Table II: Comparison of the baseline characteristics and laboratory findings of the two groups

	Admission to ICU (n=27), n (%)	**Non-admission to ICU (n=37), n (%)**	**p-value**
Age (years), median (IQR)	29 (17-33)	30 (23-41.50)	0.121
Female gender, n (%)	16 (59.3)	21 (56.8)	0.841
Site of Injury			
Head and neck, n (%)	4 (10.8)	4 (14.8)	0.632
Thorax, n (%)	6 (22.2)	2 (5.4)	0.045
Abdomen, n (%)	0 (0)	2 (5.4)	0.220
Spinal, n (%)	4 (14.8)	6 (22.2)	0.204
Extremity, n (%)	26 (96.3)	26 (70.3)	0.008
LOS-ICU time (day)	8 (4.5-14)	-	-
LOS-Hospital time (day)	16 (10-21)	5 (3-10)	<0.001
Laboratory results at admission,median (IQR)			
Creatinine (mg/dL)	0.65 (0.59-1.98)	0.69 (0.54-0.82)	0.568
CK	9630 (2000-69130)	5244 (2737-27498)	0.209
LDH	7.43 (3.71-22.14)	5.51 (4.14-13.90)	0.173
AST (U/L)	262 (66-883)	132 (59.50-539)	0.318
ALT (U/L)	105 (28-224)	76 (27-270)	0.729
Sodium (mmol/L)	137 (132-139)	137 (136-139)	0.370
Potassium (mmol/L)	4.50 (3.80-5.29)	3.96 (3.80-4.40)	0.018
Uric acid (mg/dL)	4.15 (3.07-6.50)	3.70 (2.70-5.22)	0.218
Haemoglobin (g/dl),	11.70 (9.90-16.60)	13.70 (12.00-16.05)	0.226
White cell count (10^3/ml)	16.20 (10.81-18.96)	13.25 (9.30-18.49)	0.240
Neutrophil count (10^3/ml)	12.62 (8.72-15.93)	10.98 (6.42-14.74)	0.140
Lymphocyte count (10^3/ml)	1.47 (1.17-1.94)	1.39 (1.08-1.98)	0.683
Platelet count (10^3/ml)	232 (173-298)	256 (199.50-322)	0.088
CRP (mg/dl)	1.13 (0.79-1.44)	0.61 (0.14-1.00)	0.005
Lipid profile, median (IQR)			
Triglyceride (mg/dL)	129 (86-171)	86 (68-124)	0.017
Total cholesterol (mg/dL)	100 (80-140)	111 (89-131)	0.644
HDL (mg/dL)	29 (20-35)	34 (28-39)	0.008
LDL (mg/dL)	56 (32-76)	59(42-69)	0.536
TG/HDL	4.77 (2.61-8.06)	2.37 (1.83-3.86)	0.001

Abbreviations: CRP: C-reactive protein; ICU: Intensive care unit; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; LOS: Length of stay; TG/HDL: Triglyceride/High-density lipoprotein cholesterol ratio.

A multivariate model was constructed with parameters that had a p value of <0.10 for ICU admission in the univariate analyses. The presence of thorax trauma (dichotomous), age (continuous), baseline C-reactive protein (continuous), platelet (continuous), baseline potassium level (continuous) and TG/HDL ratio (continuous) were included in the multivariate model. In the multivariate model, only TG/HDL ratio was associated with higher risk of ICU admission (OR: 1.225, 95% CI: 1.003-1.496, p=0.047) (Table 3).

Table III: Univariate and multivariate logistic regression analysis for admission to ICU

	Univariate analysis			Multivariate analysis		
Variable	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Age (continuous)	0.960	0.917-1.005	0.078	2.767	0.978-7.829	0.055
Presence of thorax trauma	5.00	0.923-27.078	0.062	3.138	0.491-20.042	0.227
Platelet	0.995	0.989-1.001	0.093	0.998	0.991-1.005	0.625
Baseline C-reactive protein	3.627	1.391-9.456	0.008	2.767	0.978-7.829	0.055
Baseline potassium level	3.049	1.341-6.929	0.008	1.320	0.462-3.774	0.604
TG/HDL	1.318	1.078-1.610	0.007	1.225	1.003-1.496	0.047

The ROC curve analysis was also used to find out the prediction in ICU admission by calculating the AUC. The triglyceride, HDL and TG/HDL ratio were all had significant predictive power for ICU admission prediction (Figure 2). The TG/HDL ratio had the highest AUC levels among all parameters (AUC: 0.737, 95% CI: 0.610-0.864, p=0.001). The TG/HDL ratio over 3.05 had 66.7% sensitivity and 73% specificity to predict the admission to ICU. The analysis of bivariate correlations showed a positive association between the TG/HDL ratio and WBC (r = 0.253, p=0.044), procalcitonin (r = 0.620, p <0.001), and CRP (r = 0.410, p =0.001). However, there were no significant correlations between the TG/HDL ratio and lymphocytes (r = 0.208, p= 0.099), as well as neutrophils (r = 0.161, p=0.203) (Table 4).

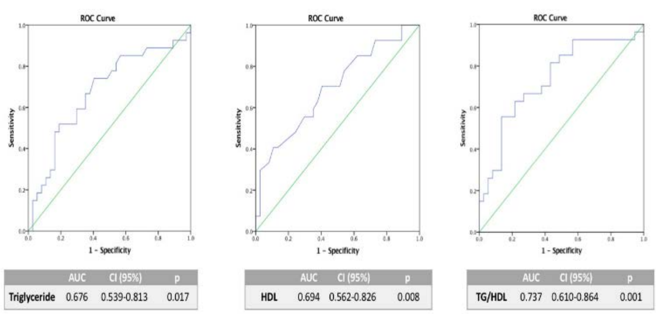

Figure 2. Evaluation of the ROC curve of the triglyceride level, HDL and the Tg/HDL ratio for the admission to ICU. Abbreviations: AUC, Area under the curve; CI, Confidence interval; HDL c, Highdensity lipoprotein cholesterol; ROC, Receiver-Operating Characteristic; Tg/HDL, Triglyceride/High-density lipoprotein cholesterol ratio.

Table IV: Correlation of TG/HDL ratio with the inflammatory indicators

Parameters	**r-values**	**p-value**
WBC	0.253	0.044
Neutrophils	0.161	0.203
Lymphocytes	0.208	0.099
CRP	0.410	0.001
Procalcitonin	0.620	<0.001

Abbreviations: CRP: C-reactive protein; WBC: White Blood Cells.

DISCUSSION

In our recent study, we discovered that patients admitted to the intensive care unit (ICU) had higher TG/HDL ratios than those who were not. We found that the TG/HDL ratio may be used to forecast if an ICU hospitalization is necessary. To our knowledge, this is the first study to report on the potential value of the TG/HDL ratio in predicting ICU admission in earthquake victims.

Crush syndrome is a significant and potentially life-threatening condition that that requires meticulous management in patients affected by earthquakes, as failing to address it promptly and effectively can result in a grim prognosis[18]. The pathogenesis of crush syndrome is very complex may involve factors such as renal ischemia-reperfusion injury, systemic inflammation, and the excessive deposition of myoglobin in renal tubules, which is released from damaged muscle tissue[19]. Recent studies in animal models of crush syndrome have demonstrated dysregulation of the inflammatory factors at both serum and tissue levels. For instance, it has been shown that a significant elevation in the levels of IL-6 and IL-17 in the serum and kidney tissue of crush-induced rats, suggesting the promotion of a pro-inflammatory response primarily led by Th17 cells[20]. Additionally, Murata et al. also observed notable increases in serum TNF-α and IL-1β, within the initial 24 hours of reperfusion in crush syndrome model rats[21]. Inflammatory cells can also promote the release of various pro-inflammatory cytokines during the pathophysiological response following trauma, resulting in a cytokine storm that may potentially trigger multi-organ dysfunctions, and in some cases, even mortality[22]. Further research is needed for elaboration of precise mechanisms of inflammation on crush syndrome.

Triglyceride levels may increase during inflammation and infection[23]. Inflammatory cytokines may play a role in promoting TG synthesis and reduce TG hydrolysis during trauma[24]. Hypertriglyceridemia has been demonstrably linked to the induction of endothelial dysfunction, characterized by impaired vasodilation, pro-inflammatory and pro-thrombotic states, and enhanced oxidative stress. This dysfunction significantly elevates the susceptibility to a spectrum of cardiovascular diseases, including coronary artery disease, atherosclerosis, and thromboembolic events[25]. Conversely, lower HDL levels have been associated with worse clinical outcomes including need of ICU admission and mortality, particularly in infectious and inflammatory diseases[26,27]. Several hypotheses can be postulated, including an acute overconsumption of HDL particles and easier redistribution from the intravascular to the extravascular compartment following trauma[28]. Recently, the TG/HDL-C ratio, which is combination of HDL and TG, has garnered increasing attention due to its superior predictive capability for cardiovascular events and insulin resistance than the either parameter alone[29]. Moreover, the ratio of TG to HDL is a measure of the general level of inflammation. Notably, Jonas et al. demonstrated that an elevated TG/HDL ratio indicates systemic inflammation in individuals with idiopathic pulmonary arterial hypertension (IPAH)17. In the present investigation, we found that the TG/HDL ratio and procalcitonin, WBC, and CRP were positively correlated. These results aligned with a prior study that found higher levels of IL-6, IL-1β, and MCP-1 in IPAH patients with elevated TG/HDL17. Furthermore, Peng et al. discovered that a higher TG/HDL ratio was associated with an increased risk of COVID-19 death in instances of COVID-19 pneumonia[30].

There are several drawbacks to this study. First, no analysis of a causal association could be made because the study was retrospective in nature. Secondly, it was not feasible to assess the long-term outcomes and mortality rates of the patients involved in the study. Third, there were no sequential data or changes in the patients' lipid profiles during their hospital stay. Employing dynamic monitoring could offer a more comprehensive characterization of dyslipidemia. Fourth, this retrospective, single-center study involved a small sample size, potentially introducing selection bias. Finally, limitations of the current study include the potential for confounding by unmeasured variables, including dietary preferences, lifestyle habits, and medication use. These factors may have influenced the observed associations and should be considered in the interpretation of the results.

In conclusion, our study indicates that the TG/HDL ratio may be a valuable predictor of ICU admission in earthquake victims, highlighting its potential utility as an early risk assessment tool. The findings of this study can contribute to improving disaster response strategies, and mitigating the impact of such catastrophic events on healthcare systems with limited ICU capacity.

Ethics Committee Approval: This study was approved by the Gazi Yaşargil Research and Training Hospital Ethics Committee on 04.08.2023 with the decision number 499. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Conflict of Interest: No conflicts of interest were disclosed by the authors.

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