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Employment Outcomes after Critical Illness: An Analysis of the BRAIN-ICU Cohort

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Abstract

Objective—To characterize survivors' employment status after critical illness and to determine if duration of delirium during hospitalization and residual cognitive function are each independently associated with decreased employment.

Design—Prospective cohort investigation with baseline and in-hospital clinical data and follow up at 3 and 12 months.

Setting—Medical and surgical intensive care units (ICUs) at two tertiary-care hospitals.

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Patients—Previously employed patients from the BRAIN-ICU study who survived a critical illness due to respiratory failure or shock and were evaluated for global cognition and employment status at 3- and 12-month follow-up.

Measurements—We used multivariable logistic regression to evaluate independent associations between employment at both 3 and 12 months and global cognitive function at the same time point, and delirium during the hospital stay.

Main Results—At 3-month follow-up, 113 of the total survival cohort of 448 (25%) were identified as being employed at study enrollment. Of these, 94 survived to 12-month follow-up. At 3 and 12months follow-up, 62% and 49% had a decrease in employment, 57% and 49% of whom, respectively, were newly unemployed. After adjustment for physical health status, depressive symptoms, marital status, level of education, and severity of illness, we did not find significant predictors of employment status at 3 months, but better cognition at 12 months was marginally associated with lower odds of employment reduction at 12 months, OR 0.49, p=0.07).

Conclusions—Reduction in employment after critical illness was present in the majority of our ICU surivors, approximately half of which was new unemployment. In this potentially underpowered pilot study, delirium at either 3 or 12 months was not a predictor yet cognitive function at 12 months was a predictor of subsequent employment status. Further research is needed into the potential relationship between the impact of critical illness on cognitive function and employment status.

Keywords

Delirium; Intensive Care Unit; Employment; Cognitive Impairment; sepsis; acute respiratory distress syndrome or ARDS; mechanical ventilation; dementia

INTRODUCTION

Given large increases in use of critical care during the last decade [1, 2], improving ICU survival rates [3-9], and rapidly growing aged population [10], it is predictable that a large number of critical illness survivors will be attempting to re-enter the workforce while facing new physical, neuropsychological and psychiatric impairments that frequently affects patients after critical illness [11-18]. Since post intensive care syndrome could very well affect patients' ability to work. it is imperative that we understand employment patterns and risks factors for unemployment amongst previously employed patients.

An early study on unemployment after critical illness suggests that approximately half of patients employed prior to their hospitalization will be unemployed one year after discharge. [19]. For individuals who remain in the workforce, difficulties including underemployment, e.g., working fewer hours or transitioning to part-time status, or taking long-term sick leave are common. While risk factors such as gender, educational level and magnitude of medical disability have been shown to be predictors of return to work. Prior work has suggested an important link between delirium, cognition, mobility, and development of the post-intensive care syndrome[20]. However, no studies that are able to control for these other factors exist specifically examining the effect of delirium and cognitive impairment on decreased employment or outright unemployment in a general ICU population.

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In this prospective cohort study, we sought to describe changes in employment level 3 months and 12 months after discharge from an episode of critical illness and specifically hypothesized delirium and cognitive function would be associated with decreased employment or unemployment amongst previously employed survivors of critical illness.

MATERIALS AND METHODS

Study Design and Population

This prospective cohort study was nested in the Bringing to Light the Risk Factors and Incidence of Neuropsychological Dysfunction in ICU Survivors (BRAIN-ICU) study [18]. The eligibility criteria for the BRAIN-ICU study have been previously reported [18]. This study was approved by the institutional review boards at Vanderbilt University and Saint Thomas Hospital. We included patients 18 years or older admitted to the medical or surgical intensive care unit in cardiogenic or septic shock. We excluded patients with extensive ICU exposure and those who we could not reliably assess delirium status.

Independent Variable

We examined two primary independent risk factors for associations with decreases in employment at 3 and 12 months after discharge: in-hospital duration of delirium and cognitive function at each follow-up time.

Delirium was assessed in the ICU and during hospitalization by trained research personnel for up to 30 days, using the Confusion Assessment Method for the ICU (CAMICU), a validated measure for diagnosis of delirium.[21] To be diagnosed with delirium by the CAM-ICU, patients had to be arousable to voice and have an alteration in mental status from baseline, inattention, and either altered levels of consciousness or disorganized thinking. Duration of delirium was assessed as total days of delirium that a patient had while in the hospital.

Cognitive function was assessed at 3- and 12-month follow-up by trained psychologists using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). The RBANS is a validated tool for the evaluation of global cognition as well as the subdomains of immediate and delayed memory, attention, visuospatial construction and language.[22]. Previous studies have established the population age-adjusted mean RBANS global score as 100±15 [23, 24]. Lower scores indicate worse global cognitive function.

Primary Outcomes and Covariates

The primary outcome was a self-reported decrease in employment level compared with the employment level prior to enrollment. This was defined as either going from employed full time to part time or unemployed, or going from part-time employment to unemployed. All employment data was collected via survey completed by the patient or surrogate at 3- and 12-month follow-up.

To adjust for potential confounding of any association between the main exposures and decrease in employment, we included covariates in our models that represented social support or potential physical, cognitive, psychiatric barriers to returning to work and were

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collected during the BRAIN-ICU study. Specifically, these included physical health status, as measured by the Medical Outcomes Study 36-item Short Form General Health Survey Physical Component Score (SF-36 PCS) [25]; depressive symptoms, as measured by the Beck Depression Inventory-II [26]; marital status; and level of education. We also included severity of illness, as measured by the Sequential Organ Failure Assessment Score (SOFA) [27, 28] in sensitivity analyses. The SOFA score is a scoring system used to predict mortality in the ICU by grading organ dysfunction in six systems. We removed the mental status component to eliminate potential colinearity with the exposure, which also involves mental status. The score ranges from 0 to 24 with higher scores reflecting higher severity of illness. [29]

Statistical Analysis

Characteristics of the study population and primary outcome measures were examined using descriptive statistics. Categorical variables were summarized using frequencies and proportions. Continuous variables were summarized using medians and interquartile ranges.

We used four separate multivariable logistic regression models to determine if duration of delirium and/or cognitive function, measured by the RBANS global score, were independently associated with the primary outcome of decreased employment at 3- and 12-month follow-up after adjusting for covariates of years of education, SF-36 physical component score, BDI-II total score, and marital status. We then performed sensitivity analyses for all models adjusting for severity of illness during the ICU stay using mean daily SOFA score.

To assess for confounding by depression and/or poor physical sense of well-being, we performed additional sensitivity analyses removing the covariates BDI and SF-36 PCS from the model. In addition, we tested for collinearity of all covariates by hierarchical cluster analysis using squared Spearman's rank order correlation test. We used R software version 3.0.1 (www.r-project.org) for all statistical analysis.

RESULTS

Amongst the 448 patients available for analysis at 3-month follow-up, 113 patients were identified as being employed prior to their illness based on interviews with patients or surrogates at 3 month follow-up and formed our employment study cohort. Employment data were unavailable for two patients at 3-month follow-up, thus 113 patients had data available for analysis. The same cohort of patients was followed to 12-month follow-up during which 19 died or were lost to follow-up, forming our 12-month employment cohort. **(Figure 1)** Demographic and clinical characteristics of the employment cohort are shown in **Table 1**. Amongst patients reporting employment at enrollment, (100/113) 88% were employed full time and (13/113) 12% were employed part time. At 3-month follow-up, (65/113) 58% of these patients were unemployed, (39/113) 34% were employed full time, (9/113) 8% were employed part time. (**Figure 2**) Overall, 70 (62%) reported decreased employment at 3-month follow-up.

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Employment data for 94 previously employed patients were available at 12-month follow-up, where 47% of patients were unemployed, 45% of patients were employed full time, 7% of patients were employed part time, and 1% had an unknown employment level. **(Figure 2)** Overall, 79 (70%) of patients employed at admission experienced a decrease in employment at 12 months.

After adjusting for covariates, neither the duration of delirium nor cognitive function at 3 months were associated with an increased risk of a decrease in employment level at 3-month follow-up **(Table 2)**. Sensitivity analysis adjusting for severity of illness using mean modified SOFA did not change odds of decreased employment. Duration of delirium was not associated with decreased level of employment at 12-month follow-up, but better cognitive function at 12 months was marginally associated with lower odds of a decrease in employment at 12-month follow-up **(Table 3)**.

DISCUSSION

Our cohort study yielded several key findings. First, we found that rates of unemployment up to a year after discharge were high among survivors of critical illness. We did not observe a statistically significant relationship between delirium duration and cognitive function and decreased employment at 3-month follow-up. However, we found that better cognitive function at 12 months was marginally associated with a trend toward lower odds of employment decrease. One explanation for the lack of association between cognitive function at 3 months and the presence of an association at 12 months may be that closer to the ICU event, physical and clinical factors acquired during the ICU stay dominate while at 12 months, the effect of persistent cognitive impairment now has a significant effect on ones odds of being employed.

Compared with prior studies of employment after episodes of critical illness, our study showed higher rates of job loss among survivors. In one British study, 33% of patients reported a decreased level of employment at 3 months and 28% at 12 months, rates that were approximately 50% lower than we reported.[30] A Norwegian study showed 55% of patients returned to work at one year follow-up, also a lower rate than we reported.[19] No prior studies have explored the relationship of delirium and employment outcomes and very few have studied the link between cognitive functioning and employment. One study investigating cognitive status and employment in 46 survivors of Acute Respiratory Distress Syndrome (ARDS) found that 6 years after discharge, approximately a quarter of patients were unemployed due to health conditions. This study found a significant relationship between cognitive function and employment and reported that all study subjects with cognitive impairment were also disabled.[31] Reasons for the discrepancy between these findings and ours are unclear, though the association between cognition and employment decrease at 12 months when not seen at 3 months may suggest that physical disability is a more proximate cause of unemployment and that as these effects decrease we see the emergence of the effect of lasting cognitive impairment on survivor's ability to maintain employment.

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The strengths of our study are that it is a relatively large investigation compared with others focused on employment outcomes post-ICU. It also employed a wide breadth of both clinical and health-related quality of life data. Trained graduate level specialists using psychometrically robust outcome tools collected this data. Another strength of this investigation involves cohort selection. That is, by analyzing only patients who were previously employed, we provide a representation of "Working America", making any implications on job loss that much more impactful.

Our study also had limitations. We experienced a lost to follow-up rate of 27% (N=169) from discharge to 3-months. These patients may have represented the highest risk patients for employment decrease, introducing risk of selection bias. Our outcome measurement of employment level was survey based and thus subject to recall bias in contrast to administrative approaches such as tax returns. We were not able to assess changes within those individuals still employed, i.e. change in job type or description nor were we able to assess the effect on caregivers' employment. In addition, this study occurred in the midst of the "Great Recession," introducing the chance of outside economic forces contributing to employment change. These confounders may have a greater effect on the 12-month outcomes, however these cannot be ignored because these outside economic forces likely have a greater effect on the physically and cognitively impaired.

More detailed employment questionnaires are already being employed in studies to address these weaknesses.

CONCLUSIONS

In conclusion, we found high rates of employment impairment in a group of otherwise young, previously working, insured individuals recovering from critical illness. Although we did not detect a relationship between 3-month cognitive function and employment, better cognitive function at 12 months was associated with a trend toward lower odds of decrease in employment one year after discharge. There was no association between duration of delirium and employment outcomes at either follow-up interval. Further research is needed to address employment changes amongst survivors of critical illness.

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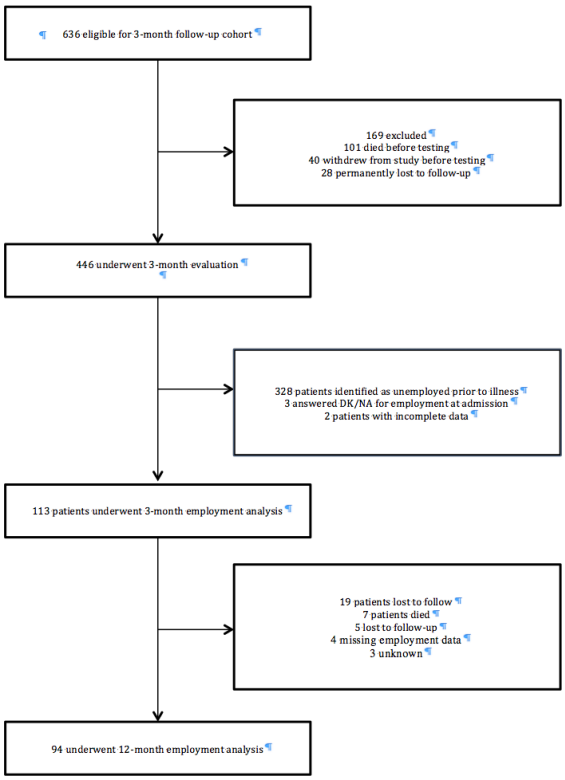

Figure 1.
Consort diagram illustrating the formation of the BRAIN-ICU Employment Cohort.

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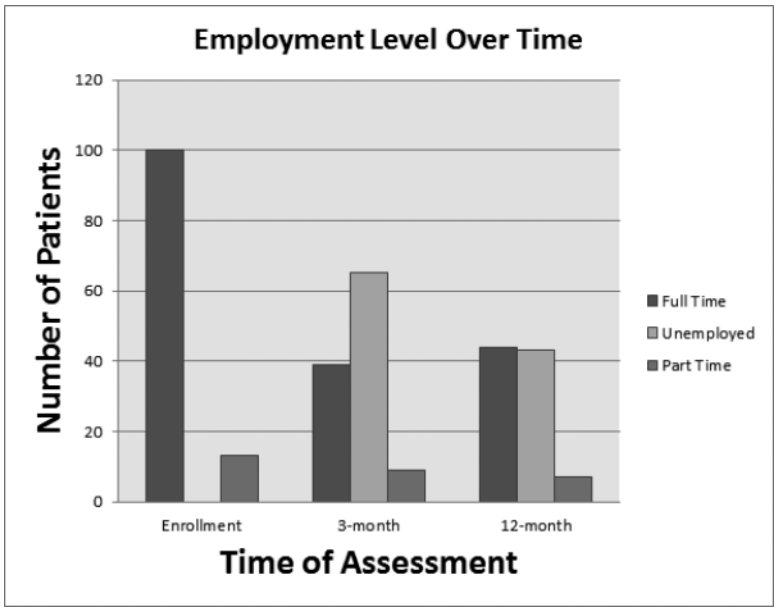

Figure 2. Level of Employment over Time amongst Survivors

Histogram demonstrating the number of patients employed at each level pre-enrollment, at 3-month follow-up, and at 12-month follow-up. Blue bars represent number of patients employed full time, green represents part time, red represents unemployed, and purple is those lost to follow-up. Almost all employed patients were employed full time prior to critical illness. The majority of employment change at 3-months was to unemployed (N=64, 57%). Some patients regained part-time employment by 12-months; however a significant proportion remained totally unemployed (n=45, 47%). Changes in numbers over time indicate deaths or lost to follow-up among the cohort.

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Table 1

	N	Enrollment	*N*	3-months		*N*	12-months	
				Decrease (n=70)	**No Decrease (n=43)**		**Decrease (n=46)**	**No Decrease (n=48)**
Days of Delirium, *days*	--	--	*113*	2.5 [0 to 6.8]	3 [1.0 to 7.0]	*94*	3.0 [1.0 to 7.0]	2.0 [1 to 4.8]
RBANS global Score*			*97*	81 [72-88]	83 [75-90]	*84*	81 [78 to 100]	84 [78-93]
Age, years	*113*	53 [44 to 60]	*113*	53 [46-60]	54 [39-60]	*94*	58 [49 to 63]	49 [41 to 56]
Sex, % (n)	*113*		*113*			*94*	61% (28)	62% (30)
Male		61% (69)		61% (43)	60% (26)		39% (18)	38% (18)
Female		39% (44)		39% (27)	40% (17)			
Race	*113*		*113*			*94*		
White		85% (96)		81% (57)	91% (39)		80% (37)	90% (43)
African American		14% (16)		17% (12)	9% (4)		20% (9)	10% (5)
Other		1% (1)		1% (1)	0% (0)		0% (0)	0% (0)
Years of Education, years	*112*	13.0 [12.0 to 14.2]	*112*	13.0 [12.0 to 14.0]	13.5 [12.0 to 16.0]	*93*	13.0 [12.0 to 15.8]	14.0 [12.0 to 16.0]
Marital Status, %	*110*		*110*			*92*	11% (5)	0% (0)
Divorced		7% (8)		9% (6)	5% (2)		72% (34)	84% (38)
Married		76% (84)		76% (52)	9% (4)		4% (2)	2% (1)
Separated		1% (1)		3% (2)	2% (1)		0% (0)	0% (0)
Single		9% (10)		1% (1)	0% (0)		11% (5)	9% (4)
Widow(er)		4% (4)		4% (3)	2% (1)		2% (1)	4% (2)
Other		3% (3)		6% (4)	14% (6)		4% (2)	2% (1)
SF-36 - PCS		n/a	*106*	31.9 [25.1 to 37.9]	43.3 [34.2 to 52.0]	*91*	36.2 [31.9 to 54.0]	44.2 [31.9 to 54.0]
IQCODE**	*113*	3.0 [3.0 to 3.0]	*113*	3.0 [3.0 to 3.0]	3.0 [3.0 to 3.0]	*94*	3.0 [3.0 to 3.0]	3.0 [3.0 to 3.0]
Katz ADL	*112*	0 [0 to 0]	*112*	0 [0 to 0]	0 [0 to 0]	*93*	0 [0 to 0]	0 [0 to 0]
FAQ	*112*	0 [0 to 0]	*112*	0 [0 to 1]	0 [0 to 0]	*93*	0 [0 to 0]	0 [0 to 0.5]
History of Depression	*111*		*111*			*92*		
Yes		31% (34)		27% (19)	37% (15)		29% (13)	34% (16)
No		69% (77)		73% (51)	63% (26)		71% (32)	66% (31)
History of any psychiatric illness (other than depression)	*112*		*112*				91	
Yes		10% (11)		7% (5)	14% (6)		7% (3)	13% (6)
No		90% (101)		93% (65)	86% (36)		93% (43)	87% (41)

* RBANS global score is a test of global cognitive function. Population mean is 100 (+/−15) with lower scores indicating poorer cognition.

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Table 2a

Multivariable Model of Associations between Days of Delirium during Hospitalization and Employment Status at 3 months

Variable	Odds Ratio	95% Confidence Interval	p-value
Days of Delirium	0.80	0.46-1.39	0.43
Depression	1.24	0.63-2.46	0.53
Marital Status (y/n)	1.23	0.41-3.63	0.71
Mean Modified SOFA	2.56	1.25-5.23	0.01
SF-36 Physical	0.30	0.15-0.61	0.001
Years of Education	0.62	0.39-0.61	0.04

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Table 2b

Multivariable Model of Associations between Cognitive Function 3 months after Discharge and Employment Status at 3 months

Variable	Odds Ratio	95% Confidence Interval	p-value
RBANS global	1.17	0.58-2.34	0.66
Depression	1.20	0.60-2.37	0.61
Marital Status (y/n)	1.11	0.37-3.31	0.86
Mean Modified SOFA	2.36	1.12-5.0	0.024
SF-36 Physical	0.33	0.16-0.68	0.003
Years of Education	0.55	0.34-0.94	0.03

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Table 3a

Multivariable Model of Associations between Days of Delirium during Hospitalization and Employment Status at 12 months

Variable	Odds Ratio	95% Confidence Interval	p-value
Days of Delirium	0.99	0.53-1.82	0.96
Depression	1.61	0.80-3.23	0.18
Marital Status (n/y)	0.42	0.13-1.30	0.13
SF-36 Physical	0.61	0.32-1.17	0.12
Years of Education	0.86	0.57-1.30	0.47

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Table 3b

Multivariable Model of Associations between Cognitive Function 12 months after Discharge and Employment Status at 12 months

Variable	Odds Ratio	95% Confidence Interval	p-value
RBANS global	0.49	0.23-1.05	0.07
Depression	1.44	0.71-2.96	0.31
Marital Status (n/y)	0.36	0.11-1.20	0.10
SF-36 Physical	0.59	0.30-1.15	0.12
Years of Education	1.10	0.68-1.79	0.70