59) | 2.37 | .001* | 10.72(2.61-43.97) |
| **Renal injury** | -18.59 | .999 | Undefined | 21.28 | .999 | Undefined |
| **Pancreatic injury** | 3.85 | .047* | 47.12(1.05-56.68) | 21.88 | .999 | Undefined |
| **Intestinal injury** | -18.92 | .999 | Undefined | 1.11 | .339 | 3.04(0.311-29.77) |
| **Shock index** | 1.76 | 0.01* | 5.78(1.08-30.85) | 8.64 | <0.001* | 60.58(50.4-65.98) |
| **Overall % predicted** | **=93.5%** | | | =83.7% | | |

AOR: Adjusted odds ratio, r: reference group

Table **(6)** demonstrated correlation between shock index and ICU stay and hospital stay duration among studied cases. Shock index was significantly correlated with total hospital stay (P<0.001) but not with ICU duration (P>0.05).

**Table (6):** Correlation between shock index and ICU Stay and hospital stay duration among studied cases

| | **Shock index** | |
|---|---|---|
| | **r** | **P value** |
| ICU stay duration (days) | 0.102 | 0.461 |
| Total hospital stay (days) | 0.430 | <0.001* |

r: Spearman correlation coefficient; *Statistically significant

Table (7) revealed the validity of shock index in differentiating complications and outcome of the studied cases. At cut off of 0.905, SI had the ability to differentiate between cases with assisted ventilation (AUC=0.666) with sensitivity and specificity of 83.3% and 36.5% respectively (P=0.179). At cut off of 1.235, SI had the validity to differentiate between cases as regards surgical intervention (AUC=0.690) with sensitivity and specificity of 70.6% and 40.5% respectively (P=0.017). At cut off of 0.905, SI had the validity to differentiate between cases as regards ICU admission (AUC=0.879) with sensitivity and specificity of 80.6% and 79.5% respectively (P=<0.001). At cut off of 0.905, SI had the validity to differentiate between cases as regards inotropic (AUC=0.836) with sensitivity and specificity of 87.5% and 80.6% respectively (P=0.002). At cut off of 0.905, SI had the validity to differentiate between the studied cases as regards mortality (AUC=1.39) with sensitivity and specificity of 75% and 82.9% respectively (P=0.076).

**Table (7):** Validity of shock index in differentiating complications and outcome of the studied cases

| | **AUC (95%CI)** | **P value** | **Cut off point** | **Sensitivity %** | **Specificity%** |
|---|---|---|---|---|---|
| **Assisted ventilation** | 0.666 (0.461-0.870) | 0.179 | 0.905 | 83.3 | 36.5 |
| **Surgical intervention** | 0.690 (0.528-0.851) | 0.017* | 1.235 | 70.6 | 40.5 |
| **ICU admission** | 0.876 (0.794-0.957) | <0.001* | 1.01 | 80.6 | 79.5 |
| **Inotropic** | 0.836 (0.705-0.967) | 0.002* | 1.265 | 87.5 | 80.6 |
| **Mortality** | 0.765 (0.539-0.991) | 0.076 | 1.39 | 75.0 | 82.9 |

AUC: Area under curve.

## DISCUSSION

The most frequent cause of morbidity and mortality in children is trauma. Ten to fifteen percent of children who have traumatic injuries and go to the hospital have abdominal injuries. After head and extremities traumas, abdominal traumas are the third most frequent type of injury in kids. Over eighty percent of stomach traumas in children are caused by blunt trauma. Traffic accidents are the most frequent cause, followed by falls from great heights, bicycle accidents, and child abuse. The liver and spleen are the organs that are most frequently hurt [6, 7]. HR divided by SBP results in the shock index (SI). It has been investigated in patients who were either experiencing or at risk for shock due to a variety of causes: ectopic pregnancy that has ruptured, MI, pulmonary embolism, trauma, bleeding, and hge. [8].

The current study objective was to assess the SIPA as a predictor of the short-term prognosis of pediatric abdominal trauma. This study, which was conducted prospectively, involved 123 pediatric cases of abdominal trauma that were gathered from Mansoura Emergency Hospital between January 2022 and January 2023. The current study showed that, with regard to sociodemographic factors, the percentages of ages (1-3), (4-6), (7-12), and >12 were 8.1, 25.2, 33.3, and 33.3% respectively. The gender split was 69.9 to 30.1. Only 4.9% of injuries were penetrating, whereas 95.1% of traumas were blunt. In a similar vein, 1066 pediatric patients who had intra-abdominal solid organ damage participated in **Ayse and Seda's study** [7]**.** They have shown that 58.5% of instances involved men. The typical mean age of the kids was 7.1 ± 4.6. The outdoors was the scene of 70.8% of the injuries. 91.8% of the injuries were blunt, and 7.2% were penetrating traumas, according to the injury type. Car accidents accounted for 41.4% of injury-causing incidents [7].

The current study demonstrated that the median values of GCS, HR, SBP, DBP, RR, WBCS, RBCS, HB, hematocrit, Platelet count, AST, ALT, bilirubin and serum creatinine were 15, 110.28 ± 18.23, 103.29 ± 17.90, 63.98 ± 12.71, 24.44 ± 4.13, 12, 4.35, 11.28, 35.01, 299.69, 46, 46, 0.310 and 0.65 respectively. With regard to the affected organs, the present study demonstrated that the percentage of liver injury, splenic injury, renal injury, pancreatic injury, intestinal injury were 22%, 22%, 8.1%, 4.9% and 7.3% respectively.

The most frequently injured organs in pediatric abdominal trauma patients were the liver (38.6%) and spleen (32.1%), according to research by **Chaudhari and his colleagues** [9], abdominal surgery was performed on a combined 3.1% of kids with liver injuries and 2.8% of kids with splenic injuries**.** Gaines, however, found that, after the spleen in blunt traumas and the SI in cutting injuries, the liver is the organ most frequently wounded [6].

The current study found that the rates of assisted ventilation, blood transfusion, surgery, ICU admission, inotropic support, infection complications, and mortality were (35.8% of the total), correspondingly 8.9, 21.1, 46.3, 10.6, 17.1, and 6.5. ICU stay duration and overall hospital stay duration had median lengths of nine and twelve days, respectively. According to **Ayse and Seda** research, patients receiving emergency care had a mean follow-up time of 8.9 ± 2.8 hours. Fluids were administered to 77.1% of patients (n=822), erythrocytes or other blood products to 10.2% (n=109), medication treatment to 85.8% (n=915), and mechanical breathing to 8.5% (n=91) of patients. Other therapies, such as plaster, splints, sutures, dressing, tetanus shots, tube thoracotomy, central catheters, and intraosseous therapy were administered to 99% of patients (n=1061). At the conclusion of their care in the emergency department, 47.5% of patients (n=506) were discharged from the emergency service [7].

In terms of blood transfusion, the present study showed that participants with high shock indices were much more likely to receive blood transfusions than those with normal shock indices. **Marenco and his colleagues** [10] have stated that patients with an increased SIPA (43%) required significantly more BPT (49.2% vs. 25%) and ESP (22.9% vs. 16%), as well as mortality (10.3% vs. 4.8%) and admission to an intensive care unit (49.9% vs. 36.1%), all with p values less than 0.001. A higher SIPA was independently correlated with both BPT and ESP, according to regression analysis. Forty-six healthy blood donors were enrolled in a prospective study by **Birkhahn and his associates** [11], and 450 mL of blood was drawn for 20 minutes. The change in the vital signs was still within the normal range even though the SBP was lower and the HR was higher. The mean SI, however, was much greater**.** A larger SI was strongly related with the requirement for a huge transfusion, according to another retrospective cohort study that examined 8111 blunt trauma patients (risk ratio: 8.13, 95% CI: 4.60–14.36) [12]. **Acker and his colleagues** [3] have shown that whereas fifty percent of the 543 children had a SI > 0.9, this number dropped to twenty-eight percent when utilizing age adjusted SI (SIPA). Compared to SI, SIPA showed improved differentiation of serious injury: Grade III liver/spleen laceration necessitating blood transfusion: forty-one percent vs. 26%; ISS > 30: 37% vs. 26%; blood transfusion during the first 24 hours: twenty-seven percent vs. twenty percent; and in-hospital mortality: eleven percent vs. seven percent. According to research by **Nordin and his colleagues** [13]**,** SIPA was high in 15.6% and 19.4% of patients, but SI was elevated in 41.3% and forty percent of these groups, respectively. For both blunt and penetrating trauma, SIPA was a considerably superior predictor of transfusion requirements, injury severity, ICU admission, ventilator use, and mortality.

The current investigation showed that only heart rate, SBP, RR, pancreatic damage, and SI could be employed as significant predictors of mortality in the analysis of factors predicting mortality among the examined cases. The current study also showed that factors such as age, GCS, heart rate, systolic blood pressure, respiration rate, liver injury, splenic injury, and shock index may be employed as reliable indicators for ICU admission exclusively. Additionally, **Strutt and his associates** [5] used the National Trauma Data Bank to analyze 28,741 pediatric trauma cases under the age of 15. In comparison with hypotension (OR, 12.6) and tachycardia (OR, 2.6), they found that a raised SI was the best predictor of mortality in pediatric trauma patients (odds ratio (OR) 22.0). They came to the conclusion that increased SI is a better predictor of death than either tachycardia or hypotension alone in pediatric trauma patients since it is accurate and specific. According to numerous reports, the shock index is a more accurate indicator of hemodynamic instability than more common vital indicators like the heart rate and blood pressure. In comparison with either HR or SBP alone, SI was a more reliable predictor of acute changes in blood volume in a prospective trial investigating the detection of early hypovolemia [11]. Similar to this, **Rousseaux *et al.*** [14] and **Yasaka *et al.*** [15] studied geriatric trauma cases and found that SI was superior to HR and SBP in terms of predicting mortality. In children with septic shock, SI is a recognised predictor of mortality and unfavorable prognosis. However, given the vast variety of normal vital signs seen in healthy children, pediatric patients rarely fit into adult physiologic parameters. The inherent distinctions in anatomy and physiology between pediatric trauma patients and adult patients call for specific consideration in terms of evaluation and management. Maintaining SBP in children does not guarantee that the child patient is not in shock [16].

Tachycardia is the coping mechanism employed to sustain cardiac output when stroke volume is lowered due to hypovolemia or diminished heart function. However, due to a higher resting heart rate than adults, children have a lower capacity to compensate with tachycardia. Infants and children's peripheral tissue microvascular beds vasoconstrict in an effort to maintain cardiac preload and perfusion pressure because of their insufficient cardiac reserve, which causes a longer capillary refill time. Child mortality and functional morbidity rates are reduced when this delayed capillary refill time and/or hypotension are treated promptly with Pediatric Advanced Life Support/Advanced Pediatric Life Support approved therapies [17]. Unfortunately, measurements of capillary refill time are not included in the NTDB data set, unlike those of hypotension. This is probably because they are subjective and lack assessment standards. However, tachycardia is still useful in predicting un-favorable outcomes in youngsters, along with hypotension. Tachycardia is frequently incorporated into validated illness severity rating systems, such as the pediatric risk of death score [18], and the Pediatric Early Warning System [17], and has been found to indicate some increased mortality risk in shock [19].

According to the current study, the total mortality rate for the paediatric group under observation was 6.5%. **Lynch and his colleagues** [1] showed that abdominal trauma can be linked to severe morbidity and may have a mortality as high as 8.5% (a similar occurrence). **Ameh and his colleagues** [20] found a higher incidence when they studied pediatric abdominal trauma cases, finding that mortality was 8 (14.5%) due to stomach perforation (3), liver injury (2), splenic injury (1), and two kids passed away before to surgery [20]**.** However, **Sabounji and his associates** [21] showed that in pediatric cases with blunt abdominal injuries, no death was reported [21]**.** The disparities in the results could be explained by the fact that penetrating traumas have a high mortality rate and that different research have used varied ratios of this type of trauma, which could affect the overall mortality rate.

The current study showed that, at a cutoff of 0.905, the shock index has the ability to distinguish between cases with assisted ventilation (AUC=0.666) with sensitivity and specificity of 83.3% t and 36.5% respectively (P=0.179), supporting the validity of shock index in differentiating complications and outcome of the studied cases. With an AUC of 0. 690 and a sensitivity and specificity of 70.6% and 40.5%, respectively, at the cutoff of 1.235, SI has the validity to distinguish between cases involving surgical intervention (P=0.017). With an AUC of 0.836 and a sensitivity and specificity of 87.5% and 80.6%, respectively, at the cutoff value of 0.905, SI is appropriate for differentiating between cases with reference to inotropy (P=0.002). With a sensitivity and specificity of seventy-five percent and 82.9% respectively (P=0.076), SI has the validity to distinguish between the examined cases as to mortality at a cutoff of 0.905 (AUC=1.39). In a similar vein, **Wikström and his colleagues** [22] demonstrated that the outcomes of interest for major trauma patients were survival to hospital release and function and health condition at 6 months after injury. Measures of discrimination and calibration were used to analyse survival and function, while R2 and MRSE measurements were used to gauge health state. The Victorian State Trauma Registry (VSTR) survival model's area under the receiver operating characteristic curve (AUC) improved when the SI was included (AUC 0.797 (0.787-0.807) versus AUC 0.807 (0.797-0.816), p<0.001)) [22].

It is still uncertain how to identify and treat injuries in pediatric trauma patients using physiologic markers as a guide. To activate the surgeon-directed trauma team, the majority of pediatric trauma centres use a combination of anatomical, physiologic, and mechanism-based criteria. As sensitive as criteria that take into account the mechanism of injury in determining which patients need resuscitation, the standard anatomic and physiological criteria also contain them [23]. Physiologically focused criteria may reduce over-triage while preventing under-triage and maximizing cost effectiveness [24].

## CONCLUSION

In pediatric trauma patients, elevated SI may be used as a precise and accurate predictor of morbidity and mortality. It enables quick evaluation of these individuals and is a useful tool that can be used to direct decisions about therapeutic care and resuscitation. The results of the current investigation support the use of increased SI as a simple, easily available measure to improve early identification of pediatric children who are at risk of shock and consequent adverse outcomes. SI has a higher sensitivity and lesser specificity for anticipating assisted breathing. With a higher sensitivity and lower specificity, SI has the potential to accurately forecast the requirement for surgical intervention.

## LIMITATIONS

We were unable to directly compare high SI to normative values due to the unfortunate lack of data on normal values of SI in children. The current study highlighted the utility of SI as an early predictor of hemodynamic instability in the pediatric population in spite of these limitations.

## RECOMMENDATIONS

SI is a straightforward measure that can help identify pediatric patients more quickly who are at risk of shock and its severe effects. SI may be utilized to direct decisions on therapeutic care and resuscitation.

**Conflict of interest:** The investigators declared no conflict of interest.

**Sources of funding:** There was no specialized grant from funding organizations for the current investigation.

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