haematologica
Journal of the Ferrata Storti Foundation

Female sex is associated with superior outcomes in patients treated with CD19-directed CAR T-cell therapy for large B-cell lymphoma

by John Behman, Nausheen Ahmed, Shahrukh Hashmi, Mahmoud Aljurf, Farrukh Awan, Praveen Ramakishnan, Mumtaz Yaseen, Mohamed A. Kharfan-Dabaja, Sairah Ahmed and Muhammad Bilal Abid

Received: March 31, 2026.
Accepted: June 22, 2026.

Citation: John Behman, Nausheen Ahmed, Shahrukh Hashmi, Mahmoud Aljurf, Farrukh Awan, Praveen Ramakishnan, Mumtaz Yaseen, Mohamed A. Kharfan-Dabaja, Sairah Ahmed and Muhammad Bilal Abid. Female sex is associated with superior outcomes in patients treated with CD19-directed CAR T-cell therapy for large B-cell lymphoma.
Haematologica. 2026 July 2. doi: 10.3324/haematol.2026.300993 [Epub ahead of print]

Female sex is associated with superior outcomes in patients treated with CD19-directed CAR T-cell therapy for large B-cell lymphoma

John Behman,[1] Nausheen Ahmed,[2] Shahrukh Hashmi,[3] Mahmoud Aljurf, [4] Farrukh Awan, [5] Praveen Ramakishnan, [5] Mumtaz Yaseen, [6] Mohamed A. Kharfan-Dabaja, [7] Sairah Ahmed, [8] Muhammad Bilal Abid[†6]

[1]Duke University, Department of Medicine, Division of Hematologic Malignancies and Cellular Therapy, Durham, NC, USA

[2]University of Kansas Medical Center, Kansas City, KS, USA

[3]Mayo Clinic, Rochester, MN, USA

[4]King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia

[5]UT Southwestern Medical Center, Dallas, TX, USA

[6]Stem Cell Transplantation & Cellular Therapy Program, Texas Tech University Health Science Center, School of Medicine, Lubbock, TX, USA

[7]Division of Hematology-Oncology, Blood and Bone Marrow Transplantation and Cellular Therapy Program, Mayo Clinic, Jacksonville, FL, USA

[8]Department of Lymphoma/Myeloma, MD Anderson Cancer Center, Houston, TX USA

[†]Corresponding Author

Muhammad Bilal Abid, MD, MS, MRCP, FRCPE
Associate Professor of Medicine
Hematology and Medical Oncology, UMC Cancer Center
Medical Director, Cellular Immunotherapy and Blood & Marrow Transplant
Director, Hematologic Malignancy Section
Associate Director, Hematology/Oncology Fellowship Program
Texas Tech University Health Science Center School of Medicine
602 Indiana Ave | Lubbock, Texas 79430
Email: bilal_abid@hotmail.com

Trial registration – Not applicable.

Short title: Sex differences in CAR T-cell therapy

Authors contributions - MBA conceptualized the idea and supervised the project. JB gathered data and performed the analysis. JB and MBA interpret the analyses and wrote the manuscript. JB, NA, SH, MA, FA, PR, MY, MAKD, SA, and MBA critically revised the manuscript.

Acknowledgements - This dataset was collected by the Center for International Blood and Marrow Transplant Research (CIBMTR)which is supported primarily by the Public Health Service U24CA076518 from the National Cancer Institute; the National Heart, Lung, and Blood Institute; the National Institute of Allergy and Infectious Diseases; 75R60222C00011 from the Health Resources and Services Administration; NMDP; and the Medical College of Wisconsin.

We acknowledge the CIBMTR staff for making the dataset publicly available. CIBMTR had no role in the study design, data analysis, interpretation of results, or manuscript preparation. The study was not reviewed by CIBMTR and does not represent its views.

We are grateful to the CIBMTR Cellular Immunotherapy Scientific Director Dr. Amy Moskop for her input and feedback on this work and manuscript.

Data availability statement:

Data available: Yes

Data types: Other (please specify)

Additional Information: Data are publicly available via the CIBMTR publicly available datasets.

How to access data: https://cibmtr.org/CIBMTR/Resources/Publicly-Available-Datasets

When available: With publication

Funding – No funding sources.

Conflict of interest disclosure: COI for NA: Advisory Board - Kite/Gilead, Bristol Myers Squibb, Astrazeneca, Abbvie, ADC Therapeutics, Autolous, Legend Bio, Jansen & Jansen, Invivyd Bio. Consultancy -Kite/ Gilead and BMS; Research Support: Genmab/Abbvie. COI for FA: FA reports contracted research for Pharmacyclics LLC, an AbbVie Company; consulting agreements for other contracted research with Janssen, Gilead, Kite Pharmaceuticals, Karyopharm, MEI Pharma, Verastem, Incyte, Johnson and Johnson, Merck, Epizyme, Loxo Oncology, Adaptive Biotechnologies, Genmab, and Actinium Pharmaceuticals; other consulting agreements with AstraZeneca Pharmaceuticals LP; other advisory committee roles with AbbVie Inc, ADC Therapeutics, AstraZeneca Pharmaceuticals LP, BeiGene Ltd, Bristol Myers Squibb (BMS) Company, Cardinal Health, Caribou Biosciences Inc, Celgene Corporation, Cellectar Biosciences Inc, Dava Oncology, Epizyme Inc, and Genentech, a member of the Roche; and advisory committee participation for AstraZeneca Pharmaceuticals LP; they also report serving on the DSMC for Ascentage, AstraZeneca, and Caribou Biosciences. COI for PR: Advisory Board/Consultancy - Kite/Gilead Pharma, Bristol Myers Squibb (BMS), ADC Therapeutics, Ono Pharma, Ipsen Biopharma, Acrotech Biopharma, Sobi and Regeneron Pharma. COI for MAKD: Research/grant: Pharmacyclics and Bristol Myers Squibb. Advisory board: Incyte Corp. COI for SA: SA reports consultancy for ADC Therapeutics, Kite/Gilead, Genmab/Abbvie, Avencell therapeutics and BMS. Research support to institution: Kite/Gilead, Janssen, Caribou, BMS and Avencell therapeutics.

Ethics approval statement- not applicable.

The results were presented at 67th American Society of Hematology Annual Meeting and Exposition in Orlando, Florida on December 8th, 2025, and at the Annual American Society of Transplantation and Cellular Therapy Meeting in Salk Lake City, Utah on February 5th, 2026.

Letter to the Editor

Despite significant existing evidence across conventional immunotherapy platforms, the impact of sex in patients undergoing chimeric antigen receptor T-cell (CAR T) therapy is unknown. Real-world analysis of 1,503 patients treated with CD19+CAR T-cells for aggressive large B-cell lymphomas (LBCL) showed a significantly higher relapse risk and inferior overall survival (OS) and progression-free survival (PFS) in males compared to females. The PFS and OS differences were significant and more pronounced among patients who were younger than 50 years. Our findings are practice-informing.

Evidence shows that females mount more vigorous antibody- and cell-mediated immune responses compared to males following infections or vaccinations. [1,2] Estradiol is associated with upregulation of CD4+ T-cells and dendritic cells, increased survival of autoreactive B-cells, and decreased tumor necrosis factor production. Additionally, androgens have immunosuppressive properties. A recent study showed that male mice mount a more robust immune response following androgen-deprivation therapy, and in humans, genes associated with poor virus-response are upregulated by androgens.[3] Also, men presenting with high serum androgen levels exhibit the weakest influenza immune responses.[1,2,4]

Studies in patients with solid tumors receiving immune checkpoint inhibitors (ICIs) suggest differences in response and toxicities based on sex. [5] The biologically stronger innate and adaptive immune responses in women foster a more immunosuppressive tumor microenvironment with paradoxically greater T-cell dysfunction and increased regulatory T-cells in women. [6]

Contrastingly, tumors in males demonstrate superior antigenicity with greater tumor mutational burden, leading to enhanced responsiveness to ICIs.[5] This was demonstrated by Wu et al[5] showing superior OS and PFS in males, compared to female patients, treated with programmed death-1 (PD-1) and cytotoxic T-cell antigen 4 (CTLA-4) inhibitors in patients with melanoma and non-small cell lung cancer. [3,5,6]

Since the pivotal RICOVER-60, multi-arm clinical trial introducing anti-CD20 monoclonal antibody, rituximab, into the therapeutic armamentarium of LBCL, males had inferior outcomes in subgroup analyses of rituximab compared to females.[7] Subsequently, the adverse prognosis of male sex was abrogated with higher dosing of rituximab in elderly males, without increased toxicity. [7,8] Despite significant existing evidence across conventional immunotherapy platforms, the impact of sex in patients undergoing CAR-T therapy is unknown.

Utilizing the Center for International Blood and Marrow Transplant Research (CIBMTR) publicly available datasets, we examined the differences in CAR-T outcomes between adult females vs males receiving CD19-directed CAR T-cell therapy for LBCL. The primary outcome of the study was PFS. Secondary outcomes included OS, disease relapse, and non-relapse mortality (NRM).

Descriptive statistics were performed and continuous variables included median with interquartile ranges (IQR). Categorical variables reported frequency with percentages. Group comparisons used Wilcoxon rank sum test for continuous variables and Chi-square test for categorical variables. Kaplan-Meier method was used to estimate survival probabilities and cumulative incidence. Log-rank test compared survival distributions by sex. Outcomes were censored at 24 months for time to event analyses. Covariate-adjusted Cox proportional hazard model examined the impact of sex on CAR-T outcomes.

Subgroup analyses of sex stratified by age were performed with cutoffs defined as ages < 50 and ≥50 -- included as a clinical surrogate for menopausal status. Analyses were performed using Python 3.x with lifelines package for survival analysis. Statistical significance was defined as $p<0.05$.

The cohort included 601 females (40%) and 902 males (60%). Median age was 62.0 years (IQR, 52.0-68.0 years) with no significant difference between the 2 sexes (females: 61.0; males: 62.0 years; p = 0.20) (Table S1).

The cumulative incidence of relapse at 24 months was significantly higher in males (51.8% [95% CI, 48.2-55.4%] vs females (43.6% [95% CI, 39.3-48.1%]; p<.001). Male sex was associated with an increased risk of relapse (HR, 1.27; 95% CI, 1.09-1.49; p<.002). Twenty-four months NRM was similar between males and females (8.3% [95% CI, 6.0-11.4%] vs 5.2% [95% CI, 3.4-8.1%]; p= 0.309). NRM hazard was similar between males and females (HR, 1.36; 95% CI, 0.87-2.12; p=.173). Twenty-four months PFS was significantly lower in males (46.9% [95% CI, 43.2-50.6%] vs 56.3% [95% CI, 51.7%-60.7%]; p<.001). Male sex was associated with an increased risk of disease progression or death (HR, 1.30; 95% CI, 1.12-1.50; p<.001). At 24 months, Kaplan-Meier estimated OS was significantly lower in males (59.1% [95% CI, 55.3-62.8%] vs 66.2% [95% CI, 61.6-70.4%]; p=.005) (Figure 1A-D).

In Cox proportional hazards analyses, male sex was associated with an increased relapse risk after adjusting for covariates (Table 1) (aHR, 1.26; 95% CI, 1.07-1.47 P= 0.005). For NRM, male sex was not significantly associated with risk (aHR, 1.31; 95% CI, 0.84-2.04; p=.24). For PFS, male sex was independently associated with an increased risk of progression or death (aHR, 1.31; 95% CI, 1.13-1.51; p<.001). For OS, male sex was associated with an increased mortality (aHR, 1.30; 95% CI, 1.08-1.56; p=.005).

Subgroup analysis, conducted to mitigate the confounding associated with pre- vs post-menopausal impact of hormones on CAR-T outcomes, with age <50 and ≥50 as a surrogate for menopause was conducted for all outcomes. The results are given in Table 2 and Figures S1-S2.

To the best of authors' knowledge, this is the first analysis to examine the impact of sex on CAR-T outcomes stratified by age of 50 as a clinical surrogate for menopausal status. We found that female sex conferred significant PFS and OS advantages in patients with LBCL receiving CD19+CAR T-cell therapy. The PFS and OS difference was significant and more pronounced among patients who were younger than 50 years. The finding was unearthed when an age cutoff of 50 years, clinical surrogate for menopause, was analyzed separately. Among patients older than 50 years of age, while both sexes derived equal relapse reduction and OS benefits with CAR-T therapy, PFS was still significantly inferior among males. The survival benefit, among patients younger than 50 years, was likely driven by significantly lowered relapse risk, as well as in females receiving axicabtagene ciloleucel (axi-cel) when compared to males. In addition, no sex-based difference in subgroup analysis was observed in the tisagenlecleucel (tisa-cel) group and when CAR-T was given in the second line setting.

Currently, there is dearth of literature related to the impact of sex on CAR-T outcomes. In congruence with our results, in a 4-center retrospective sex-based analysis of 214 patients, investigators demonstrated a superior PFS in female CAR-T recipients for LBCL.[9] In a recent real-world analysis of 1,916 adults treated with CD19-directed CAR T-cell therapy, older age did not impact outcomes, the study investigators noted male sex to be significantly associated with inferior survival and an increased relapse risk. [10] Another retrospective analysis of toxicities in 224 older patients with LBCL revealed similar risk for immune cell-associated neurotoxicity syndrome (ICANS) in older patients compared to younger patients. [11] A retrospective, multicenter study in Germany in 356 patients treated with CD19+ CAR-T for LBCL, sex was not associated with NRM. [12] In another retrospective analysis of sex-based differences of complications, investigators analyzed 1,410 hospitalized records of patients treated with axi-cel and showed a higher incidence of fever, acute kidney injury, and CRS in males and higher incidence of pancytopenia in females.[13] The association of female sex and cytopenia was also reported in a contemporary meta-analysis of 2,950 patients treated with CAR T-cell therapy.[14]

Sex-based differences in other immune-based platforms have been more extensively investigated. [7,8,12] In the pivotal Phase-III, RICOVER-60 study, 1,222 elderly patients with CD20-positive LBCL were randomized to be treated with either 6 or 8 cycles of cyclophosphamide, hydroxydaunorubicin, vincristine, and prednisone every 14 days (CHOP-14), with or without the addition of rituximab.[7] Superior outcomes were noted in both males and females in the rituximab arm; however, the benefit was more pronounced in female sex, despite significantly higher serum LDH and lower performance status among females. Males experienced a significantly higher rate of progression in the rituximab-CHOP group compared to females in multivariate analysis. The authors examined the pharmacokinetics of 20 patients, noting a trough level 1/3rd that of females compared to male patients. [7] Subsequently, in the 271 phase-II, SEXIE-R-CHOP-14, higher rituximab dosing in 148 male patients abrogated the adverse prognosis of male sex without increased toxicity, highlighting the need for wide adaptation of sex-based pharmacokinetic and toxicity assessment in the chemo-immunotherapy era of personalized medicine.[8]

Caution is advised in interpreting our findings. In addition to the limitations inherent to retrospective observational studies, our analysis was limited to available variables in the CIBMTR datasets, with the possibility of residual unmeasured confounding. Particularly, pre-CAR T-cell disease burden could not be fully assessed. Additionally, our analysis could not adjust for baseline inflammatory burden, frailty, or disease kinetics prior to CAR-T infusion. The lack of an ability to conduct an inferential analysis to directly examine the mechanistic impact of hormones on CAR-T therapy remains a major limitation.

Nonetheless, the findings are hypothesis generating and indicate that sex, age, sex hormone/menopause status, and socio-cultural sex differences may impact CAR T-cell outcomes calling for rigorous and granular analysis aimed at eliminating potential confounding of our findings and further biochemical assessment of menopausal status. Our findings underpin the need for the inclusion of broad-based sex differences into CAR-T studies**.** Overall, our findings pave the way for further investigation and prospective validation in future studies of sex-specific differences of CAR T-cell therapy.

References

1. Shepherd R, Cheung AS, Pang K, Saffery R, Novakovic B. Sexual dimorphism in innate immunity: the role of sex hormones and epigenetics. Front Immunol. 2021;11:604000.

2. Klein SL, Flanagan KL. Sex differences in immune responses. Nat Rev Immunol. 2016;16(10):626-638.

3. Yang C, Jin J, Yang Y, et al. Androgen receptor-mediated CD8+ T cell stemness programs drive sex differences in antitumor immunity. Immunity. 2022;55(7):1268-1283.e9.

4. Sciarra F, Campolo F, Franceschini E, Carlomagno F, Venneri M. Gender-specific impact of sex hormones on the immune system. Int J Mol Sci. 2023;24(7):6302.

5. Wu Y, Ju Q, Jia K, et al. Correlation between sex and efficacy of immune checkpoint inhibitors (PD -1 and CTLA -4 inhibitors). Int J Cancer. 2018;143(1):45-51.

6. Conforti F, Pala L, Pagan E, et al. Sex-based dimorphism of anticancer immune response and molecular mechanisms of immune evasion. Clin Cancer Res. 2021;27(15):4311-4324.

7. Pfreundschuh M, Murawski N, Zeynalova S, et al. Male sex is associated with lower rituximab trough serum levels and evolves as a significant prognostic factor in elderly patients with DLBCL Treated with R-CHOP: results from 4 prospective trials of the German High-Grade Non-Hodgkin-Lymphoma Study Group (DSHNHL). Blood. 2009;114(22):3715-3715.

8. Pfreundschuh M, Held G, Zeynalova S, et al. Increased rituximab (R) doses and effect on risk of elderly male patients with aggressive CD20+ B-cell lymphomas: Results from the SEXIE-R-CHOP-14 trial of the DSHNHL. J Clin Oncol. 2014;32(15_suppl):8501.

9. Buecklein VL, Rejeski K, Perez A, et al. Impact of sex on clinical outcomes after CD19 CAR T-Cell therapy for large B-Cell lymphoma: response and survival are significantly superior in female compared to male patients. Blood. 2023;142(Supplement 1):3787.

10. Mirza A-S, Hosing C, Foss F, et al. Impact of age on outcomes after CD19 CAR-T Cell therapy for large B-Cell lymphomas. Blood Neoplasia. 2025;3(2):100187.

11. Tun A, Patel R, St-Pierre F, et al. Incidence and risk factors for immune effector cell-associated neurotoxicity syndrome in older patients with relapsed or refractory large B-cell lymphoma: a multicenter study. Blood. 2025;146(Supplement 1):6310.

12. Bethge WA, Martus P, Schmitt M, et al. GLA/DRST real-world outcome analysis of CAR-T cell therapies for large B-cell lymphoma in Germany. Blood. 2022;140(4):349-358.

13. Gadhiya D, Singla N, Singh A, et al. Sex-based differences in complications in patients with diffuse large B cell lymphoma receiving axicabtagene ciloleucel therapy. J Clin Oncol. 2025;43(16_suppl):e19057.

14. Xia Y, Zhang J, Li J, et al. Cytopenias following anti-CD19 chimeric antigen receptor (CAR) T cell therapy: a systematic analysis for contributing factors. Ann Med. 2022;54(1):2950-2964.

Table 1 – Multivariate Analyses

Label	HR (95% CI)	P-value	Outcome
Sex (Male vs Female)	1.30 (1.08-1.56)	0.005	OS[1]
Age >= 65 (vs <50)	1.22 (1.02-1.46)	0.033	OS[1]
KPS >= 90 (vs <90)	0.83 (0.69-1.00)	0.045	OS[1]
Sex (Male vs Female)	1.31 (1.13-1.51)	<0.001	PFS[2]
PR Disease Status (vs CR)	1.23 (1.06-1.43)	0.0068	PFS[2]
Year 2020-2023 (vs pre-2020)	1.27 (1.09-1.49)	0.0023	PFS[2]
Sex (Male vs Female)	1.26 (1.07-1.47)	0.0046	Relapse[3]
Tisa-cel (vs Axi-cel)	1.30 (1.08-1.56)	0.0053	Relapse[3]
Prior Auto HCT	0.80 (0.66-0.98)	0.027	Relapse[3]
Prior Lines >=3 (vs =< 2)	1.27 (1.06-1.53)	0.011	Relapse[3]
Sex (Male vs. Female)	1.31 (0.84-2.04)	0.24	NRM[4]
Age >=65 (vs <50)	2.35 (1.53-3.61)	<0.001	NRM[4]
Year 2020-2023 (vs pre-2020)	1.73 (1.07-2.80)	0.024	NRM[4]

Legend Table 1:

1. Overall survival adjusted for age >=65, Tisa-cel, prior HCT, prior Lines ≥3, Karnofsky Performance Status >=90, resistant disease status, missing disease status, and year of CAR-T 2020 or later. 2. Progression-free survival adjusted for –age 50-64, Tisa-cel, prior HCT, PR disease status, missing disease status, and year of CAR-T 2020 or later. 3. Relapse adjusted for Tisa-cel, prior HCT, Lines ≥3, resistant disease status, and missing disease status, time from diagnosis to CAR-T therapy. 4. Non-relapse mortality adjusted for age greater or equal to 65, PR disease status, and year of CAR T 2020. Auto HCT: autologous hematopoietic cellular transplantation; Axi-cel: axicabtagene ciloleucel; CAR T: chimeric antigen receptor T-cell therapy; CR: complete remission; HR: hazard ratio; 95% CI: 95% confidence interval; KPS: Karnofsky performance status; NRM: non-relapse mortality; OS: overall survival; PFS: progression free survival; PR: partial response; Tisa-cel: tisagenlecleucel;

Table 2 – Subgroup Multivariate Analysis (age <= 50 and age > 50).

Subgroup	Outcome	HR (95% CI)	P-value
Age < 50	Overall Survival[1]	1.86 (1.19-2.92)	0.007
Age < 50	Progression-Free Survival[2]	1.77 (1.28-2.45)	<0.001
Age < 50	Relapse[2]	1.89 (1.35-2.65)	<0.001
Age >= 50	Overall Survival[3]	1.20 (0.98-1.46)	0.076
Age >= 50	Progression-Free Survival[4]	1.18 (1.00-1.40)	0.045
Age >= 50	Relapse[5]	1.12 (0.94-1.34)	0.200
Age >= 50	Non-Relapse Mortality[6]	1.28 (0.80-2.03)	0.300

Table 2 legend:

1. Adjusted for Tisa-cel CAR T, >=3 prior lines of therapy, PR disease status, resistant disease Status, and KPS >=90. 2. Adjusted for Tisa cel CAR T, >=3 prior lines of therapy, PR disease status, and resistant disease status. CAR T product Tisa-cel, prior lines of therapy, partial response disease status, Resistant Disease Status. 3. Adjusted for age >= 65, prior transplant, resistant disease status, missing disease status, KPS>=90, and >1 year from diagnosis to CAR T. 4. Adjusted for age >= 65, Tisa-cel CAR T, prior transplant, PR disease status, resistant disease status, missing disease status, and > 1 year from diagnosis to CAR T. 5. Adjusted for Tisa-cel CAR T product, prior transplant, resistant disease status, missing disease status, and > 1 year from diagnosis to CAR T. 6. Adjusted for age >= 65, PR disease status. CAR T: chimeric antigen receptor T cellular therapy; KPS: Karnofsky performance status; PR: partial response; Tisa-cel: tisagenlecleucel.

Figure 1 title: Sex Effect on CAR T Outcomes – Full Cohort
A) Kaplan-Meier graph of overall survival probability. B) Kaplan-Meier graph of progression-free survival probability. C) Cumulative incidence graph of relapse. D) Cumulative incidence graph of non-relapse mortality.

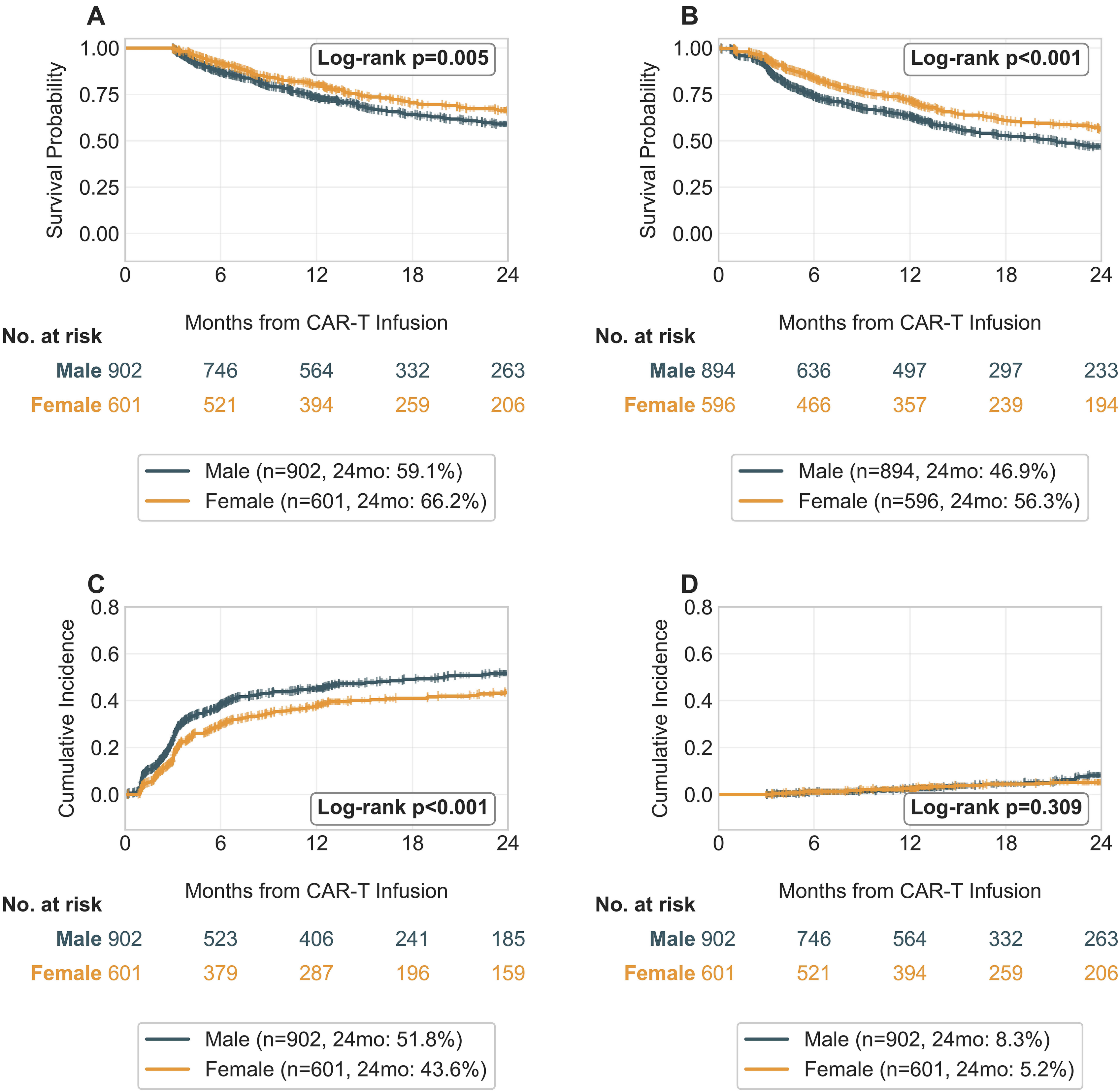

A
Log-rank p=0.005
Survival Probability
1.00
0.75
0.50
0.25
0.00
0
6
12
18
24
Months from CAR-T Infusion
No. at risk
Male 902 746 564 332 263
Female 601 521 394 259 206
Male (n=902, 24mo: 59.1%)
Female (n=601, 24mo: 66.2%)
B
Log-rank p<0.001
Survival Probability
Months from CAR-T Infusion
No. at risk
Male 894 636 497 297 233
Female 596 466 357 239 194
Male (n=894, 24mo: 46.9%)
Female (n=596, 24mo: 56.3%)
C
Cumulative Incidence
0.8
0.6
0.4
0.2
0.0
Log-rank p<0.001
Months from CAR-T Infusion
No. at risk
Male 902 523 406 241 185
Female 601 379 287 196 159
Male (n=902, 24mo: 51.8%)
Female (n=601, 24mo: 43.6%)
D
Cumulative Incidence
Log-rank p=0.309
Months from CAR-T Infusion
No. at risk
Male 902 746 564 332 263
Female 601 521 394 259 206
Male (n=902, 24mo: 8.3%)
Female (n=601, 24mo: 5.2%)

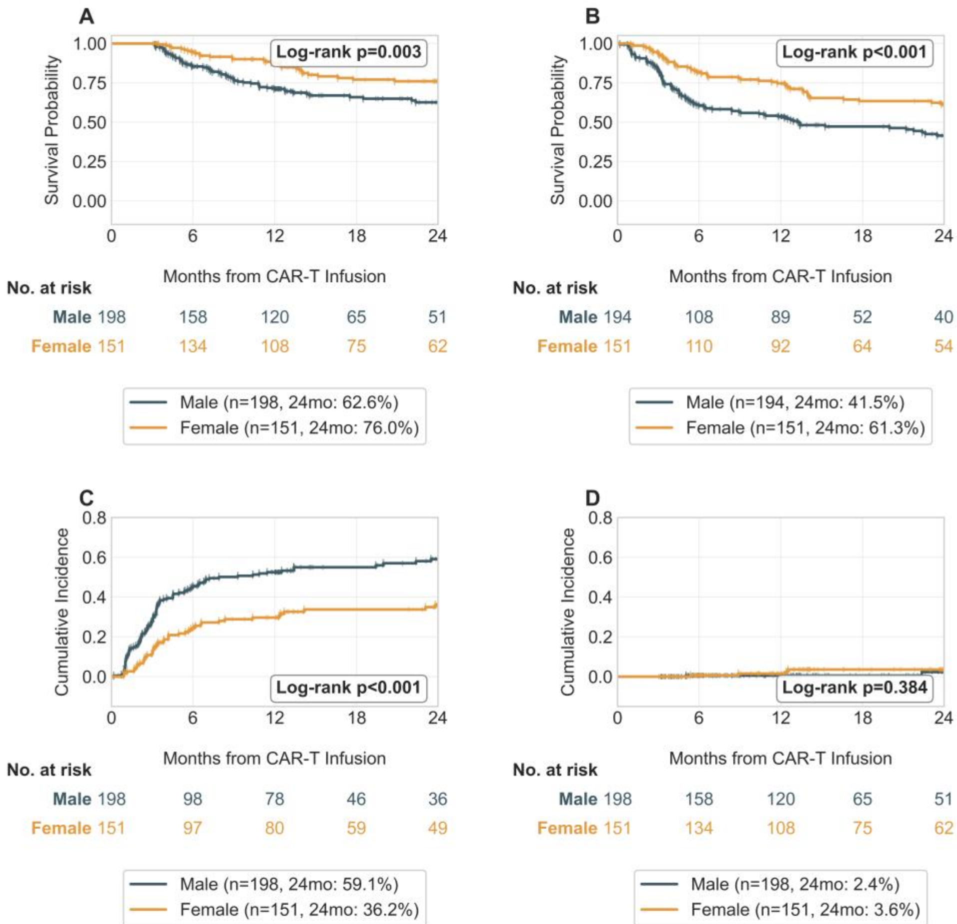
Table S1: Baseline characteristics

Variable	Overall	Male	Female	P-value
N	**1503**	**902**	**601**	
Age, median (IQR)	62.0 (51.5-68.0)	62.0 (52.0-68.0)	61.0 (50.0-68.0)	0.197
Age category, n (%)				0.527
<50	349 (23.2%)	198 (22.0%)	151 (25.1%)	
50-59	351 (23.4%)	211 (23.4%)	140 (23.3%)	
60-69	549 (36.5%)	338 (37.5%)	211 (35.1%)	
>=70	254 (16.9%)	155 (17.2%)	99 (16.5%)	
Disease type, n (%)				0.001
CNS lymphoma	20 (1.3%)	12 (1.3%)	8 (1.3%)	
DLBCL	395 (26.3%)	246 (27.3%)	149 (24.8%)	
DLBCL - myc	122 (8.1%)	65 (7.2%)	57 (9.5%)	
TCHR BLCL	47 (3.1%)	37 (4.1%)	10 (1.7%)	
Transformed FL	799 (53.2%)	487 (54.0%)	312 (51.9%)	
PMBCL	120 (8.0%)	55 (6.1%)	65 (10.8%)	
CAR-T Product, n (%)				0.556
axi-cel	1180 (78.5%)	715 (79.3%)	465 (77.4%)	
tisa-cel	288 (19.2%)	165 (18.3%)	123 (20.5%)	
liso-cel	35 (2.3%)	22 (2.4%)	13 (2.2%)	
KPS, n (%)				0.112
>=90	673 (49.4%)	421 (51.2%)	252 (46.7%)	
<90	689 (50.6%)	401 (48.8%)	288 (53.3%)	
Risk Group, n (%)				0.994
Low Risk	14 (3.6%)	9 (3.7%)	5 (3.5%)	
Intermediate Risk	197 (50.9%)	125 (51.0%)	72 (50.7%)	
High Risk	176 (45.5%)	111 (45.3%)	65 (45.8%)	
Prior Lines of Therapy, n (%)				0.152
1-2	369 (25.5%)	209 (24.1%)	160 (27.6%)	
>=3	1076 (74.5%)	657 (75.9%)	419 (72.4%)	
Prior HCT, n (%)	349 (23.2%)	207 (22.9%)	142 (23.6%)	0.808
HCT-CI Score, n (%)				0.324
0 (Low)	659 (43.8%)	409 (45.3%)	250 (41.6%)	
1-2 (Intermediate)	254 (16.9%)	156 (17.3%)	98 (16.3%)	
>=3 (High)	65 (4.3%)	38 (4.2%)	27 (4.5%)	
Missing	525 (34.9%)	299 (33.1%)	226 (37.6%)	

Time from Dx to CAR-T, n (%)				0.311
0-12mo	690 (48.3%)	423 (49.5%)	267 (46.6%)	
> 12mo	738 (51.7%)	432 (50.5%)	306 (53.4%)	
Year of Treatment, n (%)				0.51
2017-2018	248 (16.5%)	157 (17.4%)	91 (15.1%)	
2019-2020	609 (40.5%)	361 (40.0%)	248 (41.3%)	
2021-2023	646 (43.0%)	384 (42.6%)	262 (43.6%)	
Follow-up time (mo), median (IQR)	13.1 (8.20-24.7)	12.8 (8.1-24.5)	13.7(8.9-24.9)	0.03

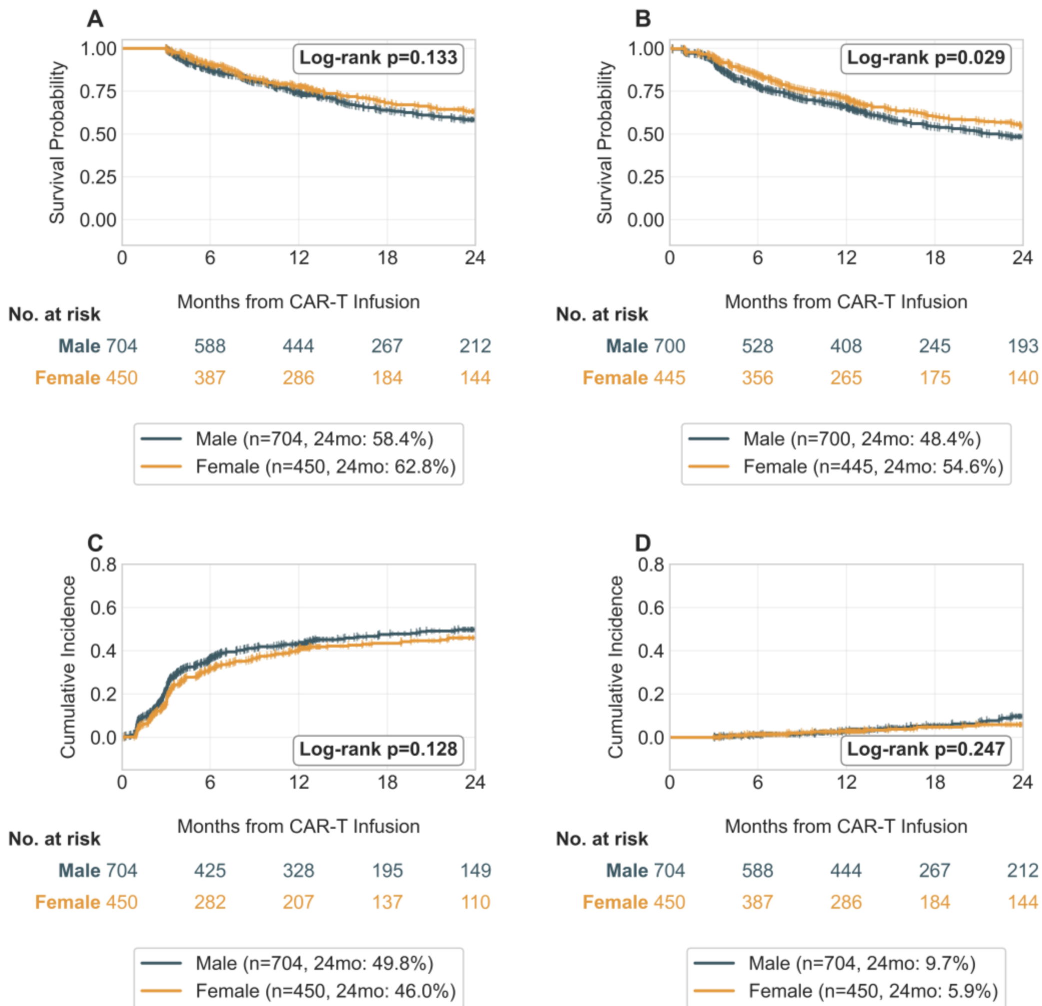
Abbreviations: aNHL, aggressive non-Hodgkin's B-cell lymphoma; CAR-T, chimeric antigen receptor T-cell; CNS, central-nervous system; DLBCL, diffuse large B-cell lymphoma; TCHR BLCL, T-cell histiocyte rich large B-cell lymphoma; DX, diagnosis; HCT, hematopoietic cell transplantation; IQR, interquartile range; mo, months; PMBCL, primary mediastinal B-cell lymphoma

Figure S1: Age < 50



A) Kaplan-Meier graph of overall survival probability. B) Kaplan-Meier graph of progression-free survival probability. C) Cumulative incidence graph of relapse. D) Cumulative incidence graph of non-relapse mortality.

Figure S2: Age >= 50 Subgroup



A) Kaplan-Meier graph of overall survival probability. B) Kaplan-Meier graph of progression-free survival probability. C) Cumulative incidence graph of relapse. D) Cumulative incidence graph of non-relapse