Research Square

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Trajectories of Psychological Distress and Health-Related Quality of Life after First-Time ST-Segment Elevation Myocardial Infarction: A Multicenter Prospective Cohort Study

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Abstract

Background

Psychosocial recovery after ST-segment elevation myocardial infarction (STEMI) is not well described, especially regarding how psychological distress and health-related quality of life (HRQoL) change together over time. We aimed to characterize the trajectories of psychological distress and HRQoL after first-time STEMI and identify demographic and behavioral factors associated with both outcomes.

Methods

In a multicenter cohort of 1,730 STEMI survivors, psychological distress and HRQoL were assessed 12, 24, and 36 months after discharge. A bivariate Student-t mixed-effects model estimated joint trajectories and the modeled association between the outcomes, adjusting for age, sex, marital status, education, physical activity, coping, and sleep quality.

Results

Among 1,730 patients (mean age 56.2 ± 9.9 years; 81.9% men), mean psychological distress increased from 1.28 ± 0.85 at year 1 to 4.72 ± 4.43 at year 2 and then decreased to 3.88 ± 4.13 at year 3, whereas HRQoL changed modestly from 32.67 ± 4.39 to 32.74 ± 4.72 and 33.29 ± 4.82. The joint model reported a negative correlation between patient-level random effects for distress and HRQoL (r = − 0.39). Poor sleep quality was associated with higher psychological distress (β = 0.85; 95% CI 0.56–1.14) and lower HRQoL (β = −2.68; 95% CI − 3.33−−2.03), while higher coping scores were associated with lower psychological distress (β = −0.86; 95% CI − 1.02−−0.70) and higher HRQoL (β = 3.45; 95% CI 3.05–3.84).

Conclusions

Across three annual follow-up assessments after first-time STEMI, psychological distress and HRQoL showed different observed patterns, and the joint model reported a negative association between patient-level random effects. Sleep and coping were associated with both outcomes. These findings support further study of psychosocial outcomes during longer-term follow-up but do not establish causal relationships or intervention effectiveness.

Background

Cardiovascular diseases remain a leading global health problem, accounting for most morbidity and mortality worldwide despite progress in prevention, diagnosis, and treatment (1, 2). Myocardial infarction (MI) is a major component of this burden and continues to pose substantial public health and clinical challenges despite advances in prevention and clinical management (3).

Among its subtypes, ST-segment elevation myocardial infarction (STEMI) is an acute presentation that may cause substantial myocardial injury and is associated with risk of disability and death (4, 5). Acute reperfusion strategies and modern drug therapies have improved short-term survival, but recovery after discharge often remains incomplete. Many patients experience ongoing psychosocial problems, including stress, anxiety, depressive symptoms, and reduced health-related quality of life (HRQoL), and these factors strongly influence long-term prognosis (6, 7).

HRQoL is a multidimensional construct that reflects patients' physical functioning, psychological well-being, and social participation (8). Following an infarction, HRQoL may improve in most survivors, although some do not improve or experience deterioration over time (9). In addition, lower HRQoL measured 1–3 years after MI has been associated with poorer subsequent prognosis (7). Psychological and stress-related factors may accompany poorer recovery after MI (10). Beyond its subjective impact, stress activates biological pathways involving dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, systemic inflammation, and autonomic imbalance, which together may contribute to recurrent cardiac events and delayed recovery (11, 12). Recent evidence indicates that psychological distress after MI, including depression, anxiety, and post-traumatic stress disorder, is highly prevalent and linked with increased morbidity and mortality (6).

Psychological distress and HRQoL may be related, although the direction and mechanisms of this association are not established by observational data (13, 14). This relationship is strongly influenced by demographic and behavioral factors, including age, sex, marital status, and socioeconomic status, which shape how individuals adjust after MI (15–17). Sleep, physical activity, smoking, diet, social support, and coping have been investigated as correlates of psychosocial and health-related outcomes after MI (15, 18–22). Overall, recovery after MI is not solely a matter of myocardial healing but also involves addressing psychological and behavioral determinants that critically influence long-term outcomes (13).

Although health-related quality of life (HRQoL) and psychological symptoms after myocardial infarction have been examined in cross-sectional and longitudinal studies (9, 14, 15, 23, 24), their concurrent patterns over repeated follow-up assessments in patients with first-time STEMI remain less clearly characterized. Analyzing these outcomes separately does not directly characterize the association between their patient-specific longitudinal profiles or allow their correlations to be represented within a single model. A joint longitudinal framework can describe the temporal course of each outcome while accounting for repeated observations and covariance between the outcomes. Accordingly, this secondary analysis of a multicenter prospective cohort aimed to describe the 12-, 24-, and 36-month trajectories of K6-measured psychological distress and SF-12-measured HRQoL after first-time STEMI, assess their modeled association, and examine demographic and behavioral correlates of both outcomes. This approach provides an integrated descriptive assessment of psychosocial recovery, without establishing the direction of association or the effects of interventions.

Methods

Study Design and Participants

This study is a secondary analysis of data from a large multicenter prospective cohort investigating clinical, behavioral, and psychosocial outcomes among patients with first-time STEMI. The design, recruitment procedures, and data collection protocol of the parent cohort have been previously published in detail (25). The parent CRAS-MI protocol identifies five participating referral hospitals in Tehran, Isfahan, Hormozgan, Yazd, and Gilan; recruitment took place between (25).

For this secondary analysis, eligible participants were those aged 18–75 years with a confirmed first-time STEMI, according to the diagnostic criteria documented in the original CRAS-MI protocol (25). Additional criteria included the ability to provide informed consent and clinical stability after acute management. The exclusion criteria included previous cardiovascular disease, severe comorbidities limiting three-year survival, unwillingness or inability to attend scheduled follow-up visits and participation in concurrent interventional studies. All baseline and follow-up assessments were performed by trained multidisciplinary teams (cardiologists, nurses, and psychologists) using standardized protocols.

Data Collection

During the index hospitalization, baseline assessments included socio-demographic characteristics, socioeconomic indicators, anthropometric measurements, and routine clinical information related to the STEMI index, such as infarction characteristics, reperfusion strategy, left ventricular function, in-hospital complications, and laboratory indices. All variables were collected using standardized procedures across the participating centers. The cohort protocol scheduled psychological distress (K6) and HRQoL (SF-12) assessments at baseline and at annual follow-up visits; this secondary analysis reports the 12-, 24-, and 36-month outcome assessments (25).

Psychosocial and Lifestyle Measures

Psychosocial and behavioral characteristics were assessed using validated instruments available in both original and Persian versions.

Psychological distress was measured using the Kessler Psychological Distress Scale (K6), a six-item screening tool scored from 0 to 4 per item, yielding a total score of 0–24, with higher values indicating greater psychological distress. K6 was treated as a continuous variable in the analyses, given its established use in longitudinal studies. The original K6 demonstrates strong validity (26), and the Persian version has shown good reliability in Iranian populations (27). HRQoL was assessed using the 12-Item Short Form Health Survey (SF-12) in accordance with the CRAS-MI cohort measurement protocol; the instrument covers eight health domains and provides physical and mental component summary measures (PCS and MCS), with higher values indicating better health (28, 29). The cohort-derived HRQoL variable supplied for this analysis was treated as a continuous outcome. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), which consists of 19 items across seven

components, producing a global score from 0–21, with higher values indicating poorer sleep quality (30). The Persian version has demonstrated good psychometric properties (31).

Coping strategies were assessed in the CRAS-MI cohort using a 23-item questionnaire with five domains: positive reinterpretation and growth, problem engagement, acceptance, seeking support, and avoidance. Each item was rated never (0), sometimes (1), or often (2) (32, 33). The cohort-derived coping score supplied in the analytic dataset was included as a continuous covariate. The parent CRAS-MI protocol recorded diet using a brief food-frequency questionnaire (original scoring range 0–12); the present secondary-analysis dataset included a nutrition summary score reported on a 0–1 scale. Socioeconomic status (SES) was assessed with the six-item Socioeconomic Status Short-Form Questionnaire (SES-SQ; total score 0–17) and categorized as low, middle, or high (34). Physical activity was measured using a single-item question asking whether participants engaged in at least 30 minutes of physical activity per day (walking, exercise, cycling, etc.). Single-item PA questions have been shown to provide acceptable validity in epidemiological studies (35).

Statistical analysis

The analyses were undertaken to describe longitudinal changes in psychological distress and HRQoL after first-time STEMI and to examine how these two outcomes moved together over time. Baseline demographic, clinical and psychosocial variables were summarized as means (SD) for continuous variables and counts with percentages for categorical variables. The course of psychological distress and HRQoL was described by reporting the mean values and SDs at each annual follow-up visit. These descriptive summaries were used to characterize the cohort and frame the longitudinal modeling; no formal hypothesis testing was performed for baseline comparisons.

To estimate the joint trajectories of psychological distress and HRQoL and their modeled association, we fitted a bivariate linear mixed-effects model with shared patient-level random effects. Time, expressed as years since the index STEMI, was entered as a continuous fixed effect in both outcome equations together with a quadratic term (time^2) to capture non-linear patterns. To reduce collinearity, time was centered at year 2 when constructing the quadratic term. At the individual level, random intercepts and random slopes for time were specified for each outcome, with an unstructured random-effects covariance to allow for correlation between psychological distress and HRQoL random effects. A set of covariates recorded in the cohort was included as fixed effects: age, sex, marital status, education, physical activity (≥ 30 min/day vs < 30 min/day), coping strategy score, and sleep quality. Smoking status, nutrition score, socioeconomic status, BMI, LVEF, and treatment type were evaluated in the preliminary models but were not retained in the final joint model as they were not statistically significant in the preliminary models and were omitted to maintain parsimony. Covariates were evaluated in a block-wise (hierarchical) manner (demographic, lifestyle, and clinical blocks). The association between the modeled outcomes was summarized using a correlation derived from the patient-level random-effects covariance structure.

All models were estimated in R version 4.3.1 using the brms package (36), which uses Stan (37) for fitting multilevel and multivariate mixed-effects models (38, 39). Weakly informative priors were used according to the default brms settings. The initial joint model was specified under a Gaussian likelihood and then re-estimated using a Student-t likelihood for the level-1 residuals of each outcome to improve robustness to heavy-tailed and outlying psychosocial scores, while patient-level random effects were kept normally distributed (40). Models were fitted using 4 Markov chains with 4000 iterations per chain, including warm-up. Convergence and sampling quality were assessed using $\hat{R}$ (< 1.01), effective sample sizes, and visual inspection of trace plots. Posterior predictive checks were used to compare the Gaussian and Student-t specifications and showed better agreement with the empirical distributions under the Student-t model. Fixed-effect results are reported as regression coefficients with 95% confidence intervals. Missing baseline covariates (including sleep quality, coping strategy score, physical activity, marital status, education, and any others with < 10% missing) were handled using multiple imputation via chained equations (10 imputations) with the mice package in R (version 4.3.1) (41). The imputation model included all fixed-effect covariates from the joint model (age, sex, marital status, education, physical activity, coping, and sleep quality) as predictors, plus auxiliary variables (e.g., baseline BMI and LVEF) to improve imputation accuracy. Missing longitudinal outcomes for psychological distress and HRQoL were accommodated within the joint mixed-effects framework under a missing-at-random assumption, using all available repeated measures. Analyses were performed separately for each imputed dataset, and estimates were pooled across imputations using Rubin's rules to account for imputation uncertainty.

Results

At baseline, 1,730 patients with first-time STEMI were included in the analysis (mean age 56.2 ± 9.9 years; 81.9% men). The parent protocol scheduled baseline psychological assessments during the index hospitalization; the present analysis describes psychological distress and HRQoL at 12, 24, and 36 months after discharge. Follow-up assessments were completed for 1,595 patients at year 1 (92.2% of baseline), 1,450 patients at year 2 (83.8%), and 1,320 patients at year 3 (76.3%). Attrition over the three-year follow-up period was due to loss to follow-up (n = 280; 16.2%) and death (n = 130; 7.5%). The baseline characteristics are summarized in Table 1, which is provided at the end of the manuscript. Over the 3-year follow-up, observed mean psychological distress showed a non-linear pattern with a peak at year 2 (Table 2, Fig. 1), increasing from 1.28 ± 0.85 at year 1 to 4.72 ± 4.43 at year 2 and decreasing to 3.88 ± 4.13 at year 3. Mean HRQoL changed modestly over time, from 32.67 ± 4.39 at year 1 to 32.74 ± 4.72 at year 2 and 33.29 ± 4.82 at year 3.

Table 1
Baseline demographic, socioeconomic, lifestyle, and clinical characteristics

Variable	Category	Value*
Demographic and socioeconomic characteristics		
Age, years	–	56.2 (SD 9.9)
Sex	Male	1,417 (81.9)
	Female	313 (18.1)
Marital status	Married	1,450 (88.0)
	Single	38 (2.3)
	Divorced	49 (3.0)
	Widowed	111 (6.7)
Education level	Less than high school	561 (34.0)
	High school diploma	788 (47.8)
	University degree	300 (18.2)
Employment status	Employed	1,351 (78.1)
	Unemployed	379 (21.9)
Socioeconomic status	Low	402 (23.2)
	Middle	827 (47.8)
	High	501 (29.0)
Lifestyle and clinical characteristics		
Smoking status	Never smoker	817 (47.2)
	Former smoker	187 (10.8)
	Current smoker	726 (42.0)
Physical activity ≥ 30 min/day	Yes	651 (37.6)
	No	1,079 (62.4)
Subjective sleep quality	Very good	420 (24.3)

*Values are n (%) for categorical variables and mean (SD) for continuous variables. Percentages for marital status, education, and reperfusion strategy are based on the reported category totals of n = 1,648, n = 1,649, and n = 1,709, respectively; other categorical percentages use n = 1,730.

BMI: body mass index; LVEF: left ventricular ejection fraction; PCI: percutaneous coronary intervention.

Variable	Category	Value*
Demographic and socioeconomic characteristics		
	Pretty good	884 (51.1)
	Pretty bad	335 (19.4)
	Poor	91 (5.3)
Coping strategy score	–	1.21 (SD 0.34)
Nutrition score	–	0.89 (SD 0.30)
BMI, kg/m²	–	27.1 (SD 4.1)
LVEF, %	–	41.3 (SD 8.7)
Reperfusion strategy	No reperfusion	38 (2.2)
	Primary PCI	1,651 (96.6)
	Thrombolysis	20 (1.2)
*Values are n (%) for categorical variables and mean (SD) for continuous variables. Percentages for marital status, education, and reperfusion strategy are based on the reported category totals of n = 1,648, n = 1,649, and n = 1,709, respectively; other categorical percentages use n = 1,730.		
BMI: body mass index; LVEF: left ventricular ejection fraction; PCI: percutaneous coronary intervention.		

Table 2
Observed psychological distress and HRQoL at annual follow-up assessments

Measure	Year 1	Year 2	Year 3
Psychological distress	1.28 (0.85)	4.72 (4.43)	3.88 (4.13)
HRQoL	32.67 (4.39)	32.74 (4.72)	33.29 (4.82)
Values are mean (SD). HRQoL: health-related quality of life.			

Because the observed psychological distress means suggested curvature (increase from year 1 to year 2 followed by a decrease in year 3), time was modeled using both linear and quadratic terms. To improve interpretability and reduce collinearity between linear and quadratic components, time was centered at year 2 when constructing the quadratic term. In the joint Student-t mixed-effects model, the reported intervals for the linear and quadratic time components excluded zero for psychological distress (linear $\beta = 1.30$, 95% CI 1.21–1.40; quadratic $\beta = -0.45$, 95% CI − 0.52 to − 0.38) and HRQoL (linear $\beta = 0.43$, 95% CI 0.29–0.56; quadratic $\beta = 0.12$, 95% CI 0.05–0.19). β coefficients represent the adjusted mean differences (effect sizes) per one-unit change in the predictor.

Covariates were evaluated in demographic, lifestyle, and clinical blocks, and estimates from the reported final joint Student-t model are presented in Table 3. In the final model, female sex was associated with higher psychological distress (β = 0.22, 95% CI 0.06–0.39) and lower HRQoL (β = −1.13, 95% CI − 1.52 to − 0.75). Divorced marital status was associated with higher psychological distress (β = 0.46, 95% CI 0.14–0.78). Poor sleep quality was associated with higher psychological distress (β = 0.85, 95% CI 0.56–1.14) and lower HRQoL (β = −2.68, 95% CI − 3.33 to − 2.03). Conversely, higher coping strategy scores were associated with lower psychological distress (β = −0.86, 95% CI − 1.02 to − 0.70) and higher HRQoL (β = 3.45, 95% CI 3.05–3.84). Regular physical activity was associated with higher HRQoL (β = 0.47, 95% CI 0.21–0.73), and having a high school diploma (vs. less than high school) was associated with slightly higher HRQoL (β = 0.35, 95% CI 0.03–0.66).

Table 3
Adjusted fixed-effect estimates (effect sizes) from the final joint Student-t mixed-effects model

Predictor	Outcome	Coefficient (95% CI)
Time (linear), years	Psychological distress	1.30 (95% CI: 1.21–1.40)
	HRQoL	0.43 (95% CI: 0.29–0.56)
Time² (quadratic), years²	Psychological distress	−0.45 (95% CI: −0.52–−0.38)
	HRQoL	0.12 (95% CI: 0.05–0.19)
Sex (female)	Psychological distress	0.22 (95% CI: 0.06–0.39)
	HRQoL	−1.13 (95% CI: −1.52–−0.75)
Marital status (divorced)	Psychological distress	0.46 (95% CI: 0.14–0.78)
Education (diploma)	HRQoL	0.35 (95% CI: 0.03–0.66)
Physical activity (yes)	HRQoL	0.47 (95% CI: 0.21–0.73)
Coping strategy score	Psychological distress	−0.86 (95% CI: −1.02–−0.70)
	HRQoL	3.45 (95% CI: 3.05–3.84)
Sleep quality (poor)	Psychological distress	0.85 (95% CI: 0.56–1.14)
	HRQoL	−2.68 (95% CI: −3.33–−2.03)

β coefficients represent adjusted mean differences (effect sizes). The joint Student-t mixed-effects model included shared random intercepts and random slopes for time. Time was modeled using centered linear and quadratic terms. CI: confidence interval; HRQoL: health-related quality of life.

The reported random-effects correlation between psychological distress and HRQoL was negative (r = − 0.39; 95% CI − 0.45 to − 0.33).

Discussion

This secondary analysis jointly described psychological distress and HRQoL at three annual follow-up assessments after first-time STEMI. Observed mean distress increased between years 1 and 2 and decreased by year 3, whereas mean HRQoL changed only modestly. The fitted model reported a negative correlation between patient-level random effects for the two outcomes (r = − 0.39). Female sex and poor sleep quality were associated with higher distress and lower HRQoL; divorce was associated with higher distress. Higher coping scores were associated with lower distress and higher HRQoL, while reported physical activity and a high school diploma were associated with higher HRQoL. These findings describe associations among patient-reported outcomes and selected characteristics; they do not establish causal pathways or individual recovery patterns.

The findings can be considered alongside prior studies of HRQoL after MI, although direct comparisons are limited by differences in study populations, instruments, and follow-up schedules. Munyombwe et al. identified heterogeneous HRQoL trajectories after acute MI, including groups with persistently poorer outcomes (9); their class-based trajectories should not be equated with the present patient-level random-effects correlation. Burnos and Wrzosek reported associations between coping, post-traumatic stress symptoms, and HRQoL (24), providing context for the coping results observed here. Gąsecka et al. reported improvement in HRQoL after first-time MI (42), but differences in measurement and follow-up prevent a direct comparison of effect magnitude. Kolarczyk et al. examined sociodemographic and clinical correlates of QoL in a cross-sectional MI sample (14); that study does not directly test the present sleep–coping associations or longitudinal covariance. Together, these studies support studying patient-reported outcomes after MI, while leaving the specific joint association examined here in need of independent replication.

The negative association reported by the joint model is compatible with the broader literature linking psychological well-being and HRQoL after cardiovascular events (11, 13), but it should not be interpreted as evidence that changes in one outcome cause changes in the other. The K6 and SF-12 also assess partly overlapping aspects of psychological health, which may contribute to their observed association. Poor sleep quality and coping scores were related to both outcomes in the adjusted analysis; whether these relationships reflect direct effects, common causes, or shared measurement content cannot be determined here. Neuroendocrine, autonomic, and inflammatory pathways have been proposed in prior research (10–12), but were not evaluated in this analysis. Thus, the results are best interpreted as a joint description of psychosocial outcomes rather than evidence of a specific biological mechanism.

Several limitations affect interpretation. The present analysis uses the 12-, 24-, and 36-month assessments, although the parent cohort protocol also scheduled baseline psychosocial measurements. Consequently, this analysis does not quantify change from the hospitalization baseline or the early post-STEMI period. With only three annual assessments, shorter-term fluctuations and alternative time patterns could not be examined. The findings are observational and may be affected by residual confounding, including unmeasured social support, illness acceptance, clinical status, and participation in rehabilitation. Missing follow-up assessments and deaths may also affect the longitudinal summaries; outcomes after death are not defined, and the missing-at-random assumption does not by itself address

this issue. Finally, the cohort included patients with first-time STEMI who survived to discharge, limiting generalizability to other MI populations. The interpretation of the estimated cross-outcome association also depends on the outcome scales and random-effects specification.

These results indicate that psychological distress and HRQoL merit attention alongside conventional clinical outcomes during longer-term STEMI follow-up. The observed relationships with sleep and coping may help frame future hypotheses about which aspects of psychosocial assessment deserve closer study. However, the analysis did not test screening strategies, risk-prediction tools, behavioral counseling, or exercise-based rehabilitation interventions; it cannot establish whether intervening on the associated factors would improve either outcome. Clinical recommendations about specific interventions should therefore be based on the broader evidence base rather than on these associations alone.

Future work could collect psychosocial outcomes more frequently, establish the timing of sleep and coping measurements, and examine whether the reported joint association is robust to alternative longitudinal specifications. Analyses that account explicitly for death and other informative loss to follow-up would strengthen interpretation of later assessments. Studies designed for prediction could evaluate risk stratification, while randomized trials would be required to estimate effects of targeted psychosocial or rehabilitation interventions on distress and HRQoL.

The principal contribution of this study is the joint longitudinal description of K6-measured psychological distress and SF-12-measured HRQoL in a multicenter cohort of patients with first-time STEMI. Joint modeling permits examination of covariance between patient-level outcome profiles alongside outcome-specific estimates. The observed associations require independent replication and careful consideration of measurement comparability across cohorts.

Conclusions

In this secondary analysis of patients with first-time STEMI, observed psychological distress increased between 12 and 24 months after discharge and then decreased by 36 months, whereas HRQoL showed modest changes. The joint model reported a negative correlation between patient-level random effects for the two outcomes, and sleep quality and coping were associated with both reported outcomes. These observational findings support evaluating psychological distress and HRQoL together during long-term follow-up but do not establish causation or the effectiveness of psychosocial or rehabilitation interventions. Further longitudinal research that addresses attrition and evaluates specific interventions is needed before translating these findings into clinical recommendations.

List of abbreviations

AHA American Heart Association

BMI Body Mass Index

CI Confidence Interval

HRQoL Health-Related Quality of Life

HPA Hypothalamic–Pituitary–Adrenal

K6 Kessler Psychological Distress Scale

LVEF Left Ventricular Ejection Fraction

MI Myocardial Infarction

NIMAD National Institute for Medical Research Development

PA Physical Activity

PSQI Pittsburgh Sleep Quality Index

$\hat{R}$ Potential Scale Reduction Factor (R-hat)

SD Standard Deviation

SES Socioeconomic Status

SF-12 12-Item Short Form Health Survey

STEMI ST-Segment Elevation Myocardial Infarction

Declarations

Ethics approval and consent to participate

The original multicenter STEMI cohort was approved by the Ethics Committee of the National Institute for Medical Research Development (NIMAD), Tehran, Iran (approval code IR.NIMAD.REC.1397.295) and by the ethics committees of the participating universities of medical sciences. Written informed consent was obtained from all the patients at enrollment. The present secondary analysis was additionally approved by the Research Ethics Committee of the Schools of Dentistry, Health Sciences and Advanced Medical Technologies, Isfahan University of Medical Sciences (approval code IR.MUI.DHMT.REC.1404.157). All procedures complied with the Declaration of Helsinki and relevant national regulations and the dataset made available to the investigators for this analysis was de-identified.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

Conceptualizing the study, designing the statistical analysis plan, writing the manuscript, and approving the manuscript: NS, MM, MS, HR, and HM; Data acquisition and clinical oversight (multicenter cohort): MS and HR; Data management, data analysis/interpretation, and drafting the first version of the manuscript: NS; Statistical modeling and statistical analysis: NS, with methodological supervision: MM and HM; Clinical interpretation of findings and critical revision of the manuscript for important intellectual content: MS and HR; Supervision or mentorship: MM, MS, HR, and HM. Each author contributed important intellectual content during the manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved. All the authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are not publicly available due to participant confidentiality and institutional policies, but de-identified data are available from the corresponding author on reasonable request and subject to institutional approvals and data-sharing agreements.

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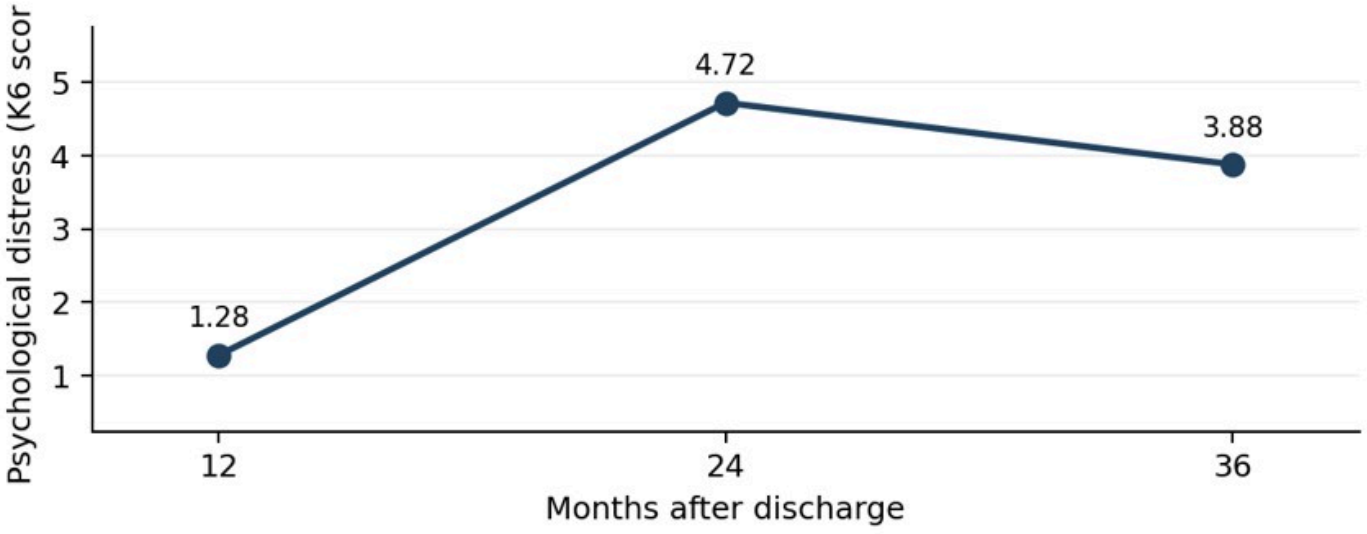
Figures



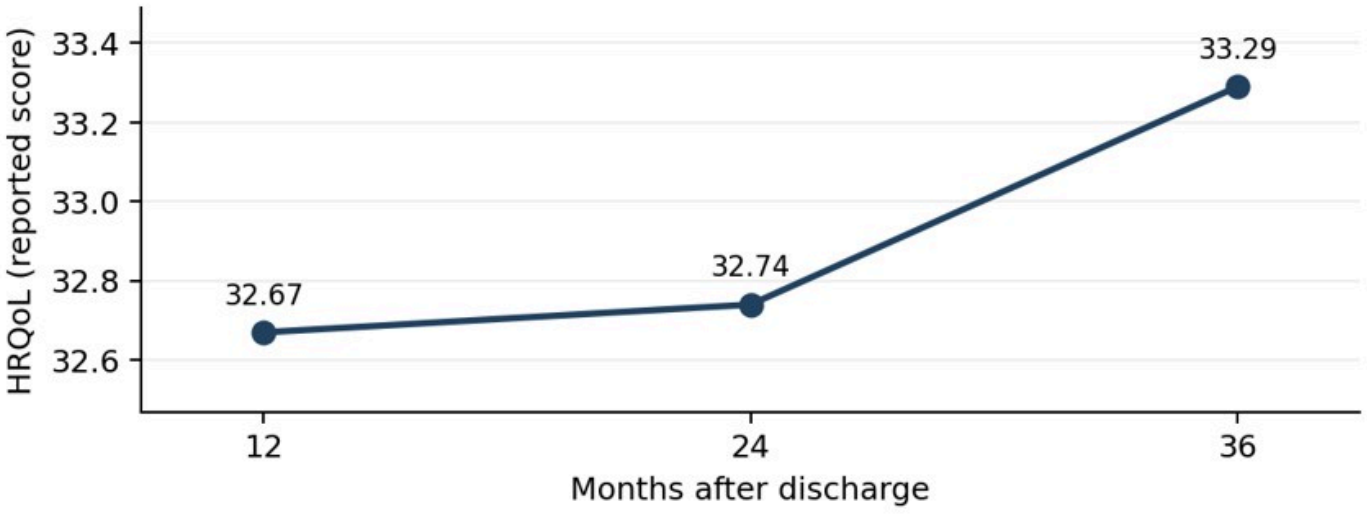


Figure 1

Observed mean psychological distress (A) and health-related quality of life (B) at 12, 24 and 36 months after discharge. Values are the descriptive means reported in Table 2; error bars are not displayed.