

ORIGINAL ARTICLE

Relationship between length of stay and relapse among patients with substance use disorders

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ABSTRACT

Background: Substance use disorders (SUDs) are chronic relapsing conditions with high relapse rates and substantial burden. Inpatient rehabilitation length of stay (LOS) has been identified internationally as a determinant of treatment outcome, but evidence from Saudi Arabia is limited. This study examined the association between inpatient LOS and relapse, and identified demographic and clinical factors associated with relapse.

Methods: A retrospective cross-sectional correlational study using inpatient medical records and follow-up data at ReLib Behavioral Rehabilitation Center, Riyadh. Records of 125 adult patients (aged 18 years or above) admitted between January and December 2025 were reviewed. Patients were observed from discharge to a common census date of 30 June 2026 (median follow-up 306 days, IQR 164–424). Relapse was the primary outcome. Analyses comprised chi-square and Fisher's exact tests, the Mann–Whitney U test, and multivariable binary logistic regression with collinearity diagnostics. Sensitivity analyses restricted the cohort to patients with guaranteed minimum follow-up windows. Significance was set at $p < 0.05$.

Results: Mean age was 33.8 ± 10.8 years; 80.8% were male. The relapse rate was 36.8% ($n = 46$). Mean LOS was 56.6 ± 53.3 days, 79.3 days in non-relapsed versus 17.5 days in relapsed patients (Mann–Whitney $p < 0.001$). Relapse by LOS category was 97.1% (1–14 days), 29.0% (15–30 days), 6.9% (31–90 days) and 6.5% (>90 days); $\chi^2 = 77.31$, $p < 0.001$. This gradient persisted in sensitivity analyses restricted to patients with at least 90 and at least 180 days of follow-up. In multivariable analysis (model $\chi^2 = 81.64$, $p < 0.001$; Nagelkerke $R^2 = 0.655$; AUC = 0.935) LOS (OR = 0.957 per day, 95% CI 0.933–0.980), readmission (OR = 6.87, 1.25–37.90) and discharge against medical advice (DAMA; OR = 6.07, 1.70–21.71) were independently associated with relapse. Variance inflation factors were 1.19–1.81, indicating no problematic collinearity.

Conclusion: Shorter inpatient LOS, readmission and DAMA discharge were strongly associated with relapse, with an apparent inflection near one month. Because the design is observational, these associations should not be interpreted as establishing that extending LOS prevents relapse; early discharge may equally be a marker of unmeasured severity, engagement or motivation. The findings identify early-discharge patients as a group warranting intensified aftercare and generate a threshold hypothesis requiring prospective validation.

Keywords: Substance use disorders, length of stay, relapse, inpatient rehabilitation, Saudi Arabia, logistic regression, predictors of relapse, discharge against medical advice.

Introduction

Substance use disorders (SUDs) are chronic, relapsing conditions imposing a profound burden on individuals, families, and healthcare systems. Pooled data indicate that 40% to 60% of individuals who complete treatment relapse within 12 months, rates comparable to other chronic conditions such as hypertension and asthma. 1

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In Saudi Arabia, the Saudi National Mental Health Survey – a nationally representative household survey of citizens aged 15–65 years – estimated the lifetime prevalence of SUDs at 4.0%.² A national scoping review of the Saudi SUD literature identified only 23 eligible primary studies, all conducted in clinical settings and all but two restricted to male participants, and judged none of the cross-sectional studies to be of good methodological quality.³

Length of stay (LOS) has emerged internationally as a correlate of treatment outcome. The National Institute on Drug Abuse states that treatment shorter than 90 days yields limited lasting effectiveness,⁴ and the Drug Abuse Treatment Outcome Study demonstrated that longer retention predicted better 12-month outcomes across modalities.⁵ A systematic review and meta-analysis found that patients receiving planned treatment or support lasting 18 months or more had a 23.9% greater likelihood of abstaining or reducing use to moderate levels than those receiving shorter standard treatment (OR = 1.35, 95% CI 1.09–1.67).⁶ Importantly, these are observational findings, and the direction of causation between retention and outcome remains contested.

Regional evidence is sparse and inconsistent. A retrospective cohort at Al-Amal Hospital, Dammam (2005–2021) found amphetamine use disorder to be the only substance type significantly associated with readmission risk in adjusted analysis (HR = 1.36, 95% CI 1.04–1.78); mean LOS did not differ between readmitted and non-readmitted patients (25.6 vs. 25.5 days, $p = 0.3$), although LOS was not modelled as a predictor of readmission in that study.⁷ A follow-up study at the Erada Complex, Eastern Province (1,160 male patients) found readmission within six months of discharge in 13.1% of program completers versus 26.9% of non-completers, with program completion the only significant predictor (OR = 0.42).⁸ Beyond LOS, discharge against medical advice (DAMA) is a consistent correlate of poor outcome in this population,⁹ as is prior admission history.¹⁰ The present study examines LOS-stratified relapse in a Saudi inpatient cohort using multivariable methods.

Methods

Study design and setting

A retrospective cross-sectional correlational study using inpatient medical records and follow-up data at ReLib Behavioral Rehabilitation Center, Riyadh, Saudi Arabia – a specialized inpatient and outpatient facility providing psychiatric illness treatment, structured detoxification, and rehabilitation.

Study population and eligibility

Inclusion criteria were age 18 years or above; a primary ICD-10 diagnosis of SUD; inpatient admission of at least one day; and complete clinical documentation. Patients with incomplete records, or admitted solely for detoxification without entering the rehabilitation program, were excluded. All index admissions occurred

between January 1 and December 30, 2025. Two patients aged 16 years were excluded under the adult criterion, yielding a final sample of 125.

Follow-up period and outcome ascertainment

Each patient was observed from their individual discharge date to a common census date of 30 June 2026. Median follow-up was 306 days (IQR 164–424; range 28–536). Because shorter stays result in earlier discharge, follow-up duration was systematically longer in the short-stay strata (median 440 days for 1–14 days, 339 days for 15–30 days, 215 days for 31–90 days, and 127 days for >90 days). This imbalance is addressed by sensitivity analyses reported below and considered in the Limitations.

Relapse was operationally defined as any documented return to substance use following discharge, confirmed through one or more of: readmission to a rehabilitation facility; a physician or nursing note in the outpatient department or inpatient record documenting resumed use; a positive toxicology screen; a structured follow-up contact note completed by the multidisciplinary team; or patient or family self-report documented in the clinical record.

Variables and definitions

Variables comprised demographic data (age, gender, and marital status), clinical history (primary substance, duration of use, and age of onset), admission data, treatment data (LOS in days; discharge status as completed program, DAMA, or referred) and follow-up data.

Two distinct admission-history variables were recorded and are not interchangeable. Admission type denotes whether the index episode was the patient's first admission to ReLib or a repeat admission to this center. Previous inpatient rehabilitation admissions denote the patient's lifetime count of prior rehabilitation admissions at any facility, including other centers. Consequently, a patient attending ReLib for the first time may nonetheless report prior admissions elsewhere; 64 patients fell into this category. One record coded as a readmission with no previous admissions was identified as a data-entry error and corrected to one previous admission following source-document verification.

Statistical analysis

Analyses were performed in Python (SciPy, statsmodels). Descriptive statistics are reported as mean $\pm$ SD or frequencies with percentages. Patients were stratified into four LOS categories: 1–14, 15–30, 31–90, and >90 days. Associations between categorical variables and relapse were assessed by chi-square tests with Cramér's V; Fisher's exact test was used where expected cell counts were small; and sparse substance categories were collapsed a priori into opioid or alcohol versus all other substances. The Mann–Whitney U test compared LOS distributions, selected over the t-test given the right-skewed distribution.

Multivariable binary logistic regression identified factors independently associated with relapse, reported as odds



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ratios with 95% confidence intervals. Collinearity was assessed by variance inflation factors (VIF), point-biserial correlations, and by comparing models with and without LOS. Model performance was summarized by model chi-square, Nagelkerke R^2 , and the area under the receiver operating characteristic curve. Sensitivity analyses repeated the primary stratified comparison among patients with at least 90, 180, and 270 days of guaranteed follow-up. Significance was set at $p < 0.05$ (two-tailed).

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was granted by the Institutional Review Board of Care Medical

(IRB-010/220925), with a waiver of informed consent given the retrospective design and absence of patient contact. All data were anonymized prior to analysis.

Results

Sample characteristics

The mean age was 33.8 ± 10.8 years (median 31; range 18–68); 101 patients (80.8%) were male. Seventy-six (60.8%) were single, 33 (26.4%) married, and 16 (12.8%) divorced. Most presented with polysubstance use ($n = 84$, 67.2%), followed by alcohol ($n = 23$, 18.4%), stimulants ($n = 9$, 7.2%), opioids ($n = 5$, 4.0%), and cannabis ($n = 4$, 3.2%). Overall, 46 patients (36.8%) relapsed (Table 1).

Table 1. Demographic and clinical characteristics ($n = 125$)

Variable	Category	n	%
Age (years)	Mean $\pm$ SD 33.8 ± 10.8 ; median 31; range 18–68	125	—
Gender	Male	101	80.8
	Female	24	19.2
Marital status	Single	76	60.8
	Married	33	26.4
	Divorced	16	12.8
Primary substance	Multiple substances	84	67.2
	Alcohol	23	18.4
	Stimulants	9	7.2
	Opioids	5	4.0
	Cannabis	4	3.2
Duration of use	>10 years	43	34.4
	6–10 years	41	32.8
	1–5 years	37	29.6
	<1 year	4	3.2
Previous admissions (any facility)	None	40	32.0
	1 prior	35	28.0
	≥ 2 prior	50	40.0
Admission type (this center)	First admission to ReLib	103	82.4
	Readmission to ReLib	22	17.6
Discharge status	Completed program	58	46.4
	DAMA	65	52.0
	Referred	2	1.6
Psychiatric follow-up	Yes	50	40.0
	No	75	60.0
Relapse	Yes	46	36.8
	No	79	63.2

DAMA = discharged against medical advice. Admission type and previous admissions capture different constructs and are not directly comparable: the former refers to admissions at this center only, the latter to prior rehabilitation admissions at any facility.



Relationship between length of stay and relapse

Length of stay by relapse outcome

Mean LOS was 56.6 ± 53.3 days (median 30; range 1–199). Non-relapsed patients had a mean LOS of 79.3 ± 51.9 days (median 62) versus 17.5 ± 26.2 days (median 9) in relapsed patients (Mann–Whitney $U = 269.5$, $p < 0.001$) (Table 2, Figure 1). As a supplementary rank-based summary, Spearman's rho between LOS and relapse was -0.712 ; this is reported for description only and is not interpreted as a measure of association strength for a binary outcome.

Relapse by length of stay category

Relapse rates were 97.1% (1–14 days), 29.0% (15–30 days), 6.9% (31–90 days), and 6.5% (>90 days); $\chi^2 = 77.31$, $df = 3$, Cramér's $V = 0.787$, $p < 0.001$ (Table 3, Figure 2). The gradient was non-linear, with the steepest change

between the 15–30 and 31–90 day categories and little further change beyond 90 days.

Sensitivity to differential follow-up

Because follow-up duration was longer in short-stay patients, the primary comparison was repeated among patients with guaranteed minimum observation windows. The gradient was essentially unchanged: at a minimum of 90 days ($n = 115$), relapse was 97.1%, 29.0%, 6.9%, and 4.8% ($V = 0.793$, $p < 0.001$); at 180 days ($n = 86$), 97.1%, 29.0%, 5.9%, and 0% ($V = 0.784$, $p < 0.001$); and at 270 days ($n = 68$), 97.0%, 28.6%, 0%, and 0% ($V = 0.829$, $p < 0.001$) (Table 4, Figure 3). Differential ascertainment therefore does not account for the observed association, although the extended-stay stratum becomes sparse under stricter thresholds.

Table 2. Length of stay by relapse outcome ($n = 125$)

Group	n	Mean $\pm$ SD (days)	Median	Range	p-value
Non-relapsed	79	79.3 ± 51.9	62.0	5–199	<0.001
Relapsed	46	17.5 ± 26.2	9.0	1–140	–
Total	125	56.6 ± 53.3	30.0	1–199	–

Mann–Whitney $U = 269.5$, $p < 0.001$.

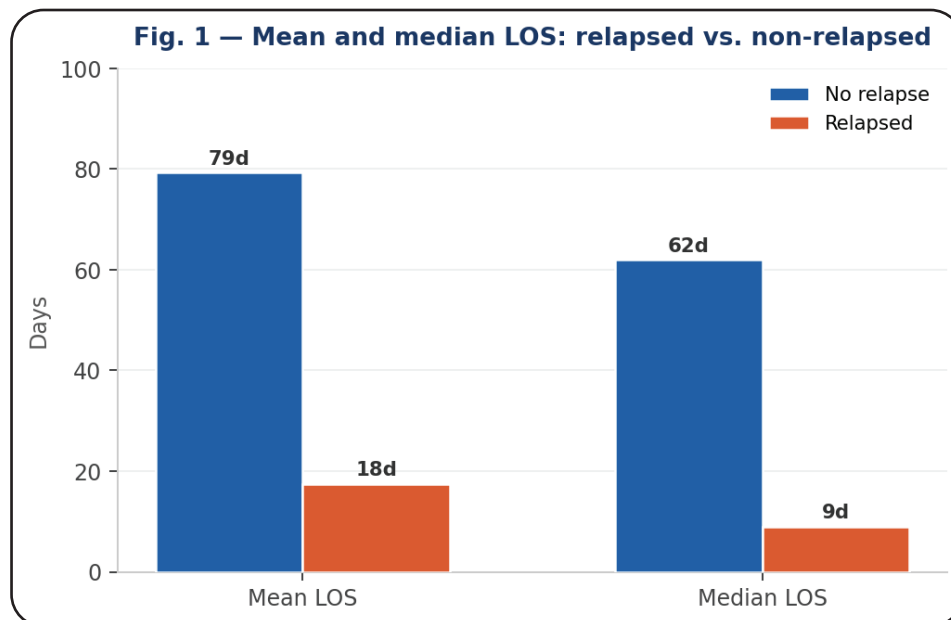


Figure 1. Mean and median length of stay by relapse outcome.

Table 3. Relapse rate by length of stay category ($n = 125$)

LOS category	n	Relapsed n (%)	Not relapsed n (%)	p-value	Cramér's V
1–14 days	34	33 (97.1)	1 (2.9)	< 0.001	0.787
15–30 days	31	9 (29.0)	22 (71.0)	–	–
31–90 days	29	2 (6.9)	27 (93.1)	–	–
>90 days	31	2 (6.5)	29 (93.5)	–	–

Chi-square across four categories ($df = 3$), $p < 0.001$.



Relationship between length of stay and relapse

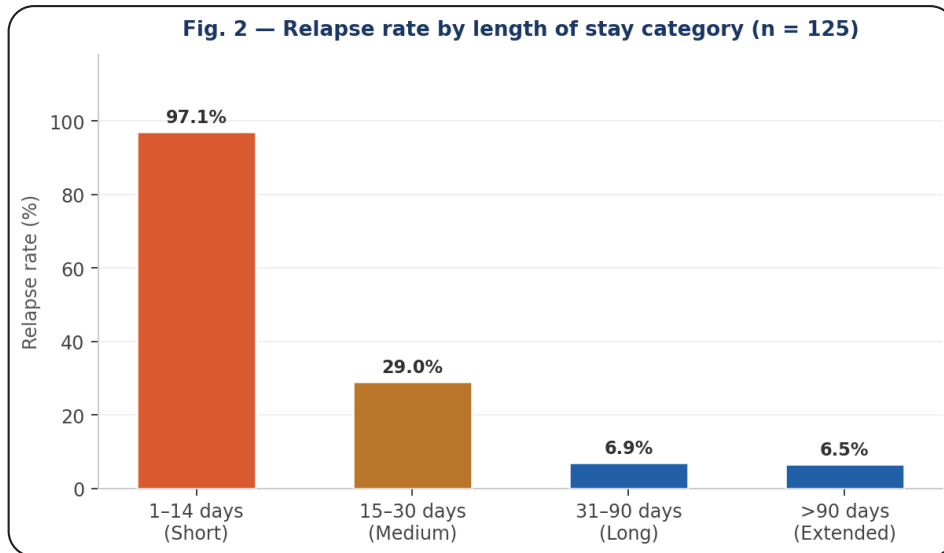


Figure 2. Relapse rate by length of stay category (n = 125).

Table 4. Sensitivity analysis by minimum follow-up window

Minimum follow-up	n	1–14 d	15–30 d	31–90 d	>90 d	Cramér's V	p-value
Full cohort	125	97.1%	29.0%	6.9%	6.5%	0.787	<0.001
≥90 days	115	97.1%	29.0%	6.9%	4.8%	0.793	<0.001
≥180 days	86	97.1%	29.0%	5.9%	0.0%	0.784	<0.001
≥270 days	68	97.0%	28.6%	0.0%	0.0%	0.829	<0.001

Cells show the relapse rate within each LOS category. Group sizes fall as the required window lengthens, particularly in the >90 day stratum (n = 4 at ≥180 days).

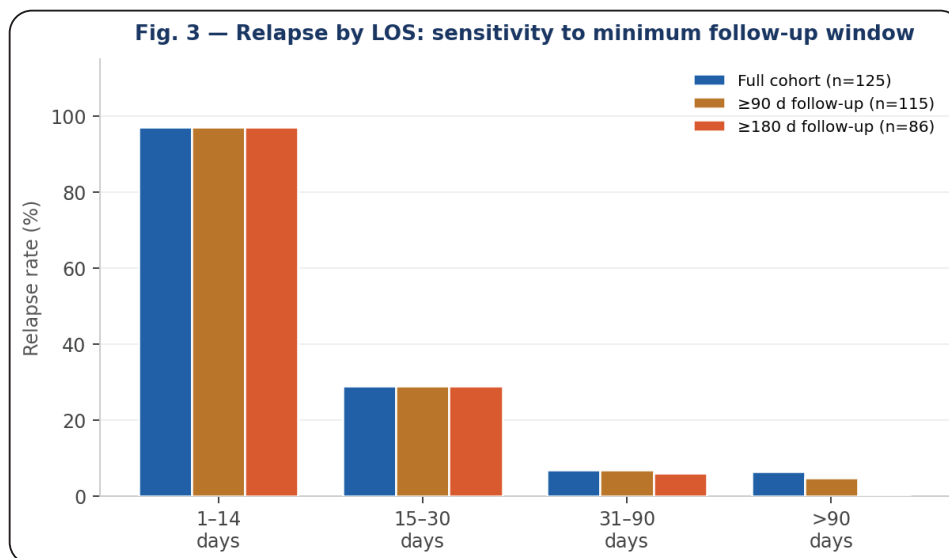


Figure 3. Relapse by length of stay under progressively stricter minimum follow-up windows.

Categorical associations

Discharge status showed the strongest categorical association with relapse ($\chi^2 = 20.36$, $df = 2$, $p < 0.001$; $V = 0.404$): 17.2% among program completers versus

55.4% among DAMA patients (Figure 4). Using the pre-specified collapsed substance grouping, relapse was 67.9% (19/28) among opioid or alcohol users versus 27.8% (27/97) among all others (Fisher's exact OR = 5.47,



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$p < 0.001$). Previous admissions ($\chi^2 = 9.49$, $p = 0.009$), marital status ($\chi^2 = 8.88$, $p = 0.012$), and admission type ($\chi^2 = 4.60$, $p = 0.032$) were also associated with relapse. Gender, duration of use, and psychiatric follow-up availability were not (Table 5).

Multivariable logistic regression

The model was significant ($\chi^2 = 81.64$, $df = 11$, $p < 0.001$), explained 65.5% of variance (Nagelkerke $R^2 = 0.655$),

and discriminated well (AUC = 0.935; accuracy 87.2%). Three predictors reached significance: LOS (OR = 0.957 per additional day, 95% CI 0.933–0.980, $p < 0.001$), readmission to this center (OR = 6.87, 1.25–37.90, $p = 0.027$), and DAMA discharge (OR = 6.07, 1.70–21.71, $p = 0.006$) (Table 6).

Collinearity diagnostics did not indicate a problem. Variance inflation factors ranged from 1.19 to 1.81 (LOS

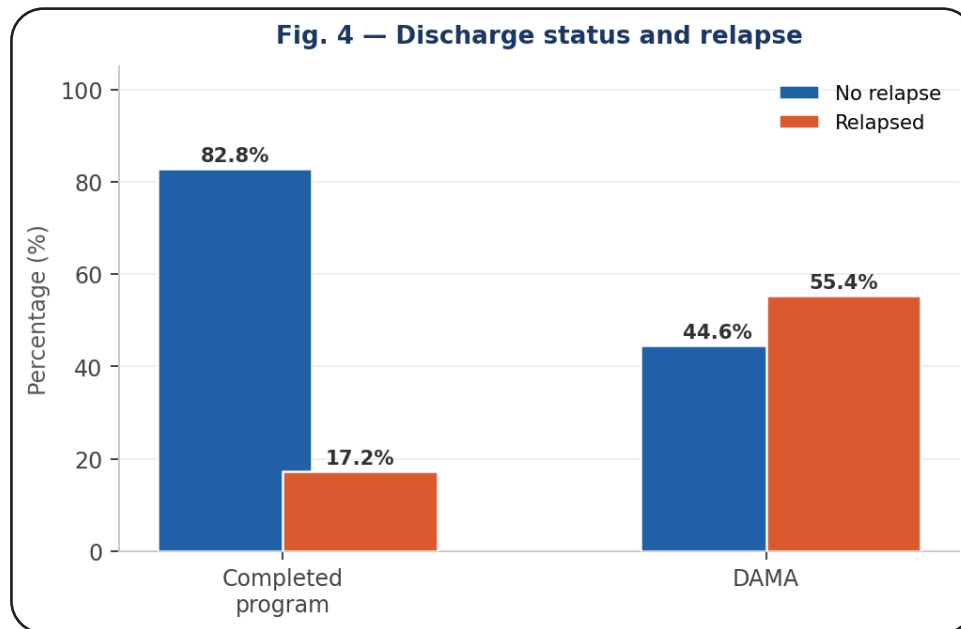


Figure 4. Relapse rate by discharge status.

Table 5. Categorical variables and relapse ($n = 125$)

Variable	Category	Relapsed n (%)	Not relapsed n (%)	Test	p-value
Gender	Male (n = 101)	34 (33.7)	67 (66.3)	$\chi^2 = 1.58$	0.209
	Female (n = 24)	12 (50.0)	12 (50.0)	—	—
Marital status	Single (n = 76)	21 (27.6)	55 (72.4)	$\chi^2 = 8.88$	0.012
	Married (n = 33)	19 (57.6)	14 (42.4)	—	—
	Divorced (n = 16)	6 (37.5)	10 (62.5)	—	—
Substance (collapsed)	Opioid/alcohol (n = 28)	19 (67.9)	9 (32.1)	Fisher	<0.001
	Other (n = 97)	27 (27.8)	70 (72.2)	—	—
Previous admissions	None (n = 40)	16 (40.0)	24 (60.0)	$\chi^2 = 9.49$	0.009
	1 prior (n = 35)	19 (54.3)	16 (45.7)	—	—
	≥ 2 prior (n = 50)	11 (22.0)	39 (78.0)	—	—
Admission type	First at ReLib (n = 103)	33 (32.0)	70 (68.0)	$\chi^2 = 4.60$	0.032
	Readmission (n = 22)	13 (59.1)	9 (40.9)	—	—
Discharge status	Completed (n = 58)	10 (17.2)	48 (82.8)	$\chi^2 = 20.36$	<0.001
	DAMA (n = 65)	36 (55.4)	29 (44.6)	—	—
	Referred (n = 2)	0 (0.0)	2 (100.0)	—	—
Psychiatric follow-up	Yes (n = 50)	16 (32.0)	34 (68.0)	$\chi^2 = 0.52$	0.472
	No (n = 75)	30 (40.0)	45 (60.0)	—	—

DAMA = discharged against medical advice. Substance categories were collapsed a priori because expected cell counts for opioids ($n = 5$) and cannabis ($n = 4$) were too small for reliable individual estimates; un-collapsed proportions are available on request but should not be interpreted as reliable substance-specific differences.



Relationship between length of stay and relapse

Table 6. Multivariable logistic regression (*n* = 125)

Predictor	OR	95% CI	p-value	VIF
Length of stay (per day)	0.957	0.933–0.980	<0.001	1.78
Readmission to ReLib	6.872	1.246–37.902	0.027	1.19
DAMA (ref: completed)	6.067	1.695–21.710	0.006	1.32
Opioid or alcohol (ref: other)	4.149	0.767–22.430	0.099	1.48
Female (ref: male)	1.155	0.265–5.036	0.848	1.28
Age (years)	0.938	0.872–1.008	0.083	1.78
Married (ref: single)	2.243	0.489–10.297	0.299	1.78
Divorced (ref: single)	0.403	0.064–2.541	0.333	1.27
1 prior admission (ref: none)	2.470	0.571–10.672	0.226	1.52
≥2 prior admissions (ref: none)	0.876	0.176–4.364	0.872	1.81
Psychiatric follow-up (yes)	0.497	0.139–1.781	0.283	1.23

Model $\chi^2 = 81.64$ (*df* = 11), *p* < 0.001; Nagelkerke *R*² = 0.655; AUC = 0.935. OR = odds ratio; CI = confidence interval; VIF = variance inflation factor; DAMA = discharged against medical advice. Wide confidence intervals, particularly for readmission, reflect near-separation in the short-stay stratum and should be interpreted with caution.

1.78; DAMA 1.32; readmission 1.19). The point-biserial correlation between LOS and DAMA was -0.383 , and median LOS was 20 days in DAMA patients versus 61 days in completers. Removing LOS from the model changed the DAMA odds ratio only modestly (7.48 to 6.07), indicating that the two variables capture overlapping but distinct constructs rather than being redundant.

Discussion

In this cohort of 125 adult patients, shorter inpatient stay, readmission, and DAMA discharge were each strongly associated with relapse. The gradient across LOS categories was steep and non-linear, with relapse falling from 97.1% among those staying 14 days or fewer to below 7% among those staying 31 days or more, and the pattern persisted when the cohort was restricted to patients with guaranteed minimum follow-up.

These associations are directionally consistent with the international retention literature. The Drug Abuse Treatment Outcome Study reported better outcomes with longer retention, 5 NIDA guidance identifies 90 days as a reference threshold, 4 and meta-analytic evidence favors extended treatment models. 6 A plausible contributing mechanism exists: the mean LOS distinguishing reliable psychological improvement from no improvement in residential treatment was 37.4 days, 11 and a systematic review of longitudinal neuroimaging studies reports that the onset of structural recovery appears to precede neurochemical recovery, while functional recovery may require longer periods of abstinence. 12 Patients leaving within two weeks therefore return to high-risk environments while these systems remain impaired.

These findings must nonetheless be interpreted with considerable caution, and we do not claim that extending LOS prevents relapse. The design is observational, and LOS is not an exogenous exposure: the decision to leave early is itself an outcome of the

clinical course. Illness severity, treatment engagement, motivation, social support, and withdrawal severity may each influence both how long a patient remains and whether they subsequently relapse, so LOS may function substantially as a marker of these unmeasured factors rather than as an independent causal agent. Reverse causation and confounding by indication cannot be excluded. The near-identity of the 31–90 and >90 day strata is equally consistent with a threshold beyond which further stay adds little, and with selection of a fundamentally different patient group into longer stays.

The association of DAMA with relapse (OR = 6.07) is consistent with evidence that self-directed discharge among patients with SUDs is common and carries elevated readmission risk. 9 In this cohort, DAMA accounted for 52.0% of discharges. Although LOS and DAMA were correlated, collinearity diagnostics indicated they carry distinct information, and qualitative work identifies undertreated withdrawal, inadequately managed pain and experienced stigma as modifiable drivers of self-directed discharge. 9

Within the unadjusted analysis, relapse was highest among patients with exactly one prior admission (54.3%) and lowest among those with two or more (22.0%); these categories did not retain significance after adjustment, and the pattern should be regarded as hypothesis-generating. Opioid or alcohol use was associated with relapse in the collapsed bivariate analysis but not after multivariable adjustment. Given that opioid (*n* = 5) and cannabis (*n* = 4) subgroups were too small for reliable individual estimates, we make no claims about substance-specific differences. Married patients showed a higher crude relapse rate than single patients, inverting the pattern typically reported in Western cohorts, in which both being married and reporting a close relationship with one's partner were associated with lower cocaine and heroin use; 13 this association did not survive adjustment and is noted



only as a signal that family-system variables merit direct measurement.

Limitations

Several limitations constrain interpretation. First, and most fundamentally, the observational design precludes causal inference for the reasons set out above. Second, relapse ascertainment relied on clinical documentation; patients who relapsed without returning to the facility may not have been captured, likely biasing the relapse rate downward. Third, follow-up duration was not uniform and was systematically longer in short-stay patients; although sensitivity analyses indicated this did not account for the association, the extended-stay stratum became sparse under stricter thresholds ($n = 4$ at ≥ 180 days), limiting power at that end of the distribution. Fourth, with 33 of 34 short-stay patients relapsing, the data approach quasi-complete separation, which inflates standard errors and widens confidence intervals; the interval for readmission in particular should not be read as a precise estimate. Fifth, the single-center retrospective design limits generalizability, and female patients were under-represented ($n = 24$). Finally, motivation, psychiatric comorbidity, social support, and withdrawal severity were not recorded and are plausible confounders.

Conclusion

Among 125 adult patients with SUDs at a Saudi rehabilitation center, shorter inpatient stay, readmission, and discharge against medical advice were each strongly associated with relapse, with an apparent inflection in relapse risk near one month of treatment. These are associations observed within a single retrospective cohort and do not establish that extending LOS would itself reduce relapse, nor that 31 days constitutes an evidence-based minimum duration. What the data do support is the identification of early-discharge patients, those readmitted, and those leaving against medical advice as groups at substantially elevated risk who warrant intensified aftercare and retention-focused intervention. The apparent one-month threshold should be regarded as a hypothesis requiring prospective, preferably multicenter, validation with standardized follow-up and measurement of motivational, psychiatric, and social variables.

List of Abbreviations

AUC	Area under the receiver operating characteristic curve
CI	Confidence interval
DAMA	Discharged against medical advice
IQR	Interquartile range
IRB	Institutional Review Board
LOS	Length of stay

NIDA	National Institute on Drug Abuse
OR	Odds ratio
SD	Standard deviation
SUD	Substance use disorder
VIF	Variance inflation factor

Declarations

Conflict of interest

The authors declare no conflicts of interest.

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Ethical approval

Granted by the Institutional Review Board of Care Medical (IRB-010/220925), with waiver of informed consent.

Data availability

The anonymized dataset and analysis scripts are available from the corresponding author on reasonable request.

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