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## Quality of Life of Caregivers of Hematopoietic Cell Transplant Recipients

Kareem Jamani, MD, Lynn E. Onstad, ScM, Merav Bar, MD, Paul A. Carpenter, MD, Elizabeth F. Krakow, MD, MSc, Rachel B. Salit, MD, Mary E.D. Flowers, MD, and Stephanie J. Lee, MD, MPH

Clinical Research Division, Fred Hutchinson Cancer Research Center, Seattle, WA

### Abstract

Caregivers are critical to recipient recovery after hematopoietic cell transplant (HCT), however, little is known about their long-term health and quality of life (QoL). In this study, we surveyed 4446 caregiver/recipient pairs in the post-HCT period to describe their QoL and its determinants. In total, 849 caregiver/recipient pairs at a median of 6 years post autologous or allogeneic HCT responded. Among 849 responding caregivers at a median of 6 years post-HCT, 67% of caregivers were female and 68% indicated that they were still providing care to the recipient. Mean and median QoL measures of caregivers were at or above general population norms; however, approximately 20% of caregivers reported poor QoL relative to general population norms. Multivariate analysis revealed that caregiver characteristics including age, gender and educational attainment were important determinants of caregiver QoL. Additional determinants of caregiver QoL included recipient QoL, relapse after autologous HCT and ongoing use of immunosuppression after allogeneic HCT. Additionally, the prevalence of depression and sleep disorders appear to be higher in caregivers than in the general population. We have identified a population of caregivers who may benefit from interventions aimed at improving QoL and health outcomes. HCT clinical practice should also consider caregiver wellbeing.

### Keywords

caregiver; family caregiver; informal caregiver; quality of life; hematopoietic cell transplant

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Corresponding Author: Kareem Jamani, Room 603 South Tower Foothills Hospital, 1403 29 St. NW, Calgary AB, Canada, T2N 2T9. P: 1 403 944 5948, F: 1 403 944 8352.

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### Authorship Contributions

SJL conceived the research question and designed the questionnaires, SJL & KJ designed the study, LEO analyzed the data, KJ & LEO prepared the manuscript, and all authors contributed to interpretation of the data and provided critical review of the manuscript.

## Introduction

Autologous (auto) and allogeneic (allo) hematopoietic stem cell transplants (HCT) are intensive therapies offered to patients with high-risk malignant and non-malignant conditions. HCT recipients face prolonged recovery from treatment-related toxicities and are at risk of further challenges, such as infection, relapse, and if they have an allo-HCT, graft-versus-host disease (GVHD). For example, chronic GVHD, occurring in almost half of long-term survivors after allo-HCT, is associated with prolonged functional impairment and reduced quality of life (QoL).<sup>1</sup> Additionally, HCT recipients face significant psychosocial and financial stressors.<sup>2</sup> Given the extent of supportive care required post-HCT, recipients are required to have a caregiver (also referred to in the literature as informal or family caregivers). Caregivers are typically spouses, siblings, children, parents and friends of recipients and they are not financially compensated for the care they provide. As an increasing proportion of post-HCT care is occurring in the outpatient setting, growing responsibility for recipient support has been delegated to caregivers. Caregivers are critical to post-HCT care, providing emotional support, medication management, assistance with activities of daily living, intake and output monitoring, transportation to medical appointments and other vital care that often spans 24 hours a day and 7 days a week for months and sometimes years of recipient recovery. Involvement of a caregiver in the early post-HCT period may be associated with improved survival.<sup>3</sup> The FHCRC trains caregivers to perform simple medical tasks. We provide psychosocial support during the acute transplant period and a list of resources when patients are leaving the transplant center. If caregivers report distress to the Long-Term Follow-Up (LTFU) program, they are referred back to their physicians or to local resources.

Caregiver burden is a well-recognized problem when patients have chronic illnesses.<sup>4</sup> Caregiver burden has been best studied in chronic progressive illnesses such as dementia and is defined as the emotional, physical, social and financial suffering that caregivers experience as a result of providing care.<sup>5</sup> While caregiving can be a positive experience,<sup>6</sup> caregivers who are burdened by their duties experience inferior mental and physical health and perhaps an increased risk of mortality.<sup>7, 8</sup> Given the complex care needs and prolonged recovery for HCT recipients, effects on caregiver health and QoL are expected. Indeed, studies to date have found that, early after HCT, caregivers experience significant levels of distress and burden, as well as declining quality of life.<sup>9, 10</sup> Hypothalamic-pituitary axis dysfunction may be a physiologic correlate of this distress.<sup>11, 12</sup>

There is, however, limited insight into the long-term health and QoL of HCT caregivers. Further study to shed light on the caregiver post-HCT experience may guide studies of assessment and supportive interventions for at-risk ICs. Here we report a large cross-sectional evaluation of HCT caregiver and recipient QoL and health issues late post-HCT with the aims of: (1) describing caregiver QoL in relation to recipient measures and (2) determining what factors predict poor caregiver QoL.

## Methods

### Study Cohort

The protocol was approved by the Fred Hutchinson Cancer Research Center (FHCRC) Institutional Review Board. Allo and auto HCT recipients at the FHCRC are invited to participate in a yearly QoL questionnaire sent on the recipient's transplant anniversary. During the July 2015-June 2016 survey cycle, an additional survey, to be completed by the HCT caregiver, was included with the mailing. Recipients were instructed to give the caregiver survey to their caregiver. The caregiver survey included its own envelope for direct return to the center. Underlying disease characteristics and HCT characteristics and outcomes were obtained from a regularly updated institutional database that contains the aforementioned data for all consenting HCT recipients treated at FHCRC.

### Survey

The caregiver survey queried demographics, relation to HCT recipient, current and past caregiving functions, performance status, employment status, medical issues, medications and the SF-36 participant-reported QoL instrument. The corresponding HCT recipient survey queried performance status, employment status, medical issues, medications, subsequent malignancies, chronic GVHD status and included the SF-36.

The SF-36 Version 2 is a 36-item self-reported questionnaire that assesses participant-reported health and functioning. The instrument examines the following domains of QoL: physical functioning (PF), role functioning-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role functioning-emotional (RE), and mental health (MH). Two summary scales of the SF-36 were used: the physical component score (PCS) and the mental component score (MCS).<sup>13</sup> A margin of 5 points on an SF-36 domain or summary score is felt to be a clinically significant difference.<sup>14</sup>

### Statistics

For descriptive data, chi-square, Fisher's exact test and the Mann-Whitney U-test were used as appropriate. SF-36 scores were standardized to the general American population (mean 50, standard deviation of 10). Multivariate analyses using forward stepwise logistic regression were used to examine determinants of caregiver QoL. Caregiver PCS and MCS summary scores >45 (representing QoL scores similar to or better than the general population) were the endpoints for all multivariate analyses. Variables examined include caregiver characteristics (age, sex, race, educational achievement and relationship to patient), HCT characteristics (conditioning, stem cell source, donor type and underlying disease) and recipient characteristics (age, history of grade II-IV aGVHD, history of moderate-severe cGVHD, current use of immunosuppression, relapse, time post-transplant and recipient MCS and PCS summary scores). Caregiver characteristics and recipient current use of immunosuppression were obtained from the surveys, while all other variables were obtained from the institutional database.

## Results

### Survey Response

Surveys were sent to 4446 recipients. In total, 849 recipient/caregiver pairs responded (19%), 1170 recipients responded without a corresponding caregiver response (26%), 43 caregivers responded without a corresponding recipient response (1%) and 2384 (54%) recipient/caregiver pairs did not respond.

### Respondent Characteristics

Responding recipient and caregiver characteristics are presented in table 1. Recipients and caregivers were predominantly Caucasian and had similar median ages. Most caregivers possessed a college, trade or graduate degree. While 56% of recipients were male, 67% of caregivers were female. The caregivers were typically spouses of the recipient and had been caregivers during the first 100 days post-HCT. Most caregivers were still living with the recipient and 68% indicated that they were still providing care to the recipient.

Table 2 details the HCT characteristics for recipients whose caregivers responded (R+CG). One third received auto-HCT. Recipients were a median of 6 years post-HCT and received HCT for a variety of predominantly hematologic malignancies. Allo-HCT was typically performed with peripheral blood stem cells from matched related and matched unrelated donors after myeloablative conditioning. Only 8% had experienced relapse of their underlying disease. With respect to GVHD, 67% and 66% of allogeneic HCT recipients had experienced grade II–IV acute and moderate-severe chronic, respectively, while 33% remained on immunosuppression at completion of the questionnaire.

Table 2 also details the HCT characteristics of those recipient/caregiver pairs that did not respond (no R+CG) and those with a recipient response but no caregiver response (R-only). Compared to R only, the R+CG responders were significantly earlier post-HCT (median 6 vs. 13 years), received peripheral blood stem cell grafts more frequently and were more likely to be on immunosuppressive therapy at the time of survey completion.

### QoL of Caregivers and Recipients

Table 3 presents standardized SF-36 measures for caregivers and recipients. Mean and median caregiver QoL measures were at or above the population norms across the SF-36 domains. With respect to the PCS and MCS summary scores; 42.7% and 51.2% of caregivers, respectively, scored  $\geq 55$  while 18.4% and 21.4% respectively scored  $\geq 45$ .

Recipients reported significantly worse QoL measures than caregivers with the exception of the MH domain and the MCS, which were equivalently above population norms. Recipient QoL was notably worse than caregivers for the PF, RP and GH domains and the PCS.

Compared to the R+CG recipients, R-only recipients scored significantly higher on the PF, RP and SF domains and the PCS summary score (supplementary table 1). However, absolute differences in these scores were small (<3 points).

## Determinants of Caregiver QoL

As an indicator of poor QoL, physical and mental component scores were examined in multivariable models that considered caregiver, recipient, and HCT variables for comparison to general population norms (Table 4). Allo-HCT recipient caregivers experienced inferior physical QoL/PCS (OR 1.46,  $p=0.05$ ) but similar mental QoL/MCS (OR 1.29,  $p=0.16$ ) compared to auto-HCT recipient caregivers. Subsequent analyses are reported separately for auto and allo-HCT recipient caregivers.

In the context of auto-HCT, lower caregiver PCS was associated with recipient relapse (OR 4.22,  $p=0.005$ ). Lower caregiver MCS was also associated with relapse (OR 7.10,  $p=0.005$ ), as well as female gender caregiver (OR 3.35,  $p=0.009$ ), fewer years since transplant (OR 1.12  $p=0.007$ ), and lower recipient MCS (OR 1.05,  $p=0.001$ ).

In the context of allo-HCT, lower caregiver PCS was associated with age  $\geq 60$  (OR 2.78,  $p<0.001$ ), lower caregiver educational attainment (OR 1.75,  $p=0.04$  and OR 3.13,  $p=0.001$  for high school versus college and graduate degrees, respectively), and lower recipient PCS (OR 1.03,  $p=0.01$ ). Lower caregiver MCS was associated with current recipient use of immunosuppressive therapy (IST) (OR 1.93,  $p=0.008$ ) and lower recipient PCS and MCS (OR 1.03,  $p=0.002$ , and OR 1.04,  $p<0.001$ , respectively), while caregiver age  $\geq 60$  was protective (OR 0.53,  $p=0.009$ ).

Notably, caregiver relationship to recipient, HCT characteristics and recipient characteristics (apart from recipient QoL and current use of IST) were not significantly associated with caregiver QoL regardless of auto/allo-HCT context.

## Medical Conditions

Table 5 details the self-reported prevalence of common medical conditions for caregivers at the time of survey completion. The table also lists age unadjusted prevalence estimates of these medical conditions in the general American population, when available, from the Centers for Disease Control (CDC) website.<sup>15</sup> As compared to the general population, caregivers appeared to have a higher prevalence of depression, sleep disorders requiring medication and hypothyroidism.

## Discussion

To the best of our knowledge, our cross-sectional QoL analysis of over 800 caregivers is the largest study of HCT caregivers to date. Acknowledging the effect of selection bias inherent to the methodology of participant-reported survey studies, we have demonstrated that at a median of 6 years post HCT: (1) most caregivers are experiencing physical and mental QoL equivalent to or better than that of the general population and (2) on average, caregivers report better physical but similar mental QoL versus recipients. However, approximately 1 in 5 caregivers are experiencing inferior physical and/or mental QoL. Additionally, the prevalence of depression and sleep disorders appear to be higher in caregivers than in the general population.

Insights into the long-term health and QoL of HCT ICs have been reported in two studies. A study of 36 caregivers and recipients of autologous-HCT at 1-6 years post-transplant revealed that caregiving obligations continued and that caregivers continued to struggle with social and emotional adjustment.<sup>16</sup> A multicenter study that compared 177 survivor/partner pairs to married, peer-nominated survivor acquaintances (controls), at a mean of 6.7 years after HCT, found that partners experienced more depressive symptoms and sleep and sexual problems than controls, as well as less social support, more loneliness, and less spiritual well-being than survivors and controls. Additionally, a number of partner factors such as partner health problems, coping, female sex, social constraint, survivor depression, optimism, multiple life changes, and social support were associated with partner outcomes.<sup>17</sup>

Our sample size allowed for a more comprehensive multivariate analysis of the determinants of HCT caregiver QoL than has been previously reported, including a separate analysis of auto and allo-HCT caregivers. Physical QoL of allo-HCT caregivers was inferior to that of auto-HCT caregivers, possibly due to the greater potential for recipients to experience prolonged treatment-related complications after allo-HCT. Notably, we found that caregiver characteristics and recipient QoL were more important drivers of caregiver QoL after HCT than were recipient or HCT characteristics. Particularly, caregiver age, gender and educational attainment were significant predictors of caregiver QoL, while recipient demographics, donor type, stem cell source, conditioning regimen and acute GVHD outcomes were unimportant. Exceptions to this were relapse after auto-HCT, which was a contributor to both inferior mental and caregiver physical QoL and current recipient use of immunosuppression after allo-HCT, which was a contributor to inferior caregiver mental QoL.

We report three important caregiver characteristics associated with caregiver QoL after HCT. Firstly, we found that female caregivers were more likely to be suffering from poor QoL and this finding has been well described in both the HCT caregiver and non-HCT caregiver literature.<sup>4, 17</sup> This finding is concerning since most caregivers, including in our survey, are women. The second is the finding of opposing effects of advancing caregiver age on caregiver QoL after allo-HCT: older caregivers experienced inferior physical QoL but better mental QoL than younger caregivers. These diverging effects of age on QoL have been demonstrated in the general population and in the HCT recipient population.<sup>18, 19</sup> Additionally, studies of caregivers of cancer survivors and of those with chronic illness reveal that younger caregivers experience more burden and inferior mental QoL as compared to older caregivers.<sup>20-22</sup> The third is the association of higher educational attainment with improved physical QoL and a trend to improved mental QoL: we hypothesize that this is mediated through educational attainment's link to improved socioeconomic status. Those caregivers with higher levels of educational attainment possibly have improved access to healthcare, financial security, and the resources to pursue healthy lifestyle choices. This link between education/socioeconomic status and QoL has been demonstrated in the general population and in caregivers of those with chronic illness.<sup>22-24</sup>

Our study has limitations. Most importantly, selection bias likely had an impact on our results: caregivers of recipients who died post-HCT could not be captured and we cannot

rule out that caregivers experiencing poor QoL and caregivers of recipients experiencing severe complications of therapy simply did not respond. In addition, responding recipient/caregiver pairs tended to be those later post-HCT (median 6 years, IQR 2-15 years). Therefore, the caregiver population in our study may be biased towards those who are doing well post-HCT. A more minor contributor to selection bias, conversely, is that if recipients are doing very well, family members might no longer view themselves as caregivers. Additionally, survey responders were predominantly Caucasian and well educated, possibly limiting the generalizability of our results. The caregiver surveys were limited to examining QoL quantitatively and did not include any other measures of psychosocial functioning, such as caregiver burden, or psychosocial supports available to the caregiver. For example, in caregivers of patients with chronic illness, social support mitigates caregiver burden.<sup>25</sup> HCT caregivers have been shown to experience less social support than recipients and controls;<sup>17</sup> therefore, one might hypothesize that social support is a contributor to HCT caregiver QoL. Finally, this was a cross-sectional study which could not provide any insight into the evolution of caregiver QoL post-HCT.

In summary, although the majority of HCT caregivers report QoL measures similar to the general population, a minority are living with inferior QoL late post-transplant. Thus, consideration should be given to the well-being of HCT caregivers. Interventions involving problem solving, communication skills and cognitive behavioural therapy have all shown promise in potentially improving the QoL of cancer and HCT caregivers.<sup>26, 27</sup> Nevertheless, the coordination and delivery of care to this population is challenging as caregivers are typically not patients of the HCT center and the HCT center may be distant from the caregiver's own healthcare providers. Further studies assessing caregiver QoL & health, coordination of caregiver care and the effect of interventions aimed at improving caregiver QoL and health outcomes are warranted.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgments

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### Highlights

- Nearly 20% of caregivers report poor quality of life versus the general population
- Age, gender and education are important predictors of caregiver quality of life
- Depression/sleep disorder are more common in caregivers vs. the general population

**Table 1**

Characteristics of Recipients and Caregivers.

Characteristic	Category	Recipient	Caregiver
<b>Age, Median (range)</b>		62.0 (18.0–87.0)	63.0 (18.0–90.0)
<b>Sex</b>	Male	502 (56%)	290 (33%)
	Female	390 (44%)	594 (67%)
	Missing		8 (1%)
<b>Race</b>	Native American	5 (1%)	19 (2%)
	African American	10 (1%)	8 (1%)
	Asian	27 (3%)	37 (4%)
	East Indian	1 (<1%)	
	Native Hawaiian		3 (<1%)
	Pacific Islander	2 (<1%)	3 (<1%)
	Caucasian	777 (87%)	791 (89%)
	Other	15 (2%)	10 (1%)
	More than 1	13 (1%)	8 (1%)
	Hispanic	10 (1%)	
	Missing	32 (4%)	13 (1%)
<b>Ethnicity</b>	Non-Hispanic	863 (97%)	764 (86%)
	Hispanic	15 (2%)	14 (2%)
	Missing	14 (2%)	114 (13%)
<b>Education</b>	<High school		11 (1%)
	High school degree		278 (31%)
	2 yr college/trade degree		97 (11%)
	4 yr college/trade degree		228 (26%)
	Graduate degree		254 (28%)
	Missing		24 (3%)
<b>Caregiver relationship</b>	Spouse		698 (78%)
	Live in partner		21 (2%)
	Parent		92 (10%)
	Child		28 (3%)
	Other		33 (4%)
	Friend		9 (1%)
	Paid caregiver		2 (<1%)
	Missing		9 (1%)
<b>Caregiver during first 100 days</b>	No		63 (7%)
	Yes		811 (91%)
	Missing		18 (2%)
<b>Still living with recipient</b>	No		111 (12%)

Characteristic	Category	Recipient	Caregiver
	Yes		760 (85%)
	Missing		21 (2%)
<b>Still providing care</b>	No		252 (28%)
	Yes		608 (68%)
	Missing		32 (4%)

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**Table 2**

HCT Characteristics of Responding and Non-Responding Recipients and Caregivers.

Characteristic	Category	All (N=4446)	No R+CG (N=2427)	R+CG (N=849)	R-only (N=1170)	p*
<b>Years-post HCT</b>	Median (Range)	10.9 (0.0–44.1)	11.0 (0.0–43.0)	6.0 (0.4–43.0)	13.0 (0.5–44.1)	<.001
	IQR	(4.0–20.0)	(4.9–21.0)	(2.0–15.0)	(6.0–22.0)	<.001
	Mean (STD)	12.8 (10.0)	13.4 (10.2)	9.1 (8.8)	14.3 (9.9)	<.001
<b>Diagnosis</b>	AML	842 (18.9%)	447 (18.4%)	162 (19.1%)	233 (19.9%)	<.001
	ALL	361 (8.1%)	232 (9.6%)	52 (6.1%)	77 (6.6%)	
	MDS	449 (10.1%)	196 (8.1%)	128 (15.1%)	125 (10.7%)	
	CLL	60 (1.3%)	26 (1.1%)	17 (2.0%)	17 (1.4%)	
	CML	711 (16.0%)	393 (16.2%)	101 (11.9%)	217 (18.6%)	
	AA	202 (4.5%)	129 (5.3%)	20 (2.4%)	53 (4.5%)	
	MM	580 (13.0%)	290 (12.0%)	149 (17.6%)	141 (12.0%)	
	NHL	715 (16.1%)	359 (14.8%)	151 (17.8%)	205 (17.5%)	
	Other	526 (11.8%)	355 (14.6%)	69 (8.1%)	102 (8.7%)	
<b>Donor relationship</b>	Rel/Matched	1447 (32.6%)	790 (32.6%)	234 (27.6%)	423 (36.2%)	0.002
	URD/Matched	921 (20.7%)	463 (19.1%)	214 (25.2%)	244 (20.8%)	
	Rel/Mismatch	168 (3.8%)	105 (4.3%)	19 (2.2%)	44 (3.8%)	
	URD/Mismatch	270 (6.1%)	147 (6.1%)	56 (6.6%)	67 (5.7%)	
	Rel/Haplo	65 (1.5%)	31 (1.3%)	16 (1.9%)	18 (1.5%)	
	Cord	111 (2.5%)	70 (2.9%)	19 (2.2%)	22 (1.9%)	
	Identical twin	37 (0.8%)	21 (0.9%)	6 (0.7%)	10 (0.8%)	
	Auto	1419 (31.9%)	794 (32.7%)	284 (33.4%)	341 (29.2)	
	Rel/Unknown	4 (0.1%)	3 (0.1%)	0	1 (0.1%)	
	URD/unknown	4 (0.1%)	3 (0.1%)	1 (0.1%)	0	
<b>Stem cell source</b>	Peripheral blood	2688 (60.5%)	1391 (57.3%)	621 (73.1%)	676 (57.8%)	<.001
	Bone marrow	1646 (37.0%)	965 (39.8%)	209 (24.6%)	472 (40.3%)	
	Cord	111 (2.5%)	70 (2.9%)	19 (2.2%)	22 (1.9%)	
	Missing	(N=1)	(N=1)	0	0	

Characteristic	Category	All (N=4446)	No R+CG (N=2427)	R+CG (N=849)	R-only (N=1170)	P*
<b>Relapse</b>	No	4088 (91.9%)	2223 (91.6%)	782 (92.1%)	1083 (92.6%)	0.703
	Yes	358 (8.1%)	204 (8.4%)	67 (7.9%)	87 (7.4%)	
<b>Conditioning</b>	Non-myeloblastic	514 (11.6%)	217 (9.0%)	150 (17.8%)	147 (12.6%)	0.001
	Myeloblastic	3918 (88.4%)	2201 (91.0%)	695 (82.2%)	1022 (87.4%)	
	Missing	(N=14)	(N=9)	(N=4)	(N=1)	
<b>Acute GVHD grade II-IV</b>	No	1031 (34.9%)	549 (34.6%)	182 (33.0%)	300 (36.8%)	0.15
	Yes	1923 (65.1%)	1038 (65.4%)	370 (67.0%)	515 (63.2%)	
	Missing	(N=73)	(N=46)	(N=13)	(N=14)	
	Not applicable	(N=1419)	(N=794)	(N=284)	(N=341)	
<b>Moderate-severe cGVHD</b>	No	1119 (38.6%)	633 (40.9%)	186 (33.8%)	300 (37.6%)	0.15
	Yes	1778 (61.4%)	914 (59.1%)	365 (66.2%)	499 (62.4%)	
	Missing	(N=130)	(N=86)	(N=14)	(N=30)	
	Not applicable	(N=1419)	(N=794)	(N=284)	(N=341)	
<b>Current level of cGVHD</b>	Mild	256 (65.3%)	0	140 (68.3%)	116 (62.0%)	0.17
	Moderate	113 (28.8%)	0	51 (24.9%)	62 (33.2%)	
	Severe	23 (5.9%)	0	14 (6.8%)	9 (4.8%)	
	Missing	(N=12)	0	(N=8)	(N=4)	
	Not applicable	(N=4054)	(N=2427)	(N=644)	(N=983)	
<b>Currently taking IST</b>	No	858 (76.3%)	0	334 (67.1%)	524 (83.7%)	<.001
	Yes	266 (23.7%)	0	164 (32.9%)	102 (16.3%)	
	Missing	(N=270)	0	(N=67)	(N=203)	
	Not applicable	(N=3052)	(N=2427)	(N=284)	(N=341)	

\* P-values are for the comparison between R+CG and R only, and were determined excluding those with missing values or not applicable. R=recipient. CG=caregiver. 'No R' refers to no recipient survey returned. 'R+CG' refers to both recipient and caregiver survey returned. 'R only' refers to recipient survey returned but no caregiver survey.



**Table 3**  
Quality of Life Scores of HCT Recipients and their Caregivers using the Short Form 36 (SF-36) Instrument.

SF-36 Measure	Recipient			Caregiver			Difference in means (95% CI)	p
	N	Mean	Median (range)	Mean	Median(range)	(Recipient-IC)		
Physical Component Score	799	44.5	46.5 (8.0–64.3)	51.5	53.7 (18.7–66.1)	-7.0 (-7.9, -6.1)	<0.001	
Mental Component Score	799	51.9	54.7 (5.1–69.8)	52.1	55.3 (15.8–68.3)	-0.3 (-1.1, 0.5)	0.51	
Physical Functioning	829	45.5	48.6 (14.9–57.0)	51.2	54.9 (14.9–57.0)	-5.7 (-6.5, -4.8)	<0.001	
Role Functioning Physical	828	44.1	47.1 (17.7–56.9)	50.8	56.9 (17.7–56.9)	-6.7 (-7.6, -5.8)	<0.001	
Bodily Pain	832	49.4	51.1 (19.9–62.1)	51.6	51.1 (19.9–62.1)	-2.2 (-3.0, -1.3)	<0.001	
General Health	827	45.5	48.2 (16.2–63.9)	52.6	54.4 (21.0–63.9)	-7.0 (-8.0, -6.1)	<0.001	
Vitality	835	50.4	52.1 (20.9–70.8)	54.0	55.2 (20.9–70.8)	-3.6 (-4.4, -2.8)	<0.001	
Social Functioning	838	47.2	51.4 (13.2–56.8)	51.0	56.8 (13.2–56.8)	-3.8 (-4.7, -2.9)	<0.001	
Role Functioning Emotional	823	48.5	55.9 (9.2–55.9)	50.2	55.9 (17.0–55.9)	-1.8 (-2.6, -1.0)	<0.001	
Mental Health	832	52.8	55.6 (7.8–64.1)	52.6	55.6 (13.4–64.1)	0.2 (-0.6, 0.9)	0.61	

**Table 4**

Results of Multivariate Analyses Examining Variables Associated with Caregiver (CG) Mental and Physical Component Scores 45.

	PCS 45 OR (95% CI)	P-value	MCS 45 OR (95% CI)	P-value
<b>Allo-HCT caregivers*</b>				
CG Age ≥ 60	2.78 (1.63, 4.75)	<0.001	0.53 (0.33, 0.86)	0.009
CG High School Education (vs. College Degree)	1.75 (1.02–3.03)	0.04		
CG High School Education (vs. Graduate Degree)	3.13 (1.59–6.25)	0.001		
Lower Recipient PCS	1.03 (1.01–1.04)	0.01	1.03 (1.01–1.05)	0.002
Lower Recipient MCS			1.04 (1.02–1.06)	<0.001
Currently on IST			1.93 (1.19, 3.14)	0.008
<b>Auto-HCT caregivers*</b>				
Recipient Relapse	4.22 (1.54, 11.6)	0.005	7.10 (1.81, 28)	0.005
Lower Recipient MCS			1.05 (1.02–1.09)	0.001
Fewer Years post-HCT			1.12 (1.03–1.23)	0.007
Female CG			3.35 (1.36, 8.25)	0.009

PCS, physical component score; MCS, mental component score; CG, caregiver.

\* Only variables that are statistically significant are shown. Variables examined include: caregiver characteristics (age, sex, race, educational achievement and relationship to patient), HCT characteristics (conditioning, stem cell source, donor type and underlying disease) and recipient characteristics (age, history of grade II–IV aGVHD, history of moderate-severe cGVHD, current use of immunosuppression, relapse, time post-transplant and recipient MCS and PCS summary scores).

**Table 5**

Self-Reported Medical Conditions &amp; Other Measures in Caregivers with Comparative Population Prevalence.

	Caregiver	General Population*
<b>Cardiovascular Disease</b>	69 (8.4%)	6.7%
<b>Hyperlipidemia</b>	253 (30.8%)	39.1%
<b>Hypertension</b>	283 (34.1%)	32.4%
<b>Hyperglycemia</b>	85 (10.3%)	10.5%
<b>Hypothyroidism</b>	123 (14.9%)	3.7%
<b>Venous Thromboembolic Disease</b>	73 (9.0%)	
<b>Osteoporosis/Osteopenia</b>	179 (22.3%)	9% †
<b>Sexual Dysfunction</b>	285 (35.8%)	
<b>Endocrinopathy</b>	63 (7.8%)	
<b>Post-Traumatic Stress Disorder</b>	31 (3.8%)	3.5%
<b>Anxiety</b>	116 (14.0%)	18.1%
<b>Depression</b>	122 (14.8%)	6.7%
<b>Joint Replacement or Avascular Necrosis</b>	71 (8.7%)	
<b>Kidney Failure Requiring Dialysis</b>	2 (0.2%)	0.2%
<b>Tobacco Use</b>	94 (11.6%)	15.1%
<b>Shingles</b>	98 (12.0%)	
<b>Sleep Disorder</b>	145 (17.6%)	4%
<b>Muscle Cramp</b>	60 (7.3%)	
<b>Use of Prescription Pain Medication</b>	76 (9.2%)	11%
<b>Karnofsky Performance Score</b>		
<b>100</b>	563 (68.1%)	
<b>90</b>	201 (24.3%)	
<b>80</b>	34 (4.1%)	
<b>70</b>	16 (1.9%)	
<b>60</b>	9 (1.1%)	
<b>50</b>	2 (0.2%)	
<b>&lt;50</b>	2 (0.2%)	
<b>Work/School Status</b>		
<b>Full time</b>	437 (52.5%)	
<b>Part time</b>	107 (12.8%)	
<b>Not working due to health</b>	26 (3.1%)	
<b>Unemployed but looking</b>	13 (1.6%)	
<b>Unemployed not looking</b>	1 (0.1%)	
<b>Retired not due to health</b>	235 (28.2%)	
<b>Other</b>	14 (1.7%)	
<b>Body Mass Index</b>		
<b>&lt;18.5</b>	8 (1.1%)	

	Caregiver	General Population <sup>*</sup>
18.5–24.9	280 (37.5%)	
25–29	271 (36.3%)	
30+	188 (25.2%)	

\* Population prevalence estimates are for the general American population and are obtained from [cdc.gov](http://cdc.gov) subpages (accessed June 20, 2017).

<sup>†</sup> Prevalence for osteoporosis only.

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