

Geriatric assessment in older patients with a hematologic malignancy: a systematic review

Ellen R.M. Scheepers,¹ Ariel M. Vondeling,² Noortje Thielen,¹ René van der Griend,¹ Reinhard Stauder³ and Marije E. Hamaker²

¹Department of Internal Medicine, Diakonessenhuis Utrecht, Utrecht, the Netherlands; ²Department of Geriatric Medicine, Diakonessenhuis Utrecht, Utrecht, the Netherlands and ³Department of Internal Medicine V (Hematology and Oncology), Innsbruck Medical University, Innsbruck, Austria

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Correspondence: *ELLEN.R.M. SCHEEPERS* - escheepers@diakhuis.nl

Supplementary data

Figure S1. Search results and study selection

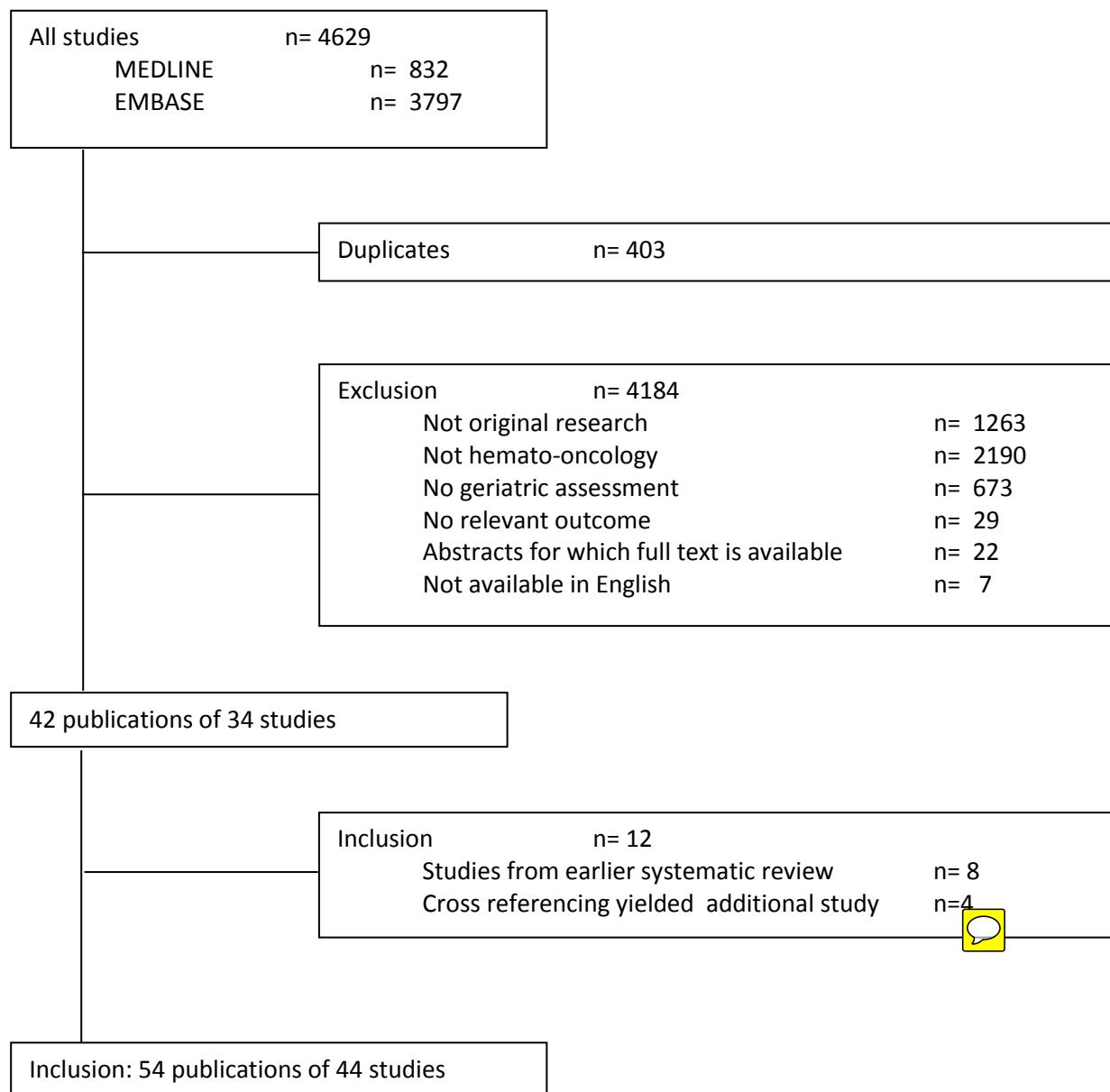


Table S1a. Quality assessment, based on the Newcastle-Ottawa Scale.

Selection	1. Representativeness of the exposed cohort	+ Truly representative of the average older patient with a haematological malignancy + In studies using a geriatric assessment to select patients for inclusion: if no other issues resulting in potential inclusion bias were encountered +/- Selected group of patients with a haematological malignancy and specific treatment - Mixed cohort of younger and older patients where median age is less than 68 years old or more than one third is < 65 years old. ? No description of the derivation of the cohort
	2. Ascertainment of exposure (Geriatric Assessment)	+ Clearly described and using validated assessment tools - Using non-validated assessment tools for > 40% of investigated geriatric domains ? No description
	3. Demonstration that outcomes of interest were not present at start of study	+ Yes - No na Not applicable in studies addressing the prevalence of geriatric impairments or using the geriatric assessment for patients selection or treatment assignment.
Outcome	1. Assessment of outcome (treatment alterations)	+ Clear description of method of assessment ? No or unclear description of method of assessment na Not applicable in studies addressing the prevalence of geriatric impairments or using the geriatric assessment for patients selection or treatment assignment.
	2. Was follow-up long enough for outcome to occur?*	+ Yes - No ? No statement na Not applicable in studies addressing the prevalence of geriatric impairments or using the geriatric assessment for patients selection or treatment assignment.
	3. Adequacy of follow-up of cohorts*	+ Complete follow-up: all subjects accounted for + Subjects lost to follow-up unlikely to introduce bias: loss to follow-up less than 10% - Follow-up rate less than 90% ? No statement na Not applicable in studies addressing the prevalence of geriatric impairments or using the geriatric assessment for patients selection or treatment assignment.

Table S1b. Quality assessment of included studies.

Publication		Selection			Outcome		
Author	Year	Representativeness of exposed cohort	Ascertainment of exposure (GA)	Outcome not present at start of study	Assessment of outcome	Sufficient duration of follow up	Adequacy of follow up
Aaldriks(1)	2015	+	+	+	+	+	+
Aguiar(2)	2020	+	+	na	na	na	na
Buckstein(3)	2016	+	+	+	+	+	+
Corsetti(4)	2011	+/-	+	+	+	+	+
Deschler(5)	2013	+	+	+	+	+	+
Deschler(6)	2018	-	+	+	+	+	+
Derman (7)	2019	+/-	+	na	na	na	na
Dubruille (8)	2015	+	+	+	+	+	+
Dumontier (9)	2019	+	+	+	+	+	+
Engelhardt(10)	2016	-	+	+	+	+	+
Gavriatopoulou(11)	2019	+	+	+	+	+	+
Goede(12)	2016	+	+	+	+	+	+
Hamaker(13–15)	2016	+	+	+	+	+	+
Holmes(16)	2014	-	+	na	na	na	na
Huang (17)	2020	+/-	+	+	+	+	+
Klepin(18–20)	2013	+/-	+	+	+	+	+
Klepin (21)	2020	+/-	+	+	+	+	-
Lin(22–24)	2020	+/-	+	+	+	+	?
Liu (25,26)	2019	+	+	+	+	+	?
Merli (27)	2020	+/-	+	na	na	na	na
Molga (28,29)	2020	+	+	+	+	+	+
Molica(30)	2019	+	+	+	+	+	+
Muffly (31,32)	2014	-	+	+	+	+	+
Naito(33)	2016	+	+	+	+	+	+
Nawas(34)	2019	-	+	+	+	+	+
Okuyama(35)	2015	+	+	na	na	na	na
Ong(36)	2019	+	+	+	+	+	?
Palumbo(37)	2015	+	+	+	+	+	+
Park(38)	2015	+	+	+	+	+	+
Ribi(39)	2017	+	+	+	+	+	-
Rodrigues(40)	2020	+/-	+	na	na	na	na
Rollot-Trad(41)	2008	+	+	+	+	+	+
Rosko(42)	2019	-	+	+	+	+	-
Siegel(43)	2006	+	+	na	na	na	na
Silay(44)	2015	+	+	+	+	+	?
Soubeyran(45)	2011	+	+	+	+	+	+

Spina (46)	2012	+	+	+	+	+	?
Tucci(47)	2009	+	+	+	+	+	+
Tucci(48)	2015	+	+	+	+	+	+
Umit(49)	2018	-	+	+	+	+	?
Velghe(50)	2014	+	+	na	na	na	na
Wildes (51,52)	2019	+	+	na	na	na	na
Winkelmann(53)	2011	-	+	+	+	+	+
Zhong(54)	2017	-	+	+	+	+	+

NA, not applicable.

References

1. Aaldriks A, Giltay E, Nortier J, et al. Prognostic significance of geriatric assessment in combination with laboratory parameters in elderly patients with aggressive non-Hodgkin lymphoma. *Leuk Lymphoma*. 2015;56(4):927–35.
2. Aguiar APN, Mendonça P da S, Ribeiro-Júnior HL, et al. Myelodysplastic syndromes: An analysis of non-hematological prognostic factors and its relationship to age. *J Geriatr Oncol*. 2020;(11):125–7.
3. Buckstein R, Wells RA, Zhu N, et al. Patient-related factors independently impact overall survival in patients with myelodysplastic syndromes: an MDS-CAN prospective study. *Br J Haematol*. 2016;174(1):88–101.
4. Corsetti MT, Salvi F, Perticone S, et al. Hematologic improvement and response in elderly AML/RAEB patients treated with valproic acid and low-dose Ara-C. *Leuk Res*. 2011;35(8):991–7.
5. Deschler B, Ihorst G, Platzbecker U, et al. Parameters detected by geriatric and quality of life assessment in 195 older patients with myelodysplastic syndromes and acute myeloid leukemia are highly predictive for outcome. *Haematologica*. 2013;98(2):208–16.
6. Deschler B, Ihorst G, Schnitzler S, Bertz H, Finke J. Geriatric assessment and quality of life in older patients considered for allogeneic hematopoietic cell transplantation: A prospective risk factor and serial assessment analysis article. *Bone Marrow Transplant*. 2018;53(5):565–75.
7. Derman BA, Kordas K, Ridgeway J, et al. Results from a multidisciplinary clinic guided by geriatric assessment before stem cell transplantation in older adults. *Blood Adv*. 2019;3(22):3488–98.
8. Dubruille S, Libert Y, Roos M, et al. Identification of clinical parameters predictive of one-year survival using two geriatric tools in clinically fit older patients with hematological malignancies: Major impact of cognition. *J Geriatr Oncol*. 2015;6(5):362–9.
9. DuMontier C, Liu MA, Murillo A, et al. Function, Survival, and Care Utilization Among Older Adults With Hematologic Malignancies. *J Am Geriatr Soc*. 2019;(67):889–97.
10. Engelhardt M, Dold SM, Ihorst G, et al. Geriatric assessment in multiple myeloma patients: Validation of the international Myeloma Working Group (IMWG) score and comparison with other common comorbidity scores. *Haematologica*. 2016;101(9):1110–9.
11. Gavriatopoulou M, Fotiou D, Koloventzou U, et al. Vulnerability variables among octogenarian myeloma patients: a single-center analysis of 110 patients. *Leuk Lymphoma*. 2019;60(3):619–28.
12. Goede V, Bahlo J, Chataline V, Eichhorst B, et al. Evaluation of geriatric assessment in patients with chronic lymphocytic leukemia: Results of the CLL9 trial of the German CLL study group. *Leuk Lymphoma*. 2016;57(4):789–96.
13. Hamaker ME, Mitrovic M, Stauder R. The G8 screening tool detects relevant geriatric impairments and predicts survival in elderly patients with a haematological malignancy. *Ann Hematol*. 2014;93(6):1031–40.
14. Hamaker ME, Augschoell J, Stauder R. Clinical judgement and geriatric assessment for predicting prognosis and chemotherapy completion in older patients with a hematological

malignancy. *Leuk Lymphoma*. 2016;57(11):2560–7.

15. Hofer F, Koinig KA, Nagl L, Borjan B, Stauder R. Fatigue at baseline is associated with geriatric impairments and represents an adverse prognostic factor in older patients with a hematological malignancy. *Ann Hematol*. 2018;97(11):2235–43.
16. Holmes H, Des Bordes JKA, Kebriaei P, et al. Optimal screening for geriatric assessment in older allogeneic hematopoietic cell transplantation candidates. *J Geriatr Oncol*. 2014;5(4):422–30.
17. Huang LW, Sheng Y, Andreadis C, et al. Functional Status as Measured by Geriatric Assessment Predicts Inferior Survival in Older Allogeneic Hematopoietic Cell Transplantation Recipients: Functional Status Predicts Post-AlloHCT Survival. *Biol Blood Marrow Transplant*. 2020;(26):189–96.
18. Klepin HD, Geiger AM, Tooze JA, et al. The feasibility of inpatient geriatric assessment for older adults receiving induction chemotherapy for acute myelogenous leukemia. *J Am Geriatr Soc*. 2011;59(10):1837–46.
19. Klepin HD, Geiger AM, Tooze JA, et al. Geriatric assessment predicts survival for older adults receiving induction chemotherapy for acute myelogenous leukemia. *Blood*. 2013;121(21):4287–94.
20. Klepin HD, Tooze JA, Pardee TS, et al. Effect of Intensive Chemotherapy on Physical, Cognitive, and Emotional Health of Older Adults with Acute Myeloid Leukemia. *J Am Geriatr Soc*. 2016;64(10):1988–95.
21. Klepin HD, Ritchie E, Major-Elechi B, et al. Geriatric assessment among older adults receiving intensive therapy for acute myeloid leukemia: Report of CALGB 361006 (Alliance). *J Geriatr Oncol*. 2020;(11):107–13.
22. Lin RJ, Shahrokn A, Dahi PB, et al. Pretransplant comprehensive geriatric assessment in hematopoietic cell transplantation: a single center experience. *Bone Marrow Transplant*. 2018;53:1184–7.
23. Lin RJ, Dahi PB, Shahrokn A, et al. Feasibility of a patient-reported, electronic geriatric assessment tool in hematopoietic cell transplantation—a single institution pilot study. *Leuk Lymphoma*. 2019;60(13):3308–11.
24. Lin RJ, Elko TA, Devlin SM, et al. Impact of geriatric vulnerabilities on allogeneic hematopoietic cell transplantation outcomes in older patients with hematologic malignancies. *Bone Marrow Transplant*. 2020;(55):157–64.
25. Liu MA, DuMontier C, Murillo A, et al. Gait speed, grip strength, and clinical outcomes in older patients with hematologic malignancies. *Blood*. 2019;134(4):374–82.
26. Hshieh TT, Jung WF, Grande LJ, et al. Prevalence of cognitive impairment and association with survival among older patients with hematologic cancers. *JAMA Oncol*. 2018;4(5):686–93.
27. Merli F, Cavallo F, Salvi F, et al. Obinutuzumab and miniCHOP for unfit patients with diffuse large B-cell lymphoma. A phase II study by Fondazione Italiana Linfomi. *J Geriatr Oncol*. 2020;(11):37–40.
28. Molga A, Wall M, Chhetri R, et al. Comprehensive geriatric assessment predicts azacitidine treatment duration and survival in older patients with myelodysplastic syndromes. *J Geriatr*

Oncol. 2020;(11):114–20.

29. Molga A, Wall M, Wee LYA, et al. Screening for deficits using the G8 and VES-13 in older patients with Myelodysplastic syndromes. *J Geriatr Oncol.* 2020;(11):128–30.
30. Molica S, Giannarelli D, Levato L, et al. A simple score based on geriatric assessment predicts survival in elderly newly diagnosed chronic lymphocytic leukemia patients. *Leuk Lymphoma.* 2019;60(3):845–7.
31. Muffly LS, Boulukos M, Swanson K, et al. Pilot Study of Comprehensive Geriatric Assessment (CGA) in Allogeneic Transplant: CGA Captures a High Prevalence of Vulnerabilities in Older Transplant Recipients. *Biol Blood Marrow Transplant.* 2013;19(3):429–34.
32. Muffly LS, Kocherginsky M, Stock W, et al. Geriatric assessment to predict survival in older allogeneic hematopoietic cell transplantation recipients. *Haematologica.* 2014;99(8):1373–9.
33. Naito Y, Sasaki H, Takamatsu Y, Kiyomi F, Tamura K. Retrospective Analysis of Treatment Outcomes and Geriatric Assessment in Elderly Malignant Lymphoma Patients. *J Clin Exp Hematop.* 2016;56(1):43–9.
34. Nawas MT, Andreadis C, Martin TG, et al. Limitation in Patient-Reported Function Is Associated with Inferior Survival in Older Adults Undergoing Autologous Hematopoietic Cell Transplantation. *Biol Blood Marrow Transplant.* 2019;25(6):1218–24.
35. Okuyama T, Sugano K, Iida S, Ishida T, Kusumoto S, Akechi T. Screening performance for frailty among older patients with cancer: A cross-sectional observational study of two approaches. *J Natl Compr Cancer Netw.* 2015;13(12):1525–31.
36. Ong DM, Ashby M, Grigg A, et al. Comprehensive geriatric assessment is useful in an elderly Australian population with diffuse large B-cell lymphoma receiving rituximab-chemotherapy combinations. *Br J Haematol.* 2019;(187):73–81.
37. Palumbo A, Bringhen S, Mateos MV, et al. Geriatric assessment predicts survival and toxicities in elderly myeloma patients: An International Myeloma Working Group report. *Blood.* 2015;125(13):2068–74.
38. Park S, Hong J, Hwang I, et al. Comprehensive geriatric assessment in elderly patients with newly diagnosed aggressive non-Hodgkin lymphoma treated with multi-agent chemotherapy. *J Geriatr Oncol.* 2015;6(6):470–8.
39. Ribi K, Rondeau S, Hitz F, et al. Cancer-specific geriatric assessment and quality of life: important factors in caring for older patients with aggressive B-cell lymphoma. *Support Care Cancer.* 2017;25(9):2833–42.
40. Rodrigues M, de Souza PMR, de Oliveira Muniz Koch L, Hamerschlak N. The use of comprehensive geriatric assessment in older patients before allogeneic hematopoietic stem cell transplantation: A cross-sectional study. *J Geriatr Oncol.* 2020;(11):100–6.
41. Rollot-Trad F, Lahjibi H, Lazarovici C, Bauer C, Saint-Jean O, Gisselbrecht M. Haematological malignancies in older adults: experience in a geriatric acute care department. *Rev Med Interne.* 2008;29:541–9.
42. Rosko AE, Huang Y, Benson DM, et al. Use of a comprehensive frailty assessment to predict morbidity in patients with multiple myeloma undergoing transplant. *J Geriatr Oncol.* 2019;10(3):479–85.

43. Siegel AB, Lachs M, Coleman M, Leonard JP. Lymphoma in elderly patients: Novel functional assessment techniques provide better discrimination among patients than traditional performance status measures. *Clin Lymphoma Myeloma*. 2006;7(1):65–9.
44. Silay K, Akinci S, Silay YS, et al. Hospitalization risk according to geriatric assessment and laboratory parameters in elderly hematologic cancer patients. *Asian Pac J Cancer Prev*. 2015;16(2):1783–6.
45. Soubeyran P, Khaled H, MacKenzie M, et al. Diffuse large B-cell and peripheral T-cell non-Hodgkin's lymphoma in the frail elderly. A phase II EORTC trial with a progressive and cautious treatment emphasizing geriatric assessment. *J Geriatr Oncol*. 2011;2(1):36–44.
46. Spina M, Balzarotti M, Uziel L, et al. Modulated Chemotherapy According to Modified Comprehensive Geriatric Assessment in 100 Consecutive Elderly Patients with Diffuse Large B-Cell Lymphoma. *Oncologist*. 2012;17(6):838–46.
47. Tucci A, Ferrari S, Bottelli C, Borlenghi E, Drera M, Rossi G. A comprehensive geriatric assessment is more effective than clinical judgment to identify elderly diffuse large cell lymphoma patients who benefit from aggressive therapy. *Cancer*. 2009;115(19):4547–53.
48. Tucci A, Martelli M, Rigacci L, et al. Comprehensive geriatric assessment is an essential tool to support treatment decisions in elderly patients with diffuse large B-cell lymphoma: A prospective multicenter evaluation in 173 patients by the Lymphoma Italian Foundation (FIL). *Leuk Lymphoma*. 2015;56(4):921–6.
49. Umit EG, Baysal M, Demir AM. Frailty in patients with acute myeloid leukaemia, conceptual misapprehension of chronological age. *Eur J Cancer Care (Engl)*. 2018;27(2):1–8.
50. Velghe A, Petrovic M, De Buyser S, Demuynck R, Noens L. Validation of the G8 screening tool in older patients with aggressive haematological malignancies. *Eur J Oncol Nurs*. 2014;18(6):645–8.
51. Wildes TM, Tuchman SA, Klepin HD, et al. Geriatric Assessment in Older Adults with Multiple Myeloma. *J Am Geriatr Soc*. 2019;67(5):987–91.
52. Isaacs A, Fiala M, Tuchman S, Wildes TM. A comparison of three different approaches to defining frailty in older patients with multiple myeloma. *J Geriatr Oncol*. 2019.
53. Winkelmann N, Petersen I, Kiehntopf M, Fricke HJ, Hochhaus A, Wedding U. Results of comprehensive geriatric assessment effect survival in patients with malignant lymphoma. *J Cancer Res Clin Oncol*. 2011;137(4):733–8.
54. Zhong YP, Zhang YZ, Liao AJ, Li SX, Tian C, Lu J. Geriatric assessment to predict survival and risk of serious adverse events in elderly newly diagnosed multiple myeloma patients: A multicenter study in China. *Chin Med J (Engl)*. 2017;130(2):130–4.