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Scientific Article

Income and Employment of Patients at the Start of and During Follow-up After Palliative Radiation Therapy for Bone Metastasis

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Abstract

Purpose: The aim of this study was to understand the income and employment status of patients at the start of and during follow-up after palliative radiation therapy for bone metastasis.

Methods and Materials: From December 2020 to March 2021, a prospective multi-institutional observational study was conducted to investigate income and employment of patients at the start of administration of radiation therapy for bone metastasis and at 2 and 6 months after treatment. Of 333 patients referred to radiation therapy for bone metastasis, 101 were not registered, mainly because of their poor general condition, and another 8 were excluded from the follow-up analysis owing to ineligibility.

Results: In 224 patients analyzed, 108 had retired for reasons unrelated to cancer, 43 had retired for reasons related to cancer, 31 were taking leave, and 2 had lost their jobs at the time of registration. The number of patients who were in the working group was 40 (30 with no change in income and 10 with decreased income) at registration, 35 at 2 months, and 24 at 6 months. Younger patients ($P = 0$), patients with better performance status ($P = 0$), patients who were ambulatory ($P = .008$), and patients with lower scores on a numerical rating scale of pain ($P = 0$) were significantly more likely to be in the working group at registration. There were 9 patients who experienced improvements in their working status or income at least once in the follow-up after radiation therapy.

Conclusions: The majority of patients with bone metastasis were not working at the start of or after radiation therapy, but the number of patients who were working was not negligible. Radiation oncologists should be aware of the working status of patients and provide appropriate support for each patient. The benefit of radiation therapy to support patients continuing their work and returning to work should be investigated further in prospective studies.

Introduction

Survival of patients with bone metastasis has been improved considerably by new anticancer drugs such as tyrosine kinase inhibitors and immune checkpoint inhibitors.[1] With the wide use of new anticancer drugs, the medical costs for patients at advanced stages of cancer have risen recently.[2] As this population lives longer, and because radiation therapy may be used for anything from simple palliation to near curative-intent treatment, understanding financial toxicity (FT)[3] in patients who receive radiation for bone metastasis and the effects of radiation therapy on work will become progressively more relevant.

Japanese medical services are based on a free-access policy, with a public medical insurance system pursuing universal health coverage by establishment of employee-based and community-based social health insurance.[4] The national pension system for all residents and employer pension systems for employees are available for older persons (62 years or older), and the average annual gross income per household among older persons was ¥3,126,000 in 2019. There is a unique system of a ceiling amount of high-cost medical expenses.[5] For example, when medical expenses total ¥1,000,000 (US$8000) per month, the maximum amount any patient has to pay in personal reimbursement ranges from approximately ¥8000 to ¥300,000 per month (US$64 to US$2400), depending on the patient's age and income. During a leave of absence, patients can receive two-thirds of their original income for up to 1.5 years in general. When individuals retire, unemployment insurance covers 45% to 80% of the original income for 90 to 360 days, depending on age, income, and years insured. Despite such systems, more than 60% of patients with cancer in Japan use alternative strategies, such as cutting spending on food, clothing, or leisure to cope with FT in cancer care.[5] Financial toxicity is now recognized as a serious issue for patients with cancer, even in countries that have national health insurance systems, such as Japan and Italy.[6] FT for patients with cancer and their families is composed of 3 factors: (1) expenditures such as drug costs, other direct medical costs, and related treatment costs; (2) loss or decrease of wealth, including income, savings, and assets; and (3) anxiety and discomfort.[7] Recently, for all oncologists, active support has been recommended to reduce the financial as well as the physical toxicity of cancer treatment.[7-10] Adding to the medical costs, low income and unemployment are known to be strongly associated with

FT.[11,12] The Japanese government has started full-scale efforts to support working people who suffer from cancer. Several university hospitals and cancer centers have started to support the balance of work and treatment for patients with cancer so they have as little loss of income and employment as possible.[13] However, few oncologists have time, interest, knowledge, or skills to mitigate FT among their patients through interviews about financial issues, as is the case in other countries.[7,10,14,15]

Recently, there have been increases in the number of reports about FT related to radiation therapy with curative intent.[16-19] However, a survey for this article found no reports on the FT of patients receiving palliative radiation therapy worldwide, except 1 study that analyzed patients treated in 1992 to 1993 and reported 22 disability days, on average, that prevented performance of usual daily duties.[20] There can be a large gap between the general belief held by physicians about FT and actual FT among current patients. Patients with metastatic bone disease are often treated with palliative radiation therapy, but little is known about their incomes or employment at the start of radiation therapy. The changes in income and employment status after radiation therapy are also worth knowing.

From these considerations, we have conducted a prospective multi-institutional observational study about the income and employment status of patients with bone metastasis at the start of and after radiation therapy. The relationship between employment status, patient characteristics, and radiation therapy methods are also reported. These basic data from an observational study will be useful to find solutions in further prospective studies.

Methods and Materials

From December 2020 to March 2021, patients with bone metastasis who were planned to be treated by external beam radiation therapy were eligible for inclusion after providing informed consent. Patients whom the attending physician evaluated as unsuited for study participation and follow-up for 6 months were not eligible. Patients were registered with basic information including age, sex, and Eastern Cooperative Oncology Group (ECOG) performance status (PS) before radiation therapy. Detailed information was registered at the end of radiation therapy. Each institution was asked to use the techniques, target volume, dose, fractionation, and treatment periods in radiation therapy and combination and supportive care that were usually used in the clinic. Because the purpose of this study was to understand the real-world practice and patient outcomes in the same time period throughout Japan, the study was not designed to be powered to a number to achieve any specific threshold for significance. The maximum number of patients per institution was limited to 10 to gather data not only from large cancer centers but also from regular-sized cancer centers. A detailed study about pain relief, bone-related events, adverse effects, and quality of life after external radiation therapy has been published previously.[21]

Age, sex, ECOG PS, primary cancer site, region treated with radiation therapy, numerical rating scale (NRS) score of pain at the region treated with radiation therapy, ambulatory status (fully ambulatory, ambulatory only indoors, or not ambulatory), planning and irradiation technique (2-dimensional, 3-dimensional, stereotactic body radiation therapy, or intensity modulated radiation therapy), and fractionation number of the radiation therapy (1, 2-9, 10, 11, or more) were used for the analysis in the present study. The NRS is an 11-point left−right scale anchored at 0 and 10: *no pain* was printed at the left under 0 and *pain which could not be more severe* was printed under 10 at the right. Patients were asked to select the number closest to the worst pain they had felt. Narcotic doses were converted to oral morphine doses.

For income and employment status, patients were asked preset items and phrases. At registration, they were asked to select 1 from the following items regarding their present situation. The term in parentheses is used to represent the item in this article.

(1) There was no decrease in income of 10% or more (no change).

(2) Income decreased by 10% or more, including relocation and job change (income decreased).

(3) I took leave of absence (taking leave).

(4) I lost my job, including early retirement (lost my job).

(5) At the start of bone treatment, I was no longer working for reasons related to the cancer (retired—cancer).

(6) At the start of bone treatment, I was not working for reasons other than the cancer, including unemployment and illness diagnosed after retirement (retired—noncancer).

Answers were collected at the end of the first radiation therapy treatment, and these data were used as the registration (base values) in this study.

The follow-up examinations were performed at 2 and 6 months after registration, either with face-to-face interviews or online. Patients were asked to select 1 from the aforementioned list of items (1 to 6) or 1 of the following 2 items (7 and 8) regarding their present situation at 2 and 6 months:

(7) I was on leave or lost my job, but I was able to return to work (return to work).

(8) My income decreased by more than 10%, but it has now returned to my previous income (income returned).

At 2 and 6 months after registration, if a patient was unable to be interviewed, the last follow-up status was investigated through the referring physician as far as possible.

The follow-up period was 6 months after the registration of the last patient. Analysis was started 12 months after the last follow-up of the last patient. No data was recorded regarding the actual amount of income and retirement income.

The basic statistical analysis was performed using Excel functions (Microsoft). The Mann-Whitney U test with independent samples was used for comparisons between groups. The Pearson χ^2 test was used for testing the independence between 2 qualitative variables.

Results

There were 333 patients with bone metastasis referred to radiation therapy in 26 institutions during the study period (Fig. 1, Table E1). Of those, 101 patients were not registered; registration was rejected by 11 patients, and the attending physician determined that the performance status was not good enough for 6 months' follow-up in 68 patients, that the performance status was good but not fit for follow-up in 13 patients, and that the treatment needed to start before explanation about this study in 9 patients. A total of 232 patients were registered; after excluding 5 ineligible patients, 1 patient who withdrew consent, and 2 patients who did not receive protocol treatment, 224 patients were analyzed. The mean age ± standard deviation (SD) was 68 ± 11 years; 38% of patients were female, 61% had a PS of 1 to 2, and 63% were ambulatory; and the mean NRS pain score was 5.3 ± 3.0

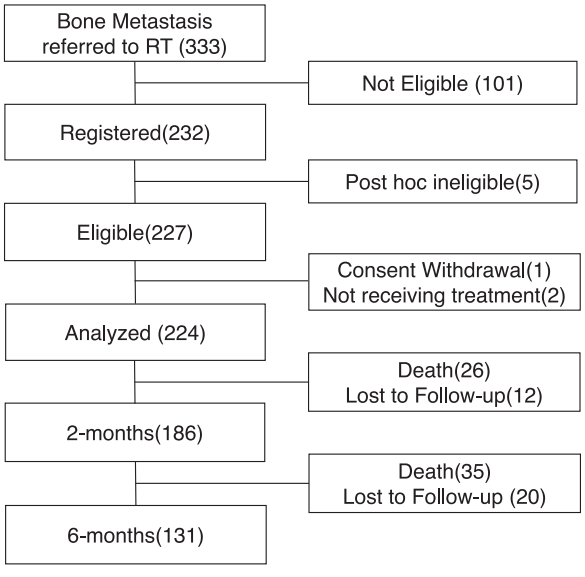

Figure 1 Flow diagram of the study.

Table 1 Patient characteristics (n = 224)

Characteristic	Value
Age, y	
Mean (standard deviation)	68 (11)
Median (range)	70 (28-89)
Sex, no. (%)	
Female	85 (38)
Male	139 (62)
ECOG PS, no. (%)	
0	52 (23)
1	86 (38)
2	50 (22)
3	28 (13)
4	8 (4)
Primary site, no. (%)	
Lung	80 (36)
Breast	33 (15)
Hepatobiliary	20 (9)
Kidney and ureter	19 (8)
Prostate	15 (7)
Rectum	15 (7)
Unknown	8 (4)
Head and neck, excluding thyroid	6 (3)
Uterus	3 (1)
Sarcoma	2 (1)
Thyroid	1 (0)
Walking status at registration, no. (%)	
Ambulatory	141 (63)
Ambulatory indoors	57 (25)
Not ambulatory	26 (12)
NRS score for pain	
Mean (standard deviation)	5.3 (3.0)
Median (range)	5 (0-10)

Abbreviations: ECOG = Eastern Cooperative Oncology Group; NRS = numerical rating scale; PS = performance status.

(Table 1). The primary site of disease was the lungs in 36% of patients, breasts in 15%, prostate in 7%, and other sites in 42% (Table 1). The summery of irradiated sites, biological equivalent dose assuming α/β = 10, and treatment periods are listed in Table E2. The income and employment status at registration, 2 months, and 6 months are shown in Fig. 2.

At registration, there were 30 patients with no change in income and 10 with decreased income, corresponding

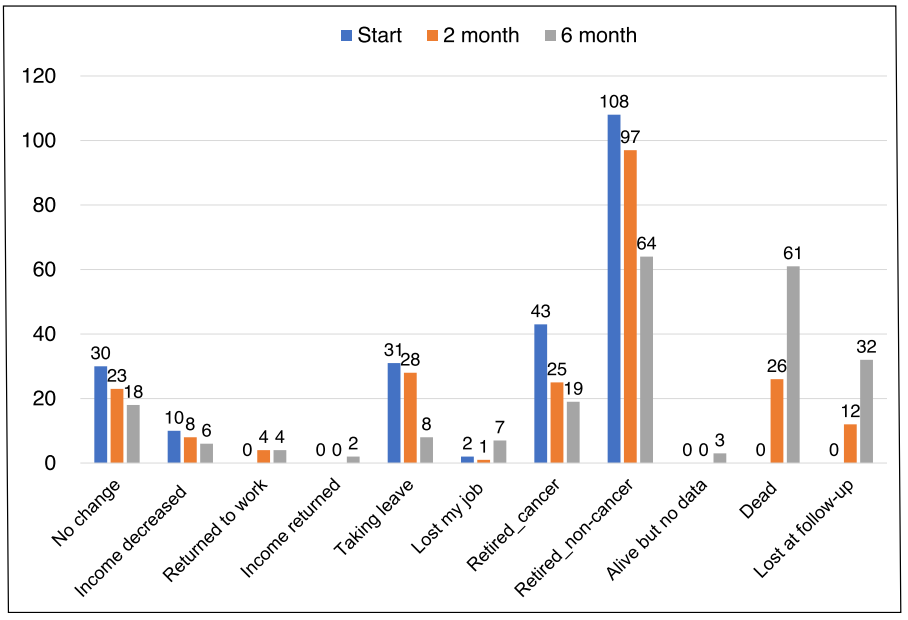

Figure 2 Income and employment status at registration (start of radiation therapy) and at 2 and 6 months after radiation therapy. The number of patients who selected each item at registration (blue), 2 months (orange), and 6 months (gray) is listed from left to right, respectively.

to 13% and 5% of the 224 patients analyzed and 9% and 3% of the 333 patients referred to radiation therapy, respectively. Thirty-one patients were taking leave, 2 had lost their jobs, 43 had retired for reasons related to cancer, and 108 had retired for reasons unrelated to cancer (Fig. 2).

At 2 months, 26 patients had died, 12 were lost to follow-up, and the remaining 186 completed the follow-up (Fig. 1). At 2 months after registration, 23 patients reported no change in income, 8 were working with decreased income, and 4 who had been taking leave or had lost their job at the time of registration were able to return to work. Twenty-eight patients were taking leave at 2 months, and 1 had lost their job. The number of patients who had retired for reasons related to cancer had decreased to 25 and for reasons unrelated to cancer, to 97 (Fig. 2).

At 6 months, an additional 35 patients had died and 20 were lost to follow-up; the remaining 131 patients completed follow-up (Fig. 1). At 6 months after registration, 18 patients reported no change in income, 6 were working with decreased income, 4 had returned to work, and 2 who had been working with a decreased income had been able to return to earning their original income. Eight patients were taking leave and 7 had lost their jobs. The number of patients who had retired for reasons related to cancer had decreased to 19 and for reasons unrelated to cancer, to 64 (Fig. 2).

When patients selected answers 1, 2, 7, or 8, we classified them into the working group. The others were classified into the nonworking group. Because patients can earn only two-thirds of their original income when they take a leave of absence, the patients selecting answer 3 were classified into the nonworking group in this study. The number of patients in the working group at registration was 40; at 2 months, 35; and at 6 months, 24, corresponding to 18%, 16%, and 11%, respectively, of the 224 patients analyzed and 12%, 11%, and 7%, respectively, of the 333 patients referred to radiation therapy.

At registration, the age distribution was significantly younger for the 40 patients in the working group (mean ± SD, 62.8 ± 9.8 years) than in the 184 patients in the nonworking group (69.0 ± 10.4 years) (Z = 15.15; P = 0). The ECOG PS was significantly better in working group (0.73 ± 0.72) than in the nonworking group (1.5 ± 1.1) (Z = 17.13; P = 0). The distribution of sex and primary disease sites in each group are shown in Table 2. There was no difference in sex and primary cancer sites between the 2 groups (Table 2).

At registration, 55 patients in the working group were fully ambulatory, 12 were ambulatory only indoors, and 4 were not ambulatory; in the nonworking group, 86 were fully ambulatory, 45 were ambulatory only indoors, and 22 were not ambulatory (Fig. 3). A statistically significant relationship was found between ambulatory status and the ratio of the number of patients in the working group to that in the nonworking group; patients who were ambulatory were more likely to be in the working group at registration (χ^2, 9.659; P = .008).

The mean NRS pain scores were 4.0 ± 3.0 (median, 3.5; range, 0-10) for the working group and 5.5 ± 3.0 (median, 5; range, 0-10) for the nonworking group at registration (Fig. 4). The NRS pain score was significantly smaller in working group compared with that in the

Table 2 Sex and primary site of cancer according to working status at registration

	Patients, no. Working status		Total
	Working	Not working	
Sex			
Female	11	74	85
Male	29	110	139
Primary disease site			
Lung	14	66	80
Breast	7	26	33
Prostate	2	13	15
Kidney	2	12	14
Other	12	63	75
Unknown	3	4	7
Total	40	184	224

nonworking group at registration ($Z = 24.92$; $P = 0$). No significant statistical relationship was found between either treatment planning and irradiation techniques or fractionation number and the ratio of the number of patients in the 2 groups.

Nine patients experienced improvements in their working status or income at least once in the follow-up (Table 3). Five were taking a leave of absence and 3 were not working at the time of registration. Seven of the 9 patients had been ambulatory throughout, and 2 other patients had been ambulatory only indoors at registration. All patients were fully ambulatory when they returned to work or experienced improvement in income.

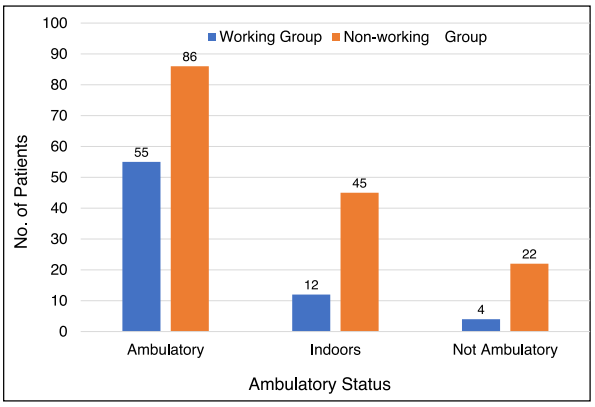

Figure 3 Number of patients who were fully ambulatory, ambulatory only indoors, or not ambulatory at registration in the working group (blue, left) and nonworking group (orange, right), respectively.

Discussion

Because palliative radiation therapy for bone metastasis commonly uses single- or hypofractionation schedules without meticulous treatment planning, the risk of FT owing to radiation therapy–related costs should not be substantial. However, if the patients are not working, the risk of FT can be high. The present study showed that as

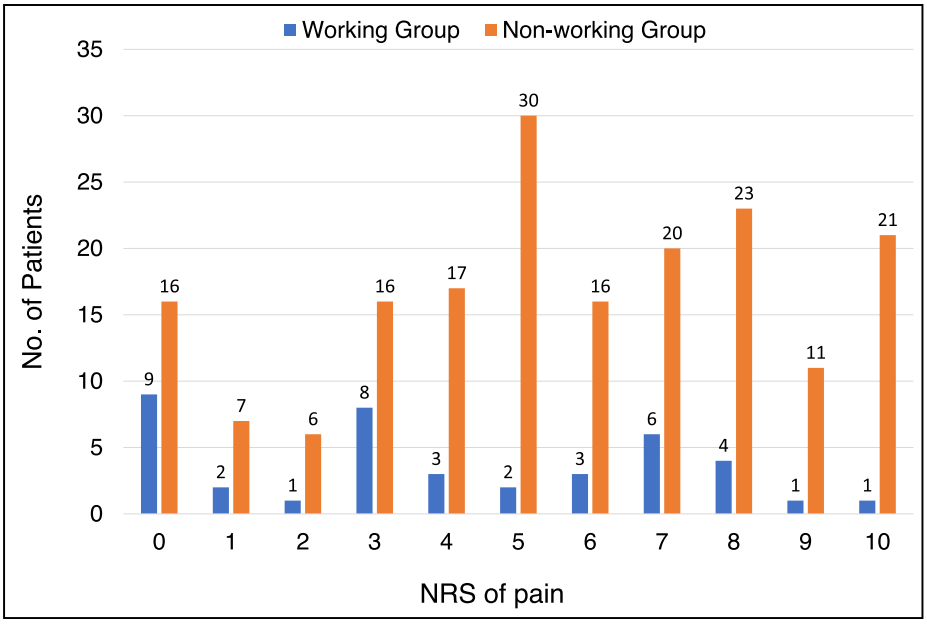

Figure 4 Number of patients with each numerical rating scale (NRS) score of pain (0-10) at registration in the working group (blue, left) and nonworking group (orange, right), respectively.

Table 3 Patients who experienced improved working status or income at least once during follow-up

No.	Age	Sex	ECOG PS	Primary site	Irradiated site	Opioid, mg	Technique	Daily dose, Gy	Total dose, Gy	Ambulatory status			NRS of pain			Working status		
										Start	2 mo	6 mo	Start	2 mo	6 mo	Start	2 mo	6 mo
1	47	F	0	Breast	Thoracic spine	0	3D CRT	2.5	37.5	Ambulatory	Ambulatory	Ambulatory	1	0	0	Taking l eave	Taking leave	Returned to work
2	52	F	1	Breast	Thoracic and pelvis	0	3D CRT	3	30	Indoors	Ambulatory	Ambulatory	5	2	1	Taking leave	Taking leave	Returned to work
3	55	F	0	Breast	Thoracic spine	0	3D CRT	4	20	Ambulatory	Ambulatory	Ambulatory	0	0	0	Taking leave	Returned to work	Returned to work
4	79	M	1	Kidney	Pelvis and rib	0	2D	5	25	Ambulatory	Indoors	Unknown	5	6	Unknown	No job because of cancer	Returned to work	Unknown
5	59	F	2	Lung	Femur	0	3D CRT	3	30	Indoors	Ambulatory	Ambulatory	9	1	0	Taking leave	Returned to work	Returned to work
6	69	M	1	Lung	Cervical spine	15	3D CRT	4	20	Ambulatory	Ambulatory	Ambulatory	4	3	5	Taking leave	Returned to work	Returned to work
7	50	M	1	Lung	Lumbar spine	45	3D CRT	3	30	Ambulatory	Ambulatory	Ambulatory	2	0	0	No job because of cancer	Taking leave	Returned to work
8	71	M	0	Head and neck	Lumbar spine	0	SBRT	12	24	Ambulatory	Ambulatory	Ambulatory	3	1	0	No job because of other reasons	Lost job	Returned to work
9	68	M	1	Lung	Rib	0	3D CRT	5	25	Ambulatory	Ambulatory	Ambulatory	0	0	0	Decreased	Decreased	Fully employed

Abbreviations: 2D = 2-dimensional; 3D = 3-dimensional; CRT = conformal radiation therapy; ECOG = Eastern Cooperative Oncology Group; F = female; M = male; NRS = numerical rating scale; PS = performance status; SBRT = stereotactic body radiation therapy.

many as 82% of the patients who registered in this study were not working at the time of registration. Because this study analyzed only patients who had been evaluated as eligible for the 6 months of follow-up and agreed to be registered, the actual percentage of patients who were not working must have been higher than this value. If we use the number of all patients with bone metastasis referred to radiation therapy during the study period as the denominator, the percentage of patients who were not working was 88%.

The percentage of patients who work may be different in different countries owing to the differences in health care systems. However, the distributions of age, sex, ECOG PS, and primary site of disease in this study are not particularly different from studies of palliative radiation therapy for bone metastasis from other countries.[20-24] It is notable that the ambulatory status and NRS pain score in addition to age and PS were associated with working status at registration. It is suggested that patients who were fully ambulatory or ambulatory only indoors and patients who had low NRS scores had a higher possibility to be working at registration. Oncologists should be aware of the findings of this study when they see patients with bone metastasis. They should try to help these patients avoid exposure to FT by starting palliative radiation therapy.

It is well known that single-fraction palliative radiation therapy is as effective as a hypofractionation schedule for pain relief and quality of life.[24-26] Single-fraction radiation therapy can be more beneficial than multiple fractions because of reducing the risk of loss or decrease in income for patients with bone metastasis, especially for those who are working. The benefit of single-fraction radiation therapy in terms of reducing the risk of FT should be investigated in a prospective study.

Although the percentage of patients in the working group was low, considering the large total number of patients with bone metastasis, the actual number of working patients is not negligible. The number of patients who maintained working-group status was 35 at 2 months after radiation therapy and 24 at 6 months after radiation therapy. The number in the working group increased by 4 patients at 2 and 6 months, respectively, owing to the increase in patients who returned to work after taking a leave of absence or who were not employed at registration. In addition, there were 2 patients whose income had fully returned after radiation therapy. Oncologists should be aware of the low but definite possibility of returning to work or regaining full income after radiation therapy among patients who are taking a leave of absence or are not employed at the start of therapy.

Having said that, the possibility of a return to work in the follow-up period was quite low in patients who had retired before registration. For these patients, it is important for physicians to pay attention to FT not by persuading them to return to work but in other ways. Also, mental support is highly recommended, because FT is associated with lower health-related quality of life in older adults with advanced cancer.[27]

Shih et al showed that more than half of patients with cancer were willing to discuss costs with physicians but that less than one-third actually did so.[10] Similar results were shown in research in Japan.[14] Medical oncologists are recommended to discuss FT with their patients.[8,9] Our results in this study and other previous studies suggest that discussion about FT is also recommended for radiation oncologists who are recommending treatment with radiation therapy, irrespective of radical or palliative intent.[16-19]

Shortcomings of this study are the following. First, there was a selection bias for patients. There were patients who were evaluated by the attending physicians as not eligible to enter this study mainly because of their poor general condition, and each institution could contribute only 10 patients. As stated before, the percentage of patients in each category should be interpreted cautiously considering this selection bias. Second, we did not ask about the status of actual incomes, full- or part-time employment, retirement, and assets. These are important data but are difficult to obtain without detailed explanations to the patients about the purpose of the study. The patients who had taken a leave of absence were classified into the nonworking group in this study, even though in general, such patients may earn two-thirds of their original income when they take a leave of absence in Japan. Third, we did not examine treatment-related costs in this study, one of the important factors of FT. Palliative radiation therapy does not cost much generally, but patients may have received expensive anticancer medications simultaneously or traveled large distances to the facility administering radiation therapy. These factors may increase the risk of FT significantly. Fourth, we did not use validated measures of FT, such as the Comprehensive Score for Financial Toxicity, which is known to be an internationally comparable scale for FT.[11] Honda et al showed that the mean Comprehensive Score for Financial Toxicity in Japan was the same as in the United State in patients with various cancers who were receiving anticancer drugs.[5] It is also important to investigate FT in palliative radiation therapy using validated measures. Lastly, this study does not answer the question of whether the radiation patients received made a difference in their employment. A prospective study is required to answer this question.

Conclusion

In this study, the majority of patients receiving palliative radiation therapy for bone metastasis were subject to decreased incomes or not working. However, at the same time, the number of patients who were working at the start of radiation therapy was not negligible. Oncologists

should be aware of the low but definite possibility of a return to work or of regaining full income after radiation therapy among patients who are taking a leave of absence or have lost their job at the start of therapy. For patients who are no longer working for reasons related or unrelated to cancer at the start of radiation therapy, it may be better not to persuade them to return to work and to provide other ways to minimize FT. Mental support is highly recommended for all patients to lessen suffering from FT. The benefit of radiation therapy to support patients continuing to work or returning to work should be investigated further in prospective studies.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.adro.2023.101205.

References

1. Clézardin P, Coleman R, Puppo M, et al. Bone metastasis: Mechanisms, therapies, and biomarkers. *Physiol Rev*. 2021;101:797-855.
2. Altice CK, Banegas MP, Tucker-Seeley RD, et al. Financial hardships experienced by cancer survivors: A systematic review. *J Natl Cancer Inst*. 2016;109:djw205.
3. Zafar SY, Peppercorn JM, Schrag D, et al. The financial toxicity of cancer treatment: A pilot study assessing out-of-pocket expenses and the insured cancer patient's experience. *Oncologist*. 2013;18:381-390.
4. Ikegami N, Yoo BK, Hashimoto H, et al. Japanese universal health coverage: Evolution, achievements, and challenges. *Lancet*. 2011;378:1106-1115.
5. Honda K, Gyawali B, Ando M, et al. Prospective survey of financial toxicity measured by the Comprehensive Score for Financial Toxicity in Japanese patients with cancer. *J Glob Oncol*. 2019;5:1-8.
6. Perrone F, Jommi C, Di Maio M, et al. The association of financial difficulties with clinical outcomes in cancer patients: Secondary analysis of 16 academic prospective clinical trials conducted in Italy. *Ann Oncol*. 2016;27:2224-2229.
7. Carrera PM, Kantarjian HM, Blinder VS. The financial burden and distress of patients with cancer: Understanding and stepping-up action on the financial toxicity of cancer treatment. *CA Cancer J Clin*. 2018;68:153-165.
8. Meropol NJ, Schrag D, Smith TJ, et al. American Society of Clinical Oncology. American Society of Clinical Oncology guidance statement: The cost of cancer care. *J Clin Oncol*. 2009;27:3868-3874.
9. Dittrich C, Kosty M, Jezdic S, et al. ESMO /ASCO recommendations for a global curriculum in medical oncology edition 2016. *ESMO Open*. 2016;1: e000097.
10. Shih YT, Chien CR. A review of cost communication in oncology: Patient attitude, provider acceptance, and outcome assessment. *Cancer*. 2017;123:928-939.
11. de Souza JA, Yap BJ, Wroblewski K, et al. Measuring financial toxicity as a clinically relevant patient-reported outcome: The validation of the Comprehensive Score for Financial Toxicity (COST). *Cancer*. 2017;123:476-484.
12. Huey RW, George GC, Phillips P, et al. Patient-reported out-of-pocket costs and financial toxicity during early-phase oncology clinical trials. *Oncologist*. 2021;26:588-596.
13. Shirato H. Financial toxicity and "support for balancing treatment and work" in cancer treatment. *Gan To Kagaku Ryoho*. 2022;49:499-503.
14. Takahashi M, Tsuchiya M, Horio Y, et al. Job resignation after cancer diagnosis among working survivors in Japan: Timing, reasons and change of information needs over time. *Jpn J Clin Oncol*. 2018;48:43-51.
15. Agarwal A, Livingstone A, Karikios DJ, et al. Physician-patient communication of costs and financial burden of cancer and its treatment: A systematic review of clinical guidelines. *BMC Cancer*. 2021;21:1036.
16. Palmer JD, Patel TT, Eldredge-Hindy H, et al. Patients undergoing radiation therapy are at risk of financial toxicity: A patient-based prospective survey study. *Int J Radiat Oncol Biol Phys*. 2018;101:299-305.
17. Yusuf M, Pan J, Rai SN, et al. Financial toxicity in women with breast cancer receiving radiation therapy: Final results of a prospective observational study. *Pract Radiat Oncol*. 2021. S1879-8500:00301-5.
18. Platek ME, Ray AD, Repasky EA, et al. Association of significant financial burden with survival for head and neck cancer patients treated with radiation therapy. *Oral Oncol*. 2021;115: 105196.
19. Minamitani M, Mukai T, Yamashita H, et al. Effects on annual income changes after radical radiotherapy versus after prostatectomy in patients with localized prostate cancer with a specific employment status: A web-based pilot study. *PLoS One*. 2021;16: e0258116.
20. Francoeur RB. Cumulative financial stress and strain in palliative radiation outpatients: The role of age and disability. *Acta Oncol*. 2005;44:369-381.
21. Harada H, Shikama N, Notsu A, et al. Multi-institutional prospective observation study of radiotherapy for metastatic bone tumor. *Int J Radiat Oncol Biol Phys*. 2022;114(Suppl):E440.
22. Spencer K, Velikova G, Henry A, et al. Net pain relief after palliative radiation therapy for painful bone metastases: A useful measure to reflect response duration? A further analysis of the Dutch Bone Metastasis Study. *Int J Radiat Oncol Biol Phys*. 2019;105:559-566.
23. Sahgal A, Myrehaug SD, Siva S, et al. Stereotactic body radiotherapy versus conventional external beam radiotherapy in patients with painful spinal metastases: An open-label, multicentre, randomised, controlled, phase 2/3 trial. *Lancet Oncol*. 2021;22:1023-1033.
24. Conway JL, Yurkowski E, Glazier J, et al. Comparison of patient-reported outcomes with single versus multiple fraction palliative radiotherapy for bone metastasis in a population-based cohort. *Radiother Oncol*. 2016;119:202-207.
25. McDonald R, Ding K, Brundage M, et al. Effect of radiotherapy on painful bone metastases: A secondary analysis of the NCIC clinical trials group Symptom Control Trial SC.23. *JAMA Oncol*. 2017;3:953-959.
26. Lutz S, Balboni T, Jones J, et al. Palliative radiation therapy for bone metastases: Update of an ASTRO evidence-based guideline. *Pract Radiat Oncol*. 2017;7:4-12.
27. Aratsu A, Patel A, Mohile SG, et al. Assessment of financial toxicity among older adults with advanced cancer. *JAMA Netw Open*. 2021;3: e2025810.