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Depression Negatively Impacts Dyadic Quality of Life Following Neuro-ICU Admission: A Prospective Study of Cognitively Intact Patients and Caregivers

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Abstract

Background—Admission to a neurological intensive care unit (Neuro-ICU) can increase risk for depressive and anxiety symptoms for both patients and caregivers. To better understand the long-term mental health impact of a Neuro-ICU admission, we examined the dyadic interdependence between depression and anxiety at Neuro-ICU admission with 3-month quality of life (QoL) for patients and caregivers in a longitudinal, observational cohort study.

Method—We assessed depressive and anxiety symptoms (Hospital Anxiety and Depression Scale; HADS) reported by neurologically intact patients ($n = 72$) and their caregivers ($n = 72$) within 2 weeks of Neuro-ICU admission (baseline) and 3-months post-discharge (follow-up). We examined the longitudinal association between dyadic depression and anxiety at Neuro-ICU admission and 3-month QoL (World Health Organization; QOL-BREF) across four domains (Physical, Psychological, Social relationships, and Environmental QoL) in separate actor-partner interdependence models (APIM) for patients and caregivers.

Results—In the overall models, patients' own baseline depression levels were negatively associated with their own 3-month QoL in all domains ($\beta = -0.53$ to -0.64 , $p < 0.001$), and for caregivers, only in the psychological ($\beta = -0.73$, $p < .001$) and social relationships ($\beta = -0.56$, $p < .001$) domains. No actor effects were found for one's own baseline anxiety impacting one's own 3-month QoL. Partner effects for one's own depression were significant for caregivers on patients' 3-month psychological ($\beta = -0.26$, $p < .02$) and environmental ($\beta = -0.29$, $p < .03$) QoL, as well as for patients on caregiver's 3-month psychological QoL ($\beta = 0.25$, $p < .02$).

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Conflict of Interest The authors declare no competing interests.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Massachusetts General Hospital Institutional Review Board (IRB) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in this study.

No partner effects were significant in association with baseline anxiety and 3-month QoL in both patients and caregivers.

Conclusion—Neuro-ICU patients' and caregivers' baseline depression has significant negative impacts on their own long-term QoL. Caregivers demonstrate significant negative impacts on patient long-term QoL in domains related to emotional distress and caregiver burden. Early identification of mental health symptoms, especially depression, during Neuro-ICU admission may provide an intervention opportunity to improve QoL post-discharge for both dyad members.

Keywords

Depression; Anxiety; Quality of life; Neurological injuries; Actor-partner interdependence model

Introduction

Admission to a neurological intensive care unit (Neuro-ICU) can be a sudden and stressful event for both patients and their caregivers (dyads), and depression and anxiety are common in both Neuro-ICU patients and caregivers. Previously reported rates of clinically significant depression symptoms have ranged from 24 to 44% for patients and 24 to 55% for caregivers [1–5]. Similarly, rates of clinically significant anxiety symptoms have ranged from 40 to 43% for patients and 42 to 46% for caregivers [1–4]. These rates are higher than those observed for other medical cohorts, including general ICU patients [6, 7] and caregivers [8]. Prior research has shown that acute neurological injuries, such as stroke or transient ischemic attack [9–12], as well as intubation [3], increase risk for depression and anxiety in patients. For caregivers, role changes and increased responsibilities [13], as well as uncertainty about their loved one's prognosis [14], also serve as important risk factors for depression and anxiety.

Quality of life (QoL), or an individual's perceived well-being and standard of living, is an important Neuro-ICU outcome given the physical, cognitive, and emotional implications of brain injuries and subsequent life changes for both patients and caregivers [15–18]. In subarachnoid hemorrhage patients, 33% reported lower Psychological, Physical, and Social relationships QoL from 3- to 12-months post-discharge [12, 19] when compared with other Neuro-ICU stroke and hemorrhage patients. Patient and caregiver psychosocial factors are interdependent and can influence outcomes for patient illness trajectory [2, 14, 20]. Despite the emotional toll of an acute neurological injury and subsequent Neuro-ICU admission, few studies have explored depression and anxiety as predictors of QoL trajectories among both patients and caregivers [21]. Prior research, which has focused on patients and rarely the caregivers, or on both individuals together as a dyad [22], has found that post-traumatic stress in patients can negatively impact caregiver psychological symptoms and QoL [1, 23].

Exploring the dyadic relationship through interdependence modeling can identify the effect that patients and caregivers have on their own and each other's mental health trajectories [2, 5, 23–27]. An increasing body of research has noted an interdependency between patient and caregiver levels of anxiety in association with patient illness [2, 26–28]. Evidence exists for dyadic patterns of interdependence for emotional distress and admission to a Neuro-ICU and medical-ICU [23, 26, 28]; however, the impact that depression and anxiety

have on QoL over time in Neuro-ICU dyads remains unknown. In a previous analysis of this dataset, higher patient and caregiver mindfulness and adaptive coping scores at admission predicted one's own lower 3-month anxiety symptoms, especially caregivers (i.e., actor effects). Further, one's own baseline anxiety symptom scores had a negative impact on one's partner's 3-month anxiety severity (i.e., partner effects) [2]. While this research is important for understanding dyadic relationships between anxiety and coping, the impacts on long-term QoL among these patients and caregivers have not been explored. This study builds on Meyers et al. [2] by investigating dyadic relationships between depression and anxiety on quality of life to advance our knowledge of the long-term psychological impact of a Neuro-ICU admission on patients and caregivers. This research gap is notable given that depression and anxiety often affect patients long after their Neuro-ICU stay [1, 9, 12, 18, 20]. Research that identifies early psychological risk factors, such as depression and anxiety experienced during Neuro-ICU admission, has the potential to inform treatments aimed at improving QoL and promoting resilience for both dyad members.

The present study aims to identify the dyadic association between levels of depression and anxiety for both patients and caregivers within 2 weeks of Neuro-ICU admission with 3-month QoL. We first hypothesize that for both patients and caregivers, one's own higher depression and anxiety symptom scores at Neuro-ICU admission would be associated with one's own lower QoL domain scores at 3-months post-discharge [1, 21, 26]. Second, we hypothesize that both patient's and caregiver's own depression and anxiety symptom scores at admission will be interdependent with their partner's lower 3-month QoL domain scores, such that one's own depression and anxiety at admission will negatively affect one's partner's long-term QoL. We discuss potential clinical implications of our findings for addressing depression and anxiety early after the Neuro-ICU, such as resiliency-based interventions [3, 9–12].

Methods

Participants and Procedures

This study is a secondary analysis of a prospective, longitudinal, observational dataset of patients admitted to the Neuro-ICU and their caregivers [2, 5, 23]. This is the only study from this dataset that investigates the dyadic relationship between anxiety and depression on long-term QoL among Neuro-ICU patients and caregivers. Our team has conducted a series of studies to integrate psychosocial care into Neuro-ICU settings [29] and inform the development of a novel dyadic resilience intervention [30]. Our team has published other analyses with these data focused on understanding the long-term psychological impact of a Neuro-ICU admission [2]. The Massachusetts General Brigham Institutional Review Board approved all study procedures (2014P002793).

We recruited patients admitted to the Neuro-ICU and their caregivers (dyads) within weeks of Neuro-ICU admission at Massachusetts General Hospital in Boston, MA, from 2015 to 2016. All participants were cleared for participation by the ICU medical team [1, 2, 5, 21, 23], and approximately 70% of all admitted patients were eligible to participate in this study [2]. Patient-caregiver dyads completed all baseline measures in the Neuro-ICU and 3-month outcomes post-discharge (follow-up). The majority of caregivers were parents,

children, and siblings in this sample [30]. Dyads were screened at bedside for the following inclusion criteria in patients: (1) 18 years of age or older, (2) literacy and English language fluency, (3) admission to the Neuro-ICU within the previous 2 weeks (most patients were enrolled within 2 days), and (4) communicative patients with transient aphasia or mild cognitive symptoms who were cleared by the medical team for participation. Exclusion criteria for patients, determined with the attending Neuro-ICU clinical team, included (1) inability to complete self-report questionnaires or make personal medical decisions due to their acute neurological injury, (2) possible impending death in the Neuro-ICU, (3) symptomatic chronic aphasia or delirium, and (4) no designated or identified primary, informal caregiver [1, 5, 21]. Inclusion criteria for caregivers included (1) 18 years of age or older, (2) literacy and English language fluency, and (3) primary informal caregiver as determined by the patient.

Figure 1 illustrates the participant flowchart. Eligible patients and caregivers completed study measures within 2 weeks of Neuro-ICU (baseline) and at 3-months (follow-up) post-discharge. We conducted paper assessments at bedside and contacted dyads via email (or phone) at follow-up online via REDCap. REDCap is a secure, web-based application for data collection and has been used in our other Neuro-ICU studies with this population [31, 32]. Study staff assisted patients with completion of questionnaires as needed. For follow-up assessment, study staff made three contact attempts before considering a participant as lost to follow-up. Due to significant data lost to 6-month follow-up, we restricted our APIM to the baseline and 3-month follow-up data.

Measures

Demographic Characteristics and Clinical Variables—We collected patient and caregiver demographic characteristics at admission including sex, age, race, ethnicity, marital status, level of education, employment status, and mental health history. Clinical variables were obtained from the patient's medical records, including primary neurological diagnosis (stroke/hemorrhage, brain aneurysm, tumor, lesion/brain mass, traumatic brain injury, seizure) and intubation status (yes/no).

Hospital Anxiety and Depression Scale (HADS)—We measured depression and anxiety symptoms for both patients and caregivers within 2 weeks of Neuro-ICU admission (baseline) and 3-months post-discharge (follow-up) using the Hospital Anxiety and Depression Scale (HADS). The HADS is a 14-item self-report tool that measures both Anxiety (7 questions) and Depression (7 questions) in the past week [33]. Items are scored on a Likert Scale rating of 0–3 with total scores ranging from 0 to 21. On their respective subscales, total scores of 0–6 indicate no anxiety or depression, and scores of 7 or greater indicate clinically significant symptoms of anxiety or depression [1]. The HADS is both valid and reliable and has been used in other Neuro-ICU settings [3, 15].

Quality of Life: World Health Organization QOL-BREF (WHOQOL-BREF)—We tested the impact on 3-month QoL for both patients and caregivers within 2 weeks of Neuro-ICU admission (baseline) and 3-months post-discharge (follow-up) using the WHOQOL-BREF. The WHOQOL-BREF is a 26-item self-report tool that measures QoL

across four domains: (1) the Physical domain addresses perceptions of independence in daily living, general health, energy, work capacity, sleep, and fatigue; (2) the Psychological domains addresses positive and negative emotions and feelings, self-esteem, cognitive function, and meaning making; (3) the Social relationships domain addresses personal life satisfactions, perceptions and availability of social support, and satisfaction with sex life; (4) the Environmental domain addresses physical freedom, safety, security, opportunities for recreation, and time for caregiving [21, 26, 34]. Scores for each domain are transformed, with higher scores (range = 0 to 20) indicating better QoL [28]. As an abbreviated version of the full WHOQOL-100, the WHOQOL-BREF is an easy-to-use, reliable, and valid measure [16, 21].

Statistical Analysis Plan—We ran descriptive statistics to report demographics, clinical characteristics, and study measures using IBM SPSS Statistics (version 25) [35]. We examined associations between these variables at admission for both patients and caregivers using independent-sample *t*-tests, one-way analysis of variance, chi-square tests of independence, and Pearson correlations as appropriate. Prior to hypothesis testing, we performed validity checks on the study measures, and we ran bivariate correlations for both patients and caregivers as an exploratory analysis to inform the actor-partner interdependence modeling (APIM) [24, 25]. Dyadic analysis must be treated as interdependent; therefore, regression alone cannot address interdependence because it focuses solely upon the individual baseline measures as a predictor of long-term QoL [22, 24, 25, 27, 36].

We used APIM with an online application (https://apimsem.ugent.be/shiny/apim_sem/) [24] and tested the impact of patients' and caregivers' depression and anxiety symptoms at baseline (within 2 weeks of Neuro-ICU admission) and 3-month QoL [23]. We were not able to adjust for demographics within APIM due to the relatively small sample size. APIM is an accepted and popular method for measuring the impact that dyads have on one another and has been used for dyadic comparisons in a Neuro-ICU [2, 5, 23, 25, 36]. In this model, interdependence addresses the relationship between a dyadic association and QoL outcomes due to patient illness [2, 23, 25, 26, 28, 36]. An "actor effect" tests for an individual's separate baseline depression and anxiety measures predicting his/her own 3-month QoL [2, 23–26]. A "partner effect" tests for a patient's and caregiver's baseline anxiety and depression measures predicting his/her partner's related 3-month QoL [2, 23–26]. We analyzed QoL domains (Physical, Psychological, Social relationships, and Environmental) as outcomes in separate APIM models. Given that depression and anxiety are highly co-morbid in Neuro-ICU patients and caregivers, analyzing outcomes from separate composite subscales of depression and anxiety scores from within the Hospital Anxiety and Depression Scale (HADS) psychometric measure can assist providers in these settings to treat symptoms concurrently [3, 14], as well as examine the unique effects of depression and anxiety. Outcomes with $p < 0.05$ were considered significant and demonstrated an impactful relationship between an individual's baseline measures and their partner's 3-month QoL outcomes [2, 23–25].

Results

Subject Characteristics

Table 1 reports the demographics and diagnosis for the analyzed sample of patients ($N = 72$, $M_{\text{age}} = 52$, standard deviation (SD) = 14.9) and caregivers ($N = 72$, $M_{\text{age}} = 51$, SD = 13.6). There was a significantly greater proportion of female (63%) than male (37%) caregivers, $\chi^2(1, 71) = 29$, $p < 0.001$, and a significantly greater proportion of male (55%) than female (45%) patients, $\chi^2(1, 71) = 4$, $p < 0.04$. Patients and caregivers did not differ on the remaining demographic variables ($p > 0.05$).

Table 2 presents depression, anxiety, and QoL scores by patients and caregivers. At admission (within 2 weeks), 42% of patients had clinically significant anxiety (HADS-A ≥ 7), and 25% of patients had clinically significant depression (HADS-D ≥ 7). Clinically significant anxiety and depression were observed in 50% and 24% of caregivers, respectively. Patients ($M = 3.17$, SD = 0.55) had significantly lower 3-month QoL within the physical domain than caregivers ($M = 3.35$, SD = 0.45) ($p < 0.03$). This may suggest that reductions in physical functioning from an acute neurological injury remained noticeable to patients 3-months post-hospitalization. Patients and caregivers did not significantly differ by depression, anxiety, or QoL at baseline or 3 months.

Bivariate Analysis of Patient and Caregiver Depression and Anxiety at Neuro-ICU Admission with 3-Month Quality of Life Domains

Table 3 presents the bivariate correlations results for patient depression and anxiety scores at admission, and their 3-month QoL (all domains). All 3-month QoL domains are negatively correlated with patient depression symptoms ($r = -0.54$ to -0.69 , $p < 0.001$) and anxiety symptoms ($r = -0.29$ to -0.45 , $p < 0.01$) at admission. Table 4 presents the bivariate correlations for caregiver depression and anxiety scores at admission, and their 3-month QoL (all domains). All 3-month QoL domains are negatively correlated with caregiver depression symptoms ($r = -0.36$ to -0.60 , $p < 0.01$) and caregiver anxiety symptoms ($r = -0.40$ to -0.46 , $p < 0.001$) at admission. These correlations provided support for dyadic hypothesis testing.

Effects of Own Depression and Anxiety at Neuro-ICU on Own 3-Month Quality of Life Domains (Actor Effects)

For patients, baseline depression was negatively associated with 3-month QoL in all domains ($\beta = -0.53$ to -0.64 , $p < 0.001$) (Table 5) (Figs. 2, 3, 4, and 5). For caregivers, baseline depression was negatively associated with 3-month QoL in two domains: psychological ($\beta = -0.73$, $p < 0.001$) and social relationships ($\beta = -0.56$, $p < 0.001$), but not the environmental or physical domains ($p > 0.05$) (Table 5) (Figs. 2 and 3). For both patients and caregivers, baseline anxiety was not significantly associated with 3-month QoL in all domains ($p > 0.05$) (Table 5).

Effects of Own Depression and Anxiety at Neuro-ICU on Partner's 3-Month Quality of Life Domains (Partner Effects)

For caregivers, one's own baseline depression had a significant, negative association with their partner's (patient's) 3-month QoL within the psychological domain ($\beta = -0.26$, $p < 0.02$) domain and the environmental domain ($\beta = -0.29$, $p < 0.03$) (Table 5) (Figs. 2 and 4). For patients, one's own baseline depression had a significant, positive association with their partner's (caregiver's) 3-month psychological QoL ($\beta = 0.25$, $p < 0.02$) domain (Table 5) (Fig. 2). For both patients and caregivers, no partner effects were significant for baseline anxiety impacting 3-month QoL.

Discussion

This prospective study examined the longitudinal association between depression and anxiety at Neuro-ICU admission and 3-month QoL domains (Physical, Psychological, Social relationships, and Environmental) in both patients and caregivers. By examining actor and partner effects in APIM, we found that depression, not anxiety, after Neuro-ICU admission significantly predicted long-term QoL in patients (all QoL domains) and caregivers (psychological and social relationships). These findings are notable given the high rates of emotional distress among Neuro-ICU patients and caregivers [8, 10, 11], which exceed other medical cohorts without neurological injuries [6–9, 11]. Our study highlights the need to further explore the psychosocial impacts of Neuro-ICU admission on dyads' long-term health outcomes.

For actor effects, patients' baseline depression significantly affected their own 3-month QoL in all domains. This significance may be due to the negative impact on a patient's long-term psychological wellbeing (e.g., emotional distress due to brain injuries, especially stroke survivors) [4, 9, 10]; physical impairment (e.g., loss of mobility and changes in roles and responsibilities) [12, 19]; social relationships impairments (e.g., loss of independence, changes in communications skills, and tendency to isolate) [12, 19, 26, 31]; and environmental impacts (e.g., the amount of time associated with physical recovery and the possible loss of work) [26]. Caregivers' baseline depression significantly affected their own 3-month QoL in only the psychological and social relationships domains ($p < 0.001$). In contrast to patients, depressive symptoms after Neuro-ICU admission appear to negatively impact caregiver's own long-term psychological wellbeing (e.g., emotional distress and self-image) and relationship quality (e.g., perceived loss of social supports) more than physical (e.g., mobility) or environmental QoL (e.g., perceived resources) [13, 19, 26]. Because depression was a significant predictor of lower long-term QoL for both dyad members, our findings suggest that psychosocial treatments in Neuro-ICU settings should address the differential impacts of depression among patients and caregivers.

With respect to partner effects, baseline depression in caregivers had a significant negative association with patients' 3-month QoL within the psychological and environmental domains. Caregivers' emotional stress after Neuro-ICU can have lasting impacts on patients' long-term QoL [21, 26]. For example, increased time and burden for caregiving may negatively impact patients and their health recovery more over time [13, 18, 19]. Counterintuitively, we also found that patient depression was associated with higher 3-

month psychological QoL in caregivers. The most likely explanation is a false positive result (i.e., type I error) due to running multiple APIM analyses. However, it is possible that caregivers had higher self-esteem and positive attitudes, and thus higher 3-month psychological QoL, after attending to patients' baseline depressive symptoms. Regardless, additional studies are needed to better understand this relationship and explore potential confounding variables, such as social support network [13, 18, 19, 26, 27], resilience [2, 15, 23], mindfulness, and coping skills [2, 5].

The observed toll of depressive symptoms, beyond the influence of anxiety, on both patient and caregiver's long-term QoL underscores the need to prioritize early assessment and treatment to promote dyads' mental health in addition to their physical recovery. This finding aligns with similar research that compared elevations in depression and anxiety symptoms in both Neuro-ICU patients and caregivers in comparison to cancer patients and caregivers [14, 27], as well as mood disorders associated with neurological injuries, such as strokes [26, 37]. Prior research has also shown that patients and caregivers have high levels of anxiety and related post-traumatic stress brought on by Neuro-ICU admission and long-term recovery [21]. Prior research utilizing APIM for the analysis of dyadic interdependence in stem cell transplantation also supports the findings for depression outweighing anxiety for long-term QoL [38]. Our findings suggest that, when examined simultaneously in dyadic models, depression is a stronger predictor of long-term QoL in patients and caregivers. Criteria for depressive disorders may overlap with QoL domain facets, such as insomnia, fatigue, and mobility issues (Physical QoL); lack of or diminished interest in activities, difficulty concentrating, and psychomotor agitation (Psychological and Environmental QoL); and low self-esteem and feelings of hopelessness/helplessness (Social relationships QoL) [34, 37]. The combination of neurological injuries contributing to depression, and the possible alignment of depressive symptoms with QoL domains, points to the need for future research to explore a better understanding of the mechanisms that explain the prominence of depression.

The results are consistent with prior research for depression in Neuro-ICU patients [6, 20, 21, 26–28] and expands our understanding by demonstrating the prospective relationship between depression and QoL across four domains. Depression in Neuro-ICU patients increases the risk for a wide range of adverse outcomes, including stroke or hemorrhage [9, 10, 12, 14, 23, 39], intubation, [3, 39], decreased physical mobility [19, 41], less abilities for self-care [26], and inability or delay in returning to work [6, 7, 42]. Particularly for stroke patients [9, 11, 40] who were intubated [3], depression is associated with increased anxiety and post-traumatic stress. After Neuro-ICU discharge, depressive symptoms such as avoidant behavior [43] may contribute to a “disability spiral” of worsening Physical, Psychological, Social relationships, and Environmental QoL that hinders their ability to regain independence [15, 44].

Previous research has shown that in caregivers of Neuro-ICU patients, higher levels of depression symptoms are associated with increased levels of emotional distress, social isolation, and caregiver burden [4, 8, 13, 14, 20, 26, 44, 45]. Long-term impairments in QoL and depression among caregivers may have negative “spillover effects” on their loved one's recovery [15, 18, 21, 26, 28, 44] — a responsibility that should not be faced by

caregivers alone given the toll of the Neuro-ICU admission on their own mental health [4]. The long-term implications of caregiver burden in this population are not fully understood, nor addressed [8, 13, 18, 22, 23]. Our findings suggest that for both patients and caregivers, long-term promotion of QoL may involve early identification and prevention of depression and anxiety symptoms following admission.

The findings from this prospective sample contribute to the mounting evidence that psychosocial interventions are needed to prevent chronic emotional distress in patients and caregivers [1, 2, 5, 14, 20, 21, 23, 28]. To fill this treatment gap in Neuro-ICU settings, our team has iteratively developed *Recovering Together*, a dyadic mindfulness-based and resilience intervention [28, 31]. In an efficacy trial conducted after this prospective study, RT demonstrated the feasibility and preliminary efficacy for reducing depression, anxiety, and post-traumatic stress in Neuro-ICU patients and caregivers [28, 31, 46]. Such resilience and mindfulness based interventions show promise for reducing depression, anxiety, and psychosocial distress, as well as improving QoL in both patients and caregivers [2, 15, 21, 23]. Future research is needed to understand whether changes in mindfulness and other resilience factors can mediate the relationship between depression and long-term QoL.

This study had five key limitations. First, the subsamples were relatively small for contrast and dyadic patterns testing for patients and caregivers ($n = 72$ each). Nevertheless, our results are meaningful because neuro-ICU patients and caregivers are a challenging population and few studies have successfully compared dyad members. Relatedly, we are unable to determine whether QoL changed beyond the 3-month follow-up due to difficulty maintaining longer-term patient and caregiver participation. Future dyadic studies with larger sample sizes are needed to fully examine the role of patient and caregiver demographic variables, such as sex and age, because of the important influence that these factors have on dyadic QoL [13, 26]. Second, QoL domains were designed for the general population and may be as sensitive to Neuro-ICU patients, especially stroke patients [19]. Third, we recruited neurologically intact patients and their caregivers only to ensure validity of the self-reports. Excluding patients (and their caregivers) with more severe acute neurological injuries may have restricted the range of depression and anxiety symptoms observed. Previous research on proxy assessments has shown that caregivers and clinicians tend to rate patients' QoL lower than how patients would assess themselves [19, 47]. Fourth, the majority of the sample, conducted at a large medical center, was white and highly educated, which limits the generalizability of our findings to more diverse populations at different treatment settings.

Conclusions

This study explored the actor-partner effects related to higher depression and anxiety symptoms and long-term QoL from hospitalization through recovery. By examining both patients and caregivers, we contributed to the growing evidence of the importance of identifying psychological symptoms on long-term QoL, especially for high-need Neuro-ICU dyads. Early identification of clinically significant depression at admission can create opportunities for patient and caregiver interventions throughout the Neuro-ICU stay to prevent long-term detrimental effects on QoL. Given the large associations identified in this

study and demands of the Neuro-ICU on staff and dyads, brief assessments of depression, anxiety, and QoL may be sufficient to identify dyads in need of psychological interventions.

Data Availability

The data that support the findings of this study are available from the corresponding author, Dr. Ana-Maria Vranceanu, upon reasonable request.

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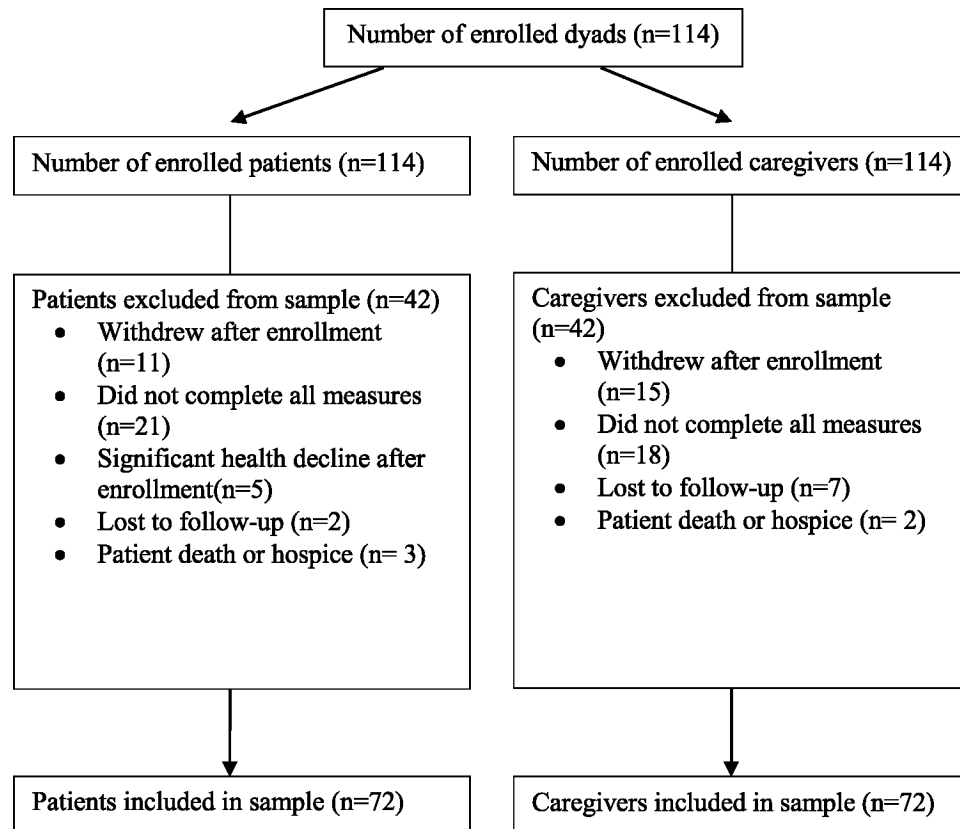


Fig. 1.
Flowchart of the analytic sample

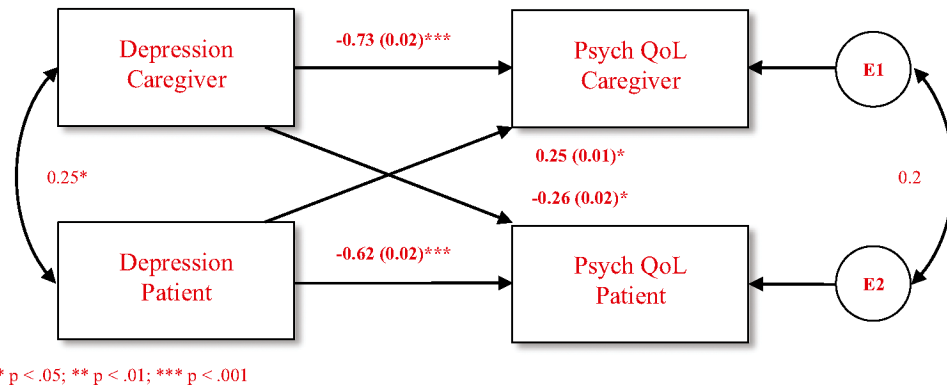


Fig. 2.
APIM outputs — significant patient and caregiver actor and partner effects for depression negatively impacting 3-month QoL — Psychological domain

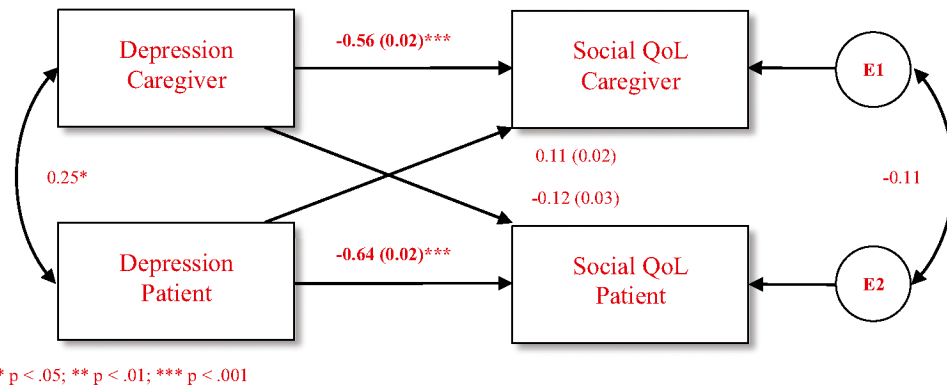
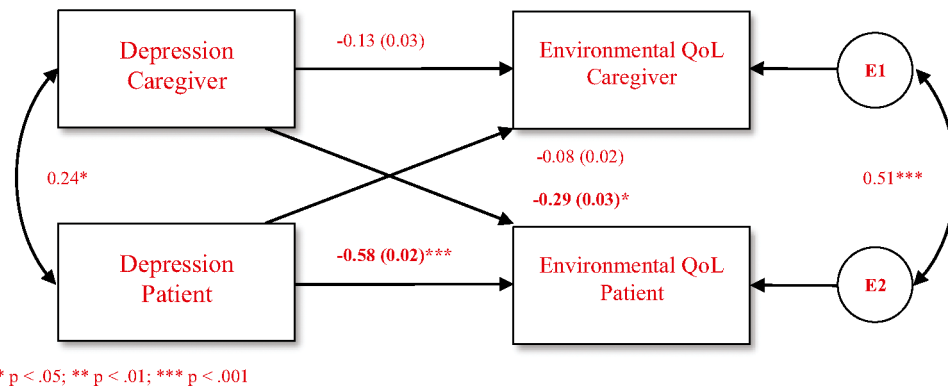


Fig. 3.
APIM outputs — significant patient and caregiver actor effects for depression negatively impacting 3-month QoL — Social relationships domain

**Fig. 4.**

APIM outputs — significant patient actor effects and caregiver partner effects for depression negatively impacting 3-month QoL — Environmental domain

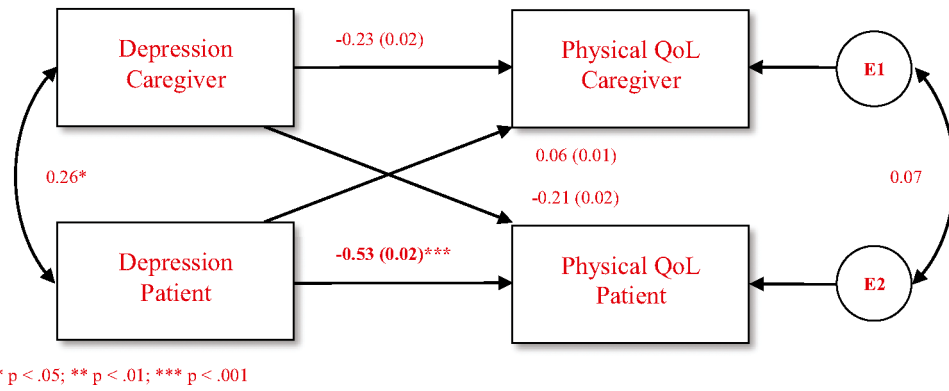


Fig. 5.
APIM outputs — significant patient actor effects for depression negatively impacting 3-month QoL — Physical domain

Table 1

Subject characteristics

Subject characteristics	Patients mean or <i>n</i> (%)	Caregivers mean or <i>n</i> (%)
Demographics		
Sex (female)	55 (45)	37 (63)
Age (<i>M</i> ± <i>SD</i>) (range: 21–84)	52.09 ± 14.90	51.27 ± 13.68
Race (white)	16.8 (80.6)	11.2 (84.7)
Education (%)		
Less than high school	2.8%	0.0%
Completed high school (GED)	20.8%	15.3%
Some college/associates degree	20.8%	25.0%
Completed 4 years of college	33.3%	23.6%
Graduate/professional degree	19.4%	33.3%
Marital status (%)		
Single, never married	13.9%	5.6%
Married	65.3%	75.0%
Living with significant other	6.9%	6.9%
Separated/divorced	5.6%	6.9%
Widowed	5.6%	1.4%
Relationship to patient		
Spouse/partner		51 (70.83)
Parent		8 (11.11)
Child		9 (12.5)
Sibling		1 (1.38)
Other, not reported		3 (4.16)
Diagnosis <i>n</i> (%)		
Cerebrovascular stroke/hemorrhage	27 (37.5)	
Tumor	20 (27.77)	
Lesion/brain mass	7 (9.72)	
Brain aneurysm (unruptured)	3 (4.16)	
Other vascular	2 (2.77)	

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Subject characteristics	Patients mean or <i>n</i> (%)	Caregivers mean or <i>n</i> (%)
Traumatic brain injury	2 (2.77)	
Seizure	2 (2.77)	
Other diagnosis	6 (8.33)	
Not reported	3 (4.16)	
Intubation		
Intubated, anytime, <i>n</i> (%)	55 (78.6)	
Intubated, other than postop, <i>n</i> (%)	9 (16.4)	
Days intubated — mean (range)	2 (1–3)	

Table 2

Subject symptoms

Subject symptoms		Raw scale range		Patients		Caregivers		Comparisons		p value
Variable				Mean	SD	Mean	SD	Mdiff	CI	
Baseline anxiety symptoms (raw scores)										
Total score		0–28		6.78	4.55	6.67	4.00	0.11	– 1.30 to 1.52	0.88
Baseline depression symptoms (raw scores)										
Total score		0–28		4.54	4.15	3.75	3.79	0.79	– 0.52 to 2.10	0.24
3-month quality of life subscales (raw scores)										
Physical		4–20		3.17	0.55	3.35	0.45	– 0.18	– 0.35 to – 0.01	0.03 *
Psychological		4–20		3.51	0.66	3.52	0.49	– 0.01	– 0.20 to 0.18	0.92
Social		4–20		3.98	0.77	4.04	0.61	– 0.06	– 0.29 to 0.17	0.61
Environmental		4–20		4.15	0.81	4.19	0.6	– 0.04	– 0.27 to 0.19	0.74

* $p < 0.05$

Bivariate analysis — patient depression and anxiety at Neuro-ICU admission with 3-month quality of life domains

Table 3

Measure	1	2	3	4	5	6
1. Patient baseline anxiety	Pearson correlation	-				
	Sig. (2-tailed)					
2. Patient baseline depression	Pearson correlation	.535**				
	Sig. (2-tailed)	0.000				
3. Patient 3-mos QoL — Physical	Pearson correlation	-.289*	-.537**	-		
	Sig. (2-tailed)	0.016	0.000			
4. Patient 3-mos QoL — Psychological	Pearson correlation	-.446**	-.693**	.786**	-	
	Sig. (2-tailed)	0.000	0.000	0.000		
5. Patient 3-mos QoL — Social relationships	Pearson correlation	-.313**	-.595**	.563**	.690**	-
	Sig. (2-tailed)	0.009	0.000	0.000	0.000	
6. Patient 3-mos QoL — Environmental	Pearson correlation	-.370**	-.615**	.766**	.837**	.679**
	Sig. (2-tailed)	0.002	0.000	0.000	0.000	0.000

* Correlation is significant at the 0.05 level (2-tailed);

** Correlation is significant at the 0.01 level (2-tailed)

Bivariate analysis – caregiver depression and anxiety at Neuro-ICU admission with 3-month quality of life domains

Table 4

Measure	1	2	3	4	5	6
1. Caregiver baseline anxiety	Pearson correlation	-				
	Sig. (2-tailed)					
2. Caregiver baseline depression	Pearson correlation	.699**	-			
	Sig. (2-tailed)	0.000				
3. Caregiver 3-mos QoL — Physical	Pearson correlation	-.449*	-.427**	-		
	Sig. (2-tailed)	0.000	0.000			
4. Caregiver 3-mos QoL — Psychological	Pearson correlation	-.433**	-.603**	.674**	-	
	Sig. (2-tailed)	0.000	0.000	0.000		
5. Caregiver 3-mos QoL — Social relationships	Pearson correlation	-.457**	-.532**	.475**	.488**	-
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
6. Caregiver 3-mos QoL — Environmental	Pearson correlation	-.405**	-.361**	.689**	.596**	.416**
	Sig. (2-tailed)	0.001	0.004	0.000	0.000	0.001

* Correlation is significant at the 0.05 level (2-tailed);

** Correlation is significant at the 0.01 level (2-tailed)

Actor-partner interdependence models on effect of own depression and anxiety symptom severity on own and partner's 3-month QoL

Table 5

Standardized	Actor effects		Partner effects	
	<i>b</i>	<i>P</i>	<i>b</i>	<i>P</i>
Depression and 3-month quality of life — Psychological				
Baseline depression—patient	− 0.62	< 0.001 ***	0.25	< 0.02 *
Baseline depression—caregiver	− 0.73	< 0.001 ***	− 0.26	< 0.02 *
Depression and 3-month quality of life - Social relationships				
Baseline depression—patient	− 0.64	< 0.001 ***	0.11	.397
Baseline depression—caregiver	− 0.56	< 0.001 ***	− 0.12	.371
Depression and 3-month quality of life—Environmental				
Baseline depression—patient	− 0.58	< 0.001 ***	− 0.08	.588
Baseline depression—caregiver	− 0.13	.465	− 0.29	< 0.03 *
Depression and 3-month quality of life—Physical				
Baseline depression—patient	− 0.53	< 0.001 ***	0.06	.637
Baseline depression—caregiver	− 0.23	.156	− 0.21	.144
Anxiety and 3-month quality of life—Psychological				
Baseline anxiety—patient	− 0.04	.699	0	.979
Baseline anxiety—caregiver	− 0.01	.967	0.04	.719
Anxiety and 3-month quality of life - Social relationships				
Baseline anxiety—patient	0.08	.466	0.06	.641
Baseline anxiety—caregiver	− 0.05	.754	− 0.02	.856
Anxiety and 3-month quality of life—Environmental				
Baseline anxiety—patient	0.02	.890	0.02	.898
Baseline anxiety—caregiver	− 0.18	.342	0.1	.423
Anxiety and 3-month quality of life—Physical				
Baseline anxiety—patient	0.05	.657	− 0.03	.817
Baseline anxiety—caregiver	− 0.31	.078	0.05	.733

* $p < 0.05$;

*** $p < 0.001$