

# Clinical Scoring Systems in Predicting Health-Related Quality of Life of Children with Injuries

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## ABSTRACT

*The aim of the study was to explore the association between Glasgow Coma Scale (GCS), Paediatric Index of Mortality (PIM2) and Injury Severity Score (ISS), and the long-term outcome of children with injuries. The health related quality of life (HRQL) was assessed by using the Royal Alexandra Hospital for children Measure of Function (RAHC MOF), 12 months post discharge. Out of 118 children with injuries (9% of all patients), 75 had injury of the head as the leading injury. There were no significant differences at admission in the severity of clinical condition, as expressed by PIM2 and ISS, between patients with head injuries and patients with other injured leading body regions. Children with head injuries had significantly worse HRQOL than children with other leading injured body region ( $p < 0.045$ ), and children from road traffic accidents had significantly worse HRQL ( $p = 0.004$ ), compared to other mechanisms of injury. HRQL correlated significantly with GCS ( $p = 0.027$ ), but not with ISS and PIM2. As the conclusion, among all scoring systems applied, only GCS, which demonstrates severity of head injury, showed significant impact on long-term outcome of injured children.*

**Key words:** clinical scoring system, injury severity score, injury, treatment outcome, intensive care unit, pediatric, quality of life

## Introduction

Injuries are the most common cause of mortality and disability during childhood and adolescence<sup>1,2</sup>. The injury fatalities have reached epidemical proportions, and therefore prevention of injuries has urged for promotion of comprehensive programs and their systematic application in most vulnerable groups<sup>3</sup>. Severe injuries can have devastating late effects on children and on their families<sup>4</sup>.

The most frequently injured body region associated with death and unfavourable outcome is head<sup>5-7</sup>. Among possible mechanisms of injury, road traffic accidents have the highest potential for functional disability after injury<sup>8</sup>.

Many studies have been conducted to explore the impact of injuries on functional outcome after hospital discharge. Persistent limitations have been shown to impose the long-term physical and psychosocial morbidity of various degrees including behavioural, academic, and family adjustment problems<sup>8-10</sup>.

The use of clinical scoring systems has become the integral part of regular practice in paediatric intensive care units (PICU)<sup>11-13</sup>. PICU represents the ideal place for collection of wide spectrum of data of populations of patients treated. The data collected can serve subsequently as the basis for regular control, comparisons, and estimate of practice<sup>14</sup>. The ability of Paediatric Risk of Mor-

tality (PRISM) score and Injury Severity Score (ISS) to predict an outcome for injured children in PICU has already been assessed<sup>15</sup>.

The aim of our study was to determine the characteristics of children with injuries admitted to our PICU, to verify the applicability of clinical scoring systems on populations of patients, and to determine the association of the obtained results with the long-term health-related quality of life (HRQL) of children who have been injured.

## Patients and Methods

The PICU of the University Hospital of Split is a 10-bed, multidisciplinary unit which includes three step-down beds. It serves to a population of approximately 1 million inhabitants from southern Croatia. The average admission rate in the study period was 335 patients. The unit admits all medical and surgical, including trauma and burn, patients.

Between 2003 and 2007 data was obtained prospectively for all injured patients aged ≤18. The data about patients' age, sex, and diagnoses, classified according to The Australian and New Zealand Intensive Care Society (ANZPIC) diagnostic codes, are recorded routinely in our unit. The ANZPIC diagnostic codes enable coding of injuries, the leading injured body region, and mechanisms of injuries<sup>16,17</sup>. Glasgow Coma Scale (GCS) is scoring system used to assess neurological function, and therefore it was calculated only for children whose leading injury was head injury. GCS was recorded according to the first finding of the emergency team<sup>18,19</sup>. Injury severity score (ISS) is an anatomic score for patients with multiple injuries which represents severity of injuries of six regions of the body: the head, face, chest, abdominal and pelvic contents, extremities or pelvic girdle, and external injuries. ISS score was recorded at the arrival to PICU<sup>20,21</sup>. Paediatric Index of Mortality (PIM2) is a general mortality-risk scoring system based mostly on indices of deterioration of physiologic functions (consciousness, ventilation, blood pressure). PIM2-based mortality risk for each patient was calculated according to the equations published in the literature during the first hour after admission to PICU<sup>22</sup>.

Health-related quality of life (HRQL) was assessed by using the Royal Alexandra Hospital for children Measure of Function (RAHC MOF)<sup>23</sup>. The instrument rates quality of life across 10 categories, and then further across 10 scales within each category. Therefore, the child's HRQL is finally scored between 1 and 100. For the purpose of the study, patients were divided in two groups: score of 81–100 reflects only minimal ongoing health problems and good quality of life, and score below 80 points to obvious health problems and impaired quality of life. The data was collected 12 months after children's discharge from PICU by means of telephone interview. The detailed protocol of HRQL assessment was delineated in detail previously<sup>24</sup>.

The study protocol was approved by the Hospital's Ethic Committee. The consent for the quality of life interview was obtained from the participants' parents.

## Statistical analysis

Statistica 8.0 (StatSoft, Inc., Tulsa, USA) was used to perform statistical analysis of the data. T-test for independent samples and Chi-square test were used to compare two samples of children (head injury and other body region) among different demographic and clinical characteristics. Pearson correlation was used to evaluate association between children Measure of Function (RAHC MOF) and clinical scoring systems (GCS, ISS, and PIM 2). All statistical values were considered significant at 95% (p<0.05).

## Results

During the observed four-year period 118 children (9% of all patients) were admitted to the PICU because of injuries. Demographic and clinical characteristics of patients with injuries are presented in Table 1.

Head was significantly the most frequently injured body region. Out of 75 children with the injury of the head, as the leading injured body region, 28 had injuries to other regions: 14 with facial injury, 9 with skeletal injury, three with abdominal injury, and two with chest in-

**TABLE 1**  
DEMOGRAPHIC AND CLINICAL CHARACTERISTICS  
OF CHILDREN WITH INJURIES

	Head injury	Other body region	p
Total	75	43	0.003
Male, No (%)	47 (62.6)	27 (62.8)	1
Age in months (range)	120.5 (1–216)	123 (4–214)	0.508
Other body region			
Abdominal		18	–
Skeletal		13	–
Chest		6	–
Facial		5	–
Spinal		1	–
ISS	20.14±11.50	18.85±7.69 (NS)	0.527
PIM 2	5.50±11.37	2.89±3.27 (NS)	0.144
GCS	9.99±3.14		-
Road traffic accident, No (%)			
Passenger	16	12	0.653
Motor bike rider	14	6	0.316
Pedestrian	13	5	0.248
Cyclist	6	9	0.072
Falls, No (%)	23 (30.6)	8 (18.6)	0.151
Other, No (%)	3 (4.0)	3 (6.9)	0.478

jury. All children who died (the observed mortality of all children with injuries was 10.1%) had head injury as the leading injury. The results of ISS and PIM2 at admission did not differ significantly between groups of children with head injury and with other leading injured body regions. Road traffic accidents followed by falls were the commonest mechanisms of injuries.

The percentage of children with RAHC MOF < 81 was significantly higher ( $p < 0.045$ ) in patients with head injury (46.7%) than in patients with other leading injured body region (27.9%) (Figure 1).

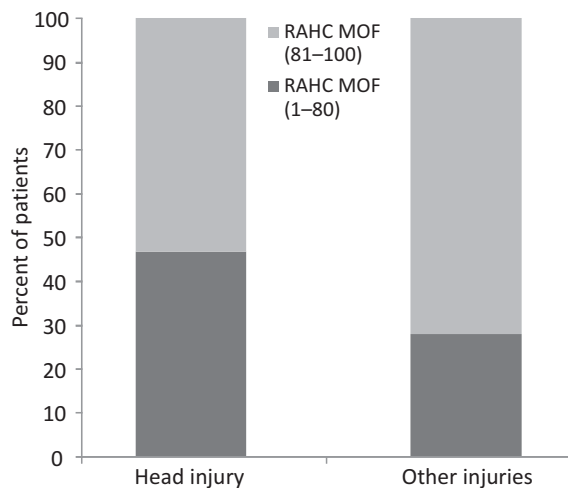


Fig. 1. Royal Alexandra Hospital for children Measure of Function (RAHC MOF) in children with head injury and in children with other injuries.

Out of 81 children injured in road traffic accidents (RTA), there were 39 (48.1%) children whose RAHC MOF was <81, and among children injured from other mechanisms there were 7 (18.9%) children with RAHC MOF <81 ( $p = 0.004$ ) (Figure 2).

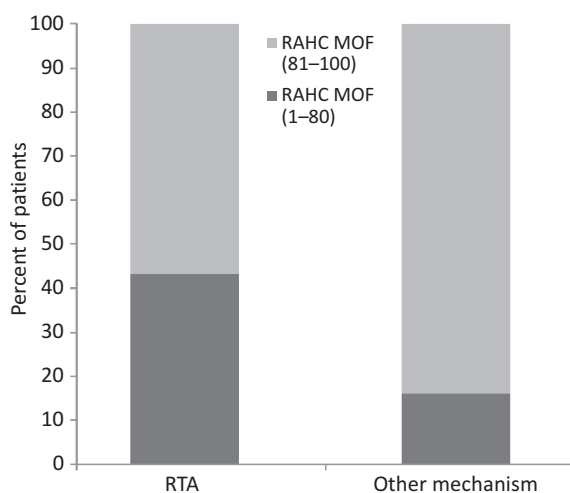


Fig. 2. Royal Alexandra Hospital for children Measure of Function (RAHC MOF) in children injured .

We analyzed the correlations between RAHC MOF Clinical Score and the three scoring systems applied in the study. The results of RAHC MOF Clinical Score correlated significantly with GCS, but not with ISS and PIM2 (Table 2).

TABLE 2  
SIGNIFICANCE OF CORRELATIONS BETWEEN RAHC MOF CLINICAL SCORE AND ISS, PIM 2 AND GCS IN CHILDREN WITH INJURIES

	GCS	ISS	PIM 2
RAHC MOF	0.027	0.060	0.889

### Discussion

The majority of our patients had head injury as the leading injury. No differences in gender, age and mechanism of injury between children with head injury and children with other leading injured body region were found. Head injury has already been reported as the leading cause of death in children with injuries<sup>25-27</sup>.

The results of two clinical scoring systems, ISS and Paediatric Risk of Mortality (PRISM), were shown to be significantly predictive of survival<sup>28,29</sup>. However, no study that would evaluate the applicability of clinical scoring systems in predicting HRQL in children has been carried out yet. In our population of patients the differences in severity of clinical conditions at admission, represented both with anatomic (ISS) and physiologic (PIM2) scoring systems, between children with head injury and children with other leading injured body regions, were not significant. However, the correlation between long-term outcomes of injuries in children was significant only with GCS, but not with PIM2 and ISS.

The impaired physiologic variables at admission may be predictive of long-term outcome<sup>30,31</sup>. The association of the level of systemic insult evidenced as PRISM score and functional outcome has been reported<sup>32</sup>. In our study we used PIM2, the more recent and more accurate pediatric mortality scoring system, with a free algorithm<sup>14</sup>.

The association of severity of injury with functional outcome is well established<sup>8,33</sup>. The results of our study emphasize that it is not overall severity of injury, calculated by general scoring systems (ISS and PIM2) at admission, which determines the outcome. Some patients with head injury had also injuries to other leading body regions, but injury to the head was dominant according to ISS. Indeed, it is the severity of injury of the head, as the leading body region, that has the decisive impact on the long-term outcome<sup>8,34</sup>. The association between low GCS and subsequent disabilities in injured children has been reported repeatedly<sup>30,31,35-37</sup>.

The results of our study demonstrate that scores calculated by clinical scoring systems at admission should always be interpreted cautiously, within the context of characteristics of the populations studied. Namely, groups of patients with equal scores at admission can have sig-

nificantly diverse outcomes. The results of our study demonstrate that in populations of patients with injuries the injury of the head, as the leading injury, has a significant impact on the long-term HRQL of children with injuries.

Mechanism of injury in our study was also significantly associated with lower HRQL. Victims of RTA have already been shown to have worse functional outcome compared to other mechanisms of injury<sup>8,33</sup>.

Since we used the first recorded GCS of our patients at their admission to the hospital, it is obvious that the outcome of patients with adverse HRQOL was unfavourable at admission. The condition of any patient with head injury at arrival to the hospital depends greatly on the quality of life support maneuvers, conducted by the emergency team, aimed to prevent the secondary brain injury. This observation points to the need of good pre-hospital training program, since support of vital functions can be decisive for the long-term outcome of patients with severe injuries<sup>37–40</sup>.

There are several obvious limitations to our study. The size of the population is small. It is possible that some findings would have been different or significant with larger sample size. A larger sample size would have enabled more detailed analysis and comparisons of sub-populations. There was no follow-up. It remains unknown how the longer post-injury period and specific re-

habilitation activities in that period would influence the development of the initial finding, especially for less disabled children. In addition, there are limitations that pertain to other studies on quality of life of children. There is no injury-specific HRQL tool available for children, and therefore the generic tool had to be used. We have no preadmission scores, yet it was not possible to determine the eventual deterioration of condition due to an injury. It is not possible to interview younger children, and therefore it is necessary to rely on the data obtained from parents or caregivers. Obviously, a tool that would enable obtaining data from children would be more advantageous.

## Conclusion

In conclusion, the results of our study point to dangers that injuries of head impose on injured children. The mortality in our study was related exclusively to head injury. In survivors, the susceptibility to long term adverse HRQL is significantly more frequent in children with head injury than in children with other injured leading body region. The clinical scoring system that had significant prognostic value was GCS in children with head injuries. Timely identification of risk populations can urge on application of rehabilitation programs for these children.

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## **KLINIČKI BODOVNI SUSTAVI U PREDVIĐANJU KVALITETE ŽIVOTA OVISNE O ZDRAVLJU U DJECE S OZLJEDAMA**

### **S A Ž E T A K**

Cilj ovog istraživanja bio je istražiti povezanost bodovnih sustava Glasgow Coma Scale (GCS) Paediatric Index of Mortality (PIM2) i Injury Severity Score (ISS) s dugoročnim ishodom djece s ozljedama. Kvalitetu života ovisnu o zdravlju (KŽOZ) smo procijenili uporabom upitnika Royal Alexandra Hospital for children Measure of Function (RAHC MOF) 12 mjeseci nakon otpusta s odjela. Od 118 bolesnika s ozljedama (9% od svih bolesnika) u njih 75 ih je vodeća ozljeda bila ozljeda glave. Nije bilo značajnih razlika pri prijemu u bolnicu u težini kliničkog stanja, izraženog sustavima PIM2 i ISS između bolesnika s ozljedama glave i bolesnika s vodećom ozljedom druge regije tijela. Djeca s ozljedama glave imala su značajno lošiju KŽOZ od djece s drugim vodećim ozljedama ( $p < 0,045$ ) a djeca ozlijeđena u prometnim nesrećama imali su značajnije lošiju KŽOZ od djece ozlijeđene drugim mehanizmom ( $p = 0,04$ ). Nađena je značajna korelacija između KŽOZ s GCS ( $p = 0,027$ ) ali ne KŽOZ s ISS i PIM2. U zaključku, između svih primijenjenih sustava procjene, samo je GCS, koji pokazuje težinu ozljede glave, imao značajan učinak na dugoročnu kvalitetu života djece s ozljedama.