Critical Care

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Labour market attachment before and after hospitalisation for sepsis: a Danish cohort study

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Abstract

Background Sepsis survivors often experience cognitive, physiological, and functional impairments that may limit return to work (RTW). We aimed to describe changes in workforce attachment among working-age patients with sepsis, both overall and stratified by treatment in general wards versus the intensive care unit (ICU). Additionally, we aimed to evaluate the impact of educational level and to identify factors associated with RTW.

Methods A register-based cohort study including all patients aged 20–63 years with incident community-acquired sepsis admitted to a hospital in the Region of Southern Denmark between 1 January 2016 and 20 March 2018. Labour market attachment was illustrated using area charts, overall and stratified by treatment in general wards versus the ICU. Further, the overall area chart was stratified by educational level. Patients were classified as part of the workforce or non-workforce. A subgroup of the workforce comprised those working. RTW was estimated for the workforce and those working after 12, 52, 104, and 156 weeks. Factors associated with RTW were identified using cause-specific hazards.

Results Of the 1610 patients with sepsis included, 651 were part of the workforce, with 488 working. After 12 weeks, 69.0% of workforce patients (excluding those censored) had returned to work. This proportion increased to 81.6%, 87.5%, and 90.4% after 52, 104, and 156 weeks, respectively. Among patients working before sepsis, RTW proportions were higher. Several baseline variables and in-hospital measures were associated with RTW among the workforce including younger age (20–39 years), HR = 1.33 (95% CI, 1.05–1.68), no ICU admission, HR = 2.64 (95% CI, 1.81–3.86), lactate < 4 mmol/L, HR = 2.19 (1.13–4.24), and single organ failure, HR = 2.33 (95% CI, 1.16–4.69). While ICU admission had impact on RTW in both the workforce and those working, educational level was unrelated to RTW among those working.

Conclusions Most working-age patients with sepsis were outside the workforce. Working before sepsis was the strongest predictor of RTW. While educational level influenced whether patients were part of the workforce, it was not associated with RTW among those working. No ICU admission was associated with RTW.

Keywords Sepsis, Occupation, Return to work, Intensive care unit, Educational level, Mortality, Retirement

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Introduction

Cognitive and functional impairments are often experienced by sepsis survivors, resulting in altered conditions in everyday life. [1, 2] Long-term sequelae, along with the increased risk of new medical, psychological, and cognitive diagnoses may hinder their ability to return to work (RTW) [3, 4].

A Danish study of septic shock survivors from an intensive care unit (ICU) found that 43% of the previously employed had returned to work one year after discharge. [5] Higher proportions of RTW among ICU-treated sepsis survivors were reported in a Norwegian and a German study, with 53.6% and 65.3% returning to work within a year, respectively. The proportions were 68.6 and 82.6% among those treated in general wards, but the results reflect variation between the countries [6, 7].

Although the incidence of sepsis is highest among elderly patients, it is also common in young adults. [8, 9] Lower age, fewer comorbidities, and fewer organ dysfunctions are associated with a sustainable RTW in sepsis survivors. [6] Knowledge of long-term prognosis in working-aged patients with sepsis, including adherence to workforce, is important because the younger survivors may live with the potential impact for years. Knowledge of factors related to RTW among sepsis survivors is limited and without socioeconomic measures. In this study, we aimed to describe labour market attachment among working-aged patients with sepsis, both overall and stratified by treatment in general wards versus the intensive care unit. We further aimed to evaluate the impact of educational level on labour market affiliations. Additionally, we sought to identify factors associated with return to work among those who were part of the workforce.

Methods

Study design and setting

This retrospective, Danish population-based register cohort study included all adult patients in the Region of Southern Denmark (RSD) with an acute hospital admission from 1 January 2016 to 20 March 2018. As of 1 January 2017, the RSD had a total population of 1,217,224 citizens, with a working-aged (20–63 years) population of 672,292 individuals. [10] In the region, there are five emergency hospitals that receive and treat acutely referred patients 24 h a day. In addition, some smaller regional hospitals treat selected acute patients.

Study participants

All adult (aged ≥ 18 years) patients acutely admitted to a hospital in the RSD were initially included in the cohort. From this cohort, we identified all patients aged 20–63 years who were admitted with sepsis. These patients were included at their first admission with sepsis (the index date). We excluded patients with potential nosocomial sepsis (hospital admission within seven days prior to the index date). Sepsis was defined as an infection with the simultaneous presence of organ failure(s), according to the Third International Consensus Definitions for Sepsis and Septic Shock [11]. The criteria for infection were: blood cultures performed within 48 h of arrival, antibiotics initiated within 48 h of arrival, and a discharge diagnosis of infection (eTable1, Additional file 1). A modified Sequential Organ Failure Assessment score (SOFA score) [12] was used to classify the presence of organ failure(s), Additional file 1, eTable 2.

Data sources

After extracting all acute hospital admissions from the electronic medical records, we extracted information on antibiotic administration and vital signs upon arrival. The hospitals' logistic system provided us with data on the time of arrival and discharge. Blood test results and data from blood cultures were extracted from the laboratory and microbiological databases, respectively.

All Danish residents have a unique personal identifier allowing cross-linkage of data at a personal level from multiple registers. [13] Using Danish nationwide registers, we extracted data on hospital discharge diagnoses, ICU admissions (the Danish National Patient Registry) [14], age, sex, civil status, emigration, and death (the Danish Civil Registry) [13]. Discharge diagnoses were used to identify markers of smoking, alcohol-related disorders, major mental illness, immunosuppression (Additional file 1, eTable 3), and to calculate the Charlson Comorbidity Index (CCI) for a 10 years period ending on the index date. The cohort was enriched with data on the highest completed education from the Danish Education Registers [15], and weekly employment status and social benefits transfers from the Danish Register for Evaluation of Marginalisation (DREAM) database (Additional file 1, eMethods) [16].

Labour market attachment

Occupational status was divided into five groups based on codes from the DREAM database [16]; employed/self-supporting, unemployed/receiving labour market related benefits, sick leave, flex job (special employment arrangement for people with reduced ability to work) [17], and retired (Additional file 1, eTable 4).

Being part of the workforce was defined as being employed/self-supporting, or unemployed/receiving labour market related benefits, provided that the individual had no long-term sick leave before index (sickness absence benefits for more than 4 weeks in the preceding 8 weeks prior to the index date). Working was

defined as employed/self-supporting without long-term sick leave prior to the index date. RTW was defined as being employed/self-supported for at least 4 consecutive weeks after the index date. The first week of RTW was recorded as the first week within these 4 consecutive weeks.

Statistical analyses

We described baseline characteristics and in-hospital measures overall, stratified by workforce versus non-workforce at the index date. The distribution of labour market attachment for the entire cohort was assessed weekly from 52 weeks before the index date to 156 weeks after, and visualised with an area plot, both overall, stratified by treatment at the general wards versus ICU, and stratified by educational level.

In the RTW analysis, we restricted the cohort to patients with sepsis who were part of the workforce at the index date. To identify factors associated with RTW, we calculated cause-specific hazard ratios (HRs). Patients were censored when they returned to work, died, retired, or emigrated whichever occurred first. We adjusted the model for age, sex, and CCI. [18] HRs were estimated at 12 and 52 weeks of follow-up. In a sensitivity analysis, we repeated the analyses for those working at the index date and. The proportionality assumption was tested using log-minus-log plots and Schoenfeld residuals.

The Aalen-Johansen cumulative incidence function (CIF) was used to illustrate the time to RTW, with death or retirement as competing events. CIF was performed for the workforce and stratified by treatment in general wards versus the ICU (repeated for the working group). Additionally, a CIF stratified by working and not working was conducted. Finally, we created a CIF stratified by educational level. Analyses were performed using Stata version 18 (StataCorp LLC, Texas, USA).

Missing data

Number of missing data in baseline characteristics are outlined in Table 1. In the RTW analyses, missing data were treated as a separate category for each variable, with the results shown in Table 2. A few patients (n = 3) were recorded as 'not resident in Denmark' in the DREAM database but had not emigrated according to the Danish Civil Registry. These patients were treated according to the information in the Danish Civil Registry.

Results

Between 1 January 2016 and 20 March 2018, there were 443,953 acute admissions to a hospital in the RSD, with 7824 cases of incident community-acquired sepsis, of whom 1610 were aged 20–63 years at the index date. This corresponds to an incidence of 108/100,000

Table 1 Baseline characteristics of the study population overall and stratified into workforce and non-workforce at index

	Overall	Workforce	Non-workforce
Demographics	N = 1610	N = 651	N = 959
Age, median (IQR)	55 (46;60)	51 (38;57)	57 (50;61)
20–39	246 (15.3)	179 (27.5)	67 (7.0)
40–54	551 (34.2)	234 (35.9)	317 (33.1)
55–63	813 (50.5)	238 (36.6)	575 (60.0)
Sex, n (%)			
Male	873 (54.2)	375 (57.6)	498 (51.9)
Country of origin, n (%)			
Denmark	1470 (91.3)	575 (88.3)	895 (93.3)
Western countries	46 (2.9)	22 (3.4)	24 (2.5)
Non-western countries[a]	94 (5.8)	54 (8.3)	40 (4.2)
Charlson Comorbidity Index, n (%)			
CCI = 0	873 (54.2)	474 (72.8)	399 (41.6)
CCI = 1	257 (16.0)	72 (11.1)	185 (19.3)
CCI = ≥ 2	480 (29.8)	105 (16.1)	375 (39.1)
Immunosuppression, n (%)			
No	1460 (90.7)	618 (94.9)	842 (87.8)
Yes	150 (9.3)	33 (5.1)	117 (12.2)
Severe mental illness, n (%)			
No	1479 (91.9)	626 (96.2)	853 (88.9)
Yes	131 (8.1)	25 (3.8)	106 (11.1)
Markers of smoking, n (%)			
No	1250 (77.6)	582 (89.4)	668 (69.7)
Yes	360 (22.4)	69 (10.6)	291 (30.3)
Alcohol related disorder, n (%)			
No	1371 (85.2)	603 (92.6)	768 (80.1)
Yes	239 (14.8)	48 (7.4)	191 (19.9)
Educational level, n (%)			
Low secondary	683 (42.4)	173 (26.6)	510 (53.2)
Upper secondary	619 (38.4)	321 (49.3)	298 (31.1)
Post secondary	211 (13.1)	131 (20.1)	80 (8.3)
Missing	97 (6.0)	26 (4.0)	71 (7.4)
Civil status, n (%)[b]			
Married	652 (40.5)	313 (48.1)	339 (35.3)
Divorced	328 (20.4)	100 (15.4)	228 (23.8)
Widowed	35 (2.2)	11 (1.7)	24 (2.5)
Unmarried[a]	595 (37.0)	227 (34.9)	368 (38.4)
Mortality after index, n (%)			
12 weeks	161 (10.0)	30 (4.6)	131 (13.7)
52 weeks	268 (16.6)	46 (7.1)	222 (23.1)
104 weeks	355 (22.0)	57 (8.8)	298 (31.1)
156 weeks	416 (25.8)	70 (10.8)	346 (36.1)
In-hospital measures			
Site of infection, n (%)			
Abdominal	142 (8.8)	78 (12.0)	64 (6.7)
Pulmonal	856 (53.2)	310 (47.6)	546 (56.9)
Urinary tract	178 (11.1)	56 (8.6)	122 (12.7)
Skin, muscle, bones	81 (5.0)	36 (5.5)	45 (4.7)
Viral/systemic	36 (2.2)	17 (2.6)	19 (2.0)

Table 1 (continued)

	Overall	Workforce	Non-workforce
Other	45 (2.8)	27 (4.1)	18 (1.9)
Unknown	272 (16.9)	127 (19.5)	145 (15.1)
Bacteraemia, n (%)			
No	1325 (82.3)	541 (83.1)	784 (81.8)
Yes	285 (17.7)	110 (16.9)	175 (18.2)
Lactate ≥ 4 mmol/L, n (%)			
No	1530 (95.0)	623 (95.7)	907 (94.6)
Yes	80 (5.0)	28 (4.3)	52 (5.4)
Organ failure, n (%)			
1	1384 (86.0)	570 (87.6)	814 (84.9)
2	182 (11.3)	57 (8.8)	125 (13.0)
≥ 3	44 (2.7)	24 (3.7)	20 (2.1)
Type of failure, n (%)[c]			
Renal	177 (11.0)	80 (12.3)	97 (10.1)
Respiratory	992 (61.6)	366 (56.2)	626 (65.3)
Liver	207 (12.9)	123 (18.8)	84 (8.8)
Circulatory	307 (19.1)	107 (16.4)	200 (20.9)
Cerebral	56 (3.5)	6 (0.9)	50 (5.2)
Coagulation	148 (9.2)	77 (11.8)	71 (7.4)
Length of hospital stay, median (IQR)	4 (2;9)	4 (2;8)	5 (2;9)
ICU-admission, n (%)			
No	1340 (83.2)	558 (85.7)	782 (81.5)
Yes	270 (16.8)	93 (14.3)	177 (18.5)

[a] n < 3 had missing data and was incorporated in the marked variable

[b] Married also included people living in a partnership. Divorced included cancelled partnership. Widowed included longest surviving in a partnership

[c] Total number exceed N as some patients had more than one organ failure

person-years in the RSD (95% CI, 103–114). At the index date, 651 (40.4%) patients with sepsis were part of the workforce, while 959 (59.6%) patients were outside the workforce (non-workforce). Of those classified as part of the workforce, 488 were working at the index date. Patients in the non-workforce group were older, had a higher CCI, and lower educational level than patients in the workforce (Table 1). During three years of follow-up, 416/1610 (25.8%) of the patients with sepsis had died, with most deaths occurring within the first 12 weeks after the index date (n = 161, 10.0%). The mortality rates were higher in the non-workforce patients, especially after three years, with a mortality of 36.1% compared to 10.8% in the workforce (Table 1).

During the three years of follow-up, 92 (14.1%) of those who were initially part of the workforce had retired (median age at index: 58 years [IQR, 54–62]), with 42 categorised as 'working' (median age at index: 61 years [IQR, 58–63]).

Labour market attachment

An area chart illustrated weekly labour market attachment for the entire cohort, further stratified by treatment in general wards versus the ICU (Fig. 1). The plot revealed a peak in sick leave around the index week, with the peak being more prominent among patients admitted to the ICU. One year before the index date, 516 (32.0%) of the cohort were employed, 154 (9.6%) were unemployed, 86 (5.3%) received sickness benefits, 89 (5.5%) had a flex job, and 751 (46.6%) were retired while the remaining 14 (0.8%) patients were either missing or registered as not residing in Denmark. The proportion of patients employed one year before hospitalisation was highest among those with a post-secondary education level (n = 118, 55.9%) and decreased with lower levels of education: upper secondary (n = 276, 44.6%) and lower secondary (n = 111, 16.3%) (eFigure 1, Additional file 1).

After 3 years of observation, 1194 (74.2%) patients were alive. The proportion of employed sepsis survivors remained unchanged compared to one year before the index date, n = 393 (32.9%). The proportion of unemployed patients increased to 7.9% (n = 94), 40 (3.4%) were on sick leave, 78 (6.5%) had a flex job, and 584 (48.9%) were retired.

Return to work

After 12 weeks of follow-up, 427 (65.6%) sepsis survivors who were initially part of the workforce had returned to work—defined as four consecutive weeks of employment at any point during the follow-up period. This included 29 (31.2%) of those admitted to the ICU (n = 93) and 398 (71.3%) of those treated in general wards. Overall, this corresponds to a working rate of 69.0% among survivors who remained part of the workforce (i.e., those who had not retired, emigrated, or died). This number increased over the three years following the index to 482 (81.6%) after 52 weeks, 502 (87.5%) after 104 weeks, and 507 (90.4%) after 156 weeks. The proportion of RTW was higher among those who were categorised as working at index: 415 (87.6%) at 12 weeks, 451 (96.2%) at 52 weeks, 455 (97.6%) at 104 weeks, and 458 (99.3%) at 156 weeks.

Patient characteristics associated with RTW within 12 weeks in the workforce group included younger age (20–39 years), HR = 1.33 (95% CI, 1.05–1.68), a CCI of zero, HR = 1.48 (95% CI, 1.10–1.97), absence of major mental illness, HR = 5.30 (95% CI, 1.98–14.21), no markers of smoking, HR = 1.70 (95% CI, 1.17–2.46), no alcohol-related disorders, HR = 3.94 (95% CI, 2.10–7.39), and post-secondary level of education, HR = 1.64 (95% CI, 1.24–2.18) (Table 2).

Among factors related to disease severity, hospitalisation < 7 days, HR = 1.80 (95% CI, 1.43–2.27), no

Table 2 Factors associated RTW within 12 weeks after index among patients in the workforce group

Variable	Workforce		
Total	**RTW 12 weeks, [n (%)]**	**Crude HR**	**Adjusted HR**
Sex			
Female (276)	182 (65.9)	1.01 (0.84–1.23)	1.02 (0.84–1.24)
Male (375)	245 (65.3)	1.00 (ref)	1.00 (ref)
Age group			
20–39 (179)	135 (75.4)	1.33 (1.05–1.68)	1.27 (1.00–1.61)
40–54 (234)	150 (64.1)	1.07 (0.85–1.34)	1.03 (0.81–1.29)
55–64 (238)	142 (59.7)	1.00 (ref)	1.00 (ref)
Country of origin			
Denmark (575)	389 (67.7)	1.53 (1.03–2.27)	1.68 (1.12–2.52)
Western (22)	12 (54.5)	1.20 (0.61– 2.38)	1.25 (0.63–2.49)
Non-western (54)	26 (48.1)	1.00 (ref)	1.00 (ref)
Charlson comorbidity index			
0 (474)	329 (72.8)	1.48 (1.10–1.97)	1.43 (1.07–1.92)
1 (72)	45 (62.5)	1.28 (0.86–1.90)	1.26 (0.84–1.87)
≥ 2 (105)	53 (50.5)	1.00 (ref)	1.00 (ref)
Major mental illness			
No (626)	423 (67.6)	5.32 (1.98–14.24)	5.28 (1.97–14.18)
Yes (25)	4 (16.0)	1.00 (ref)	1.00 (ref)
Immunosuppression			
No (618)	410 (66.3)	1.31 (0.81–2.13)	0.95 (0.55–1.64)
Yes (33)	17 (51.5)	1.00 (ref)	1.00 (ref)
Markers of smoking			
No (582)	397(68.2)	1.71 (1.18–2.47)	1.61 (1.08–2.40)
Yes (69)	30 (43.5)	1.00 (ref)	1.00 (ref)
Alcohol-related disorders			
No (603)	417 (69.2)	3.95 (2.11–7.41)	3.67 (1.96–6.90)
Yes (48)	10 (20.8)	1.00 (ref)	1.00 (ref)
Civil status[a]			
Married (313)	235 (75.1)	1.32 (1.07–1.63)	1.46 (1.16–1.83)
Divorced (100)	NA	NA	NA
Widowed (11)	NA	NA	NA
Unmarried (227)	138 (60.8)	1.00 (ref)	1.00 (ref)
Educational level			
Lower secondary (173)	92 (53.2)	1.00 (ref)	1.00 (ref)
Upper secondary (321)	226 (70.4)	1.44 (1.13–1.84)	1.47 (1.15–1.88)
Post secondary (131)	102 (77.9)	1.64 (1.24–2.18)	1.67 (1.26–2.22)
Missing (26)	7 (26.9)	0.46 (0.21–1.00)	0.47 (0.22–1.02)
Working at index			
No (163)	12 (7.4)	1.00 (ref)	1.00 (ref)
Yes (488)	415 (85.0)	19.21 (10.77–34.29)	19.67 (11.00–35.17)
Site of infection			
Pulmonal (310)	199 (64.2)	1.04 (0.80–1.35)	1.05 (0.81–1.37)
Abdominal (78)	61 (78.2)	1.34 (0.96–1.88)	1.31 (0.94–1.84)
Urinary tract (56)	36 (64.3)	1.02 (0.69–1.52)	0.99 (0.66–1.47)
Skin, muscle, bones (36)	22 (61.1)	0.95 (0.59–1.53)	0.98 (0.61–1.58)
Viral/systemic (17)	10 (58.8)	0.94 (0.49–1.82)	0.92 (0.47–1.78)
Other (27)	21 (77.8)	1.37 (0.85–2.22)	1.30 (0.80–2.12)
Unknown (127)	79 (61.7)	1.00 (ref)	1.00 (ref)

Table 2 (continued)

Variable	Workforce		
Total	**RTW 12 weeks, [n (%)]**	**Crude HR**	**Adjusted HR**
Bacteremia			
No (541)	362 (66.9)	1.21 (0.93–1.57)	1.17 (0.90–1.53)
Yes (110)	65 (59.1)	1.00 (ref)	1.00 (ref)
Lactate ≥ 4 mmol/L			
No (623)	418 (67.1)	2.30 (1.19–4.45)	2.19 (1.13–4.24)
Yes (28)	9 (32.1)	1.00 (ref)	1.00 (ref)
Organ failure			
1 (570)	389 (68.2)	2.33 (1.16–4.69)	2.37 (1.18–4.78)
2 (57)	30 (52.6)	1.69 (0.78–3.69)	1.77 (0.81–3.87)
≥ 3 (24)	8 (33.3)	1.00 (ref)	1.00 (ref)
Type of organ failure			
Renal (80)	45 (56.2)	1.22 (0.73–2.04)	1.31 (0.78–2.20)
Respiratory (366)	247 (67.5)	1.38 (0.94–2.03)	1.45 (0.98–2.14)
Liver (123)	80 (65.0)	1.42 (0.92–2.20)	1.38 (0.89–2.13)
Circulatory (107)	65 (60.7)	1.18 (0.76 –1.83)	1.21 (0.78–1.89)
Cerebral (6)	NA	NA	NA
Coagulation (77)	35 (45.5)	1.00 (ref)	1.00 (ref)
Length of hospital stay			
< 7 days (452)	333 (73.7)	1.80 (1.43–2.27)	1.76 (1.39–2.22)
≥ 7 days (199)	94 (47.2)	1.00 (ref)	1.00 (ref)
ICU-admission			
No (558)	398 (71.3)	2.64 (1.81–3.86)	2.58 (1.76–3.77)
Yes (93)	29 (31.2)	1.00 (ref)	1.00 (ref)

[a] Married also included people living in a partnership. Divorced included cancelled partnership. Widowed included longest surviving in a partnership

ICU admission, HR = 2.64 (95% CI, 1.81–3.86), lactate < 4 mmol/L, HR = 2.19 (95% CI, 1.13–4.24), and single organ failure, HR = 2.33 (95% CI, 1.16–4.69), were associated with RTW. Being at work before sepsis was the strongest factor associated with RTW, HR = 19.21 (95% CI, 10.77—34.29). One-year follow-up results are available in eTable 5 (Additional file 1).

The CIFs of RTW are shown in Fig. 2 and eFigure 2 in Additional file 1. The CIFs emphasise that the chance of RTW is low after one year.

Sensitivity analysis

When the analysis was restricted to those working at the index date, younger age, no ICU admission, and a hospitalisation < 7 days were associated with RTW (eTable 6 and eTable 7 in Additional file 1).

Discussion

This study examines the labour market attachments of 1610 patients with sepsis aged 20–63 years, from one year before index and to three years after. At the time of inclusion, more than half of the cohort (59.6%) were not part of the workforce. Among other factors, patients in the non-workforce group were characterised by a higher CCI, a higher proportion with severe mental illness and alcohol related disorders. This reflects several health-related challenges in this group, which increase the risk of sepsis. [19, 20] Several factors were associated with RTW in patients from the workforce, but the most important factor was working prior to hospitalisation. After 12 weeks of follow-up, 69.0% of sepsis survivors who were part of the workforce at index had returned to work (87.6% among those classified as working). The proportion of RTW among sepsis survivors who were working at index and not censored was high after 52 weeks, with 96.2%, compared to 67.5% and 76.9% in previous studies from Norway and Germany, respectively. [6, 7] It is important to note that patients in our cohort were followed from index to their first event (RTW, retirement, death, or emigration). Furthermore, we did not exclude patients without sickness benefits in the weeks prior to admission or following discharge, as in the Norwegian study. [6] For comparison, of the 488 patients categorised as 'working' in the index week, 396 (81.1%) were reported in DREAM as 'employed' in week 52 after index, which is close to the

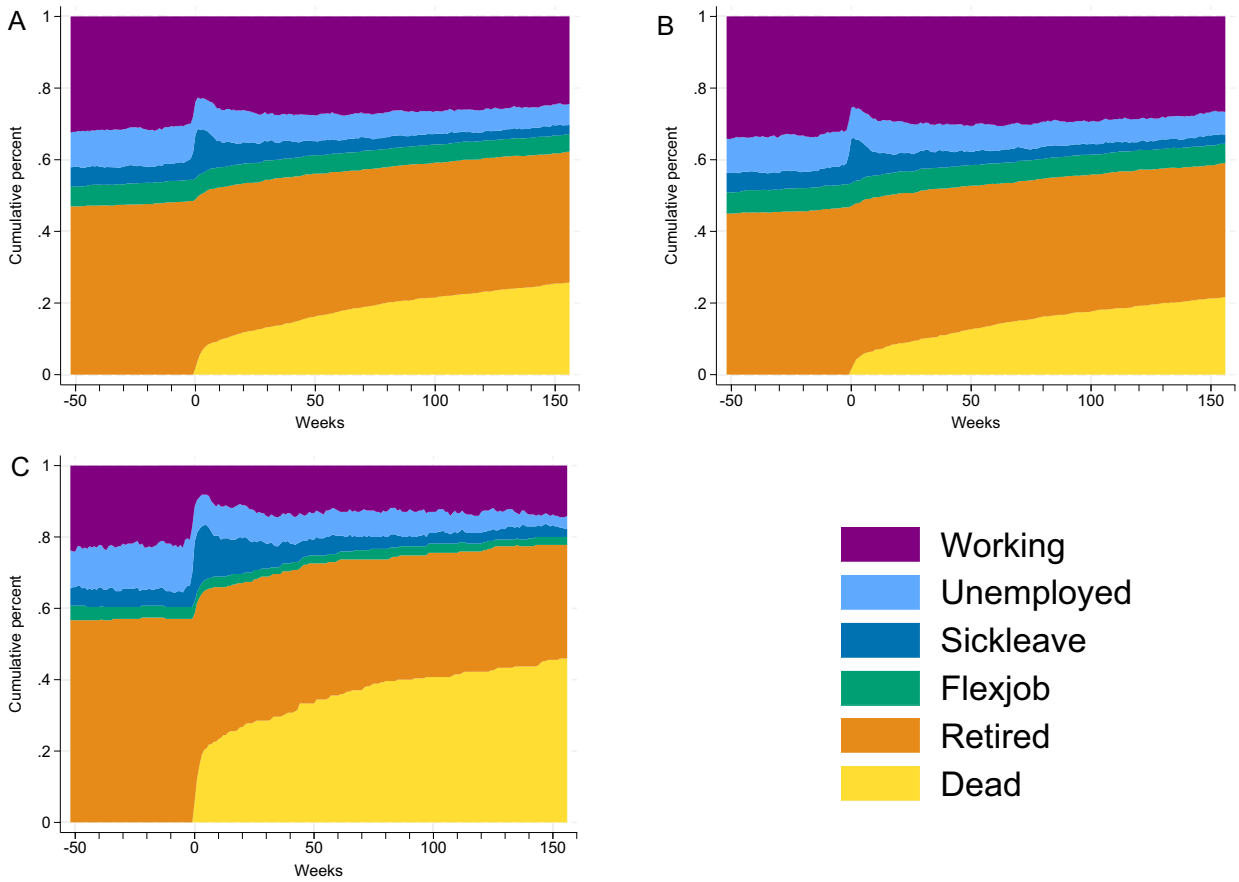

Fig. 1 Area plots illustrating weekly changes in labour market attachment. Overall (**A**) and stratified by treatment in general wards (**B**) and the ICU (**C**)

reported proportion of 76.9% from Germany (Additional file 1, eTable 8) [7].

Most survivors returned to work within 52 weeks, suggesting that the chance of RTW diminishes beyond the first year. This plateau in RTW after one year (Fig. 2) has also been observed in patients with infectious spondylodiscitis. [21] However, RTW patterns in infectious diseases likely vary depending on the type and severity of the infectious disease. In the aftermath of the COVID-19 pandemic, attention has turned to long-term sequelae, including RTW after COVID-19 infection. A Danish study revealed that 99% of patients with a positive SARS-CoV-2 PCR test returned to work within three months, with 94% among those hospitalised. [22] Other studies on the same topic report results that differ remarkably from the Danish study, as illustrated in a systematic review by Ottiger et al. [23] Differences in patient selection, disease severity, definitions of working and RTW, sick leave registration, and medical benefits across countries may explain the variability in results.

RTW after critical illness has been studied in both Denmark and other countries. A Danish study estimated that 60.0% of ICU survivors returned to work within the first year, while a Norwegian study reported a proportion of 55%. [24, 25] However, variation exists between countries, with some studies relying on self-reported data, likely due to limited access to register-based labour market data. [25, 26] Lower education, pre-existing comorbidities, and mental health impairments are factors associated with delayed RTW in ICU survivors [26].

Our findings suggest that both patient characteristics and the severity of sepsis influence the ability to RTW. Being a person who has completed their education seems to be of importance for whether you are part of the workforce. The difference in RTW between those with lower and higher educational level is striking, possibly explained by a higher proportion of health-related problems among those with lower educational. However, for patients who were working before sepsis, the chance of RTW was similar, regardless of educational level.

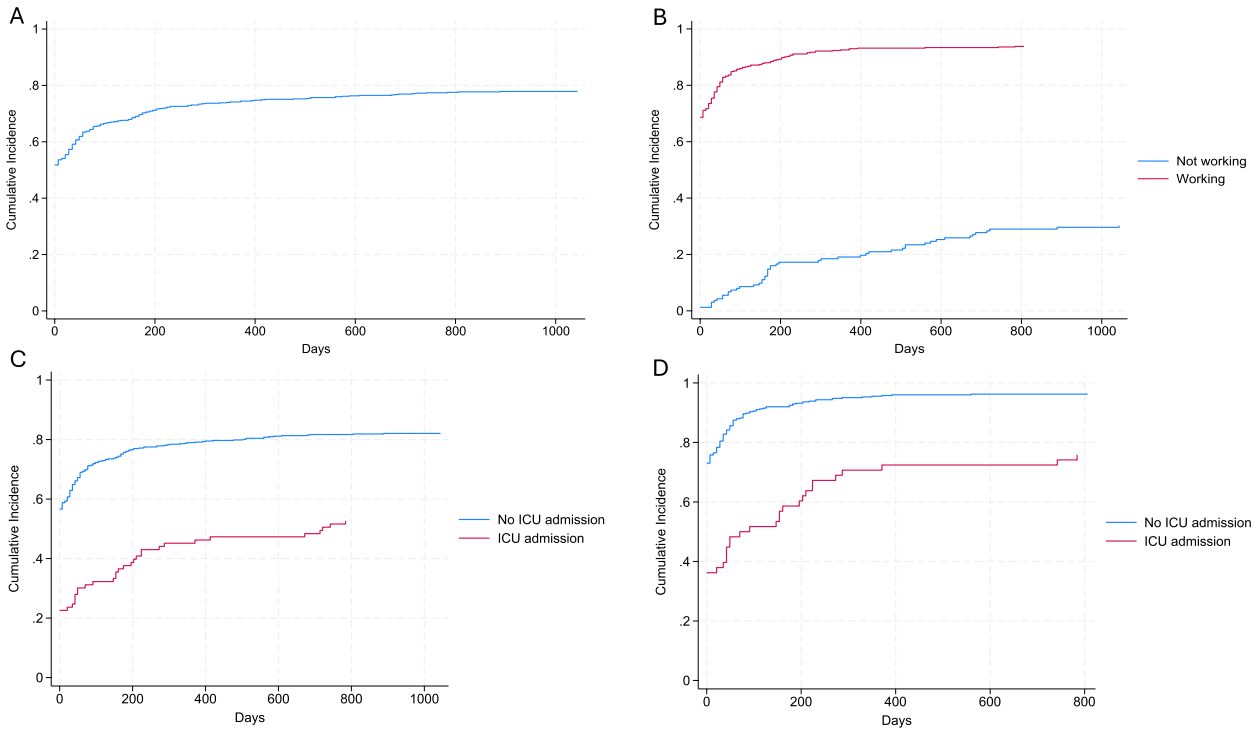

Fig. 2 Cumulative incidence curves (CIFs) for time to RTW. Death and retirement were treated as competing events. **A** CIF for those who were a part of the workforce, **B** CIF for those working versus not working at index, **C** CIF for the workforce stratified by treatment in general wards or ICU, and **D** working stratified on treatment at general wards or ICU. Abbreviation: *CIF* cumulative incidence function

Understanding the aftermath of sepsis, particularly in working-aged patients, is important as it can inform targeted rehabilitation interventions aimed at improving patients' ability to RTW. Although the proportion of RTW in sepsis survivors who were part of the workforce was high, 14.1% of patients retired at some point during the three years of follow-up (median age: 58). The public pension age in Denmark gradually increased from 65 years in 2018 to 67 years in 2022. [27] The reasons for early retirement among the sepsis survivors are unknown, as is their potential to remain in the workforce with targeted rehabilitation programs.

Strengths and limitations

A strength of this study is the combination of the Danish nationwide registers with clinical data, allowing us to identify sepsis based on a combination of clinical measures at hospital arrival and discharge diagnoses. Using these registers, we have access to detailed demographic information, including socioeconomic factors such as educational level, which have not been evaluated in previous studies on RTW among sepsis survivors. We have few missing data and complete follow-up data suitable for survival analysis.

Limitations of this study include the potential for immortal time bias. Participants were followed for up to 3 years after the index date. Since RTW is not possible during hospitalisation, participants could not experience the outcome while hospitalised. However, employees must have four consecutive weeks of sick leave for the employer to apply for reimbursement, so sick leave is only registered in DREAM if a person has four or more weeks of sick leave. The median hospital stay was 4 days (IQR, 2–8) in the workforce, which reduces the impact of this potential bias, though long hospitalisation could still influence the results. If an employer pays for sick leave without applying to the municipality for reimbursement, it is not registered in DREAM. People receiving public transfer benefits are registered with sick leave benefits from the first day of sick leave. Another important consideration is that we do not know whether the sepsis survivors who returned to work had returned to their previous jobs or to work under special conditions. Variation in labour market structures, employment policies, and other factors across countries may reduce the generalisability of our results to other contexts. Part of the follow-up period overlaps with the COVID-19 pandemic which could have potentially influenced

our results. Data on vasopressor use or mechanical ventilation were not available in this study.

Conclusion

Less than half of the working-aged patients with sepsis in the RSD were part of the workforce upon admission. Among those who were part of the workforce, most returned to work within the first year. A substantial proportion of patients with sepsis retired early, though the reasons remain unknown. Working prior to hospital admission was the strongest prognostic factor for RTW. A higher educational level was a strong prognostic factor for RTW in the workforce group but was unrelated to RTW in patients who were working before sepsis.

Abbreviations

CCI	Charlson comorbidity index
CI	Confidence interval
CIF	Cumulative incidence function
DREAM	Danish register for evaluation of marginalisation
ED	Emergency department
HR	Hazard ratio
ICU	Intensive care unit
IQR	Inter quartile range
RSD	Region of Southern Denmark
RTW	Return to work
SOFA	Sequential organ failure assessment

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13054-025-05446-z.

Additional file1 (DOCX 787 KB)

Acknowledgements

A special thanks to our professional data manager, Niels Ibsgaard Agerbek, for establishing the study data. We would also like to acknowledge the Open Patient data Explorative Network (OPEN) at Odense University Hospital for their guidance in extracting socioeconomic data provided by Statistics Denmark and for statistical advise.

Author contributions

CSS and ATL invented the study and agreed on the applied methodology. CSS analysed the data and wrote the first draft of the manuscript. The results were interpreted by all authors. All authors critically reviewed and commented on the manuscript. All authors have read and approved the final version.

Funding

Open access funding provided by University of Southern Denmark. This study was funded by Odense University Hospital and the University of Southern Denmark.

Availability of data and materials

The study is based on data from Danish nationwide registers (provided by Statistics Denmark) and personal medical records (provided by the Region of Southern Denmark). In compliance with the Danish Data Protection Act, we are unable to share the data directly. However, the data used in this study can be accessed by applying to Statistics Denmark. University-affiliated Danish scientific organisations may be authorized to access microdata through a secure external electronic platform, and these authorized organisations can grant access to individual researchers both in Denmark and internationally. For more information and contact details, please visit: Statistics Denmark (https://www.dst.dk/en/TilSalg/Forskningsservice/Dataadgang). Additionally, access to medical record data can be requested through the Region of Southern Denmark: https://regionsyddanmark.dk/fagfolk/forskning/patientjournaloplysninger-til-forskning-statistik-eller-planlaegning. Upon request, the corresponding author (CSS) can assist with contacting relevant authorities to facilitate the necessary approvals for data access and transfer.

Declarations

Ethics approval

According to Danish law, studies based solely on registry data does not require patient consent. The permission to collect and use the data for scientific purpose was given by the Danish Patient Safety Authority (no. 3–3013-2272/1) and data storage was permitted by the RSD (17/24904, 20/24502).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 25 February 2025 Accepted: 7 May 2025
Published online: 19 May 2025

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