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Prevalence of severe malnutrition in cancer patients: a systematic review and meta-analysis

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Abstract

Background Cancer remains the foremost cause of mortality worldwide. Additionally, malnutrition frequently occurs among cancer patients and constitutes a significant factor contributing to adverse clinical outcomes and poor prognosis in this population. The present systematic review and meta-analysis study aimed to evaluate the prevalence of severe malnutrition in cancer patients.

Method This study was conducted based on data extracted from previous published studies reporting the prevalence of malnutrition in cancer patients. Statistical analysis of collected data was performed using Comprehensive Meta-Analysis software (v.2). Systematic searching was applied based on MeSH keywords in medical databases of ScienceDirect, Embase, Scopus, PubMed, Web of Science (WoS), MagIran, SID, and Google Scholar (by December 2024). Following the elimination of duplicate articles, further evaluation was applied through the assessment of Titles and Abstract. Then, the eligibility assessment was performed based on the inclusion and exclusion criteria by two reviewers, independently. The information extracted from Citation Management Software of EndNote was also added. In order to achieve the highest number of eligible articles, the references of all relevant studies were reviewed, manually.

Results Totally, 19 eligible studies were selected for data extraction and meta-analysis. According to the Random Effect Model, the prevalence of severe malnutrition among cancer patients was reported 19.3% (95% CI: 14.1–25.9%). Also, the results of meta-regression examining the effective factors on heterogeneity, it was found that the rate of malnutrition in cancer patients decreases with sample size, year of study, and the age of cancer patients ($p < 0.05$).

Conclusion Malnutrition is a common phenomenon in cancer patients. Continuous monitoring of nutritional status in cancer patients and associated economic and social factors are critical objectives during cancer therapies. According to the results of the present study, cancer therapy should be applied parallel to examination and attention to nutritional status in cancer patients.

Keywords Nutritional deficiencies, Neoplasm, Malignant neoplasms, Cancer patient

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Background

Cancer is an abnormal growth of cells [1] occurs in many organs of the body. Neoplastic diseases are characterized by populations of cells acquired the capacity for uncontrolled proliferation due to the loss of normal regulatory mechanisms governing cell cycle arrest and growth inhibition [1]. Incidental detection of malignancies may occur during routine laboratory investigations or radiological examinations performed for unrelated clinical indications [1]. The incidence of malignancies is significantly elevated among individuals experiencing immunosuppression due to factors such as chronic psychological stress, advanced age, prior exposure to chemotherapy, and inappropriate use of pharmacological agents including analgesics, antibiotics, and corticosteroids. This immunocompromised state predisposes patients to an increased oncogenic risk [1]. The incidence and distribution of various cancer types differ across populations and are influenced by an interplay of social, cultural, racial, geographical, and dietary factors [2].

Cancer remains a highly detrimental disease of the twentieth century, with its incidence continuing to rise in the 21st century. It constitutes the foremost cause of mortality globally and imposes substantial economic burdens on healthcare systems and societies [3].

Approximately 150 types of cancer and at least 500 different subtypes of carcinogens are identified in humans [2]. According to GLOBOCAN, the global cancer incidence was estimated to reach 18.1×10^6 new cases and 9.6×10^6 deaths in 2018 [4]. It is estimated that this value can reach to 15.5×10^6 new cases and 11.5×10^6 deaths by 2030 [2].

Diagnosis and management of cancer not only result in considerable physical morbidity and psychological distress for patients but also profoundly disrupt routine daily functions and quality of life [5, 6]. Cancer and the associated treatments cause considerable changes in patient's nutritional status [7]. Malnutrition frequently occurs among oncology patients and constitutes a significant factor contributing to adverse clinical outcomes in this type of population [8–10].

Malnutrition affects 20 to 70% of cancer patients [11]. The effects of malnutrition in oncology patients encompass a higher incidence of postoperative complications, prolonged hospitalization periods, exacerbated adverse reactions to cytotoxic therapies, reduction in bone mineral density, compromised immune competence, diminished therapeutic efficacy, and a decline in overall quality of life. These outcomes underscore the critical impact of nutritional status on treatment tolerance and clinical prognosis in cancer care [9, 12]. Also, malnutrition increases mortality rate in cancer patients [8]. Thus, more than 20% of cancer patients die due to malnutrition [7]. Malnutrition is identified as a factor exacerbating the severity of mucositis, which represents the predominant cause of unintended interruptions in radiotherapy treatment schedules [8]. This factor could also interrupt the therapies by reducing the effect of chemotherapy [8].

Malnutrition in oncology patients may arise from multiple etiologies, including the systemic metabolic alterations induced by malignancy, localized impact of tumor on organ function or nutrient absorption, as well as adverse effects related to anticancer therapies. These factors collectively contribute to the nutritional deficits observed in these cases [7]. Systemic manifestations associated with cachexia, including anorexia and metabolic dysregulation, are diverse and vary in both nature and intensity according to the specific type of malignancy [7]. Local effects usually are associated with malabsorption, obstruction, diarrhea, and vomiting [7]. Fatigue, depression, anxiety, or pain (resulting from the cancer or treatment) can interfere with dietary intake [7]. Nutritional challenges during cancer treatment affect appetite, early satiety, swallowing difficulties, dry mouth, mouth sores, odor sensitivities, taste changes, diarrhea, constipation, nausea, and vomiting [7].

Oral nutritional interventions can enhance the nutritional status of patients capable of oral intake but requiring specialized dietary modifications due to gastrointestinal pathologies. In addition to diet, commercially available dietary supplements can be used to increase nutrient intake [13].

The prevalence of malnutrition depends on the type of tumor and the stage of cancer development, involved organs, and anticancer treatment. The high prevalence of malnutrition was reported in various types of cancer including pancreas (80–85%), stomach (65–85%), head and neck (65–75%), lung (45–60%), and colorectal cancer (30–60%) [8].

According to the adverse effects of malnutrition in cancer patients and urgent need for timely diagnosis, along with various reports of associated prevalence, the present systematic review and meta-analysis study aimed to evaluate the prevalence of severe malnutrition in cancer patients in order to reduce cancer-related complications.

Method

In this systematic review and meta-analysis study, various databases were searched (including ScienceDirect, Embase, Scopus, PubMed, Web of Science (WoS), Mag-Iran, SID, and Google Scholar) using main keywords of Prevalence, Malnutrition, Nutrition, Severe Malnutrition, Undernutrition, Nutritional Deficiencies, Cancer, Neoplasia, Neoplasm, Tumor, Malignancies, Benign Neoplasm, Malignant Neoplasms, Cancer Patient, Nutrition, Cancer, and Prevalence of Malnutrition. Also, all possible combinations of these keywords were searched in databases.

PubMed Advanced Search:
((((((((((Prevalence[Title/Abstract]) AND (Nutrition[Title/Abstract])) OR (Malnutrition[Title/Abstract])) OR (Severe malnutrition [Title/Abstract])) OR(Undernutrition[Title/Abstract])) OR (Nutritional Deficiencies[Title/Abstract])) AND (Neoplasm[Title/Abstract])) OR (Cancer[Title/Abstract])) OR (Neoplasia[Title/Abstract])) OR (Malignant Neoplasms[Title/Abstract])) OR (Cancer Patient[Title/Abstract])) AND (Nutrition[Title/Abstract] AND Cancer[Title/Abstract]))))))))))

Study selection procedure

Initially, duplicate papers were identified and merged. Subsequently, a list of remaining Titles was prepared for further evaluation. In primary screening, the Title and Abstract of articles were examined carefully and irrelevant studies were excluded based on the inclusion and exclusion criteria. In secondary screening, the eligibility evaluation of full texts was applied based on the inclusion and exclusion criteria. In this stage, irrelevant studies were also omitted. To prevent the probable bias, all stages of resource review and data extraction were performed by two reviewers independently. Following the exclusion of a study, the associated reason was recorded. Also, in the presence of a disagreement between two reviewers, the third author was responsible for final decision. No time restriction was considered in searching process (by December 2024). The selected citations were imported into the EndNote Citation Management Software. In order to maximize the comprehensiveness of the search, the lists of references of included articles were also reviewed, manually.

Regarding the inclusion criteria, all observational (non-interventional), cross-sectional, population-based studies, investigations reporting the prevalence of malnutrition among cancer patients, English-based investigations, and non-English studies with English abstracts were totally considered for data extraction. Moreover, the exclusion criteria were all case-control studies, case reports, interventional investigations, cohort studies, letters to editor, studies with unavailable full-text, irrelevant subjects, investigations with no sufficient data, duplicates, and systematic review and meta-analysis studies were ignored. In order to examine gray literature, the unpublished evidence or documentation, as well as theses with no associated published articles, correspondence with the authors of these sources, and a review of websites related to the subject of the study were totally included in the agenda.

Data extraction and quality evaluation

The data of all eligible articles were extracted from a pre-prepared checklist including the First author's name, Year of publication, Place of study, Type of study, Mean age of samples, Total sample size, and Prevalence of malnutrition. To evaluate the quality of articles, the STROBE checklist was used. In this regard, STROBE score ≥ 16 were considered as medium or high-quality articles. Besides, the articles with STROBE scores < 16 were considered low-quality and excluded from the study.

Statistical analysis

The I^2 test was used to evaluate the heterogeneity of the selected studies. In order to investigate the publication bias (due to the high volume of samples) the Egger's test and corresponding Funnel plots were adopted with a significance level of 0.05. Data analysis was performed using the Comprehensive Meta-Analysis (v.2) software.

Results

This systematic review and meta-analysis were conducted according to the PRISMA guidelines to examine the prevalence of malnutrition among cancer patients with no time limitation. Following a systematic searching in repositories and medical databases, a total of 2379 primary articles were identified and transferred into the EndNote Citation Management Software. After excluding 286 duplicate articles, the Title and Abstract of 1754 remaining investigations were reviewed according to the inclusion and exclusion criteria (screening stage). In the eligibility evaluation stage, 316 irrelevant articles were also excluded (out of 339 papers). In quality assessment stage, all full texts were reviewed and extracted using the STROBE checklist. In this regard, 3 poor-quality articles were detected and removed. Finally, 19 moderate to high-quality articles were selected for meta-analysis (Fig. 1).

According to the data presented in Table 1, the prevalence of malnutrition as well as study location were categorized. In this regard, the lowest and highest sample sizes were related to Thoresen, L. et al. (2013) ($n = 77$), and de Pinho, N. B. et al. (2020) ($n = 4783$), respectively. The static characteristics extracted from the eligible articles were summarized in Table 1.

Based on the results of I^2 index (I^2:96.6) and due to the heterogeneity among the selected studies, the Random Effect Model was used to evaluate the total prevalence of severe malnutrition among cancer patients. The high heterogeneity index among the included studies was probably related to the sample size, sampling error, year of study conduction, and place of study. To assess the publication bias of the global prevalence of severe malnutrition among cancer patients, Funnel plot and Egger's test (at the significance level of 0.05) showed no significant alteration ($P = 0.175$) (Fig. 2).

Following the review of 19 studies with the total sample size of 8549 individuals, the prevalence of severe malnutrition among cancer patients was 19.3% (95%CI:

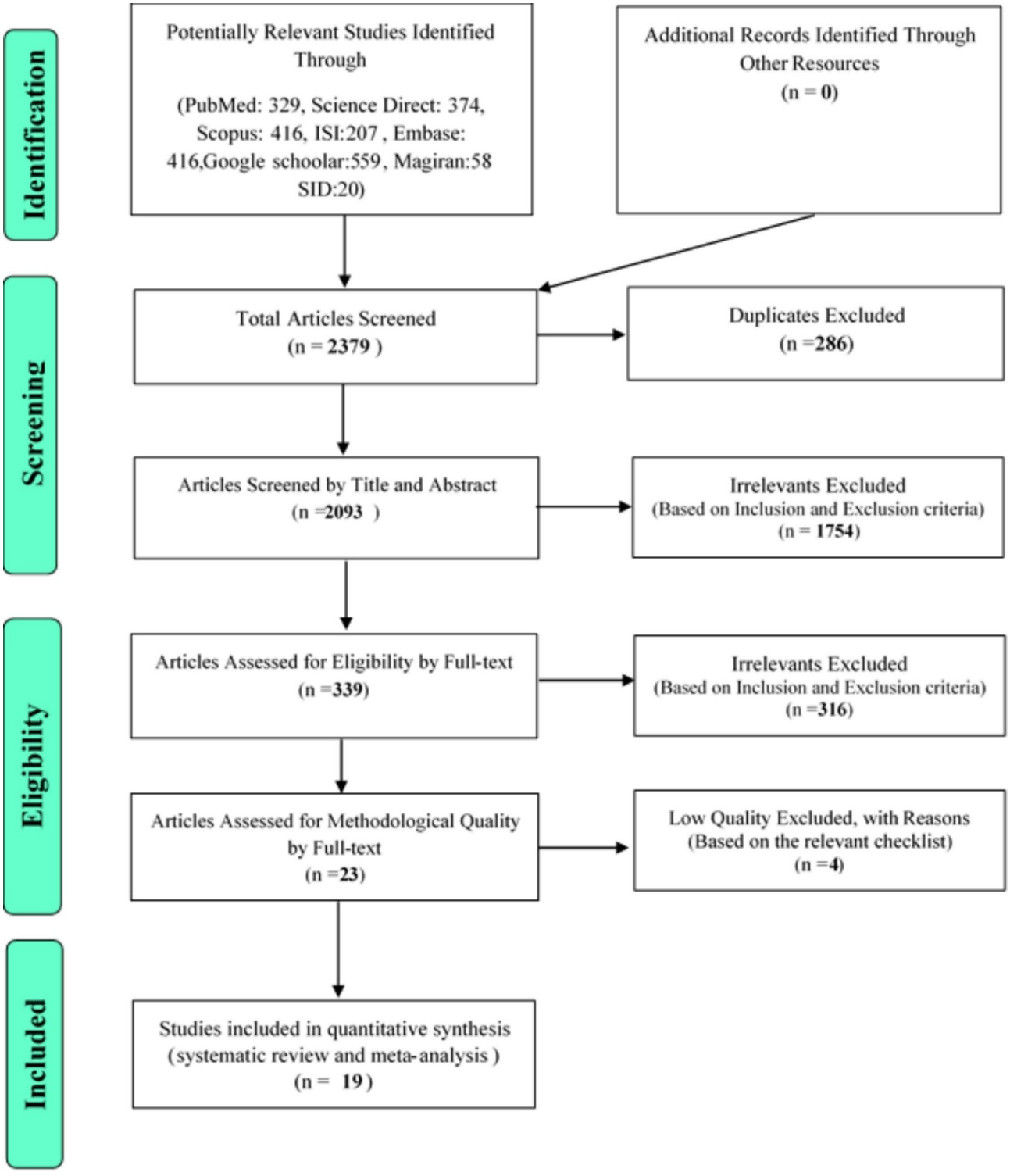

Fig. 1 Flowchart representing the stages of study selection in systematic review and meta-analysis (PRISMA 2009)

Table 1 Data extracted from eligible articles

NO	Author [Ref]	Year	Research location	Mean age (Year)	Total sample size	Prevalence of severe malnutrition
1	Aktas, A. [14]	2017	America	61	182	24.1
2	Attar, A. [11]	2012	France	63	313	24.9
3	Chantragawee, C. [15]	2016	Thailand	54	97	21.6
4	De Melo Silva, F. R. [16]	2015	Brazil	54.7	277	35.7
5	de Pinho, N. B. [17]	2020	Brazil	56.7	4783	11.7
6	do Prado, C. D. [18]	2013	Brazil	57.45	143	12.5
7	dos Santos, C. A. [19]	2015	Brazil	70.6	96	14.5
8	Isenring, E. [20]	2010	Australia	62.5	191	2
9	Khoshnevis, N. [21]	2012	Iran	53.4	416	24
10	Krishnasamy, K. [22]	2017	Malaysia	47.9	132	48.4
11	Laky, B. [23]	2008	Australia	58.7	194	1.5
12	Mansour, F. [24]	2018	Algeria	44	167	40.4
13	Montoya, J. E. [25]	2010	Philippines	55.7	88	4.5
14	Nho, J. H. [26]	2014	Republic of Korea	52.9	129	53.4
15	Sarvarian R. [2]	2013	Iran	53	300	23.3
16	Segura, A. [27]	2005	Spain	62	781	11.9
17	Sharma, D. [28]	2016	India		57	52.6
18	Shaw, C. [29]	2015	England	59	126	21.4
19	Thoresen, L. [30]	2013	Norway and Canada		77	7.7

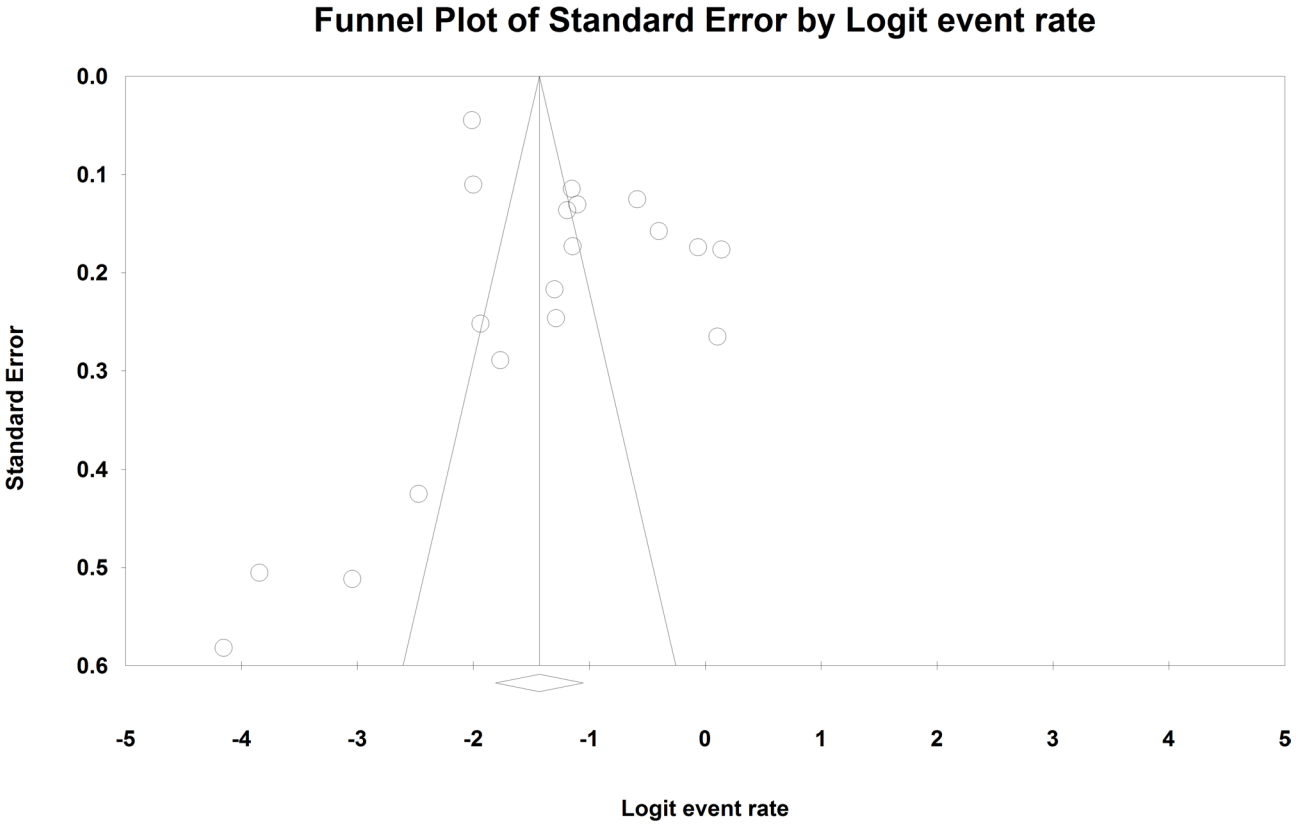

Fig. 2 Funnel plot examining publication bias in included studies regarding the prevalence of severe malnutrition in cancer patients

14.1–25.9%). According to the Fig. 3, the Forest plot represents the overall prevalence among the reviewed studies. The midpoint of each line segment indicates the prevalence in each study and the rhombic shape indicates the prevalence in the population for the entire study (Fig. 3).

Meta-regression test

In order to investigate the effects of interfering variables on heterogeneity of severe malnutrition prevalence among cancer patients, meta-regression was used to assess the sample size, year of study, and the participants' age (Figs. 4, 5 and 6). The prevalence of severe malnutrition among cancer patients decreases significantly ($P < 0.05$) with sample size (Fig. 4), year of study (Fig. 5), and the participants' age (Fig. 6).

Discussion

The present systematic review and meta-analysis study aimed to estimate the prevalence of severe malnutrition in cancer patients. In a review of 19 studies with the total sample size of 8549 cancer patients, the prevalence of severe malnutrition among cancer patients was reported 19.3%. In order to investigate the effects of interfering variables on heterogeneity of malnutrition prevalence among cancer patients, meta-regression analysis was used regarding the sample size, year of study, and participants' age. According to the results of meta-regression, the prevalence of malnutrition among cancer patients decreases with sample size, year of paper publication, and the age of participants. This finding returns to more care provided for elderly people with cancer in medical centers and more attention paid by families to the health of this type of population. Several studies cited within this discussion represented major challenge with the current

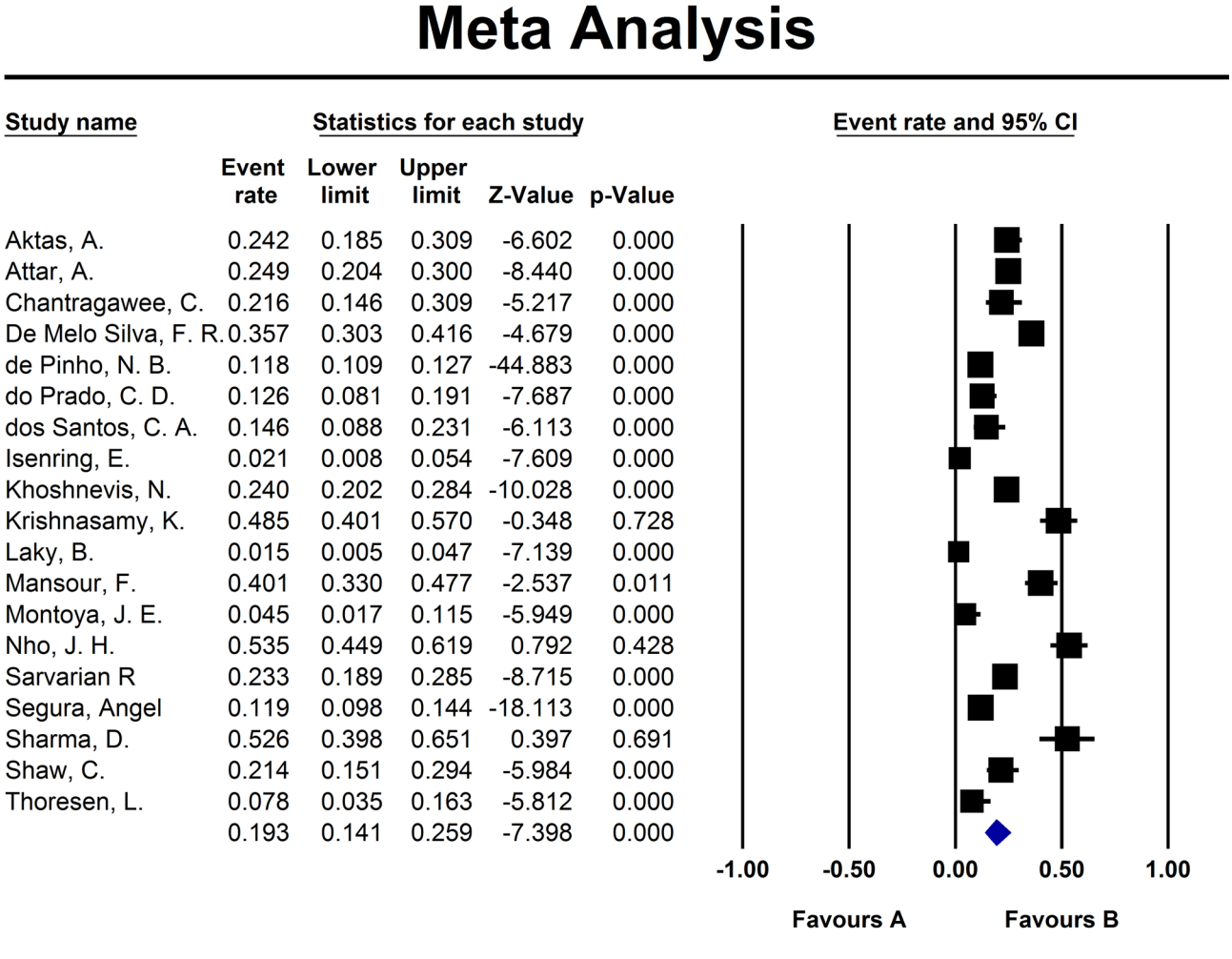

Fig. 3 Forest plot representing the meta-analysis of prevalence of severe malnutrition in cancer patients based on a random effect model

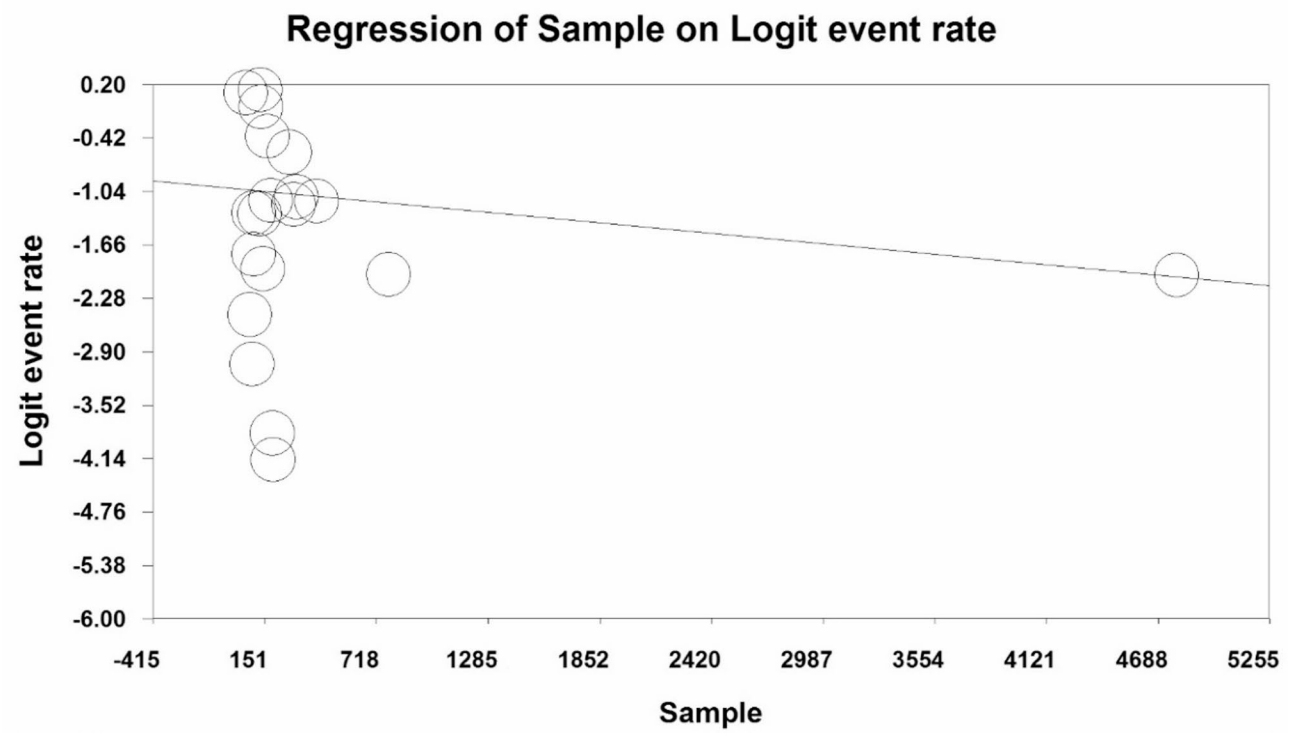

Fig. 4 The meta-regression diagram of severe malnutrition prevalence among cancer patients regarding the sample size

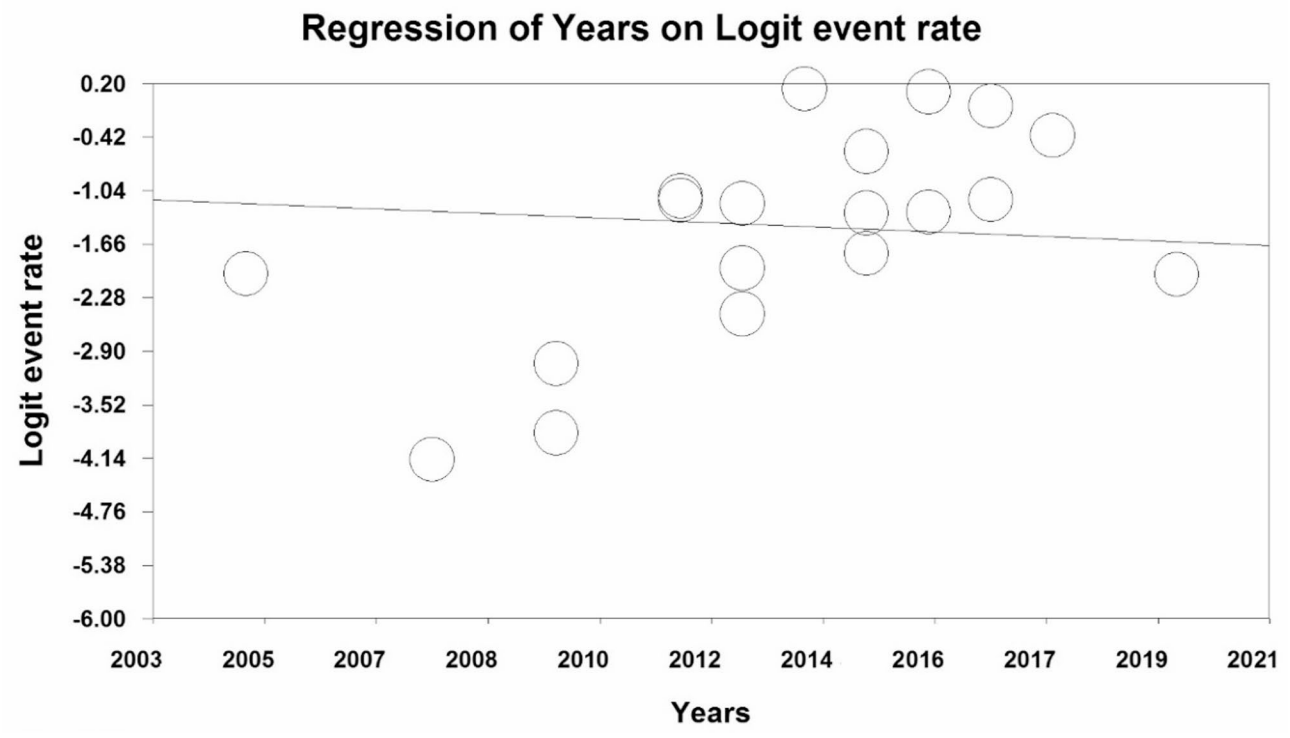

Fig. 5 The meta-regression diagram of severe malnutrition prevalence among cancer patients regrading the year of study

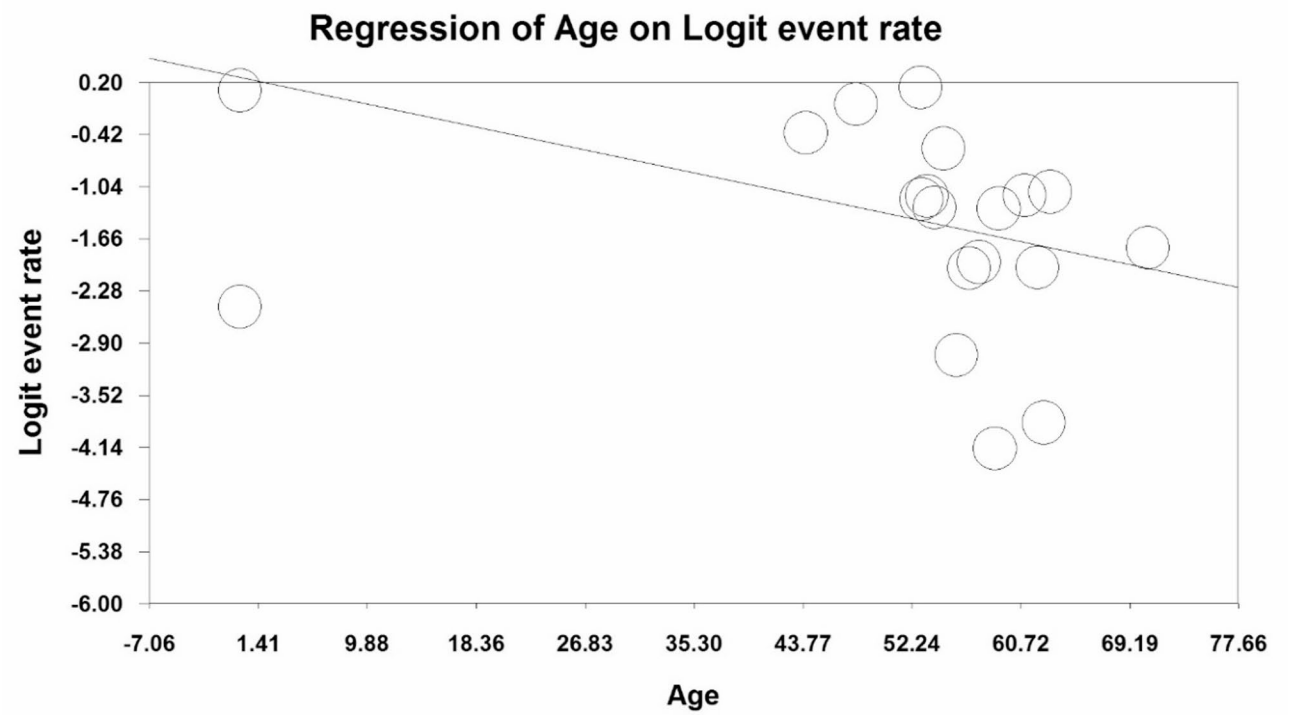

Fig. 6 The meta-regression diagram of severe malnutrition prevalence among cancer patients regarding the participants' age

results, suggesting that observed differences among elite groups may be attributable to variations in demographic factors such as the age, race, and gender, as well as disparities in management and intervention strategies across different countries.

Changes in appetite are common among cancer patients affecting nutritional status and the quality of life [31]. Malnutrition is more prevalent among cancer patients [32]. Tumor and associated host response can increase the risk of malnutrition by affecting fat metabolism and protein synthesis [32]. Chi et al. reported that the prevalence of nutritional risk among cancer patients ranges from 33.9 to 55.7% based on SGA and NRS 2002 criteria [32].

According to the study of Pinho et al., the hospitalized older cancer patients are at higher risk of malnutrition than younger patients [17]. Also, the results of this study showed that the risk of anorexia, dysphagia, and xerostomia in older cancer patients is higher than in people < 50 years [17]. In the abovementioned study, the prevalence of malnutrition in hospitalized cancer patients > 65 years was 55%, and also 14.6% of which had severe malnutrition [17].

According to the studies, approximately 30 to 87% of cancer patients are diagnosed with malnutrition [33]. According to the results of Movahed et al.'s study, 13% and 39% of patients were at moderate and higher risk of malnutrition, respectively [33]. Protein-calorie malnutrition is reported in 30 to 60% of cancer patients. Also, according to the results of the previously stated study, the most common cancers with severe risk of malnutrition were respectively detected in upper gastrointestinal cancers (28.1%) and lower gastrointestinal malignancies (20.3%) [33]. On the other hand, 73.7% of patients with breast cancer were at lower risk of malnutrition. It was noteworthy that 65% of patients with a lower gastrointestinal cancer, 64.3% of patients with brain cancer, and 60% of patients with upper gastrointestinal cancer were at risk of malnutrition [33]. Several studies suggested that the observed outcomes may be explained by the fact that a substantial proportion of individuals diagnosed with lower gastrointestinal malignancies and primary brain neoplasms recently underwent surgical intervention [33].

According to the various studies, the prevalence of malnutrition in the elderly is higher than younger people [17, 34]. Also, several investigations reported that the age of individuals is probably associated with impaired regulation of food intake [34]. A decreased sense of taste and smell, which generally occurs with aging, may cause a decrease in appetite. Chemotherapy, radiation therapy and surgery can also affect the sense of taste and smell causing dysgeusia [34]. Poor oral health and dental problems can also reduce the chewing and swallowing abilities with a higher risk of malnutrition [34].

In the study of Sarvarian et al., the prevalence of mild to moderate protein-energy malnutrition in cancer patients referred to Shohada-e-Tajrish Hospital was 30% (based on SGA index). Also, the prevalence of severe

protein-energy malnutrition [based on SGA] was 23%. According to this study, insufficient energy intake in cancer patients reduced the quality of life, and increased the progression of cancer, and mortality rate. Lack of energy-protein intake in cancer patients could be due to anorexia, other complications of chemotherapy (e.g., nausea, vomiting, dry mouth, etc.), dental problems, and physical disabilities or economic problems for food preparation. Anorexia is the most important factor. In Sarvarian study, the highest percentage of protein-energy malnutrition in cancer patients was related to gastrointestinal malignancies, and the highest percentage of normal nutritional status was related to breast cancers. In other words, the relationship between cancer type and nutritional status is statistically significant [2, 34].

Cancer patients frequently require hospitalization, particularly within emergency care settings, due to adverse effects stemming from either the malignancy itself or its therapeutic interventions. Existing evidence indicates that a considerable proportion of patients with cancer are susceptible to malnutrition, attributable both to the malignancy itself and the adverse effects associated with antineoplastic treatments (7, 32–34). The prevalence of weight loss or malnutrition among cancer patients has been reported to range from 31 to 87%. Malnutrition in this population is linked to a diminished therapeutic response, with cancer cachexia identified as the leading cause of mortality in affected individuals. This scenario underscores the critical importance of promptly assessing nutritional status and implementing appropriate interventions at the time of hospital admission in patients diagnosed with cancer to mitigate the risks associated with malnutrition (7, 32–34).

Limitations and future perspectives

The most important limitation of the present study is the lack of additional information regarding the nutritional status of patients, the lack of reporting on the type of cancer, and the lack of uniformity in geographical distribution for subgroup analyses. Thus, for future studies, it is recommended to focus on clinical trials and interventional studies to improve malnutrition in these cases.

Conclusion

Malnutrition is widespread in cancer patients. Continuous monitoring of the nutritional status of cancer patients and the economic or social factors are critical indices throughout the therapies. The results of the present study suggest that the treatment of cancer patients by specialists can include the examination of nutritional status along with paying special attention.

Abbreviations

GLOBOCAN	The Global Cancer Observatory
WoS	Web of Science
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology for cross-sectional Study
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis

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Author contributions

SMH and NS and ND and ZS contributed to the design, MM statistical analysis, participated in most of the study steps. MM prepared the manuscript. ZS and SHSH and AR and SHF assisted in designing the study, and helped in the, interpretation of the study. All authors have read and approved the content of the manuscript.

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Data availability

Datasets are available through the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethics approval was received from the ethics committee of deputy of research and technology, Kermanshah University of Medical Sciences (IR.KUMS.REC.1399.892).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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