

## A PROSPECTIVE STUDY OF RISK FACTORS AND NEW PREDICTION MODEL FOR INPATIENT AGGRESSION IN A TURKISH FORENSIC PSYCHIATRIC COHORT WITH PSYCHOTIC ILLNESS

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**BACKGROUND AND AIM:** Inpatient violence and aggression are critical concerns in forensic and general psychiatry, leading to injuries, trauma, and care disruptions while also impacting secure transitions and post-release violence risk, underscoring the need for structured risk assessment tools. While static factors (e.g., criminal history, age) contribute to aggression, dynamic factors (e.g., impulsivity, medication adherence) offer opportunities for intervention. However, existing tools lack practicality, predictive accuracy, or integration of modifiable factors, limiting their clinical utility. The Forensic Oxford Web (FOxWeb) tool was developed to systematically track dynamic risk factors, supporting real-time risk assessment and intervention planning. However, it lacks external validation in diverse forensic populations, and its predictive accuracy across different healthcare systems remains uncertain. Additionally, its applicability in non-Western settings has not been established. In Türkiye, structured risk assessments remain underutilized, and research on inpatient aggression risk factors is limited. This study evaluates the association between FOxWeb risk items and inpatient aggression in a Turkish forensic psychiatric cohort, adapting the model (FOxWeb-TR) to address sociocultural and healthcare system differences.

**METHODS:** This prospective cohort study was conducted in a forensic psychiatry inpatient unit, enrolling adults under compulsory court-ordered treatment due to criminal irresponsibility or diminished responsibility. Only patients with psychotic disorders (ICD-10 F20-F29) were included, while those without consent, an eligible diagnosis, or scheduled for discharge within a month were excluded. The study assessed static (e.g., age, history of violence, baseline anger, substance use) and dynamic risk factors using the FOxWeb tool, translated into Turkish and back-translated for accuracy. Dynamic factors were recorded biweekly by trained nursing staff based on electronic patient records and multidisciplinary ward rounds to track meaningful changes over time. A researcher reviewed assessments for consistency and accuracy. The primary outcome was any verbal or physical aggression incident, verified through routine incident reports. (IRB approval date: 24.03.2023, number: 23/129). The relationship between static risk factors and aggression

outcomes (occurrence and frequency of incidents) was assessed using univariable analyses. Univariable and multivariable multilevel regression analyses examined the association between each dynamic factor and aggression occurrence (logistic regression) and frequency (negative binomial regression) across all assessments. Multivariable models adjusted for age, high baseline anger—identified as predictors in univariable analysis—and the round effect. A series of models were developed to assess the clinical utility of the total dynamic score in risk prediction, incorporating both static and dynamic factors. Variables significantly associated with inpatient aggression were included as covariates. Model performance was evaluated using the area under the receiver operating characteristic curve (ROC AUC) with a 95% confidence interval (CI). Model 1 employed fixed effects, including age, baseline anger, the round effect, and the total dynamic score. Model 2 included the same fixed effects but excluded the total dynamic score. Model 3 applied random effects, incorporating age, baseline anger, the round effect, and the total dynamic score. These models aimed to determine the role of dynamic risk factors in aggression prediction and compare their predictive accuracy. A calibration plot was generated to assess how well predicted probabilities aligned with observed outcomes across deciles.

**RESULTS:** A total of 102 forensic psychiatric inpatients were prospectively followed for 4 months, resulting in 811 separate assessment rounds. The study sample had a mean age of 45.1 years, with 67% diagnosed with schizophrenia and 86% having a history of interpersonal violence. A total of 588 aggression incidents were recorded, involving 43% of patients. Younger age and high baseline anger were strongly linked to increased aggression risk. Multivariable multilevel logistic regression analyses identified non-adherence to medication, greater aggression, impulsivity, anger related to psychotic symptoms, increased anxiety, and total dynamic scores as significant predictors of both the occurrence and frequency of aggressive incidents. While non-adherence to therapy, paranoid/persecutory delusions, and hallucinations did not predict the occurrence of aggression, they significantly predicted the number of incidents. In univariable analysis, a total dynamic score >0 predicted the number of aggressive incidents; however,

dichotomized scores ( $>0$  vs.  $0$  or  $>4$  vs.  $\leq 4$ ) were not predictive in other analyses. Across all models, high baseline anger and the round effect remained the strongest predictors of aggression, outweighing the influence of age. The AUC of the main model for predicting the occurrence of aggressive incidents was 0.84 (95% CI: 0.81 – 0.87), incorporating fixed effects such as age, baseline anger, the round effect, and the total dynamic score. When the fixed-effects model included only age, high baseline anger, and the round effect, without the total dynamic score, the AUC decreased to 0.73 (95% CI: 0.69–0.77). When the first model incorporated random effects instead of fixed effects, the AUC was 0.95 (95% CI: 0.94–0.96). Model calibration was deemed acceptable. For the main model, the positive predictive value (PPV) and negative predictive value (NPV) were 0.47 and 0.93, respectively.

**CONCLUSIONS:** To our knowledge, this is the first study to examine risk factors for inpatient aggression in a Turkish forensic psychiatric population, integrating static and dynamic risk factors into a structured risk prediction model. This study is also the first to refit previously developed FOxWeb risk assessment models to existing data exclusively from Turkish forensic psychiatric inpatients with psychotic illness, establishing a new population-specific risk assessment model. We evaluated the predictive accuracy of several statistical models for both aggression occurrence and frequency. The FOxWeb-TR model, incorporating fixed effects and the total dynamic score, demonstrated strong discriminative ability and

robust calibration for predicting aggressive incidents. This model also outperformed a version that excluded the total dynamic score, reinforcing the importance of incorporating dynamic factors in risk assessment. Key differences from the original study include forensic-only patients, psychotic disorder specificity, and biweekly assessment intervals (3). The continuous dynamic score provided better predictive performance than dichotomized versions, highlighting the importance of tracking incremental risk changes. However, limitations such as sample size, lack of inter-rater reliability, and absence of external validation underscore the need for further research and larger studies to confirm FOxWeb-TR's clinical utility.

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**Table 1.** Static risk factors for occurrence and number of aggressive incidents of 102 patients in a forensic psychiatry unit

			Occurrence(a)		No. of incidents(b)	
			OR (95% CI)	p	IRR (95% CI)	p
	Age in years, mean (S.D.)	45.10±10.12	0.92 (0.85, 1.00)	0.042	0.95 (0.90, 1.00)	0.047
	Female sex, n (%)	5 (5%)	5.41 (0.19, 153)	0.32	3.20 (0.37, 27.6)	0.29
Historical risk factors, n (%)						
	Conviction for interpersonal violence	89 (87%)	4.22 (0.44, 40.8)	0.21	2.67 (0.55, 13.0)	0.22
	Civil commitment	83 (81%)	1.77 (0.24, 13.2)	0.58	1.76 (0.46, 6.66)	0.41
	Substance use disorder	28 (27%)	1.28 (0.23, 7.20)	0.78	1.12 (0.36, 3.46)	0.84
	Alcohol use disorder	11 (11%)	0.53 (0.04, 6.68)	0.62	0.69 (0.13, 3.65)	0.66
	High baseline anger*	56 (55%)	31.4 (6.75, 146)	<0.001	10.3 (3.69, 28.6)	<0.001
	History of self-harm	20 (20%)	4.20 (0.64, 27.5)	0.14	2.64 (0.79, 8.79)	0.11

(a) Univariable logistic binomial regression  
(b) Univariable negative binomial regression

**Table 2.** Associations between dynamic risk factors and occurrence of aggressive incidents

	Univariable		Multivariable†	
	OR (95% CI)	p	OR (95% CI)	p
1. Non-adherence with therapy	1.21 (0.90, 1.63)	0.20	1.23 (0.91, 1.67)	0.18
2. Non-adherence with medication	2.38 (1.74, 3.26)	<0.001	1.99 (1.42, 2.78)	<0.001
3. Greater aggression (verbal or physical)	2.34 (1.78, 3.08)	<0.001	1.91 (1.43, 2.56)	<0.001
4. Greater impulsivity	1.87 (1.39, 2.53)	<0.001	1.61 (1.17, 2.21)	0.003
5. Paranoid/persecutory delusions	1.06 (0.90, 1.26)	0.47	1.10 (0.92, 1.30)	0.30
6. Hallucinations	1.24 (0.96, 1.60)	0.10	1.15 (0.88, 1.50)	0.31
7. Anger due to psychotic symptoms	2.02 (1.54, 2.66)	<0.001	1.65 (1.24, 2.21)	<0.001
8. Drug misuse	5.75 (0.00, inf)	>0.99	5.55 (0.00, inf)	>0.99
9. Alcohol misuse	1.23 (0.42, 3.62)	0.71	1.27 (0.29, 5.58)	0.75
10. Increase in anxiety	1.85 (1.38, 2.47)	<0.001	1.66 (1.22, 2.26)	<0.001
Total dynamic score (n = 811)	1.13 (1.08, 1.19)	<0.001	1.10 (1.05, 1.16)	<0.001
Total dynamic score > 0 (v. 0 score)	10.8 (0.80, 145)	0.07	4.90 (0.28, 84.6)	0.27
Total dynamic score > 4 (v. ≤ 4 score)	2.45 (0.93, 6.45)	0.07	1.89 (0.70, 5.10)	0.21

Note: Occurrence of any aggressive incident as the outcome (Multilevel logistic binomial regression) for 811 separate assessments  
† Included age, high baseline anger and the round effect