

Prevalence of Depression in Metastatic Spine Disease Patients Undergoing Surgical Intervention

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Short Title: Perioperative Depression in MSD

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ABSTRACT

Study Design: Retrospective cohort study

Objective: To evaluate rates of self-reported depression in MSD patients undergoing surgery overall and at each timepoint in the perioperative period, and also to explore associations with sociodemographic factors.

Summary of Background Data: Depression is a common comorbidity in patients with metastatic spine disease (MSD) undergoing surgery. Understanding its prevalence is vital, as it impacts clinical outcomes, recovery, and overall well-being.

Methods: Electronic medical records were retrospectively analyzed for MSD patients undergoing surgery at a large academic center between 2015 and 2023. Patients under 18 years old and those without National Comprehensive Cancer Network (NCCN) Distress Thermometer Problem List data were excluded. The overall prevalence of depression was identified as the proportion of patients that reported depression at any timepoint in their perioperative period. Prevalence was also evaluated at baseline (defined as the closest recorded timepoint prior to surgery within 30 days preoperative), 30 days post-op, and at 90 days post-op. The rate of depression was compared across sociodemographic subgroups of race, sex, age, marital status and insurance type.

Results: Of 342 patients, 33.3% reported depression at least once during their perioperative period. At baseline, 17.3% reported depression, at 30 days, 17.3%, and at 90 days, 14.1%. There was no significant difference in depression rates across timepoints or across sociodemographic subgroup.

Conclusion: Depression affects a substantial portion of MSD patients and remains consistent across the perioperative course. Its prevalence appears independent of sociodemographic factors, highlighting the importance of routine, universal psychological assessment and support for this vulnerable population.

Key Points:

- A third of metastatic spine disease patients self-reported depression at least once in the perioperative period.
- There were no significant differences when considering rates at preoperative, 30-day and 90-day timepoints.
- There were no significant differences when considering rates of depression by sociodemographic subgroups of age, sex, race, marital/partnered status and insurance type.

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INTRODUCTION

In cancer patients, major depressive disorder has prevalence rates noted to reach up to five times higher than the general population, ranging from 8-24% likely due to the burden these patients face from diagnoses, treatments and disease symptoms.^{1,2} It is seen that even subclinical levels of depression can worsen outcomes and lead to increased mortality through both non-adherence to treatment and psychosocial stressor effects on the body, among other factors.³ Screening for depression in the oncology population is often performed via self-reported tools given to patients in both outpatient and inpatient settings.⁴ In comparison to clinician diagnoses, these tools may better evaluate prevalence of depressive symptoms in those that are experiencing a sub-diagnostic threshold or have not been formally assessed by a psychiatrist. The guidelines from the American Society of Clinical Oncology recommend screening for anxiety and depression at, “initial diagnosis, regular intervals during treatment, 3, 6, and 12 months after treatment, at diagnosis of recurrence or progression, when approaching death and during times of personal transition or reappraisal such as family crisis.”^{5,6} However, in routine clinical practice, provider or institution-specific decisions lead to differences in screening rates, with a large cancer center study displaying the first screen for depression delayed until a year after diagnosis.⁷

Operative spine patients are noted to have depression rates around 30% which can reach up to 46% in older patients and are noted to have higher depression prevalence than those without chronic back pain and those not requiring surgery.⁸⁻¹³ Although there is a higher burden of depression in operative spine patients and oncology patients, few studies have formally assessed rates of depression in metastatic spine disease (MSD) patients undergoing surgical intervention. Furthermore, the lack of literature reporting the impact of surgical course on self-

depression in MSD patients is largely unexplored, as highlighted by a recent systematic review analyzing the screening tools and prevalence of depression in surgical oncology patients.¹⁴

The study aims to evaluate rates of self-reported depression in MSD patients undergoing surgery overall and at each timepoint in the perioperative period and to explore associations with sociodemographic factors using a common patient-reported tool in oncology, the National Comprehensive Cancer Network (NCCN) Distress Thermometer Problem List.

METHODS

We conducted a retrospective study of adult patients with metastatic spine disease who underwent surgical intervention. It was categorized as exempt by our institution's Institutional Review Board (IRB).

Patient Sample

Patients were identified from the pool of those treated at our institution's Center for Brain and Spine Metastases. We reviewed all patients with a diagnosis of metastatic spine disease who underwent surgical intervention for their spine metastases between January 2015 and October 2023. Data were accessed and collected December 2023. Pediatric patients (<18 years old) and those that did not answer the depression section of the Distress Thermometer (DT) Problem List were excluded.

Patient Variables

Patient demographic and clinical data were extracted from the electronic medical record.

Demographic variables included patient age at surgery, age at first diagnosis of spine metastasis, sex, race, marital status, and insurance status. Clinical variables included date of surgery, admission date, discharge date, procedure and procedure date.

Depression Data

Depression data from the NCCN Distress Thermometer Problem List, as well as the date of completion of the Distress Thermometer were extracted for all eligible patients. Depression data completed within 30 days before surgery and 12 months after surgery were included. Patients who had subsequent surgeries within these timeframes were excluded from the analysis. For those surveyed at multiple timepoints, overall prevalence was considered as measure of patient-identified depression at any point in their perioperative period, whereas timepoint analysis only included data within the specified time intervals.

Depression Prevalence in Patients at Any Timepoint

Each patient who completed the depression portion of the NCCN Distress Thermometer Problem List was analyzed for every instance they were surveyed. Patients were classified as having depression if yes was recorded at any time point. Patients that never reported depression were counted in the “no” cohort.

Depression Prevalence at Baseline, 30-day and 90-day timepoints

The preoperative depression data point closest to the surgery date was designated the baseline score, of which all were within 30 days preoperative. Postoperative depression data were

recorded for 30 days and 90 days, which included data specified as 3 weeks \pm 1 week and 3 months \pm 2 weeks, respectively. The number of patients who answered “yes” to depression as a concern on the NCCN Distress Thermometer Problem List were recorded at each time point, as a count and as a percentage of the total patients who answered to the depression portion on the NCCN Distress Thermometer Problem List, specifically.

Presence of Depression and its Sociodemographic Associations

Sociodemographic variables including race, sex, age, marital status and insurance type were extracted for each timepoint, including baseline, 30-days and 90-days. The proportion of each demographic subgroup in the “yes” or “no” depression cohorts was recorded and were compared to evaluate the associations between sociodemographic factors and the presence of depression. The subgroups used to dichotomize sociodemographic factors were white/nonwhite, female versus male, married versus not married or partnered, less than 65 years old versus greater than 65 years old, and public versus private insurance.

Statistical Analysis

Patient characteristics were summarized with N (%) for categorical variables and mean (SD) for continuous variables. The association between sociodemographic subgroups and the presence of depression, as well as an analysis of these groups across timepoints, were assessed using chi-square tests. McNemar’s test was used to compare baseline to 30 days postoperatively in the cohort that was observed longitudinally. All statistical analyses were conducted using R Studio

Version 4.2.2 (The R Foundation for Statistical Computing, Vienna, Austria), and a significance level of $P < 0.05$ was applied for all tests. No adjustments were made for multiple comparisons.

Results

Overall Cohort Demographics

A total of 342 patients were included in our study of which the majority of patients were white (67.3%), male (51.8%), married or partnered (65.2%), and had private insurance (61.1%). The average age of patients was 61 years old \pm 11.8 years (Table 1).

Depression Prevalence at Baseline, 30-day and 90-day timepoints

Our study found that a third (33.3%) of metastatic spine disease patients who completed the depression portion of the NCCN Distress Thermometer Problem List reported depression at least once in the designated perioperative period. The rate of depression at the baseline timepoint, defined as within 30 days of surgery, was 17.4%. This did not differ significantly when compared to the rate at 30 days and 90 days, which were 17.3% and 14.1%, respectively (Figure 1). A portion of the cohort, 91 patients, had responses at both baseline and at 30-days postop. At baseline, 18 of these patients (19.8%) reported depression. This did not differ significantly from this cohort's depression rate at 30 days postop, which was prevalent in 15 patients (16.5%) ($p=0.61$) (Supplemental Table 1, Supplemental Digital Content 1, <http://links.lww.com/BRS/C893>, Supplemental Figure 1, Supplemental Digital Content 2, <http://links.lww.com/BRS/C894>).

Presence of Depression and its Sociodemographic Associations

When comparing rates of depression in each sociodemographic subgroup, there were no significant differences between white versus nonwhite patients, females versus males, married/partnered patients versus not married/partnered patients, patients over 65 years old and less than or equal to 65 years old and patients with private insurance and patients with public insurance at baseline, 30-day or 90-day timepoints. Although nonsignificant, not married/partnered patients had higher rates of depression than married/partnered patients at each timepoint recorded. Married/partnered patients had rates of 16.2%, 16.7% and 12.9% at baseline, 30-day and 90-day timepoints, respectively, compared to the not married/partnered patients who had rates of 20.0%, 19.7% and 16.3%, respectively. The rates of depression for each subgroup at the baseline, 30- day and 90-day timepoints are shown (Table 2a-c, Supplemental Table 2a-c, Supplemental Digital Content 3, <http://links.lww.com/BRS/C895>, Supplemental Figure 2, Supplemental Digital Content 2, <http://links.lww.com/BRS/C894>.)

Discussion

Our study found that a third of surgical patients with metastatic spine disease (MSD) at our institution's Center for Brain and Spine Metastasis reported depression in their perioperative period. There were no significant differences in rates of depression when comparing across perioperative timepoints or when comparing rates across sociodemographic subgroups. This study is the first to elucidate self-reported depression rates in metastatic spine disease patients in their perioperative period, expanding the mental health literature in this at-risk population.

Overall Depression Prevalence

Depression is present in cancer patients at a rate of anywhere from 8-24%, with some studies placing the average around 17%.^{2,15} A systematic review analyzing perioperative depression prevalence in cancer patients showed that a fourth of these patients self-reported depression.¹⁴ Our findings of a third of MSD surgical patients exceeds that of cancer patients and even surgical cancer patients, as detailed. This may be due to the innate severity of metastatic disease compared to other primary cancers, given that more advanced disease has been associated with increased depression risk.¹⁶ Furthermore, it has been established in the literature that there is a link between cancer-related symptom burden and depression risk.¹⁷ These findings thus consider the particularly debilitating nature of vertebral metastases, which can manifest with burdensome symptoms such as local back or neck pain, weakness, sensory loss or even sphincter dysfunction.¹⁸ The only other studies to date to examine depression in metastatic spine disease patients are that of Yeung et al., which reported a rate of depression at 15% and Li et al., which examined self-reported depression as a risk factor to quality of life, noting a prevalence rate of 29.3%.^{19,20} Notably, these studies lacked examination of patients in the perioperative period, which can introduce further risk for depression.²¹⁻²³ Yeung et al., also recorded patients with a formal diagnosis of depression, while our study measured self-reported depression. Our method may detect better “subthreshold” depression for which the literature has shown can be equally detrimental to outcomes.³ These components likely contribute to our identification of a higher rate than previously found.

Depression Prevalence by Timepoint

Our study found no significant difference in depression prevalence when comparing preoperative, 30-day and 90-day timepoints. This counters the findings of the systematic review

of surgical cancer patients where lower rates were seen at 90-days and highest prevalence was at the preoperative and 30-day postoperative timepoints.¹⁴ Other studies suggest that in patients undergoing general surgery, depression rates increased from discharge to 6 months when analyzing the postoperative period.²⁴ This inconsistency suggests that other factors in the perioperative period may influence prevalence beyond timing relative to surgery. The literature suggests that factors such as unsuccessful recovery, advanced cancer stages, socioeconomic status, cancer-related symptom burden, pain, maladaptive coping, higher risk behavior and disease awareness have all been shown to be predictors of depression in cancer patients, regardless of the presence of surgical intervention.^{16,17,24}

Of the 91 patients who responded at both baseline and 30 days postoperatively, we did not observe a significant difference in depression rates. This suggests that patients who approach surgery with a diagnosis of depression will likely maintain this diagnosis throughout the perioperative period. However, it also indicates that patients will likely not acquire a new diagnosis of depression in the perioperative period. Overall, this longitudinal analysis indicates that surgical intervention may not be the driving factor in depression rates among patients with MSD, but rather it may be their overall disease process that is influencing depression rates in this population. Furthermore, the relative consistency in pre and postoperative depression rates in this small cohort emphasizes the importance of regular, continued screening throughout a patient's oncologic care, not just during the perioperative period.

Sociodemographic Associations

When evaluating depression rates by sociodemographic subgroup, prevalence did not vary by race, marital status, gender, age, or insurance type. In contrast, the greater mental health

literature shows that those who are unmarried/unpartnered, of lower socioeconomic status, are of younger age, are female, or who have chronic conditions tend to have higher rates of depression.²⁵⁻²⁷ However, similar to our study, Yeung et al., found that sociodemographic factors such as age, sex, and race did not bear any significant correlations with higher rates of depression or anxiety in the MSD population.¹⁹ This data suggests that depression is an inherent risk for any patient, regardless of sociodemographic profile. It also considers that other factors may be responsible for differential risk, like social support, which has been shown to correlate with quality of life in spine surgery patients. Throughout the timepoints, although nonsignificant, there were higher rates of depression among the unmarried/unpartnered subgroup as compared to the married/partnered subgroup, which is consistent with the literature.²⁵

Implications for Depression Screening and Interventions in MSD

The Patient Health Questionnaire-9 (PHQ9) and the NCCN Distress Thermometer are common screening tools used to detect depression in cancer patients, however the rates of depression screening in the MSD population specifically are exceedingly low.¹⁴ The high rates of depression demonstrated in our study suggest a role for increased depression screening in all MSD patients undergoing surgery, but especially in those who have a prior history of depression. Furthermore, in cancer patients generally, depression is consistently undertreated, with studies showing that up to 85% of patients reporting depressive or anxiety symptoms do not receive treatment.²⁸⁻³⁰

Therefore, in addition to improved screening, following up positive screening tests with interventions such as referrals for psychosocial therapy or psychiatric care will be necessary to reduce depression rates in this high risk population.

Limitations

The limitations of this study include those inherent to a retrospective study design, which includes lack of control of confounding variables. Additionally, the small sample size may have limited the ability to discern differences across timepoints or sociodemographic profiles.

Although we were able to observe a small cohort of patients longitudinally with both baseline and 30-day postoperative timepoints, this also was limited by sample size. Moreover, we only calculated proportions using the total amount of patients who responded to the depression portion of the NCCN Distress Thermometer Problem List which may introduce selection bias and overestimate or underestimate true prevalence considering the proportion of patients that are unaccounted for due to lack of response. This study also analyzed sociodemographic associations with delineated subgroups, which may not appreciate depression risk introduced by intersectionality. Lastly, we reported on observed depression rates of a population at a large academic center, which may not be representative of the greater metastatic spine disease surgical patient population.

Despite these limitations, this study represents the first to quantify the prevalence of self-reported depression in metastatic spine disease surgical patients throughout their perioperative period.

Conclusion

Our study revealed that a third of MSD patients report depression as a concern in their perioperative period, with rates remaining consistent across the perioperative course. Its prevalence appears independent of sociodemographic factors, including race, age, sex, marital status, and insurance status. This motivates universal depression screening in the perioperative

period and, if indicated, implementation of psychological interventions, with appreciation for depression as a prominent concern that may otherwise lead to adverse outcomes. Future prospective studies may elucidate the presence of any true sociodemographic associations or predictors of depression to further delineate if there are risk factors in particular patients that can be accounted for and supported in perioperative care.

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References

1. Krishnasamy M, Hassan H, Jewell C, Moravski I, Lewin T. Perspectives on Emotional Care: A Qualitative Study with Cancer Patients, Carers, and Health Professionals. *Healthcare (Basel)*. Feb 4 2023;11(4)doi:10.3390/healthcare11040452
2. Hartung TJ, Brähler E, Faller H, et al. The risk of being depressed is significantly higher in cancer patients than in the general population: Prevalence and severity of depressive symptoms across major cancer types. *Eur J Cancer*. Feb 2017;72:46-53. doi:10.1016/j.ejca.2016.11.017
3. Bortolato B, Hyphantis TN, Valpione S, et al. Depression in cancer: The many biobehavioral pathways driving tumor progression. *Cancer Treat Rev*. Jan 2017;52:58-70. doi:10.1016/j.ctrv.2016.11.004
4. Larkin DR. Routine Depression Screenings for Advanced Cancer Patients: Reducing Disparities, Identifying Depression, and Improving Quality of Life. *J Hosp Palliat Nurs*. Feb 2020;22(1):12-16. doi:10.1097/njh.0000000000000618
5. Andersen BL, DeRubeis RJ, Berman BS, et al. Screening, Assessment, and Care of Anxiety and Depressive Symptoms in Adults With Cancer: An American Society of Clinical Oncology Guideline Adaptation. *Journal of Clinical Oncology*. 2014;32(15):1605-1619. doi:10.1200/jco.2013.52.4611
6. Howell D, Currie, S., Mayo, S., Jones, G., Boyle, M., Hack, T., Green, E., Hoffman,, L. S, J., Collacutt, V., McLeod, D., and Digout, C. A Pan-Canadian Clinical Practice Guideline: Assessment of Psychosocial Health Care Needs of the Adult Cancer Patient. *Toronto: Canadian Partnership Against Cancer (Cancer Journey Action Group) and the Canadian Association of Psychosocial Oncology*. 2009;
7. Walker J, Hansen CH, Martin P, et al. Prevalence, associations, and adequacy of treatment of major depression in patients with cancer: a cross-sectional analysis of routinely collected clinical data. *The Lancet Psychiatry*. 2014/10/01/ 2014;1(5):343-350. doi:https://doi.org/10.1016/S2215-0366(14)70313-X
8. Chen A, An E, Yan E, et al. Prevalence of preoperative depression and adverse outcomes in older patients undergoing elective surgery: A systematic review and meta-analysis. *J Clin Anesth*. Oct 2024;97:111532. doi:10.1016/j.jclinane.2024.111532
9. Siempis T, Prassas A, Alexiou GA, Voulgaris S, Tsitsopoulos PP. A systematic review on the prevalence of preoperative and postoperative depression in lumbar fusion. *J Clin Neurosci*. Oct 2022;104:91-95. doi:10.1016/j.jocn.2022.08.001
10. Arts MP, Kols NI, Onderwater SM, Peul WC. Clinical outcome of instrumented fusion for the treatment of failed back surgery syndrome: a case series of 100 patients. *Acta Neurochir (Wien)*. Jul 2012;154(7):1213-7. doi:10.1007/s00701-012-1380-7
11. Falavigna A, Righesso O, Teles AR, et al. Depression Subscale of the Hospital Anxiety and Depression Scale applied preoperatively in spinal surgery. Article. *Arquivos de Neuro-Psiquiatria*. 2012;70(5):352-356. doi:10.1590/S0004-282X2012000500009
12. Chen Z, Luo R, Yang Y, Xiang Z. The prevalence of depression in degenerative spine disease patients: A systematic review and meta-analysis. *Eur Spine J*. Dec 2021;30(12):3417-3427. doi:10.1007/s00586-021-06977-z

13. Cole JS, Patchell RA. Metastatic epidural spinal cord compression. *Lancet Neurol*. May 2008;7(5):459-66. doi:10.1016/s1474-4422(08)70089-9
14. O'Callaghan E AK, Rivera N, Rowe D, Blasingame M, Reitz K, Dalton T, Crowell KA, Herndon J, Kaplan S, Applegate K, Garcia M, De la Garza Ramos R, Shin J, Erickson M, Goodwin CR. Perioperative Depressive Symptoms in Surgical Cancer Patients: A Systematic Review and Meta-Analysis. 2025.
15. Krebber AM, Buffart LM, Kleijn G, et al. Prevalence of depression in cancer patients: a meta-analysis of diagnostic interviews and self-report instruments. *Psychooncology*. Feb 2014;23(2):121-30. doi:10.1002/pon.3409
16. Shankar A, Dracham C, Ghoshal S, Grover S. Prevalence of depression and anxiety disorder in cancer patients: An institutional experience. *Indian J Cancer*. Jul-Sep 2016;53(3):432-434. doi:10.4103/0019-509x.200651
17. Riedl D, Schüßler G. Factors associated with and risk factors for depression in cancer patients - A systematic literature review. *Transl Oncol*. Feb 2022;16:101328. doi:10.1016/j.tranon.2021.101328
18. Perrin RG, Laxton AW. Metastatic spine disease: epidemiology, pathophysiology, and evaluation of patients. *Neurosurg Clin N Am*. Oct 2004;15(4):365-73. doi:10.1016/j.nec.2004.04.018
19. Yeung C, Heard J, Lee Y, et al. The prevalence of depression and anxiety in patients with metastatic disease to the spine. *J Craniovertebr Junction Spine*. Jul-Sep 2024;15(3):308-314. doi:10.4103/jcvjs.jcvjs_23_24
20. Li Y, Long Z, Wang X, et al. A novel nomogram to stratify quality of life among advanced cancer patients with spinal metastatic disease after examining demographics, dietary habits, therapeutic interventions, and mental health status. *BMC Cancer*. 2022/11/23 2022;22(1):1205. doi:10.1186/s12885-022-10294-z
21. Grassi L, Caruso R, Riba MB, et al. Anxiety and depression in adult cancer patients: ESMO Clinical Practice Guideline. *ESMO Open*. Apr 2023;8(2):101155. doi:10.1016/j.esmoop.2023.101155
22. Fornetti J, Welm AL, Stewart SA. Understanding the Bone in Cancer Metastasis. *J Bone Miner Res*. Dec 2018;33(12):2099-2113. doi:10.1002/jbmr.3618
23. Yin JJ, Pollock CB, Kelly K. Mechanisms of cancer metastasis to the bone. *Cell Res*. Jan 2005;15(1):57-62. doi:10.1038/sj.cr.7290266
24. Sveinsdóttir H, Zoëga S, Ingadóttir B, Blöndal K. Symptoms of anxiety and depression in surgical patients at the hospital, 6 weeks and 6 months postsurgery: A questionnaire study. *Nurs Open*. Jan 2021;8(1):210-223. doi:10.1002/nop2.620
25. Alfaqeeh M, Alfian SD, Abdulah R. Sociodemographic Factors, Health-Risk Behaviors, and Chronic Conditions Are Associated with a High Prevalence of Depressive Symptoms: Findings from the Indonesian Family Life Survey-5. *Behavioral Medicine*. 1-11. doi:10.1080/08964289.2024.2375205
26. Domènech-Abella J, Mundó J, Leonardi M, et al. The association between socioeconomic status and depression among older adults in Finland, Poland and Spain: A comparative cross-sectional study of distinct measures and pathways. *Journal of Affective Disorders*. 2018/12/01/ 2018;241:311-318. doi:https://doi.org/10.1016/j.jad.2018.08.077
27. Lim E, Davis J, Chen JJ. The Association of Race/Ethnicity, Dietary Intake, and Physical Activity with Depression. *Journal of Racial and Ethnic Health Disparities*. 2021/04/01 2021;8(2):315-331. doi:10.1007/s40615-020-00784-w

28. Naser AY, Hameed AN, Mustafa N, et al. Depression and Anxiety in Patients With Cancer: A Cross-Sectional Study. *Front Psychol.* 2021;12:585534. doi:10.3389/fpsyg.2021.585534
29. Hallet J, Davis LE, Isenberg-Grzeda E, et al. Gaps in the Management of Depression Symptoms Following Cancer Diagnosis: A Population-Based Analysis of Prospective Patient-Reported Outcomes. *Oncologist.* Jul 2020;25(7):e1098-e1108. doi:10.1634/theoncologist.2019-0709
30. Walker J, Hansen CH, Martin P, et al. Prevalence, associations, and adequacy of treatment of major depression in patients with cancer: a cross-sectional analysis of routinely collected clinical data. *Lancet Psychiatry.* Oct 2014;1(5):343-50. doi:10.1016/s2215-0366(14)70313-x

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Figure 1. Depression Prevalence Over Perioperative Timepoints

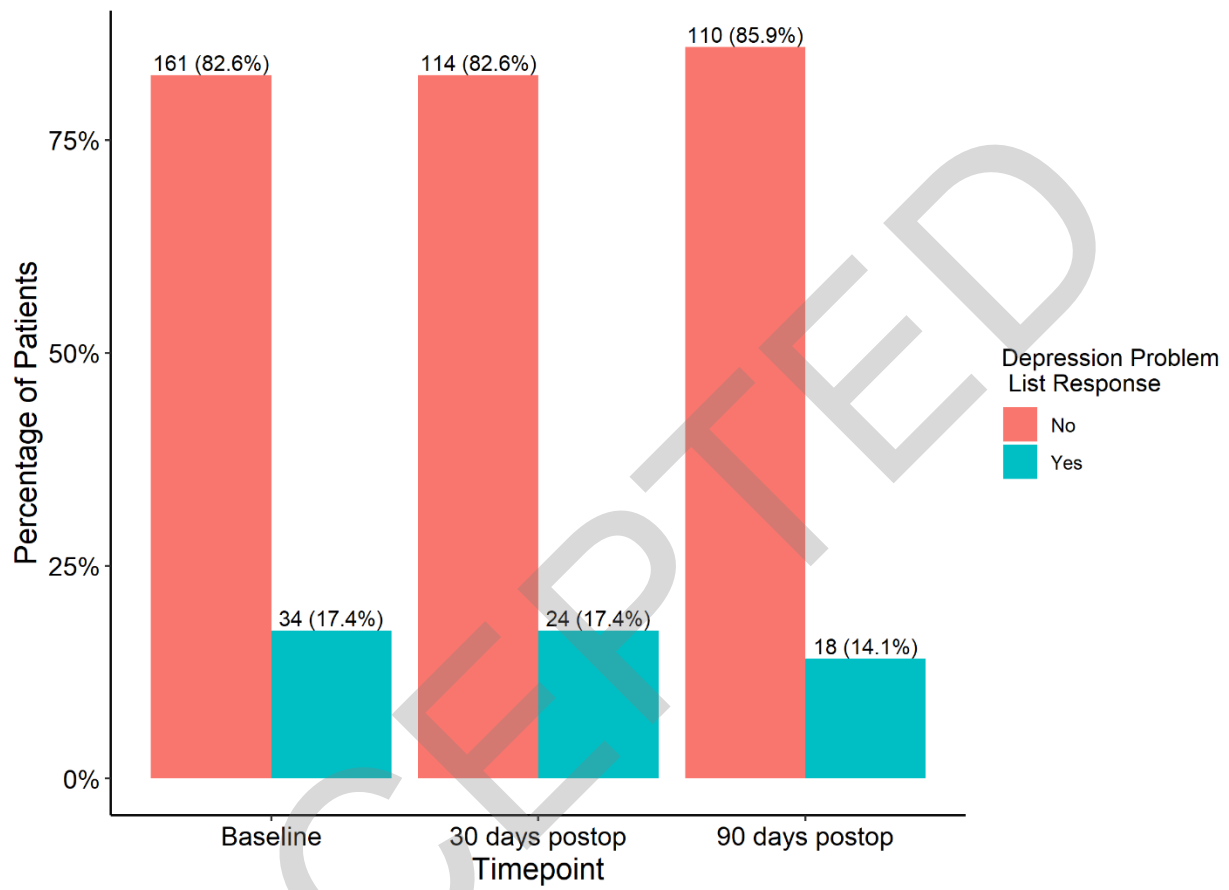


Table 1. Demographics of Patients with Reported Depression(yes/no)

	All patients	No	Yes
	<i>N=342</i>	<i>N=228</i>	<i>N=114</i>
Race			
Non-white	99 (28.9%)	75 (32.9%)	24 (21.1%)
White	230 (67.3%)	143 (62.7%)	87 (76.3%)
Not reported	13 (3.80%)	10 (4.39%)	3 (2.63%)
Sex			
Female	164 (48.0%)	111 (48.7%)	53 (46.5%)
Male	177 (51.8%)	116 (50.9%)	61 (53.5%)
Not reported	1 (0.29%)	1 (0.44%)	0 (0.00%)
Marital Status			
Married/Partnered	223 (65.2%)	146 (64.0%)	77 (67.5%)
Not married/Not partnered	116 (33.9%)	79 (34.6%)	37 (32.5%)
Not reported	3 (0.88%)	3 (1.32%)	0 (0.00%)
Age at first spine mets dx			
Median [IQR]	63.0 [53.0;70.0]	63.0 [52.0;71.0]	62.0 [55.0;69.0]
Mean (SD)	61.1 (11.8)	60.9 (12.2)	61.4 (11.0)
Age at first spine mets dx category			
<65	191 (55.8%)	122 (53.5%)	69 (60.5%)
≥65	150 (43.9%)	105 (46.1%)	45 (39.5%)
Not reported	1 (0.29%)	1 (0.44%)	0 (0.00%)
Insurance Status			
Private	209 (61.1%)	135 (59.2%)	74 (64.9%)
Public	132 (38.6%)	92 (40.4%)	40 (35.1%)
Not reported	1 (0.29%)	1 (0.44%)	0 (0.00%)

Table 2a. Differences in Depression Rates Between Sociodemographic Subgroups at Baseline

	No	Yes	P Value
	<i>N=161</i>	<i>N=34</i>	
Race			0.732
Non-white	38 (23.6%)	9 (26.5%)	
White	116 (72.0%)	23 (67.6%)	
Not reported	7 (4.35%)	2 (5.88%)	
Sex			0.125
Female	83 (51.6%)	12 (35.3%)	
Male	78 (48.4%)	22 (64.7%)	
Marital Status			0.626
Married/Partnered	109 (67.7%)	21 (61.8%)	
Not married/Not partnered	51 (31.7%)	13 (38.2%)	
Not reported	1 (0.62%)	0 (0.00%)	
Age at first spine mets dx			0.819
Median [IQR]	63.0	62.5	
Mean (SD)	[52.0;71.0] 61.0 (12.3)	[57.2;68.8] 62.2 (11.6)	
Age at first spine mets dx category			0.444
<65	85 (52.8%)	21 (61.8%)	
≥65	76 (47.2%)	13 (38.2%)	
Insurance Status			0.452
Private	90 (55.9%)	22 (64.7%)	
Public	71 (44.1%)	12 (35.3%)	

Table 2b. Differences in Depression Rates Between Sociodemographic Subgroups at 30 Days Postoperative

	No	Yes	P Value
	<i>N=114</i>	<i>N=24</i>	
Race			0.290
Non-white	37 (32.5%)	4 (16.7%)	
White	74 (64.9%)	19 (79.2%)	
Not reported	3 (2.63%)	1 (4.17%)	
Sex			0.884
Female	57 (50.0%)	13 (54.2%)	
Male	57 (50.0%)	11 (45.8%)	
Marital Status			1.000
Married/Partnered	74 (64.9%)	15 (62.5%)	
Not married/Not partnered	40 (35.1%)	9 (37.5%)	
Age at first spine mets dx			0.088
Median [IQR]	61.0 [50.2;71.0]	66.0 [57.0;70.2]	
Mean (SD)	59.4 (12.3)	64.9 (9.50)	
Age at first spine mets dx category			0.309
<65	68 (59.6%)	11 (45.8%)	
≥65	46 (40.4%)	13 (54.2%)	
Insurance Status			0.812
Private	77 (67.5%)	15 (62.5%)	
Public	37 (32.5%)	9 (37.5%)	

Table 2c. Differences in Depression Rates Between Sociodemographic Subgroups at 90 Days Postoperative

	No	Yes	P Value
	<i>N=110</i>	<i>N=18</i>	
Race			0.222
Non-white	32 (29.1%)	2 (11.1%)	
White	75 (68.2%)	16 (88.9%)	
Not reported	3 (2.73%)	0 (0.00%)	
Sex			0.861
Female	61 (55.5%)	9 (50.0%)	
Male	49 (44.5%)	9 (50.0%)	
Marital Status			0.652
Married/Partnered	74 (67.3%)	11 (61.1%)	
Not married/Not partnered	35 (31.8%)	7 (38.9%)	
Not reported	1 (0.91%)	0 (0.00%)	
Age at first spine mets dx			0.189
Median [IQR]	61.0 [53.0;69.0]	64.5 [57.0;70.0]	
Mean (SD)	60.0 (10.7)	63.8 (7.95)	
Age at first spine mets dx category			0.400
<65	70 (63.6%)	9 (50.0%)	
≥65	40 (36.4%)	9 (50.0%)	
Insurance Status			0.896
Private	68 (61.8%)	12 (66.7%)	
Public	42 (38.2%)	6 (33.3%)	