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Return to Work Among Young Adult Survivors of Allogeneic Hematopoietic Cell Transplantation in the United States

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Abstract

Background—Young adult (YA) survivors of allogeneic hematopoietic cell transplant (HCT) are at risk for late psychosocial challenges, including inability to return to work post-HCT. However, work-related outcomes in this population remain understudied.

Objectives—To assess the post-HCT work status of survivors of allogeneic HCT who underwent HCT as YA and analyze the patient-, disease-, and HCT-related factors associated with their work status at 1-year post-HCT.

Study Design—Using the Center for International Blood and Marrow Transplant Research (CIBMTR) data, we described post-HCT work status (full-time, part-time work, unemployed, and medical disability) of YA HCT survivors (N=1365) who underwent HCT between 2008 and 2015. Percentages of work status categories were reported at four timepoints: 6-months, 1-, 2-, and 3-year post-HCT. Percentages of post-HCT work status categories at the 1-year timepoint were also described in relation to survivors' pre-HCT work status categories. Factors associated with 1-year post-HCT work status (full-time or part-time work) were examined using logistic regression.

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CIBMTR supports accessibility of research in accord with the National Institutes of Health (NIH) Data Sharing Policy and the National Cancer Institute (NCI) Cancer Moonshot Public Access and Data Sharing Policy. The CIBMTR only releases de-identified datasets that comply with all relevant global regulations regarding privacy and confidentiality.

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Results—From 6 months to 3 years post-HCT, the percentage of survivors working full-time and part-time increased from 18.3% to 50.7%, and from 6.9% to 10.5%, respectively. Of patients in full-time work pre-HCT, 50% were unemployed or on medical disability at 1-year post-HCT. Female sex (Odds ratio [OR] 0.55; 95% confidence interval [CI] 0.40–0.77), HCT-comorbidity index (HCT-CI) score ≥3 (OR 0.57; 95% CI 0.39–0.82), pre-HCT unemployment (OR 0.37; 95% CI 0.24–0.56), and medical disability (OR 0.44; 95% CI 0.28–0.70), development of grade 3–4 acute graft vs. host disease (OR 0.52; 95% CI 0.34–0.80), and relapse within one-year post-HCT (OR 0.34; 95% CI 0.21–0.56) were associated with lower likelihood of employment at 1-year post-HCT. Compared to myeloablative conditioning with total body irradiation (TBI), myeloablative conditioning without TBI (OR 1.71; 95% CI 1.16–2.53) was associated with higher likelihood of employment at 1-year post-HCT. Graduate school level education (OR 2.47; 95% CI 1.49–4.10) was also associated with higher likelihood of employment at 1-year post-HCT.

Conclusions—While the work status among YA HCT survivors continued to improve over time, a substantial subset became or remained unemployed or on medical disability. These findings underscore the need for effective return to work supportive interventions in this population.

Keywords

hematopoietic cell transplant; return to work; quality of life; young adult

Introduction:

Allogeneic hematopoietic cell transplantation (HCT) is commonly used as a curative therapy for young adults (YA; age 18–39 years) with malignant and non-malignant hematological conditions.[1,2] Annually nearly 1,500 YA undergo allogeneic HCT, and its utilization has increased by 40% in the last decade.[3] Survival rates after HCT have gradually improved due to several factors, such as better donor availability, improvements in human leukocyte antigen (HLA) typing techniques, and supportive care.[3] However, many survivors continue to be at risk for treatment-related late morbidity and impairments in quality of life (QOL).[4–6]

From prior studies focusing on YA cancer survivors, it is known that they have a unique set of long-term psychosocial challenges, affecting their social relationships and functioning, emotional health, and educational, vocational, and financial status.[7–9] Given the age range of YA, they face critical personal and professional milestones, including transitioning into adult roles at the time of their illness, which may impact their ability to resume age appropriate activities, such as attending work or school, and may eventually affect their educational or vocational progression.[9] Particularly, YA cancer survivors have been noted to struggle to return to work secondary to treatment-related physical and cognitive dysfunction,[10] and have higher unemployment rates compared to the general population.[7,8,11] Patients undergoing allogeneic HCT are known to be at a higher risk of late morbidities and QOL impairments compared to survivors treated with non-HCT cancer directed therapy.[4,5] While work-related challenges in HCT survivors transplanted as children[12] or older adults[13–18] are known, and return-to-work at 1-year post-HCT is considered an important indicator of survivors' overall social and economic well-being,[19] YA HCT survivors' ability to return to work and factors affecting their post-HCT work status remain understudied.

To address this knowledge gap, we aimed to characterize the post-HCT work status of survivors of allogeneic HCT who underwent HCT as YA using data from the Center for International Blood and Marrow Transplant Research (CIBMTR). We also analyzed the patient-, disease-, and HCT-related factors associated with work status at 1-year post-HCT.

Materials and Methods:

Data source:

The CIBMTR is a research collaboration between the National Marrow Donor Program® (NMDP)/Be The Match® and the Medical College of Wisconsin. Approximately 200 transplant centers in the United States prospectively contribute data on consecutive transplants to the CIBMTR. The clinical database contains records of more than 550,000 patients. Participating centers are required to report all transplants consecutively, with long-term follow-up. The CIBMTR ensures data quality through computerized checks for discrepancies, physicians' review of submitted data, and on-site audits. Patients and/or guardian(s) provide written informed consent for data submission and research participation. This study was conducted in accordance with the Declaration of Helsinki; the institutional review board of the NMDP approved this study.

Patient eligibility:

Young adults (age 18–39 years at time of HCT) who underwent allogeneic HCT for malignant or non-malignant conditions between January 1, 2008 and December 31, 2015 in the United States and were reported to the CIBMTR were included (N=3,008). Patients transplanted with all donor types/graft sources and conditioning regimens were included, with the exception of patients undergoing syngeneic HCT (N=28). Patients who did not survive at least one-year post-HCT or were lost to follow-up prior to that time-point were excluded (N=530). Additional exclusions were made, if the completeness of data was <80% (N=58), the post-HCT CIBMTR case report forms were missing (N=18), or the patients did not consent to research (N=36). Patients who were reported to be students prior to HCT (N=442) or had missing work status at all possible longitudinal timepoints post-HCT (n=531) were also excluded. Our final study population consisted of 1,365 patients.

Statistical analysis:

Descriptive statistics were presented for patient-, disease-, and transplant-related variables. Categorical and continuous variables were described using frequency and percentages and median and ranges, respectively. Survivors' characteristics were compared between those with and without available post-HCT work status information using Chi-square and Wilcoxon rank sum tests (Supplemental Table S1).

CIBMTR's database was used to determine survivors' work status information. The specific question regarding work status on the post-HCT data forms was: "What is the recipient's current or most recent work status during the reporting period?" with the following response options: full-time work, part-time work, unemployed, medical disability, or unknown. This question has previously been used in our study which assessed post-HCT work status of adult survivors of childhood allogeneic HCT.[12] Percentages of work status categories

(full-time work, part-time work, unemployed, retired, and medical disability) were reported at four timepoints: 6-months, 1-, 2-, and 3-year post-HCT. Percentages of post-HCT work status categories at the 1-year timepoint were also described in relation to survivors' pre-HCT work status categories. Acute graft-vs-host disease (GVHD) was graded according to the Glucksberg grading criteria[20] and chronic GVHD according to the National Institutes of Health chronic GVHD consensus criteria[21] as reported to the CIBMTR.

A logistic regression model was created to study factors associated with survivors' work status at the 1-year timepoint post-HCT, using both pre-HCT and post-HCT covariates. The primary outcome was work status at 1-year dichotomized as working (full-time or part-time work) vs. unemployed (unemployed or claiming medical disability). Upon review of survivors' work status at 1-year, 487 survivors were noted have missing work status. To account for these survivors, a separate logistic regression model was created using multiple imputation. Results of both models are shown (Supplemental Table S2). Patient- (age at HCT, sex, race/ ethnicity, Karnofsky score before HCT, hematopoietic cell transplant comorbidity index [HCT-CI], pre-HCT marital status, pre-HCT work status, pre-HCT highest education grade), disease- (disease diagnosis), and HCT-related (composite graft source and donor type variable, conditioning regimen, year of transplant, acute and chronic graft-vs-host disease [GVHD], and disease relapse) variables were included in the model. Odds ratio (OR) and 95% confidence intervals (CI) were provided. A P-value <0.05 was considered statistically significant. SAS 9.4 (SAS Inc., Cary, NC) was used for all analyses.

Results:

Patient characteristics:

Characteristics of the study population are described in Table 1. Median age at transplant was 30.8 years (range 18–39). Fifty-six percent were males and nearly 90% of patients received HCT for a malignant disease. Acute myeloid leukemia (41%) was the most common primary diagnosis. Ten percent of patients received HCT for non-malignant disorders such as severe aplastic anemia, inherited abnormalities of erythrocyte differentiation or function, and primary immune deficiency. Myeloablative conditioning (MAC) with total body irradiation (TBI) was the most common conditioning regimen (43%). Among those with available pre-HCT work status data, 57% were either in full- or part-time work and 23% were reported as unemployed. Two thirds of the population with available education information had college level or lower education. The median follow-up was 5.1 years (1–10.1). Forty-one percent developed acute GVHD with 33% having severe (Grade 3–4) acute GVHD. Chronic GVHD occurred in 26% survivors. Disease relapse or progression before 1-year post-HCT was noted in 17% of patients with malignancy.

In comparing HCT survivors according to the availability of post-HCT work status data (Supplemental Table S1), there were no differences in age at HCT or sex noted. Compared to survivors with available information on post-HCT work status (n=1365), those with missing work status data (n=531) were significantly different in terms of patient race/ ethnicity (P<0.001), pre-HCT highest educational grade (P<0.001), pre-HCT work status (P<0.001), pre-HCT marital status (P<0.001), disease type (P=0.04), and year of HCT (P<0.001). The median follow-up of survivors with missing post-HCT work status was

shorter compared to those with available work-status (3.5 years [1–9.9] vs. 5.1 years [1–10.1]).

Post-HCT work status:

Figure 1 describes the percentages of work status categories post-HCT. Percentages of survivors working full-time and part-time increased from the 6-month to 3-year post-HCT timepoint (full-time: 18.3% at 6 months to 50.7% at 3 years; part-time: 6.9% at 6 months to 10.5% at 3 years). Similarly, the rates of unemployment (6 months: 38.2%; 3 years: 18.3%) and medical disability (6 months: 36.6%; 3 years: 21%) decreased from the 6-month to 3-year post-HCT timepoint. When studied in relation to survivors' pre-HCT work status, 50% of those working full-time pre-HCT had returned to either full-time (41%) or part-time work (9%) by one year after HCT (Figure 2). In contrast, of those reported as unemployed or claiming medical disability pre-HCT, 19% and 29% had returned to some form of work (either full-time or part-time) at the 1-year timepoint, respectively.

Factors associated with work status at 1-year post-HCT:

A multivariable analysis (Table 2) assessing factors associated with post-HCT work status at the 1-year timepoint (in full- /part-time work vs. unemployed or claiming medical disability) showed that female sex, HCT-CI of 3 or more, pre-HCT unemployment or medical disability, acute GVHD, and relapse within 1-year post-HCT were significantly associated with being unemployed at one year after HCT. Conversely, graduate school educational level and myeloablative conditioning without TBI were associated with higher odds of being employed at 1-year post-HCT.

Discussion:

Using a large nationally representative sample of YA HCT survivors, we showed that the percentage of survivors working full-time and part-time steadily increased post-HCT. At one-year post-HCT, only 39% were working full or part-time. By 3 years post-HCT, this rate had improved to 62% in full or part-time work. Of patients in full-time work pre-HCT, 50% were either unemployed or claimed medical disability status at 1-year post-HCT. This study also identified factors associated with survivors' ability to return to work by one year after HCT. In particular, we found that female survivors, and those with pre-transplant comorbidities (HCT-CI ≥3), unemployment or medical disability, and lower educational attainment represented a vulnerable population, who were more likely to be unemployed at 1-year post-HCT. In addition, we found several modifiable risk factors for unemployment such as the use of TBI in a myeloablative conditioning regimen, grade 3–4 acute GVHD, and relapse.

Overall, we noted an increase in the proportion of YA HCT recipients returning to full-time or part-time work over time. This observation is consistent with prior studies focusing on YA with cancer. Parsons and colleagues reported work outcomes of YA cancer survivors and found that 72% of survivors working full-time or in school prior to diagnosis were back to work or school at 15 to 35 months post-diagnosis.[7] Similarly, another study using the LIVESTRONG survey showed that 86% of YA breast cancer survivors were

employed at nearly 3 years after diagnosis.[22] Survivors' ability to return to work is a reassuring observation and could potentially positively impact survivors' social, emotional, and financial well-being.[13,14,23] However, it could also be indicative of survivors' rushed efforts to make up for lost time, go back to pre-diagnosis life, or alleviate the fear of falling behind.[24] Efforts to transition back to work can be further challenged without an established professional network and persistent symptoms, such as fatigue and cognitive challenges, that may ultimately impact work performance.[25,26] Therefore, further efforts are needed to explore survivors' challenges even after returning to work.

Our study also noted that a substantial number of YA survivors were unemployed even at 3-year post-HCT. These unemployment estimates are higher than those reported among YA treated with non-HCT cancer directed therapy.[7,8,10,11,27] These differences may be due to the higher intensity of treatment exposures, prolonged immune suppression, higher frequency of severe and life-threatening morbidities, and prolonged and recurrent hospitalizations requiring HCT survivors to be out of work for a prolonged period of time.[4,5] Additionally, we found that a substantial proportion of survivors who were in full-time work prior to HCT were unable to return to work post-HCT. While the reason for their inability to return to work is unclear, it may be associated with the type of work they did (manual labor vs. desk job), their work demands, and employers' willingness to provide a flexible work schedule (part-time vs. full-time).

While studying the factors associated with unemployment at 1-year post-HCT, patients who were unemployed or on medical disability prior to transplant were found to be more vulnerable. While the causes of unemployment were unavailable due to the CIBMTR dataset limitations, it is possible that survivors' pre-HCT unemployment was due to illness/disability secondary to pre-HCT treatment-related toxicities. Another possible explanation for high pre-HCT unemployment and medical disability rates could be the disruption in YA patients' school or college education while they undergo cancer-directed therapy.[28] As education plays a major role in an individual's ability to achieve employment, lower educational attainment could be associated with survivors unemployment prior to HCT, as it was associated with post-HCT work status in our study. Pre-HCT unemployment could also be due to survivors not being part of the labor force (e.g. students, homemakers); however, we excluded survivors who were reported to be students prior to HCT. None of the patients reported to be retired pre- or post-HCT.

Our study also revealed that female survivors had 50% lower odds of being employed compared to males. This finding is consistent with prior studies assessing work status in adult survivors of childhood cancer[29] and older adult HCT survivors.[14,16] While a clear explanation for this disparity is unknown, some studies have attributed worse health outcomes to female survivors compared to males. Specifically, Kirchhoff et al. found a differential impact of TBI on female survivors' ability to return to work, which was not seen in male survivors.[14] Syrjala and colleagues showed that female HCT survivors were significantly more likely to report depression, and treatment-related distress compared to males.[30] The sex disparities in health outcomes are likely not age-dependent, since in our prior study assessing QOL among children and adolescent undergoing allogeneic HCT, we also found that female survivors were more likely to report worse QOL at 1-year

post-HCT.[31] Based on these findings, further work should be conducted to delineate factors affecting female health and employment outcomes.

Our study revealed several modifiable treatment-related factors associated with survivors' work-status. Survivors who received MAC with TBI were less likely to be working at 1-year compared to those treated with myeloablative conditioning without TBI. In our previous study focusing on work outcomes of YA survivors of childhood HCT, we observed a similar impact of MAC with TBI on survivors' work status post-HCT.[12] This association may be explained by the myriad late effects associated with TBI, including neurocognitive dysfunction,[32] and calls for development of less toxic preparative regimens while ensuring adequate disease control. Not unexpectedly, we also found that survivors who suffered from grade 3–4 acute GVHD or relapse were more likely to be out of work at 1-year post-HCT given those conditions are known to be associated with long-term morbidity and mortality after HCT. While donor and graft type were not found to be significantly associated, they have been shown to affect return to work status in a prior study. Lee et al. studied patient-reported outcomes among HCT survivors enrolled in the Blood and Marrow Transplant Clinical Trials Network 0201 study and found that survivors who received matched unrelated donor with a peripheral blood stem cell graft were significantly less likely to be working full-time or part-time at 5-years post-HCT compared to those who received a bone marrow graft.[33] Factors such as pre-HCT marital status, disease diagnosis, or post-HCT chronic GVHD were not found to be associated with survivors' work status.

While the use of the CIBMTR dataset allowed us to examine the understudied work outcomes in a large, nationally representative sample of YA HCT survivors, there are certain limitations to this approach which need to be acknowledged. We were unable to ascertain the causes or duration of unemployment, type of work, and changes in work status in between measurements in this population, as these outcomes are not captured through CIBMTR forms. Also, because of this limitation, we were unable to account for certain survivors who are not part of the labor force, such as those categorized as not seeking work. Lack of direct patient report did not allow us to study survivors' self-reported health status, especially mental or physical function which could have impacted their return to work status. It is important to note that more than a third of the study eligible survivors had to be excluded due to missing work status at all possible timepoints post-HCT. Therefore, our study findings might be underrepresenting the true magnitude of unemployment among young adult HCT survivors. Additionally, we noted that several survivors had a missing work status at 1-year post-HCT. To overcome the limitation of patient exclusion, we performed a logistic regression analysis using multiple imputation and did not see a significant difference in results (Supplemental Table S2). Nevertheless, unavailability of work status is an important reminder for improving QOL measurement in clinical practice. Lastly, we could not account for the impact of external factors such as recession, seasonal employment variations, number of dependents, and availability of social support on survivors' work status.

Despite these limitations, our study findings provide further insights into the factors affecting YA HCT survivors' ability to return to work post-HCT and also emphasizes the need for further work in this direction. Return to work after completion of therapy is a complex process and strong support from caregivers, healthcare professionals, and

employers is equally important. Therefore, additional efforts should be directed toward understanding the challenges, perceived barriers, and facilitators of the return to work process from the perspective of all stakeholders using both qualitative and quantitative research methodology. Since unemployment, underemployment, and medical disability have potential associations with poor QOL and insurance coverage, future work should also focus on understanding their relationship with survivors' physical, social, and cognitive function, financial wellbeing, access to healthcare, and treatment adherence. Subsequently, informed by the findings of these studies, we envision development of scalable supportive care interventions adapted to the unique needs of YA HCT survivors with a goal to prevent, mitigate or ameliorate return to work challenges. These interventions should be directed towards at-risk population identified in our study (females, those with comorbidities, lower educational attainment, treated with TBI-based myeloablative conditioning, and who develop acute GVHD) and should be delivered earlier in their HCT course. These interventions should be multi-modal, including aggressive management of survivors' chronic health conditions, pre- and post-HCT education/ training, and vocational rehabilitation, along with the development of effective communication strategies with employers to balance work expectations with survivors' treatment-related complications. Additionally, given the impact of conditioning intensity, acute GVHD, and relapse on survivors' ability to return to work, future interventions should also be directed toward development of reduced intensity and radiation free conditioning regimens and novel GVHD prophylaxis regimens. It will be critical to test the impact of novel treatment regimens on various QOL domains. Ultimately, we anticipate HCT centers to develop and implement standardized return to work guidelines and supportive care programs in order to ensure successful return to work, achieve better work productivity, and in turn, QOL in this at-risk population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights:

- Nearly 40% of YA HCT survivors were out of work at 3-year post-HCT.
- Of those in full-time work pre-HCT, 50% were not working at 1-year post-HCT.
- MAC with TBI was associated with higher likelihood of unemployment at 1-year post-HCT.

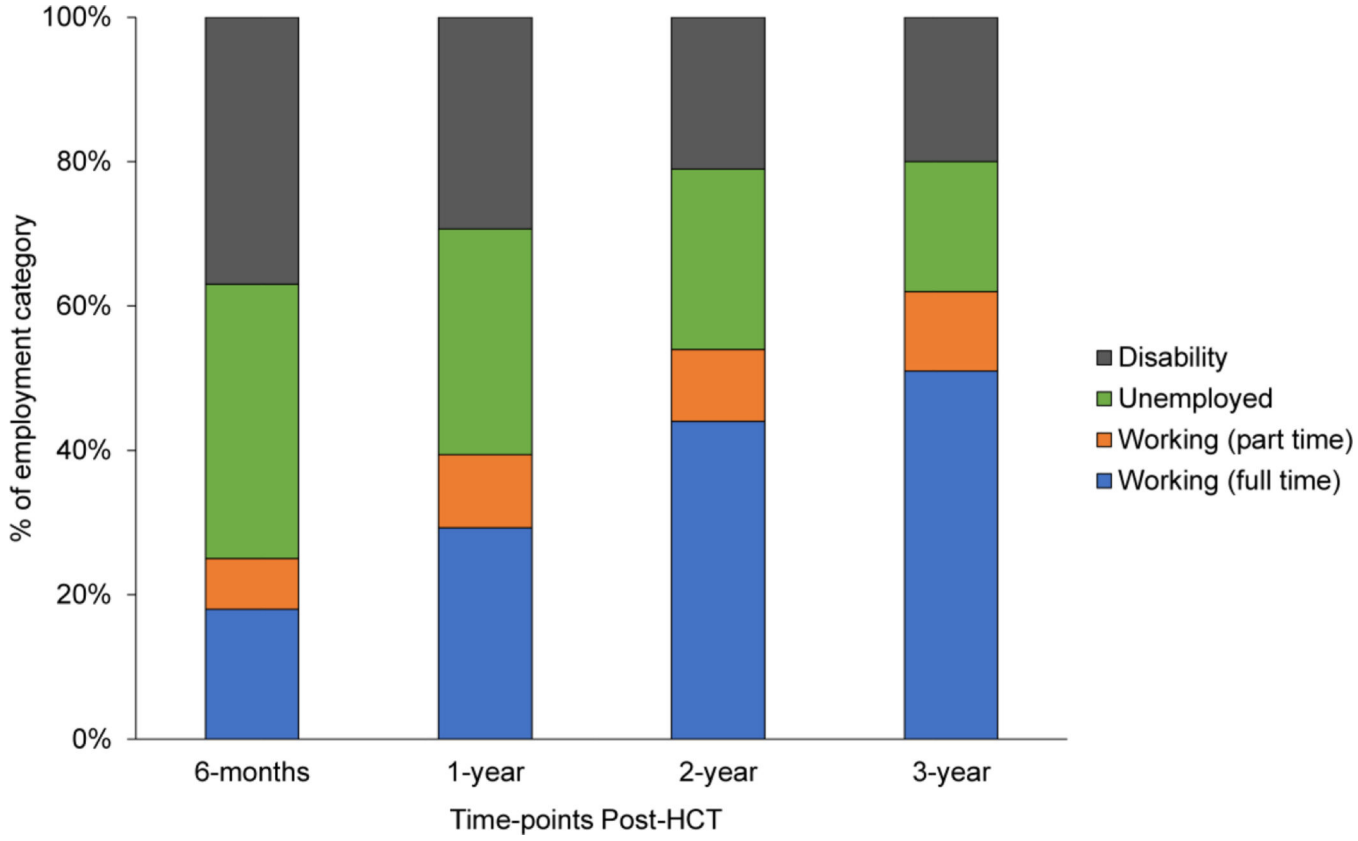

Figure 1.
Work status of young adult (18–39 years) survivors of allogeneic hematopoietic cell transplant (HCT) at 6-months, 1-, 2-, and 3-year post-HCT

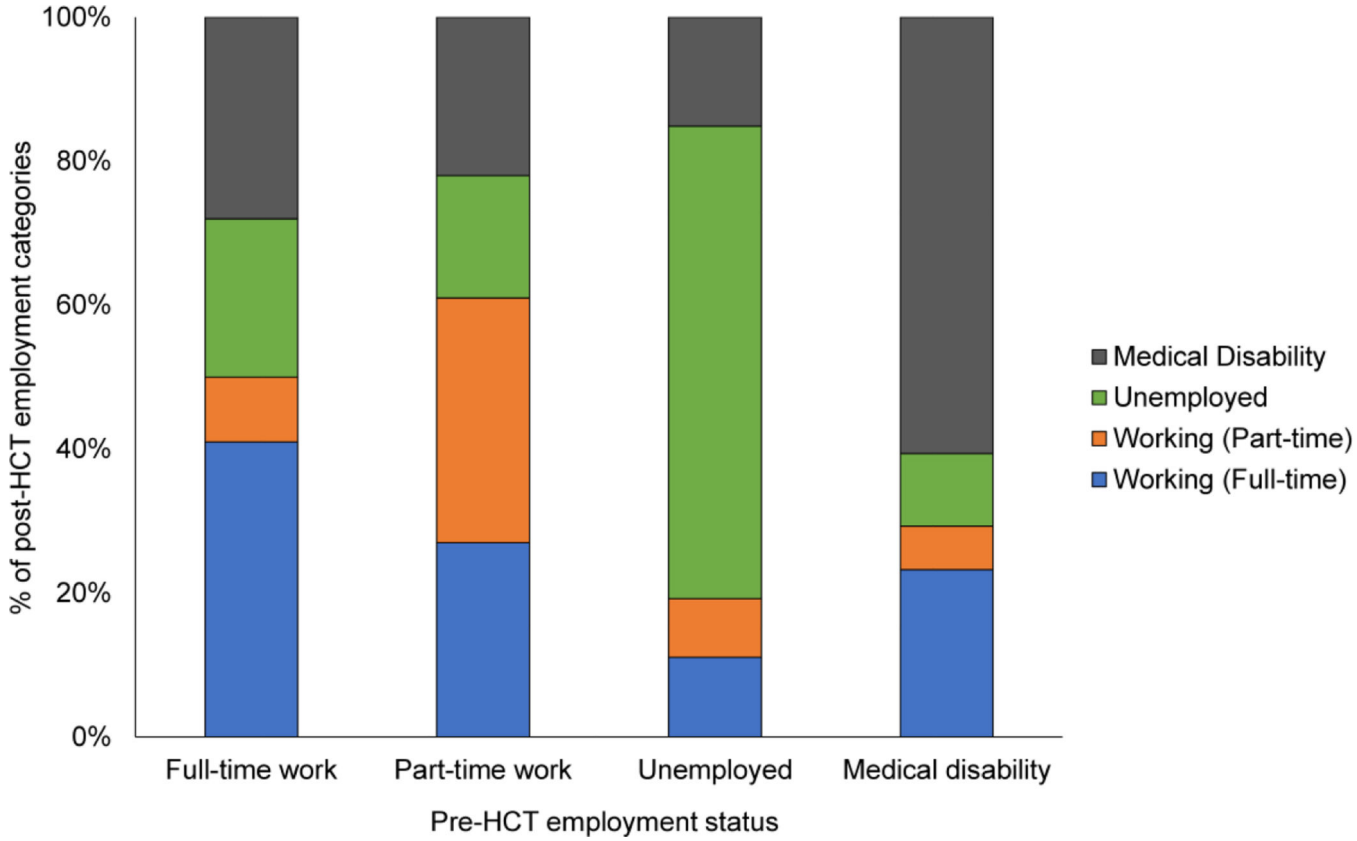

Figure 2.

Work status of young adult (18–39 years) survivors of allogeneic hematopoietic cell transplant (HCT) at 1-year post-HCT by pre-HCT work status categories

Table 1:

Characteristics of young adult (YA) patients (age 18–39) that underwent first allogeneic HCT from 2008–2015 and survived for at least 1 year, reported to CIBMTR (N=1365)

Variable	N (%)
Number of centers	149
Median age at transplant (range)	30.8 (18–39)
Age groups at transplant, n (%)	
18–24 years	266 (19)
25–29 years	349 (26)
30–34 years	364 (27)
35–39 years	386 (28)
Sex, n (%)	
Male	767 (56)
Female	598 (44)
Race, n (%)	
Caucasian/White	1089 (80)
Other	230 (17)
Unknown/ declined	46 (3)
Ethnicity, n (%)	
Hispanic or Latino	214 (16)
Non-Hispanic or Non-Latino	1131 (83)
Missing	20 (1)
Karnofsky score, n (%)	
<90	392 (29)
90–100	953 (70)
Missing	20 (1)
HCT-CI index, n (%)	
0	501 (37)
1	184 (13)
2	223 (16)
≥3	421 (31)
Missing	36 (3)
Pre-transplant highest education grade, n (%)	
High school or lower	489 (36)
College	207 (15)
Graduate school	362 (26)
Missing	307 (22)
Pre-transplant work status, n (%)	
Full-time	591 (43)
Part-time	60 (4)

Variable	N (%)
Unemployed	265 (19)
Medical disability	220 (16)
Unknown	229 (17)
Pre-transplant Marital Status, n (%)	
Single, never married/ Separated/ Divorced/ Widowed	644 (47)
Married or living with a partner	695 (51)
Missing	26 (2)
Insurance status, n (%)	
None	25 (2)
Government sponsored	444 (32)
Private	871 (64)
Employer sponsored disability insurance	18 (1)
Missing	7 (<1)
Disease type, n (%)	
AML	566 (41)
ALL	281 (21)
CML	83 (6)
MDS	99 (7)
NHL	80 (6)
HL	65 (5)
Other heme malignancies[1]	42 (3)
Severe aplastic anemia	88 (6)
Inherited abnormalities of erythrocyte differentiation/ function	35 (3)
SCID and other immune system disorders	19 (1)
Other non-malignant disorders[2]	7 (<1)
Graft source/ Donor type, n (%)	
8/8 Matched related donor BM	65 (5)
8/8 Matched related donor PBSC	266 (19)
≤ 7/8 Mis-matched related donor BM	45 (3)
≤ 7/8 Mis-matched related donor PBSC	54 (4)
8/8 Unrelated donor BM	141 (10)
8/8 Unrelated donor PBSC	376 (27)
≤ 7/8 Mis-matched unrelated donor BM	20 (1)
≤ 7/8 Mis-matched unrelated donor PBSC	90 (7)
Cord blood	255 (19)
Missing	53 (4)
Conditioning regimen, n (%)	
Myeloablative w TBI	581 (43)
Myeloablative w/o TBI	422 (31)

Variable	N (%)
Reduced intensity/ Non-myeloablative w TBI	177 (13)
Reduced intensity/ Non-myeloablative w/o TBI	181 (13)
Missing	4 (<1)
ATG/ Alemtuzumab, n (%)	
ATG only	333 (24)
Alemtuzumab only	36 (3)
None	994 (73)
Missing	2 (<1)
GVHD prophylaxis, n (%)	
None	27 (2)
TAC + MTX +/− Others (except MMF, Post-Cy)	581 (43)
TAC + MMF +/− Others (except Post-Cy)	238 (17)
TAC +/− Others (except MMF, MTX, Post-Cy)	149 (11)
CSA + MMF +/− Others (except Post-Cy)	151 (11)
CSA + MTX +/− Others (except MMF, Post-Cy)	95 (7)
CSA +/− Others (except MTX, MMF, Post-Cy)	16 (1)
Post-Cy +/− Others	68 (5)
Others[3]	39 (3)
Missing	1 (<1)
Year of transplant, n (%)	
2008	268 (20)
2009	219 (16)
2010	175 (13)
2011	96 (7)
2012	86 (6)
2013	158 (12)
2014	211 (15)
2015	152 (11)
Median follow-up of survivors (range), months	60.6 (12–121)

N, number; HCT, hematopoietic cell transplantation; HCT-CI, hematopoietic cell transplantation – comorbidity index; AML, acute myeloid leukemia; ALL, acute lymphoblastic leukemia; CML, chronic myeloid leukemia; MDS, myelodysplastic syndrome; NHL, non-Hodgkin lymphoma; HL, Hodgkin lymphoma; SCID, severe combined immunodeficiency; BM, bone marrow; PBSC, peripheral blood stem cells; TBI, total body irradiation; ATG, antithymocyte globulin; GVHD, graft-versus-host disease; Tac, tacrolimus; MTX, methotrexate; MMF, mycophenolate mofetil; CSA, cyclosporine

[1]Other heme malignancy (Acute undifferentiated leukemia- 3, Biphenotypic, bilineage or hybrid leukemia- 17, chronic lymphocytic leukemia- 9, Blastic plasmacytoid dendritic cell neoplasm- 1, plasma cell disorders- 11, Solid tumors-1)

[2]Other non-malignant conditions (Inherited disorder of metabolism- 2, Histiocytic disorders- 4, Other- 1)

[3]Other GVHD prophylaxis (*Ex vivo* T-cell depletion-9, CD34 selection-21, ATG +/− others- 2, Sirolimus +/− others- 4, Methotrexate- 2, MMF-1)

Table 2:

Multivariable logistic regression analysis of factors[1] associated with work-status at 1-year post-HCT (full-time/ part-time work vs. unemployed)

Variables	OR	95% CI	*P* value
Sex			
Male	1		
Female	0.55	0.40–0.77	<0.001
HCT Comorbidity Index			0.016
0	1		
1	0.72	0.47–1.12	0.147
2	0.66	0.43–1.01	0.055
≥3	0.57	0.39–0.82	0.002
Pre-HCT Education			<0.001
High school or lower	1		
College	1.09	0.65–1.80	0.743
Graduate school	2.47	1.49–4.10	<0.001
Pre-HCT Employment			<0.001
Full-time work	1		
Part-time work	1.94	0.94–3.99	0.072
Unemployed	0.37	0.24–0.56	<0.001
Medical disability	0.44	0.28–0.70	<0.001
Conditioning			<0.001
Myeloablative with TBI	1		
Myeloablative without TBI	1.71	1.16–2.53	0.007
Reduced Intensity/ Non-myeloablative with TBI	1.58	0.95–2.62	0.08
Reduced Intensity/ Non-myeloablative without TBI	1.37	0.77–2.45	0.28
Acute GVHD by 1-year			0.017
None	1		
Grade 2	0.75	0.52–1.09	0.137
Grade 3–4	0.52	0.34–0.80	0.003
Relapse by 1-year			<0.001
No	1		
Yes	0.34	0.21–0.56	<0.001

Variables	OR	95% CI	*P* value
Non-malignant disease	1.10	0.65–1.86	0.71

HCT, hematopoietic cell transplantation; OR, odds ratio; CI, confidence interval; TBI, total body irradiation; GVHD, graft-versus-host disease
Only info on patients with non-missing work status at 1 year was used (n=878; 1 patient who indicated to be retired at 1 year is removed from the analysis; n=2 patients with unknown conditioning are removed; remaining n=875)

[1]Variables in the model: Age groups, sex, race, ethnicity, pre-HCT employment status, pre-HCT education, pre-HCT marital status, Karnofsky score, HCT-CI, disease type, graft source combined with donor type, TBI/ conditioning, year of transplant, acute GVHD by 1-year, chronic GVHD by 1-year, relapse by 1-year