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ORIGINAL ARTICLE

Performance of ISS, NISS, and RTS trauma scales in traffic accidents to predict mortality in a high-complexity hospital

Rendimiento de escalas de trauma ISS, NISS y RTS en accidentes de tránsito para predecir mortalidad en un hospital de alta complejidad

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Abstract

Background. The global population is on the rise and with such motor vehicle collisions, increasing the morbidity and mortality of individuals implicated in traffic accidents. The combination of clinical and paraclinical factors, as done by the different trauma scales, have an impact upon morbidity and mortality by allowing timely actions.

Methods. Cross-sectional study that included patients with collision injuries in traffic accidents, treated at an emergency department from 2017 to 2018 at Hospital Universitario San José in Popayán, Colombia, a high-complexity hospital. The study defined the universe, collected sociodemographic and biological variables, and applied three trauma scales: Revised Trauma Score, Injury Severity Score, and New Injury Severity Score. Subsequently, its performance in predicting mortality was evaluated.

Results. Six-hundred-fifty patients with collision injuries were treated in the emergency department with lesions due to collisions in traffic accidents; 16 deaths were reported. We found that the sensitivity varies between 75% for the Revised Trauma Score to 93.8% for the Injury Severity Score and the New Injury Severity Score. Likewise, an adequate specificity varying from 89,1% for the Injury Severity Score to 96,8% for the Revised Trauma Score. The best

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positive likelihood ratio was for the Revised Trauma Score. The negative likelihood ratios for the Injury Severity Score and the New Injury Severity Score were adequate.

Conclusion. The results show an adequate performance of the trauma scales evaluated to predict mortality. The scale that presented the best performance was Injury Severity Score due to its sensitivity, specificity and positive likelihood ratio.

Keywords: traffic accidents; emergencies; wounds and injuries; trauma severity indices; x-ray computed tomography; mortality.

Resumen

Introducción. La población mundial crece y con ello los accidentes de tránsito, incrementando la morbimortalidad. La combinación de factores clínicos y paraclínicos mediante las escalas de trauma impacta en los desenlaces al permitir tomar acciones oportunas.

Métodos. Estudio de corte transversal en el que se incluyeron pacientes con lesiones por colisión en accidentes de tránsito, atendidos entre 2017 y 2018, en urgencias del Hospital Universitario San José de Popayán, Colombia, un hospital de alta complejidad. Se recolectaron variables sociodemográficas y biológicas y se aplicaron tres escalas de trauma, *Revised Trauma Score, Injury Severity Score* y *New Injury Severity Score*. Posteriormente, se evaluó su rendimiento para predecir mortalidad.

Resultados. Se atendieron en el servicio de urgencias 650 pacientes con lesiones en accidentes de tránsito y se presentaron 16 muertes. Al evaluar el rendimiento de las escalas de trauma se encontró que la sensibilidad para mortalidad varía entre el 75 % para *Revised Trauma Score* y el 93,8 % para *Injury Severity Score* y *New Injury Severity Score*, con una especificidad que varía entre 89,1 % y 96,8 %. Se identificó que la mejor razón de verosimilitud positiva fue para *Revised Trauma Score*, mientras que la mejor razón de verosimilitud negativa fue para *Injury Severity Score* y *New Injury Severity Score*.

Conclusiones. Los resultados evidencian un adecuado rendimiento de las escalas de trauma evaluadas para predecir mortalidad. La escala que presentó mejor rendimiento fue *Injury Severity Score* por su sensibilidad, especificidad y razón de verosimilitud positiva.

Palabras clave: accidentes de tránsito; urgencias médicas; heridas y traumatismos; índices de gravedad del trauma; tomografía computarizada por rayos x; mortalidad.

Introduction

The world population is growing and in turn the number of cars in the world. It is estimated a world population of 7.6 billion people and about 1.2 billion vehicles[1,2]. Nearly 3,500 people die every day and at least 50 million people are left with some degree of disability after a traffic accident[3-6]. In addition to the consequences on health, traffic injuries cause a great economic impact. According to the World Health Organization (WHO), the cost of these injuries is 1% of gross domestic product in low-income countries, 1.5% in medium-income countries, and 2% in high-income countries, affecting predominantly to the most disadvantaged sectors[7]. It is considered that the annual cost of traffic accidents in low- and middle-income countries ranges between $65 and 100 billion dollars, a value that exceeds the total amount received by the government for the development of each country. The years of working life lost mainly affect men, and studies show 490.83 years lost due to disability and a value of productive years of life lost of 1,433,103, with an approximate cost of 9,521.2 million euros[7,8].

Colombia is no stranger to this global epidemic, it has an incidence of traffic accidents of around 11%, like the rest of the Latin American countries. According to the Pan American Health Organization (PAHO), the 2009 mortality rate in Colombia was 11.73 per 1,000,000 inhabitants, and according to the Institute of Legal Medicine, 15% of deaths are the product of traffic accidents, being the second non-organic or biological cause of death, only ahead of violent deaths[9-12]. According to Quitian and collaborators[13], the years of life lost due to premature death due to traffic accidents in Colombia rank third. In Bogotá, D.C., in 2015 there were an average of 8 deaths per week due to traffic accidents, with 1.4 years of life lost per 1,000 inhabitants[13]. However, this figure is low compared to the national average of 3.7 years of life lost per 1,000 inhabitants reported by CENDEX (Center for Projects for the Development of the Javeriana University - Colombia), who additionally report that the greatest impact is between 15 and 34 years of age, generating an impact on the economy given that most deaths occur in the most productive years of life[13].

Trauma scoring scales are the cornerstone of trauma epidemiology, as they allow the severity of injuries to be determined and the most appropriate management to be defined, facilitating auditing and investigation processes by achieving standardization of traffic accident trauma[14]. Both anatomical and physiological scales are of great help in predicting mortality[10,11]. These instruments were introduced more than 30 years ago and consist of assigning a numerical value to an anatomical injury or physiological changes caused after an injury; additionally, those that combine physiological and anatomical variables are considered useful to assess prognosis[15].

The Injury Severity Score (ISS) and New Injury Severity Score (NISS) are anatomical scales that can only be calculated after a patient is admitted to the trauma center and injuries are assessed and tabulated. On the other hand, the Revised Trauma Score (RTS) scale is a scale of physiological variables that can be quickly calculated by healthcare personnel[4,15-17]. The RTS is a physiological scale with 97.2% inter-rater reliability and demonstrated accuracy in predicting mortality; this is scored from the first data obtained from the patient and is based on the Glasgow Coma Scale, systolic pressure and respiratory rate[18]. The ISS is an anatomical scale that provides a score for patients with multiple injuries and is linearly correlated with mortality, morbidity, hospital stay and other measures of severity; its main drawback is that it considers only one injury in each region of the body and may omit some of the injuries in the same anatomical region evaluated[17,19]. The NISS, designed by Osler and collaborators, is a modification of the ISS consisting of the sum of the three most important injuries squared, regardless of the region of the body injured, therefore, the NISS will be equal to or greater than the ISS[17,19].

Numerous studies in different countries have used different methodologies to compare the predictive capacity in terms of mortality of the ISS and NISS, finding that the NISS is superior to the ISS, especially for predicting mortality in blunt trauma. Comparing the ISS and the NISS, they were found to have similar accuracy in predicting mortality; however, the sensitivity of the NISS was slightly higher and the specificity lower. The likelihood ratio of the NISS and the ISS are similar, with a result that indicates approximately 5 times greater risk of mortality; however, it is established that this ratio must be at least 10 to be highly relevant[5,20-22]. On the other hand, the lower the score on the Glasgow scale, the RTS values are associated with an increase in mortality and a longer stay in the intensive care unit, demonstrating that an increase in the ISS values and a decrease in in those of the RTS they were correlated with a longer hospital stay[23].

Taking into account that the information on the epidemiology of traffic accidents and the application of these scales and their performance in our environment is unknown, added to the great impact at the economic, social and health system levels, this research was proposed with the objective of determining the performance of the ISS, NISS, and RTS scales to identify the best scoring system and predictor of mortality in a population exposed to traffic accidents at the Hospital Universitario San José (HUSJ) in Popayán, Colombia.

Methods

Descriptive, cross-sectional study that included all patients over 15 years of age with collision injuries in traffic accidents, who were admitted to the emergency department through the type of insurance covered by the Compulsory Traffic Accident Insurance (SOAT), during the period between August 2017 and August 2018, at the Hospital Universitario San José in Popayán, a high-complexity public hospital and reference center in the department of Cauca and the south-west of Colombia, which serves the population of the contributory and subsidized regime of the social security system in the country. Those patients who were admitted without vital signs, with previous surgical management in another institution or who did not have complete information in the clinical history were excluded, which corresponded to 15% of the sample described.

Data collection proceeded prior approval by the institutional ethics committee. For this, a semi-structured instrument prepared by the researchers and reviewed by experts (professors of the Department of Surgery of the University of Cauca) was used. It was adjusted through a pilot test and later a database was created in Excel. To guarantee the quality of these data, input control was performed using validation rules. Finally, the data were managed and analyzed in the statistical program Stata (StataCorp LLC, College Station, USA), version 11.0.

Mortality in their first admission to the institution after the traffic accident was taken as the outcome variable. A traffic accident was defined as an event caused or in which at least one motor vehicle was involved in motion, on a public or private road with public access, intended for the transit of vehicles, people and/or animals and which, as a consequence of its circulation or transit, or due to violation of a legal or regulatory precept of transit, causes damage to the physical integrity of people[24].

The RTS trauma scale was applied, which integrates the Glasgow Coma Scale, systolic blood pressure and respiratory rate; the sum of the previous values allows predicting mortality using a scale that ranges between 0 - 7.84, with the best cut-off point being ≤ 6 according to previous research, which is why it was taken as the cut-off point for the present study[25]. Also the ISS was applied, which is used as a standard measure to determine the severity of patients in terms of anatomical measurements by independent anatomical regions, and the NISS, which takes the three largest lesions regardless of the anatomical region in which they are located, with the ability to predict mortality. For both the ISS and the NISS, its highest score is 75 points, and mild trauma is classified as one with a score of 1 to 9, moderate from 10 to 15 points, moderate to severe from 16 to 25 points, and severe trauma is one with more 25 points; however, a score greater than 15 points on the ISS scale is described as polytrauma, so for this study we took the cut-off point greater than 25 points as the best for predicting mortality[25,26].

Prior to the application of the trauma scales, they were standardized and a specialist in general surgery trained the health personnel of the emergency service that treats patients with trauma, homogenizing their application.

Sociodemographic variables were measured, such as age, gender, type of civil unions of couples (stable: includes married couples and those in a relationship that, without being married, form a permanent life community), race (mestizo and minorities, considering minorities to indigenous people and Afro-descendants), comorbidities (if they had any previous disease or physical limitation such as high blood pressure, diabetes mellitus, heart disease and cognitive disorders), place of accident, previous medical care, referral from a less complex level, type of vehicle (car or truck, motorcycle or bicycle), high energy mechanism defined as partial or total ejection of the vehicle, death of passenger or pedestrian, pedestrian or cyclist run over at more than 30 km/hour, motorcycle collision greater than 30 km/h hour, time of hospital admission after trauma and death[20]. Additionally, biological variables such as blood pressure, heart rate, frequency respiratory insufficiency, venous saturation, temperature, shock index expressed as heart rate divided by systolic blood pressure (with

a cut-off point less than or greater than 0.9) and Glasgow Coma Scale, which is calculated by adding the best motor response score, the best verbal response and the best ocular response, with a range from 3 (worst) to 15 (best)[27].

Performing a full-body computed tomography (panCT) was defined as a protocol for polytraumatized patients, as follows:

1. full body anteroposterior and lateral views from head to toe,
2. brain without contrast: from the vertex to C2 with 0.6 mm slices and 3 mm reconstructions,
3. face and cervical or total spine without contrast with reconstructions in the 3 planes,
4. neck and chest in arterial phase with 0.6 mm cuts and,
5. abdomen and pelvis in arterial phase (30 seconds after contrast injection), portal phase (70 seconds), and late phase (2 to 5 minutes)[28,29].

Statistic analysis

The variables were analyzed from the exploratory point of view to look at the normality of their distribution and identify missing or extreme values that could influence the result. Student's t test was used for continuous variables with normal distribution, after analysis of variance, and for those that did not have normal distribution, the Mann-Whitney U test was used, after application of the Shapiro-Wilk normality test and chi square or Fisher, as appropriate. Subsequently, the performance of the different scales, their sensitivity, specificity, predictive values and likelihood ratio (LR), with their respective 95% confidence intervals, were evaluated.

Results

The final analysis was performed with 650 patients; 2.5% (n=16) of the patients died, of these 93.2% were men; 75% traveled by motorcycle, 18.7% by car and 6.2% as pedestrians.

Regarding the sociodemographic characteristics (Table 1), an average age of 36.3 +/- 16 years was found, the majority of traffic accidents occurred in men (70.9%), mestizo ethnicity (95.8%) and without comorbidities (90%). More than half of the accidents (59.2%) occurred in the urban area, but only 38.8% received prior medical attention by paramedics, ambulances or health personnel from the level 1 of care. On the other hand, 32% of the patients admitted referred from

Table 1. Demographic and trauma characteristics in patients treated for traffic accidents. Hospital Universitario San José, Popayan, Colombia. 2018 (n= 650).

Variable	Frequency	%
Age (years ± SD*)	36.3 ± 16.0	
Gender		
Male	461	70.9
Female	189	29.1
Civil status		
Stable union	434	66.7
Non-stable	216	33.3
Ethnic		
Mestizo	623	95.8
Minorities	27	4.2
Comorbidities		
Yes	65	10
No	585	(90)
Place of accident		
Urban	385	59.2
Rural	248	38.2
Expressway	17	2.6
Previous medical attention		
Yes	252	38.8
No	398	61.2
Remission		
Yes	208	32
No	442	68
Type of vehicle		
Motorcicle	460	70.8
Car	79	12.2
Bicycle	31	4.8
Pedestrian	80	12.3
Mecanism of high energy		
Yes	157	24.2
No	493	75.8
Time before admission		
Less than 1 hour	104	16
More than 1 hour	546	84
Deaths		
Yes	16	2.5
No	634	97.5

*SD: standard deviation. Source: own data.

the level 1 of care. Most accidents occurred on a motorcycle (70.8%) and 75.8% were low energy accidents; 84% of the injured were admitted to the hospital one hour after the accident occurred.

Regarding the physiological variables (Table 2), we found that 93.2% of the patients were admitted with normal systolic blood pressure (SBP), while 5.5% of the patients presented an altered heart rate and the 1.9% of patients had low oxygen saturation in peripheral blood. Only 2.3% were admitted with some degree of hypothermia and, with respect to the shock index, 7% were greater than 0.9. The Glasgow scale was less than 14 in 10.2%. Regarding the severity scores of the evaluated scales, the ISS had a score higher than 25 in 13%, the NISS had a score higher than 25 in 17.9%, and the RTS had a score lower than 6 in 5%.

In reference to the procedures and diagnostic tests performed in the population evaluated (Table 3), 5.7% required orotracheal intubation

Table 2. Physiological variables and ISS, NISS and RTS severity scores in traffic accidents at the Hospital Universitario San José, Popayán, Colombia. 2018 (n= 650).

Variable	Frequency	%
Arterial systolic blood pressure (mmHg)		
≥ 141	35	5.4
91 - 140	606	93.2
≤ 90	9	1.4
Arterial diastolic blood pressure (mmHg)		
≤ 59	22	3.4
> 60	628	96.6
Heart rate (beats/min)		
≤ 59	7	1.1
60 – 100	611	94
≥ 101	32	4.4
Respiratory rate (breaths/min)		
≤ 12	2	0.3
≥ 13	585	98.7
Oxygen saturation (%)		
≤ 89	12	1.9
≥ 90	638	98.1
Temperature (°C)		
≤ 35.9	15	2.3
≥ 36	635	97.7
Shcok index		
≤ 0.9	605	93
> 0.9	45	7
Glasgow Coma Scale		
15	584	89.8
≤ 14	66	10.2
ISS (Injury Severity Score)		
≤ 25	566	87
> 25	84	13
NISS (New Injury Severity Score)		
≤ 25	534	82.1
> 25	116	17.9
RTS (Revised Trauma Score)		
≤ 5.9	32	5
> 6.0	618	95

Source: own data.

Table 3. Special requirements and interventions in patients treated for traffic accidents. Hospital Universitario San José, Popayan, Colombia. 2018 (n= 650).

Variable	Frequency	%
Orotraqueal intubation		
Yes	37	5.7
No	613	94.3
Required mechanical ventilation		
Yes	37	5.7
No	613	94.3
Mechanical ventilation (days) (n=36)		
< 5	19	52.8
> 5	17	47.2
Intensive Care Unit (ICU)		
Yes	57	8.8
No	593	91.2
ICU stay (days) (n=57)		
≤ 5	26	45.6
> 5	31	54.4
Hospital stay (days)		
≤ 10	589	84.3
> 10	102	15.7
Pan CT		
Yes	314	48.3
No	336	51.7
Required surgical procedure		
Yes	273	42
No	377	58
Number of surgical procedures (n=273)		
One	171	62.6
More than one	102	37.2
Vasopressors		
Yes	21	3.2
No	629	96.7
Nutritional support		
Yes	24	3.7
No	626	96.3
Lactate level (mmol/l) (n=45)		
< 2	10	1.5
> 2	35	5.4

Source: own data.

and mechanical ventilation, and of these, 47.2% required it for more than 5 days. 54.4% of the population required a stay of more than 5 days in the intensive care unit (ICU). Of those who did not require ICU, 15.7% remained hospitalized in the general ward for more than 10 days. PanCT was performed in 48.3% of the patients. Surgical management was necessary in 42% of the population; 62.6% required a single intervention and 37.2% more than one procedure. On the other hand, 3.2% required vasoactive support and 3.7% nutritional support.

When evaluating the performance of the trauma scales (Table 4), it was found that the sensitivity and specificity were adequate. The LR (+) was 23.7 for the RTS and 5.88 for the NISS. The LR (–) was adequate for ISS and NISS and poor for RTS. Comparing the baseline characteristics according to the results of the different scales (positive or negative), it was shown that there are statistical significances regarding the variables of gender, place where the accident occurs, previous hospital medical care, high-energy mechanism, and mortality. No statistical differences were found in the other variables (Table 5).

With the analysis of the different interventions or procedures practiced regarding the result of the ISS, NISS, and RTS scales, it was evidenced that there is a statistically significant difference in all of them, which correlates with the adequate performance of the evaluated trauma scales (Table 6).

Discussion

In the analysis of these 650 patients, the mean age agrees is the same as several published studies[30-32], although it differs from the study by Evans et al, whose average age was 55 years, explained by differences in the study sample given by the selection of a population older than 50 years[8,14].

The male gender prevailed, similar to various investigations[6,14,15,31], and the mestizo ethnic group, unlike the study by Nemunaitis et al, where the white race was more prevalent, with 76.2%, since it was carried out in the United States, where the majority of race is white[33]. A lower percentage of comorbidities was found, compared to the study by Bege et al (35.3%), because they used the Charlson Scale to estimate survival at 10 years in patients with multiple comorbidities and a mean age of 64 years[34].

The found mortality of 2.5% is similar to that of other studies, which varied between 3 and 3.5%, unlike the Yousefzadeh-Chabok study in which mortality was three times higher due to the selection of a elderly population, from which it was assumed that there is a higher risk of complications due to situations and comorbidities typical of age[30,31,35].

Prehospital care was provided to only 38.8% of the participants, unlike a Colombian study by Seijas et al, where 70.5% of injured people received care from trained personnel[36]. Regarding the time of admission to emergencies, the highest percentage corresponded to more than 60 minu-

Table 4. Performance of the ISS, NISS, and RTS scales in traffic accidents at the Hospital Universitario San José, Popayán, Colombia. 2018.

	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	LR (+)	LR (-)
ISS	93.8% (71.7 - 989)	89.1% (86.5 – 91.3)	17.9% (11.1 - 27.4)	99.8% (99 - 100)	8.61 (6.67 – 11.13)	0.07 (0.01 – 0.47)
NISS	93.8% (71.7 – 98.9)	84.1% (81 – 86.7)	12.9% (8 - 20,2)	99.8% (98.9 - 100)	5.88 (4.73 – 7.33)	0.07 (0.01 – 0.5)
RTS	75.0% (50.5 – 89.8)	96.8% (95.2 – 97.9)	37.5% (22.9 – 54.7)	99.4% (98.3 - 99.7)	23.7 (14.1 – 39.82)	0.26 (0.11 – 0.60)

* CI: confidence interval; PPV: positive predictive value; NPV: negative predictive value; LR: likehood ratio. Source: own data.

Table 5. Analysis of the demographic characteristics regarding the ISS, NISS, and RTS scales in traffic accidents at the Hospital Universitario San José, Popayán, Colombia. 2018.

	ISS			NISS			RTS		
	< 25 (-)	>25 (+)	p	< 25 (-)	>25 (+)	P	< 6 (+)	> 6 (-)	p
Gender									
Male	389 (84.38)	72 (15.62)	0.001	359 (67.23)	102 (87.93)	0.000	29 (90.63)	432 (69.90)	0.006
Female	177 (93.65)	12 (6.35)		175 (32.77)	14 (12.07)		3 (9.38)	186 (30.10)	
Civil status									
Stable	190 (33,57)	26 (30.95)	0.635	178 (33.33)	37 (32.76)	0.905	7 (21.88)	209 (33.82)	0.162
Non-stable	376 (66,43)	58 (69.05)		356 (66.67)	78 (67.24)		25 (78.13)	409 (66.18)	
Ethnic									
Mestizo	542 (95,76)	81 (96.43)	0.530	512 (33.33)	111 (95.69)	0.545	32 (100)	591 (95.63)	0.249
Minorities	24 (4,24)	3 (3.57)		22 (66.67)	5 (4.31)		0 (0)	27 (4.37)	
Comorbidities									
Yes	58 (10.25)	7 (8.33)	0.585	512 (89.89)	11 (9.48)	0.838	2 (6.25)	555 (89.81)	0.468
No	508 (89.75)	77 (91.67)		54 (10.11)	105 (90.52)		30 (93.75)	63 (10.19)	
Place of accident									
Urban	360 (63.60)	25 (29.76)	0.000	387 (65.17)	37 (31.90)	0.000	8 (25)	377 (61.00)	0.000
Rural	193 (34.10)	55 (65.48)		175 (32.77)	73 (61.93)		22 (68.75)	226 (36.57)	
Expressway	13 (2.3)	4 (4.76)		11 (2.06)	6 (5.17)		2 (6.25)	15 (2.43)	
Previous medical attention									
Yes	185 (32.69)	67 (79.76)	0.000	163 (30.52)	89 (76.72)	0.000	27 (84.38)	225 (36.41)	0.000
No	381 (67.31)	17 (20.24)		371 (69.48)	27 (23.28)		5 (15.63)	393 (63.59)	
Remission									
Yes	151 (26.68)	57 (67.86)	0.000	133 (24.91)	75 (76.72)	0.000	23 (71.88)	185 (29.94)	0.000
No	415 (73.32)	27 (32.14)		401 (75.09)	41 (35.34)		9 (28.13)	433 (70.06)	
Type of vehicle									
Motorcicle	400 (70.67)	60 (71.43)	0.334	375 (70.22)	85 (73.28)	0.136	23 (71.88)	437 (70.71)	0.654
Car	69 (12.19)	10 (11.90)		65 (12.17)	14 (12.07)		4 (12.50)	75 (12.14)	
Bicycle	30 (5.30)	1 (1.19)		30 (5.62)	1 (0.86)		0 (0)	31 (5.02)	
Pedestrian	67 (11.84)	13 (15.48)		64 (11.99)	16 (13.79)		5 (15.63)	75 (12.14)	
Mecanism of high energy									
Yes	93 (16.43)	64 (76.19)	0.000	76 (14.23)	81 (69.83)	0.000	28 (87.50)	129 (20.87)	0.000
No	473 (83.57)	20 (23.81)		458 (85.77)	35 (30.17)		4 (12.50)	489 (79.13)	
Deaths									
Yes	1 (0.18)	15 (17.86)	0.000	1 (0.19)	15 (12.93)	0.000	12 (37.50)	4 (0.65)	0.000
No	565 (99.82)	69 (82.14)		533 (99.81)	101 (87.07)		20 (62.50)	614 (99.33)	
Time before admission									
Less than 1 hour	88 (15.55)	16 (19.05)	0.251	83 (15.54)	21 (18.10)	0.289	11 (34.38)	93 (15.05)	0.007
More than 1 hour	478 (84.45)	68 (80.95)		451 (84.46)	95 (81.90)		21 (65.63)	525 (84.95)	

Source: own data.

Table 6. Analysis of interventions performed regarding the ISS, NISS, and RTS scales in patients with traffic accidents. Hospital Universitario San José, Popayán, Colombia. 2018.

	ISS			NISS			RTS		
	< 25 (-)	**>25 (+)**	**P**	**< 25 (-)**	**>25 (+)**	**P**	**< 6 (+)**	**> 6 (-)**	**p**
Orotraqueal intubation									
Yes	4 (0.71)	33 (39.29)	0.000	3 (0.56)	34 (29.31)	0.000	29 (90.63)	8 (1.29)	0.000
No	562 (99.29)	51 (60.71)		531 (99.44)	82 (70.69)		3 (9.38)	610 (98.71)	
Required mechanical ventilation									
Yes	3 (0.53)	34 (40.48)	0.000	2 (0.37)	35 (30.17)	0.000	29 (90.63)	8 (1.29)	0.000
No	563 (99.47)	50 (59.52)		532 (99.63)	81 (69.83)		3 (9.38)	610 (98.71)	
Mechanical ventilation (days) (n=36)									
≤ 5	2 (5.6)	17 (47.2)	0.000	2 (5.6)	17 (47.2)	0.000	5 (13.8)	14 (38.9)	0.000
> 5	1 (2.8)	16 (44.4)		0	17 (47.2)		3 (8.4)	14 (38.9)	
Intensive Care Unit									
Yes	14(2.47)	43 (51.19)	0.000	9 (1.69)	48 (41.38)	0.000	29 (90.63)	28 (4.53)	0.000
No	552 (97.53)	41 (48.81)		525 (98.31)	68 (58.62)		3 (9.38)	590 (95.47)	
ICU stay (days) (n=57)									
≤ 5	6 (10.3)	20 (34.5)	0.000	3 (5.2)	23 (39.7)	0.000	10 (17.2)	16 (27.6)	0.000
> 5	9 (15.5)	23 (39.7)		7 (12)	25 (43.1)		19 (32.8)	13 (22.4)	
Hospital stay (days)									
≤ 10	508 (89.75)	40 (47.62)	0.000	492 (92.13)	56 (48.28)	0.000	14 (43.75)	534 (86.41)	0.000
>10	58 (10.25)	44 (52.38)		42 (7.87)	60 (51.72)		18 (56.25)	84 (13.59)	
CT									
Yes	238 (42.05)	76 (90.48)	0.000	216 (40.45)	98 (84.48)	0,000	30 (93.75)	284 (45.95)	0.000
No	328 (57,95)	8 (9.52)		318 (59.55)	18 (15.52)		2 (6.25)	334 (54.05)	
Required surgical management									
Yes	200 (35.34)	73 (86.90)	0.000	171 (32.02)	102 (87.93)	0.000	30 (93.75)	248 (40.13)	0.000
No	366 (64.66)	11 (13.10)		363 (67.98)	14 (12.07)		2 (6.25)	370 (59.87)	
Number of surgical procedures (n=273)									
One	143 (52.4)	29 (10.2)	0.000	129 (47)	43 (15.7)	0.000	166 (60.7)	6 (2.1)	0.000
More than one	58 (21.2)	44 (16.2)		44 (16.2)	58 (21.1)		83 (30.3)	19 (6.9)	
Vasopressors									
Yes	1 (0.18)	20 (23.81)	0.000	1 (0.19)	20 (17.24)	0.000	19 (59.38)	2 (0.32)	0.000
No	565 (99.82)	64 (76.19)		533 (99.81)	96 (82.76)		13 (40.63)	616 (99.68)	
Nutritional support									
Yes	3 (0.53)	21 (25.00)	0.000	1 (0.19)	23 (19.83)	0.000	20 (62.50)	4 (0.65)	0.000
No	563 (99.47)	63 (75.00)		533 (99.81)	93 (80.17)		12 (37.50)	614 (99.35)	
Lactate level									
Yes:	13 (2.31)	32 (38.10)	0.000	8 (1.49)	37 (31.90)	0.000	22 (68.76)	23 (3.72)	0.000
<2	4 (0.71)	6 (7.14)		2 (0.37)	8 (6.90)		3 (9.38)	7 (1.13)	
>2	9 (1.59)	26 (30.95)		6 (1.12)	29 (25.00)		19 (59.38)	16 (2.59)	
No dato	553 (97.79)	52 (61.90)		526 (98.51)	79 (68.10)		10 (31.25)	595 (96.28)	

Source: own data.

tes, compared to the study by Mills in Denmark, which reported an admission time of less than 47 minutes, which may be due to better accessibility to health services being one of the countries with the highest development index[37].

When characterizing the type of vehicle, it was found that most of the participants traveled by motorcycle, and in turn these contributed the highest mortality. Studies in Nepal show that motorcycles constitute one of the most dangerous forms of transportation and their risk of accidents is mainly linked to poor road conditions[8]. Quitian-Reyes et al[13] found that in Bogotá, Colombia, the group with the highest number of fatalities was pedestrians (54%), followed by motorcyclists (21%), passengers (15%), cyclists (9%), and drivers (1%). These differences may be due to the fact that the study was carried out in the capital of the country, where the conditions and preferences of mobilization vary.

Regarding other biological variables analyzed, we found that systolic blood pressure at admission was comparable to other studies[14,30]. In contrast, the other physiological variables, such as diastolic blood pressure, heart rate, respiratory rate, and venous oxygen saturation, were not routinely assessed in other studies. The state of consciousness according to the Glasgow Coma Scale of the participants was less than 14 in 10.2%, which is in concordance with the studies where a percentage of 27% was found with Glasgow less than 13 and a mean of 12,7[14,31].

In summary, a good performance was observed in the different trauma scales evaluated to predict mortality. Mohammadzadeh et al[32] found that the RTS scale has a sensitivity of 99%, a specificity of 62%, LR+ of 2.6 and LR- of 0.02. On the contrary, the ISS scale showed a sensitivity of 84%, specificity of 62%, LR+ of 2.04 and LR- of 0.24, results that are different from this study, which could be explained by the type of population in which study was applied, where they reported an average age of 71.5 years, which suggests the presence of more comorbidities. In comparison, in the study by Patil et al[17], the RTS reached 97.1% sensitivity and 80.1% specificity, the ISS 91.2% sensitivity and 89.9% specificity, and the NISS 91.2% sensitivity and 93.4% specificity. For their part, Reyhan et al[38] reported that all scales had the same ability to predict mortality, correlating with the results of this study.

In relation to the scales as predictors of mortality in closed trauma, Eid et al[15] found that the ISS scale has an OR of 1.049 (95% CI 0.947-1.162) and the NISS an OR of 1.093 (95% CI 1.002-1.194), so they concluded that the latter is better as a predictor of mortality. Smith[21] reported a predictor of mortality for the trauma scales with scores greater than 25 points, in the ISS, a value of OR 1.062 (95% CI 1.034-1.091; p<0.001), and in the NISS OR 1.100 (95% CI 1.061-1.139; p<0.001), concluding that the NISS scale is better. In this research study, both scales presented similar performance.

Conclusion

The results of the research study show that the population most affected by injuries in traffic accidents are young males who travel by motorcycle. Regarding the performance of the different scales, it was found to be adequate to predict mortality, being similar to what was found in most of the published studies.

Compliance with ethical standards

Informed consent: This research was designed in accordance with current international bioethical standards, such as the Nuremberg code, the Declaration of Helsinki and the Belmont report; as well as the regulations of the Colombian Civil Code, art. 1502, Law 23 of 1981, Decree 3380 of 1981, Resolution 8430 of 1993 art.11. Institutional approval was obtained from the ethics committee of the HUSJ of Popayán through Act number 7 of 2017 for the design, methodology and conduct of the study, as well as to have access to the clinical records of the participants.

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Author's contributions

- Conception and design of the study: Hanier Hernán Agudelo-Ledezma, Karla Andrea Bravo-Realpe, Alexei Bernardo Rojas-Díaz, Roberth Alirio Ortiz-Martínez.
- Acquisition of data: Laura Catalina Ruiz-Mazuera, Nathalie Valencia-Amaya.

- Data analysis and interpretation: Hanier Hernán Agudelo-Ledezma, Karla Andrea Bravo-Realpe, Alexei Bernardo Rojas-Díaz, Roberth Alirio Ortiz-Martínez.
- Drafting the manuscript: Hanier Hernán Agudelo-Ledezma, Laura Catalina Ruiz-Mazuera, Nathalie Valencia-Amaya, Yady Vanessa Hurtado-Burbano, María Carolina Cabrera-Correal.
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