Should the New Injury Severity Score replace the Injury Severity Score in the Trauma and Injury Severity Score?

Travma ve Yaralanma Şiddeti Ölçeği'nde, Yaralanma Şiddeti Ölçeği'nin yerini Yeni Yaralanma Şiddeti Ölçeği alabilir mi?

Şule Akköse AYDIN,[1] Mehtap BULUT,[1] Halil ÖZGÜÇ,[2]
İlker ERCAN,[3] Nursel TÜRKMEN,[4] Bülent EREN,[4] Mehmet ESEN[1]

BACKGROUND
This study was performed to compare the efficacies of Injury Severity Score (ISS) and New Injury Severity Score (NISS), and to investigate whether replacing ISS with NISS in Trauma and Injury Severity Score (TRISS) changes the predictive power for mortality.

METHODS
We retrospectively analyzed 550 patients aged over 16 years seen in our center over a period of four years who had injuries in at least two organ systems. The ISS, NISS and TRISS were calculated for each patient. TRISS was calculated in two ways: TRISS 1 with age, Revised Trauma Score (RTS) and ISS, and TRISS 2 with age, RTS and NISS. The cut-off values for TRISS 1, TRISS 2, ISS and NISS were determined by ROC analysis.

RESULTS
The ideal cut-off values for the prediction of mortality were 21.0 (AUC: 0.907) for ISS and 25.0 (AUC: 0.914) for NISS. There was no statistically significant difference between the ROC curves of ISS and NISS. The ideal cut-off values for predicting mortality were 90 (AUC: 0.934) for TRISS 1 and 86 (AUC: 0.935) for TRISS 2. There was no statistically significant difference between the ROC curves of TRISS 1 and TRISS 2.

CONCLUSION
Use of NISS instead of ISS in the TRISS model demonstrated no significant difference, and it can thus be recommended for use.

Key Words: Injury Severity Score; New Injury Severity Score; Trauma and Injury Severity Score.

AMAÇ
Bu çalışmada, çoklu travmalı olgularda mortalitenin öngörülmesinde hem Yaralanma Şiddeti Ölçeği (ISS) ile Yeni Yaralanma Şiddeti Ölçeği (NISS) etkinliği karşılaştırıldı, hem de "Travma ve Yaralanma Şiddeti Ölçeği'nde (TRISS) ISS'nin yerini NISS alabilir mi?" sorusuna cevaplar arandı.

GEREÇ VE YÖNTEM
En az iki organ sistemi yaralanması olan 16 yaş üstü 550 travma olgusunun Revize Edilmiş Travma Skoru (RTS), ISS ve NISS'leri saptandı. Bu olguların TRISS'leri önce önerilen yönteme göre; ISS, RTS, yaş parametreleriyle (TRISS 1) sonra NISS, RTS ve yaş parametreleriyle (TRISS 2) hesaplandı. Her skorun *cut-off* değerleri ROC analizi ile belirlendi. Belirlenen *cut-off* değerlerine göre sınıflanan travma skorları, diğer olası risk faktörleriyle birlikte lojistik regresyon analizine konuldu ve mortaliteyi etkilemedeki risk düzeyi araştırıldı.

BULGULAR
ISS, NISS, TRISS 1 ve TRISS 2'için ideal *cut-off* değerleri sırasıyla 21.0 (AUC: 0,907), 25.0 (AUC: 0,914), 90 (AUC: 0,934), 86 (AUC: 0,935) olarak hesaplandı. Mortalitenin öngörülmesinde ISS ile NISS ve TRISS 1 ile TRISS 2 arasında istatistiksel olarak anlamlı bir farklılık saptanmadı.

SONUÇ
Sonuç olarak, mortaliteyi öngörmede ISS ile NISS arasında anlamlı bir fark yoktur. TRISS modelinde ISS yerine NISS kullanılması anlamlı bir farklılığa yol açmamaktadır ve bu nedenle önerilebilir.

Anahtar Sözcükler: Yaralanma Şiddeti Ölçeği; Yeni Yaralanma Şiddeti Ölçeği; Travma ve Yaralanma Şiddeti Ölçeği.

Departments of [1]Emergency Medicine, [2]General Surgery, [3]Biostatistic, [4]Forensic Medicine
Medicine Faculty of Uludağ University, Bursa, Turkey.

Uludağ Üniversitesi Tıp Fakültesi, [1]Acil Tıp Anabilim Dalı, [2]Genel Cerrahi Anabilim Dalı, [3]Biyoistatistik Anabilim Dalı, [4]Adli Tıp Anabilim Dalı, Bursa.

Correspondence *(İletişim):* Şule Akköse Aydın, M.D. Uludağ Üniversitesi Tıp Fakültesi Acil Tıp Anabilim Dalı, Görükle 16059 Bursa, Turkey.
Tel: +090 - 224 - 442 84 00 / 1803 e-mail*(e-posta):* suleakkose@yahoo.com

Scoring systems are the cornerstones of trauma epidemiology. Accurate assessment and management of injury are vital for treatment and clinical trials.

Numerous scoring systems have been developed to represent the severity of injury. The Trauma and Injury Severity Score (TRISS) and the Injury Severity Score (ISS) have been used widely for the prediction of trauma-related mortality.[1,2] TRISS is based on three parameters: the Revised Trauma Score (RTS), ISS and age. The Abbreviated Injury Scale (AIS) is used in the calculation of ISS.[3] The AIS assigns points for each injury and together with the associated severity score, categorizes them as follows: minor 1, moderate 2, serious 3, severe 4, critical 5 and moribund 6. The ISS has been devised to summarize the condition of patients with multiple injuries. ISS is calculated by adding the squares of the AIS values of the three most severely injured body areas. However, ISS has some limitations:[4] it ignores injuries outside the three most severely injured body areas as well as the injuries with the same AIS in each body area. The New Injury Severity Score (NISS) has been developed to overcome these shortcomings.[5] In contrast with ISS, NISS considers severe injuries in multiple body areas.[5] Various studies have been performed to compare the efficacies of ISS and NISS.[6,7]

This study was performed to compare the efficacies of ISS and NISS and to investigate whether replacing ISS with NISS in TRISS changes the predictive power for mortality.

MATERIALS AND METHODS

The records of the 550 patients who were admitted to the Emergency Unit of the Uludağ University School of Medicine between January 1st 2002 and January 1st 2006 were evaluated retrospectively. Patients who were older than 16 years of age and had injuries in at least two organ systems were enrolled. The resuscitation, diagnosis and treatment of the patients were conducted according to the Advanced Trauma Life Support principles. The records were compiled in two ways: First, the records of the admitted trauma patients who had at least two organ system injuries were considered, and age, sex, trauma mechanism, vital signs at admission, injuries, Glasgow Coma Score (GCS) and RTS were noted. Second, the clinical charts of the patients were used to obtain information on the definite diagnoses, mortality, duration of hospital stay, and operation findings. An AIS revision 1990 (AIS-90) score was assigned for each injury, and in patients for whom the definite diagnoses could be obtained, ISS, NISS and TRISS were calculated. TRISS was calculated in two ways: TRISS 1 with age, RTS and ISS, and TRISS 2 with age, RTS and NISS.

Statistical analysis

All data were analyzed using SPSS software (version 11.0, SPSS Inc., IL, USA). The data were expressed as mean±standard error and median value.

The cut-off values for TRISS 1, TRISS 2, ISS and NISS were determined by receiver operating characteristics (ROC) analysis. The trauma scores categorized with respect to the cut-off values were entered into logistic regression together with other possible risk factors, and their contributions to the prediction of mortality were assessed.

Categorical values were compared with the chi-square test. Probability values smaller than 0.05 were considered significant.

Table 1. Epidemiological findings

Variable	Results
Demographic data	
Age (years), (mean±SE)	39.56±0.70
Male sex, %, (n)	78% (n: 429)
Region of trauma, %, (n)	
Head-neck	44.2% (n: 243)
Face	21.5% (n: 118)
Thorax	47.8% (n: 263)
Abdomen	26% (n: 143)
Extremity	70.7% (n: 389)
External	0.5% (n: 3)
Trauma score (mean±SE, median)	
GCS	12.25±0.17, 15
RTS	6.75±0.07, 7.80
ISS	19.86±0.44, 18.0
NISS	21.88±0.46, 20.0
Mechanism of injury, % (n)	
Traffic accidents	71% (n: 391)
Fall	23.3% (n: 128)
Other	5.7% (n: 31)
Mortality	21.6% (n: 119)

Table 2. Prediction of mortality for various scores

Score	Cut-off	AUC	Sensitivity (%)	Specificity (%)	p
ISS	21.0	0.907	89.1	78.7	p<0.001
NISS	25.0	0.914	85.7	82.4	p<0.001
TRISS 1	90.0	0.934	83.2	87.9	p<0.001
TRISS 2	86.0	0.935	81.5	90.5	p<0.001

RESULTS

The mean (± standard error) age of the 550 patients was 39.56±0.7 years; 22% of the patients (n: 121) were women and 78% (n: 429) were men. Mortality was 21.6% (n: 119). The trauma mechanisms and injury sites are presented in Table 1.

The mean (± standard error, median) GCS, RTS, ISS and NISS of the patients were 12.25± (0.173, 15), 6.75± (0.071, 7.80), 19.86± (0.441, 18.00), and 21.88 ± (0.462, 20.00), respectively (Table 1).

The ideal cut-off value of ISS for the prediction of mortality was 21.0 (Area under the curve [AUC]: 0.907, p<0.001, sensitivity: 89.1%, specificity: 78.7%); for NISS, it was 25.0 (AUC: 0.914, p<0.001, sensitivity: 85.7%, specificity: 82.4%) (Table 2, Figs. 1, 2).

There was no statistically significant difference between the ROC curves of ISS and NISS (p>0.05) (Fig. 3).

The ideal cut-off value of TRISS 1 for predicting mortality was 90 (AUC: 0.934, p<0.001, sensitivity: 83.2%, specificity: 87.9%); for TRISS 2, it was 86 (AUC: 0.935, p<0.001, sensitivity: 81.5%, specificity: 90.5%) (Table 2, Figs. 4, 5). There was no statistically significant difference between the

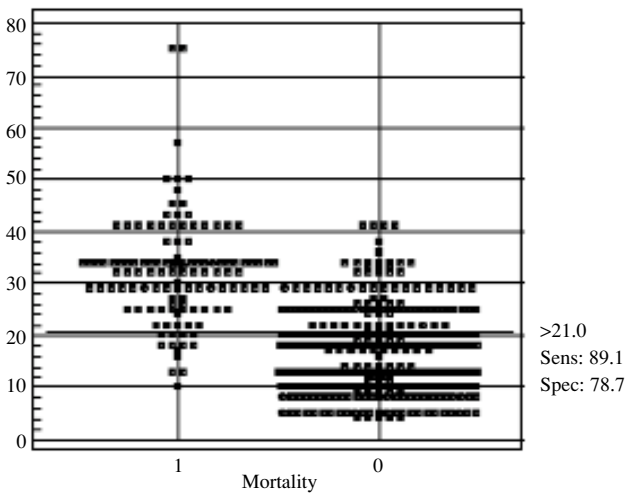

Fig. 1. The distribution of survivors and non-survivors with respect to the cut-off value of ISS.

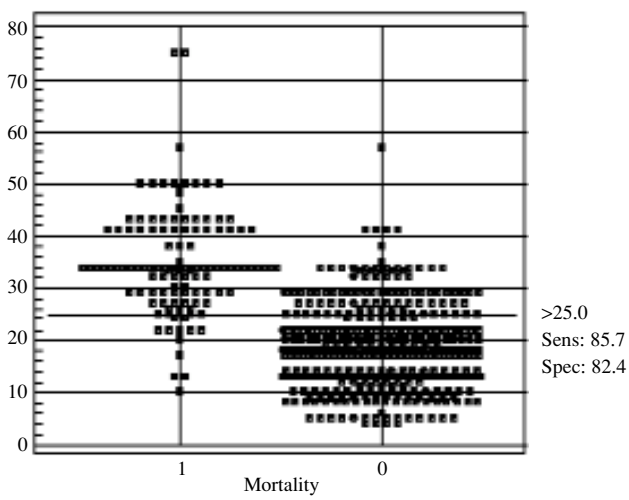

Fig. 2. The distribution of survivors and non-survivors with respect to the cut-off value of NISS.

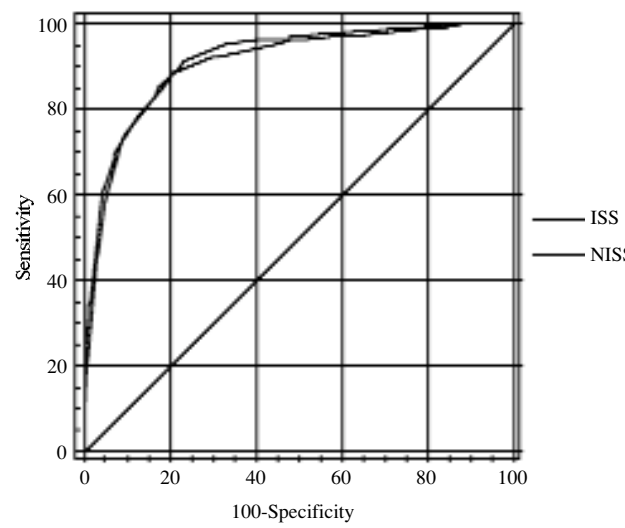

Fig. 3. Comparison of the ROC curves of ISS and NISS.

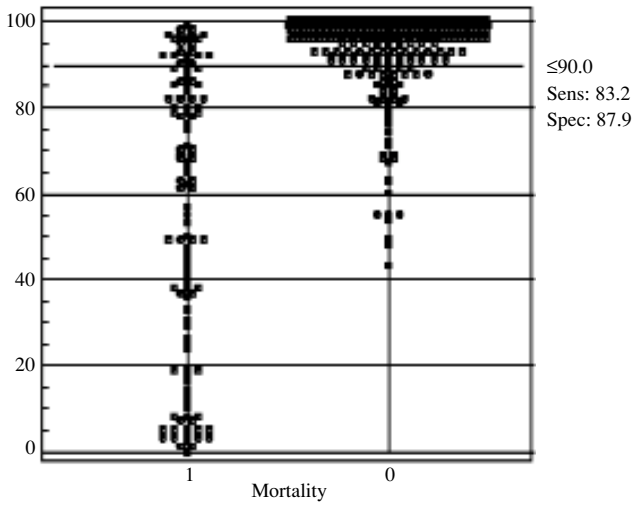

Fig. 4. The distribution of survivors and non-survivors with respect to the cut-off value of TRISS 1.

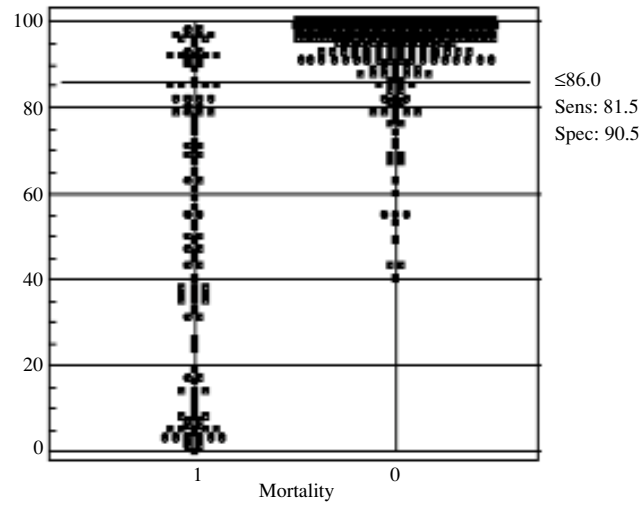

Fig. 5. The distribution of survivors and non-survivors with respect to the cut-off value of TRISS 2.

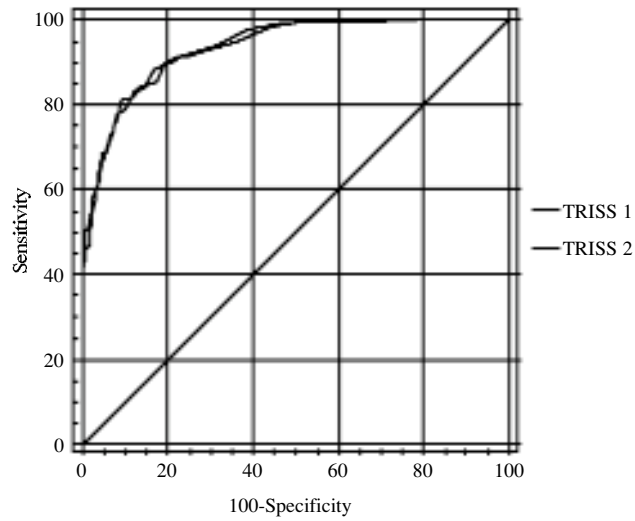

Fig. 6. Comparison of the ROC curves of TRISS 1 and TRISS 2.

ROC curves of TRISS 1 and TRISS 2 (p>0.05) (Fig. 6).

As possible factors affecting mortality, sex, age, trauma mechanism, ISS and NISS (categorized with respect to the cut-off values) were entered into logistic regression and the model was found to be statistically significant (Hosmer-Lemeshow [HL] test, model: p>0.05). NISS above the cut-off value increased the risk of mortality 30.87 times (95% confidence interval [CI]; 16.98-56.13), while ISS above the cut-off value increased it 31.30 times (95%CI: 16.59-59.05) (p<0.001).

TRISS 1, TRISS 2, sex and trauma mechanism were entered separately into the model and analyzed by logistic regression. and the model was found to be statistically significant (HL test, model: p>0.05). Above the cut-off value, TRISS 1 increased the risk of mortality 34.37 times (95%CI: 19.52-60.51) and TRISS 2 44.01 times (95%CI: 24.48-79.12) (p<0.001).

The ratio of patients with equal ISS vs NISS values was 34.4% (n: 189); the NISS was higher than the ISS in 65.6% (n: 361). There was no statistically significant difference in the prediction of mortality in the patients with equal or different ISS and NISS scores (p>0.05).

Patients exposed to severe trauma and with ISS ≥24 (n: 180) were considered in two categories as ISS = NISS and NISS > ISS, and no statistically significant difference between their predictive powers for mortality was found (p>0.05).

DISCUSSION

Injury Severity Score has been used in trauma epidemiology for many years. NISS, which was devised in view of the limitations of ISS, is also used, although not as widely. There are studies comparing the efficacies of ISS and NISS for mortality prediction. In some studies, NISS appears to have more predictive power,[7,8] whereas in others,[9-11] there was no significant difference. In the present study, no difference was determined between the predictive powers of ISS and NISS.

The New Injury Severity Score has some clinical and practical advantages over ISS. In the case of multiple injuries at a single body site, ISS is calculated by taking the square of the most severe injury according to the AIS-90 code. However, in the same patient, NISS is calculated by adding the squares of the AIS-90 codes for the two injuries. For example, in a head trauma patient with two injuries on the head and an AIS-90 severity code of 5, ISS is 25 and NISS is 50. In order to overcome this problem, patients with injuries at a single site were excluded form the present study.

In studies in patients exposed to severe trauma and with ISS higher than 24, patients were categorized as those with equal ISS and NISS and those with NISS higher than the ISS. In some studies, the predictive value was higher in the group with a NISS higher than the ISS,[7,10,12] whereas in others, no difference was detected.[9] No difference was found in the present study as well. This confirms that the ideal cut-off values for ISS and NISS have been identified.

In the present study, NISS was used instead of ISS in the TRISS model. TRISS was calculated in two ways: according to the proposed model (RTS+ISS+age: TRISS 1) as well as by using NISS instead of ISS (RTS+NISS+age: TRISS 2). There was no significant difference between TRISS 1 and TRISS 2 in the prediction of mortality. In a study conducted in blunt trauma patients in Iran,[13] TRISS calculated with RTS + NISS + age had marginally better predictive power than TRISS calculated with the previously recommended parameters - RTS + ISS + age. The discrepancy between that study and our results may be due to the smaller number of patients in the Iranian study and the inclusion of only severely injures patients in the present study.

The low number of patients is an important limitation of our study.

CONCLUSION

In patients with injuries in at least two body sites, there was no difference between ISS and NISS in the prediction of mortality. Since the use of NISS instead of ISS in the TRISS model demonstrated no significant difference, it can be recommended for use. This suggestion should be tested in a larger study of patients exposed to severe trauma.

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