

Associations between physical activity and health-related quality of life in cancer patients on active treatment

Research Article

Merve Gezen Bolukbas^{1*} , Serife Vatansever¹ , Deniz Zeynep Sonmez² 

¹ Faculty of Sports Sciences, Department of Coach Education, Bursa Uludağ University, Bursa, Türkiye

² CUNY School of Medicine, New York, NY, United States of America

Received 04 August 2025; Accepted 14 December 2025

Abstract

Study aim: The aim of this study is to determine the physical activity levels of patients undergoing active cancer treatment and to examine the relationship between physical activity and quality of life.

Material and methods: A total of 213 cancer patients (112 females and 101 males: mean age = 58.7 ± 12.5 years) voluntarily participated in the study. Physical activity levels were assessed using the International Physical Activity Questionnaire Short Form, while quality of life was measured with the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire. Demographic and medical data were collected via a Personal Information Form developed by the researchers.

Results: The overall mean physical activity score was 739.6 ± 983.5 MET min/week, indicating a generally low activity level. Significant differences were observed across cancer types ($p < 0.05$), with prostate cancer patients showing the highest physical (77.1 ± 24.6), emotional (86.3 ± 23.3), and global health status (72.0 ± 35.2) scores. A moderate positive correlation was found between total physical activity and global health status ($r = 0.39$, $p < 0.001$).

Conclusion: During active cancer treatment, most patients demonstrated low levels of physical activity, which were closely associated with poorer health-related quality of life, particularly in the physical, emotional, and global health domains. These findings underscore the importance of integrating structured physical activity into comprehensive cancer care, particularly for patients with lung and other non-prostate cancers who appear most susceptible to inactivity-related declines in quality of life. During active cancer treatment, further prospective and interventional studies are needed to better understand the relationship between physical activity and quality of life in these patients.

Keywords: Physical activity · Exercise · Quality of life · Cancer

1. Introduction

Cancer is a major global public health concern and remains one of the leading causes of death from non-communicable diseases (Rodríguez-Cañamero et al., 2022; Siegel et al., 2023). The prevalence of cancer is marginally greater among men (40.9%) than among women (39.1%) (Siegel et al., 2023). Key factors contributing to cancer development include smoking, alcohol consumption, obesity, and excessive exposure to ultraviolet light. These

factors can disrupt the body's normal functions at multiple levels and increase the risk of developing diseases, including cancer (Sarich et al., 2021; Sohn et al., 2021).

Cancer treatment often involves a combination of methods, including chemotherapy, radiotherapy, immunotherapy, surgery, and bone marrow transplantation (Pekmezci et al., 2022). Cancer and its treatment often have detrimental effects on a patient's physical, psychological, and cognitive health. These challenges can hinder the ability to carry out daily activities or return to work.

Author's address: Merve Gezen Bolukbas, Faculty of Sports Sciences, Department of Coach Education, Bursa Uludağ University, Bursa, Türkiye mgezenn@gmail.com

Common severe side effects, including pain, fatigue, nausea, hematologic complications, and depression, are key contributors to treatment non-adherence and may adversely impact survival (Soones et al., 2022; Zhu et al., 2022). Therefore, implementing strategies to alleviate the wide-ranging negative effects of cancer is crucial for improving both clinical outcomes and overall public health (Martínez-Vizcaíno et al., 2023).

Among various complementary approaches, exercise has emerged as an effective strategy to mitigate cancer symptoms and treatment-related side effects (Pekmezci et al., 2022; Stout et al., 2021). Exercise, defined as a structured, repetitive, and goal-oriented form of physical activity, has been shown to improve physical function and quality of life while reducing fatigue in cancer patients (Buffart et al., 2017; Hojman et al., 2018; Rendeiro et al., 2021; Sweegers et al., 2018). Beyond its therapeutic role during cancer treatment, exercise has also been associated with a lower risk of developing certain types of cancer (Matthews et al., 2020). These benefits have contributed to the development of evidence-based physical activity guidelines specifically tailored for individuals diagnosed with cancer. These guidelines recommend that individuals diagnosed with cancer should participate in at least 150 min of moderate-to-vigorous physical activity per week (10 metabolic equivalent (MET) hours per week, approximately 3 h of walking per week) or three 30 min sessions of aerobic and/or resistance exercise per week to achieve health benefits (Campbell et al., 2019; Rock et al., 2022).

Many cancer patients encounter environmental, social, and structural barriers that hinder their ability to engage in physical activity during and after treatment. These challenges limit the use of exercise as a therapeutic strategy to counter the adverse effects of cancer diagnosis and treatment such as reduced physical function, fatigue, anxiety, depressive symptoms, and diminished quality of life. Notably, these issues can disproportionately affect individuals from diverse racial and ethnic backgrounds and often vary based on the type, stage, and intensity of cancer treatment (Al Maqbali et al., 2021; Chapman et al., 2022; Henson et al., 2020; Rock et al., 2022; Soones et al., 2022).

Although a growing body of literature supports the benefits of exercise for improving quality of life in cancer survivors, relatively little is known about exercise adherence and its relationship with quality of life among patients undergoing active treatment (Buffart et al., 2017; Mishra et al., 2012; Lipsett et al., 2017). For example, Buffart et al. (2017) demonstrated that exercise interventions improved global health status, physical functioning, and

reduced fatigue across multiple cancer types. Similarly, Mishra et al. (2012) and Lipsett et al. (2017) found that aerobic and resistance exercise significantly improved health-related quality of life, emotional well-being, and treatment tolerance in post-treatment cancer survivors.

Most previous studies have focused on cancer survivors or individuals in the post-treatment phase, whereas limited evidence is available for those receiving treatment (Caetano et al., 2020; Al-Mhanna et al., 2022; Martínez-Vizcaíno et al., 2023). These gaps are important because adherence to physical activity during treatment may differ substantially due to fatigue, treatment side effects, or psychosocial barriers, yet these factors remain underexplored. Despite the well-established benefits of exercise, many cancer patients face barriers that limit their engagement in physical activity during treatment. Therefore, the aim of this study is to quantify physical activity levels among patients undergoing active cancer treatment and examine their association with health-related quality of life.

2. Material and methods

2.1 Research design

This study was designed according to a cross-sectional descriptive research model to examine the relationship between physical activity and quality of life in patients undergoing active cancer treatment.

2.2 Research group

The study included a total of 213 volunteer patients, 112 females and 101 males, who were undergoing active cancer treatment at Bursa Ali Osman Sonmez Oncology Hospital. Patients who were 18 years or older, had a confirmed diagnosis of cancer, and were currently receiving active treatment (chemotherapy, radiotherapy, immunotherapy, or combined modalities) at Bursa Ali Osman Sonmez Oncology Hospital were eligible for inclusion. Participants were required to be physically capable of completing questionnaires and to provide voluntary informed consent. Exclusion criteria included patients who were in remission or palliative care, had severe cognitive impairment or psychiatric conditions that could interfere with questionnaire completion, or had physical disabilities preventing participation in physical activity assessment.

The study received “Ethics Committee Approval” dated 30.12.2020 and numbered 2020-11 from the “Bursa Uludağ University, Health Sciences Research and Publication Ethics Committee.” Before the study, the necessary permissions were obtained from the Bursa Health Provincial Directorate to conduct the study at Bursa Ali Osman Sonmez Oncology Hospital. The purpose and scope of the study were explained to the individuals participating in the study and “Voluntary Consent Forms” were obtained. This study was conducted in accordance with the “Helsinki Declaration principles.”

2.3 Data collection tools

All data were collected through face-to-face interviews.

2.3.1 Personal information form

The “Personal Information Form” prepared by the researchers by scanning the literature consists of questions regarding the sociodemographic characteristics of cancer patients (age, height, weight, education status, smoking and alcohol consumption, type of cancer, type of cancer treatment, sleep duration, etc.).

2.3.2 International physical activity questionnaire short form (IPAQ-SF)

The IPAQ-SF was used to determine the physical activity level of the participants. Although originally developed for use in the general adult population, the IPAQ-SF has also been applied in cancer research and has demonstrated acceptable psychometric properties among oncology patients (Courneya *et al.*, 2014). This questionnaire, whose validity and reliability in Turkish were established by Ozturk (2005), assesses physical activity over the previous 7 days, evaluating time spent in vigorous-intensity, moderate-intensity activities, and walking, based on episodes lasting at least 10 min (Ozturk, 2005). The calculation of the SF total score of the questionnaire includes the sum of the duration (minutes) and frequency (days) of vigorous-intensity activity, moderate-intensity activity, and walking activity. A sitting question is not included in the physical activity score. The duration (minutes), frequency (days), and MET value are multiplied to obtain a score as “MET-minutes/week.” MET-min/week values were calculated for IPAQ-SF by using these equations: 8 METs were multiplied for vigorous-intensity activity, 4 METs for moderate-intensity activity and 3.3 METs for walking activity. Physical activity levels were classified as: physically inactive

(<600 MET-min/week), low physical activity (600–3,000 MET-min/week), and sufficient physical activity (beneficial for health) (>3,000 MET-min/week) (Craig *et al.*, 2003).

2.3.3 European organization for research and treatment of cancer quality of life scale (EORTC QLQ-C30-version 3.0)

To assess participants’ quality of life, the EORTC QLQ-C30, version 3.0 was used. This widely recognized scale is specifically designed for use in cancer populations and was developed by the EORTC. This scale, whose validity and reliability studies in Turkish were conducted by Guzelant *et al.* (2004), consists of three subscales as Functional scale, General health scale (general well-being), and Symptom scale, and 30 questions about the past week. The functional scale consists of sub-dimensions including physical (questions 1–5), role (questions 6 and 7), cognitive (questions 20 and 25), emotional (questions 21–24), and social (questions 26 and 27) functions. The Symptom Scale consists of sub-dimensions including dyspnea (8th question), pain (9th and 19th questions), fatigue (10th, 12th, and 18th questions), insomnia (11th question), loss of appetite (13th question), nausea-vomiting (14th and 15th questions), constipation (16th question), diarrhea (17th question), and financial difficulty (28th question). The first 28 of the 30 items in the scale used are four-point Likert-type scales and the items are evaluated as Very (4), Quite (3), A Little (2), Not at All (1). General health scale (general well-being): In question 29, participants are asked to evaluate their health on a scale from 1 (1: very bad) to 7 (7: excellent) and in question 30, they are asked to evaluate their general quality of life. The lowest total score that cancer patients can get from the three sub-scales is 0, and the highest score is 100. A high score on the Functional scale indicates a high level of functioning; a high score on the Global health status/quality of life scale reflects better overall quality of life; and a high score on the Symptom scale signifies more severe symptoms and greater symptom burden (Fayers *et al.*, 2002).

2.4 Statistical analysis

Descriptive statistics, including frequency (*n*), percentage (%), and mean value $\pm$ standard deviation, were used to summarize the data. The normality of continuous variables was assessed using the Shapiro–Wilk test. The homogeneity of variances was evaluated using Levene’s test, and the assumptions required for parametric analysis were met. Effect sizes for the independent samples *t*-tests were calculated using Cohen’s *d*, and 95% confidence intervals were reported. Effect sizes were interpreted as small

(0.20), medium (0.50), and large (0.80). The independent samples test (independent t-test) was used to examine the relationship between binary categorical variables. One-way ANOVA (One-way analysis of variance ANOVA) was used to examine the relationship between three or more variables. When significant differences were found in ANOVA, the Least significant difference (LSD) *post hoc* test was employed to identify the source of the variation. To assess correlations between selected variables, Pearson correlation analysis was conducted.

All statistical analyses were performed using IBM SPSS (Statistical Package for the Social Science) version 28.0, and the level of significance was set at $p < 0.05$.

3. Results

A total of 213 volunteer patients participated in the study, 52.6% ($n = 112$) of whom were female and 47.4% ($n = 101$) were male. When the marital status of the participants was examined, it was seen that 79.8% were married and 20.2% were unmarried. The average age of the participants was determined as 58.72 ± 12.47 , their total weight average (kg) was 72.58 ± 13.13 , their average height (cm) was 1.65 ± 0.07 , and their body mass index was 26.57 ± 4.67 .

31% of the patients participating in the study had lung cancer, 13.6% had colon cancer, 33.3% had breast cancer, 6.6% had prostate cancer, and 15.5% had other types of cancer (head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer). Regarding the type of treatment actively being received, 68.1% of patients were undergoing chemotherapy, 9.9% were receiving radiotherapy, and 22% were receiving combination therapy (involving multiple modalities such as chemotherapy with radiotherapy or hormone therapy). It was determined that 22.5% of the patients are in Stage I, 16% are in Stage II, 18.3% are in Stage III, and 43.2% are in Stage IV. It was determined that 78.4% of the participants are primary school graduates, 15.5% are high school graduates, 1.9% are associate degree graduates, and 4.2% are undergraduate graduates. 81.7% of the participants stated that they do not smoke and 96.7% stated that they do not consume alcohol. When the participants were questioned about their chronic health conditions, 30.2% stated that they have hypertension. Among the participants, 47.4% were housewives and 25.8% were retired. It was determined that the majority of the participants (68.1%) were not physically active (289.97 ± 161.76 MET-min/week). The total average physical activity score of the participants was determined to be 739.61 ± 983.46 MET-min/week (Table 1).

When the participants' cancer type and total physical activity scores were compared, a statistically significant

difference was found ($p < 0.05$). Participants with lung cancer had significantly lower physical activity scores compared to those with colon cancer ($p < 0.05$) and prostate cancer ($p < 0.05$). Furthermore, individuals diagnosed with other types of cancer (i.e., head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer) reported significantly lower physical activity scores than those with colon cancer and prostate cancer ($p < 0.05$). No significant differences were found between breast cancer and any other cancer types, including colon, prostate, lung, and other types of cancer (i.e., head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer) ($p > 0.05$). Patients with lung and other cancer types exhibited the lowest physical activity levels, likely reflecting disease-related limitations such as fatigue and respiratory symptoms. In contrast, prostate cancer patients had the highest scores, suggesting that less aggressive treatment regimens may allow greater participation in physical activity (Table 2).

No statistically significant differences were found in the total physical activity scores (MET-min/week) of participants based on gender, marital status, smoking status, or alcohol use ($p > 0.05$). These findings indicate that demographic and lifestyle factors did not significantly influence physical activity levels among patients undergoing active cancer treatment. This may suggest that treatment-related fatigue and clinical symptoms play a more dominant role in determining activity levels than personal or behavioral characteristics (Table 3).

No statistically significant differences were observed between cancer types in the quality of life sub-dimensions of role functioning, cognitive functioning, and social functioning, nor in the symptom sub-dimensions of nausea and vomiting, dyspnea, constipation, diarrhea, and financial difficulties ($p > 0.05$). However, significant differences were observed in the sub-dimensions of physical functioning, emotional functioning, fatigue, pain, insomnia, appetite loss, and global health status ($p < 0.05$). Among these, the highest scores were observed in participants with other types of cancer (i.e., head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer) in the sub-dimensions of fatigue, pain, insomnia and appetite loss ($p < 0.05$), indicating a lower quality of life in these domains for this group. The most pronounced differences were observed in emotional functioning and fatigue, suggesting that disease site and treatment burden strongly influence both psychological well-being and energy levels. Patients with prostate cancer maintained better overall health and functioning, whereas those with lung and other cancer types experienced the most severe declines across multiple quality of life domains (Table 4).

Table 1. Demographic and clinical characteristics of study participants

Variables		<i>n</i>	Percentage (%)
Gender	Female	112	52.6
	Male	101	47.4
Marital status	Unmarried	43	20.2
	Married	170	79.8
Cancer type	Lung cancer	66	31
	Colon cancer	29	13.6
	Breast cancer	71	33.3
	Prostate cancer	14	6.6
	Other cancer types ^a	33	15.5
Type of cancer treatment	Chemotherapy	145	68.1
	Radiotherapy	21	9.9
	Combined	47	22
Cancer stage	Stage I	48	22.5
	Stage II	34	16
	Stage III	39	18.3
	Stage IV	92	43.2
Education level	Primary	167	78.4
	High school	33	15.5
	Associate's degree	4	1.9
	Undergraduate degree	9	4.2
Smoking status	Yes	39	18.3
	No	174	81.7
Alcohol consumption	Yes	7	3.3
	No	206	96.7
Chronic disease status	Diabetes	15	23.8
	Diabetes and blood pressure	16	25.4
	Blood pressure	19	30.2
	Other	12	20.6
Occupational status	Freelance	29	13.6
	Housewife	101	47.4
	Unemployed	5	2.4
	Retired	55	25.8
	Worker	17	8
	Public servant	6	2.8
Physical activity level	Physically inactive (<600 MET-min/week)	145	68.1
	Low physical activity level (600–3,000 MET-min/week)	62	29.1
	Adequate physical activity level (beneficial for health) ($>3,000$ MET-min/week)	6	2.8

(Continued)

Table 1: Continued

Variables	<i>n</i>	Mean value ± SD
Physical activity level		
Physically inactive (<600 MET-min/week)	145	289.97 ± 161.76
Low physical activity level (600–3,000 MET-min/week)	62	1387.69 ± 679.47
Adequate physical activity level (beneficial for health) (>3,000 MET-min/week)	6	4909.16 ± 1640.11
Total physical activity score (MET-min/week)	213	739.61 ± 983.46

^aOther cancer types; head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer.

Source: Author's contribution.

Table 2. Total physical activity score (MET-min/week) of participants according to cancer type (one-way ANOVA)

Cancer type	<i>n</i>	Mean value ± SD	<i>F</i>	<i>p</i>	η^2	LSD post hoc
Lung cancer ¹	66	564.48 ± 629.54	2.90	0.02*	0.05	1–2*
Colon cancer ²	29	1087.37 ± 1750.59				1–4*
Breast cancer ³	71	767.10 ± 873.52				2–5*
Prostate cancer ⁴	14	1243.57 ± 1207.16				4–5*
Other cancer types ^{a,5}	33	511.318 ± 566.24				
Total	213	739.61 ± 983.46				

^aOther cancer types; head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer, **p* < 0.05.

Source: Author's contribution.

It was found that there were no statistically significant differences between the participants' quality of life scores according to gender (*p* > 0.05). The absence of gender-related differences suggests that both male and female patients experience similar quality of life outcomes during active cancer treatment. This finding may indicate that the physical and psychological burden of treatment affects patients comparably, regardless of sex (Table 5).

A statistically significant moderate positive correlation was found between participants' total physical activity scores (MET-min/week) and their global health status

(*r* = 0.396, *p* < 0.00). This moderate positive association indicates that higher levels of physical activity are linked to better overall health and quality of life among patients undergoing active cancer treatment (Table 6).

4. Discussion

This study aimed to assess the physical activity levels of patients actively undergoing cancer treatment in Türkiye and to examine their relationship with quality of life. The

Table 3. Relationship between participants' general physical activity scores and some variables (independent samples test)

Variables	Groups	Mean value ± SD	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Total physical activity scores by gender (MET-min/week)	Female	757.93 ± 935.40	0.28	0.77	0.04
	Male	719.29 ± 1038.48			
Total physical activity scores (MET-min/week) by marital status	Unmarried	682.97 ± 645.63	-0.42	0.67	0.08
	Married	753.94 ± 1052.94			
Total physical activity scores (MET-min/week) according to smoking status	Yes	776.57 ± 973.95	0.25	0.79	0.05
	No	731.33 ± 988.18			
Total physical activity scores according to alcohol consumption status (MET-min/week)	Yes	520.71 ± 501.43	-0.59	0.55	0.28
	No	747.05 ± 995.58			

Source: Author's contribution.

Table 4. Relationship between participants' quality of life and cancer type (one-way ANOVA)

Quality of life items	Cancer type	Mean value ± SD	F	p	η^2	LSD post hoc
	Functional scales					
Physical functioning	Lung cancer ¹	56.46 ± 33.01	2.30	0.05*	0.04	1–4*
	Colon cancer ²	62.98 ± 30.11				2–5*
	Breast cancer ³	59.71 ± 29.24				3–4*
	Prostate cancer ⁴	77.14 ± 24.62				4–5*
	Other cancer types ^{a, 5}	49.29 ± 30.77				
Role functioning	Lung cancer	67.67 ± 36.26	1.13	0.34	0.03	
	Colon cancer	72.41 ± 36.80				
	Breast cancer	70.42 ± 36.96				
	Prostate cancer	84.52 ± 32.33				
	Other cancer types ^a	60.60 ± 41.20				
Emotional functioning	Lung cancer ¹	64.77 ± 30.89	2.74	0.03*	0.05	1–4*
	Colon cancer ²	73.85 ± 30.10				2–5*
	Breast cancer ³	68.54 ±± 26.65				3–4*
	Prostate cancer ⁴	86.30 ± 23.25				4–5*
	Other cancer types ^{a, 5}	57.82 ± 35.77				
Cognitive functioning	Lung cancer	70.45 ± 30.49	1.13	0.34	0.03	
	Colon cancer	77.58 ± 32.20				
	Breast cancer	69.71 ± 30.64				
	Prostate cancer	78.57 ± 31.64				
	Other cancer types ^a	62.62 ± 33.34				
Social functioning	Lung cancer	71.46 ± 33.30	1.29	0.27	0.03	
	Colon cancer	75.28 ± 31.37				
	Breast cancer	68.07 ± 31.21				
	Prostate cancer	85.71 ± 25.19				
	Other cancer types ^a	65.15 ± 33.94				
	Symptoms scales					
Fatigue	Lung cancer ¹	51.01 ± 30.81	4.01	0.00*	0.07	1–4*
	Colon cancer ²	42.52 ± 27.38				2–5*
	Breast cancer ³	50.86 ± 28.58				3–4*
	Prostate cancer ⁴	27.77 ± 24.55				3–5*
	Other cancer types ^{a, 5}	62.62 ± 31.89				
Nausea and vomiting	Lung cancer	23.98 ± 30.40	1.34	0.25	0.01	
	Colon cancer	21.83 ± 29.91				
	Breast cancer	19.48 ± 26.87				
	Prostate cancer	20.23 ± 27.09				
	Other cancer types ^a	33.83 ± 37.38				
Pain	Lung cancer ¹	39.14 ± 31.00	2.36	0.05*	0.04	2–5*
	Colon cancer ²	33.33 ± 30.53				3–4*
	Breast cancer ³	43.42 ± 31.80				4–5*
	Prostate cancer ⁴	25.00 ± 29.77				
	Other cancer types ^{a, 5}	51.01 ± 31.44				

(Continued)

Table 4: Continued

Quality of life items	Cancer type	Mean value $\pm$ SD	F	p	η^2	LSD post hoc
Dyspnea	Lung cancer	37.87 $\pm$ 36.92	1.89	0.11	0.02	
	Colon cancer	25.28 $\pm$ 35.24				
	Breast cancer	25.82 $\pm$ 33.89				
	Prostate cancer	19.04 $\pm$ 25.19				
	Other cancer types ^a	36.36 $\pm$ 31.58				
Insomnia	Lung cancer ¹	43.43 $\pm$ 39.64	3.36	0.01*	0.06	1–2*
	Colon cancer ²	19.54 $\pm$ 30.23				1–4*
	Breast cancer ³	37.08 $\pm$ 38.02				2–3*
	Prostate cancer ⁴	19.04 $\pm$ 25.19				2–5*
	Other cancer types ^{a, 5}	44.44 $\pm$ 35.02				4–5*
Appetite loss	Lung cancer ¹	37.87 $\pm$ 35.02	3.46	0.00*	0.06	1–5*
	Colon cancer ²	28.73 $\pm$ 34.18				2–5*
	Breast cancer ³	30.04 $\pm$ 36.14				3–5*
	Prostate cancer ⁴	19.04 $\pm$ 25.19				4–5*
	Other cancer types ^{a, 5}	52.52 $\pm$ 37.29				
Constipation	Lung cancer	29.29 $\pm$ 34.35	0.59	0.66	0.02	
	Colon cancer	21.83 $\pm$ 29.91				
	Breast cancer	21.59 $\pm$ 29.33				
	Prostate cancer	28.57 $\pm$ 34.23				
	Other cancer types ^a	26.26 $\pm$ 37.96				
Diarrhea	Lung cancer	15.15 $\pm$ 24.93	0.87	0.47	0.02	
	Colon cancer	19.54 $\pm$ 30.23				
	Breast cancer	20.18 $\pm$ 32.11				
	Prostate cancer	7.14 $\pm$ 14.19				
	Other cancer types ^a	21.21 $\pm$ 32.07				
Financial difficulties	Lung cancer	33.83 $\pm$ 35.32	1.80	0.12	0.02	
	Colon cancer	21.83 $\pm$ 28.55				
	Breast cancer	32.39 $\pm$ 32.35				
	Prostate cancer	16.66 $\pm$ 17.29				
	Other cancer types ^a	22.22 $\pm$ 32.98				
Global health status	Lung cancer ¹	45.32 $\pm$ 32.36	2.58	0.03*	0.05	1–4*
	Colon cancer ²	49.99 $\pm$ 32.58				2–4*
	Breast cancer ³	54.46 $\pm$ 31.86				4–5*
	Prostate cancer ⁴	72.02 $\pm$ 35.23				
	Other cancer types ^{a, 5}	44.69 $\pm$ 32.26				

^aOther cancer types; head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer, * $p < 0.05$.

Source: Author's contribution.

findings showed that cancer patients had a total mean physical activity score of 739.61 $\pm$ 983.46 (MET-min/week), indicating a low level of physical activity. Compared to

individuals with colon, breast, and prostate cancer, those diagnosed with lung cancer and other types of cancer (head and neck, uterine, bone, lymphoma, liver, stomach,

Table 5. Relationship between participants' quality of life according to gender (independent samples test)

Quality of life items	Gender	Mean value ± SD	<i>t</i>	<i>p</i>	Cohen's <i>d</i> (95% CI)
		Functional scales			
Physical functioning	Female	56.36 ± 29.81	−1.15	0.25	0.15 (−0.12–0.42)
	Male	61.25 ± 32.09			
Role functioning	Female	68.15 ± 37.60	−0.45	0.65	0.06 (−0.21–0.33)
	Male	70.46 ± 36.88			
Emotional functioning	Female	66.44 ± 29.17	−0.58	0.55	0.08 (−0.19–0.35)
	Male	68.89 ± 31.64			
Cognitive functioning	Female	70.23 ± 30.46	−0.12	0.89	0.02 (−0.25–0.29)
	Male	70.79 ± 32.43			
Social functioning	Female	70.38 ± 31.61	−0.20	0.83	0.03 (−0.24–0.30)
	Male	71.28 ± 32.75			
		Symptoms scales			
Fatigue	Female	52.38 ± 29.43	1.17	0.24	0.15 (−0.12–0.42)
	Male	47.52 ± 31.11			
Nausea and vomiting	Female	24.40 ± 30.42	0.47	0.63	0.06 (−0.21–0.33)
	Male	22.44 ± 30.31			
Pain	Female	42.41 ± 31.94	0.83	0.40	0.11 (−0.16–0.38)
	Male	38.77 ± 31.27			
Dyspnea	Female	28.57 ± 34.32	−0.93	0.35	0.13 (−0.14–0.40)
	Male	33.00 ± 34.79			
Insomnia	Female	36.90 ± 37.53	0.11	0.90	0.01 (−0.26–0.28)
	Male	36.30 ± 37.14			
Appetite loss	Female	34.82 ± 37.53	−0.10	0.92	0.03 (−0.24–0.30)
	Male	35.31 ± 34.26			
Constipation	Female	25.89 ± 31.86	0.32	0.74	0.24 (−0.12–0.59)
	Male	15.18 ± 23.81			
Diarrhea	Female	20.23 ± 32.68	1.27	0.20	0.18 (−0.09–0.45)
	Male	15.18 ± 23.81			
Financial difficulties	Female	27.97 ± 31.81	−0.38	0.69	0.05 (−0.22–0.32)
	Male	29.70 ± 33.30			
Global health status	Female	51.7 ± 31.87	0.49	0.62	0.07 (−0.20–0.34)
	Male	4,950 ± 32.84			

Source: Author's contribution.

esophageal cancer) tended to report lower physical activity levels. Moreover, significant differences were observed across cancer types in several sub-dimensions of quality of life, including physical functioning, emotional functioning, fatigue, pain, insomnia, appetite loss, and global health status. Additionally, a positive association was observed between physical activity levels and global health status among patients actively continuing their cancer treatment ($r = 0.396$, $p < 0.00$).

Cancer patients undergoing treatment often have negative psychological and physical effects due to cancer-related symptoms and treatments. These adverse effects also lead to a lower quality of life. The literature suggests that physical activity and exercise can help mitigate these adverse effects and enhance the quality of life of cancer patients undergoing treatment. In particular, it has been found that cancer patients who engage in at least 150 min of moderate-to-vigorous physical activity per

Table 6. Relationship between participants' total physical activity score (MET-min/week) and global health status

Variable	Mean value $\pm$ SD	Pearson <i>r</i>	<i>p</i>
Total physical activity (MET-min/week)	739.61 $\pm$ 983.46	0.396	0.00*
Global health status	50.66 $\pm$ 32.28		

**p* < 0.05.

Source: Author's contribution.

week during treatment experience less fatigue and have higher quality of life scores (Caetano et al., 2020; Mishra et al., 2012; Ramírez-Vélez et al., 2021; Thraen-Borowski et al., 2013). Another study found that higher levels of physical activity in cancer patients were linked to improvements in physical health, overall well-being, and fewer limitations in daily roles caused by physical symptoms (Robertson et al., 2019). It has also been reported that cancer patients with higher physical activity levels are associated with better physical, role, and emotional function and reduced appetite loss and nausea/vomiting (Yan et al., 2021). Unhealthy lifestyle factors, including failure to meet physical activity guidelines and smoking have been linked to lower quality of life (Han et al., 2021). Consistent with previous studies, our study also observed a positive association between physical activity and quality of life. The average physical activity level among cancer patients undergoing treatment in our study (739.61 MET-min/week) falls within the low physical activity category as defined in our study. Despite this low level, participants reported a moderate level of quality of life, suggesting that even minimal engagement in physical activity may positively influence perceived quality of life among cancer patients.

4.1 Effects of different exercise programs in enhancing quality of life during and after cancer treatment and improving treatment tolerance

It is shown that physical activity and exercise may play a role in enhancing the quality of life during and after cancer treatment and improving tolerance to treatments (Wilkinson & Smith, 2023); however, there is no consensus about the most effective type of exercise. Aerobic or resistance exercise programs implemented during breast cancer treatment have been reported to be an effective intervention for reducing fatigue, improving physical fitness, and enhancing cancer-specific quality of life (Furmaniak et al., 2016). Another study suggests that walking and combined exercises are the only

methods that positively impact quality of life (Martínez-Vizcaíno et al., 2023). These inconsistencies across studies may be partly explained by differences in patient populations, cancer types, and treatment phases. For instance, aerobic exercise tends to be more feasible during early-stage or less intensive treatment regimens, whereas patients undergoing chemotherapy or advanced-stage care may tolerate only low-intensity or unstructured activity. However, larger-scale studies are still needed to evaluate the comparative effects of various exercise modalities on fatigue, depression, and quality of life in patients with cancer (Al-Mhanna et al., 2022).

Beyond specific types of exercise interventions, general engagement in physical activity has been associated with improved quality of life across a diverse array of cancer populations. International studies have shown that individuals with cancer who meet recommended physical activity levels – typically defined as at least 150 min of moderate-intensity activity per week – report better quality of life outcomes compared to those who are less active (Andersen et al., 2022; Kalra et al., 2021; Leach et al., 2023; Lipsett et al., 2017). Physical activity has also been linked to reductions in both acute and long-term treatment-related side effects, including fatigue, insomnia, sexual dysfunction, metabolic syndrome, and cognitive impairment (Shapiro, 2018). Although our study did not focus on specific types of exercise, participants reported a moderate level of quality of life despite having low physical activity scores. These findings suggest that even unstructured or lower levels of physical activity may contribute to improved well-being during treatment and support the existing literature on the benefits of exercise in cancer care. This pattern may reflect that even light, routine activities – such as household movements or short walks – can provide psychological and physiological benefits, especially when structured exercise participation is limited by treatment fatigue or medical restrictions. The finding aligns with the growing evidence that maintaining any form of movement during cancer treatment, regardless of intensity, can support emotional well-being and treatment tolerance.

4.2 Physical activity level according to cancer type and the quality of life sub-dimensions

In our study, we observed that physical activity levels differ according to cancer type and accordingly interact with quality of life sub-dimensions. We observed that patients with certain types of cancer were able to participate in physical activity programs and experienced

greater improvements in quality of life outcomes. Additionally, evidence suggests that physical activity helps mitigate disease and treatment-related adverse effects such as reduced body strength, fatigue, diminished quality of life, and impaired functional performance in patients with advanced cancer (Albrecht & Taylor, 2012; Stone et al., 2023). This variability among cancer types may be influenced by differences in treatment intensity, symptom burden, and disease progression. Moreover, social support and cultural perceptions of exercise may vary by cancer type and gender, potentially affecting participation and motivation levels. Therefore, expanding access to care – while taking cancer type into account during treatment – may enhance patients' quality of life and accelerate progress in cancer management (Siegel et al., 2023).

4.3 Sedentary time and quality of life subscales

In cancer patients, sedentary time (i.e., waking time spent sitting or lying with low energy expenditure, typically ≥ 30 min) has been shown to be associated with lower scores on many individual quality of life subscales such as physical, role, and cognitive functions, as well as general health and vitality (Nurnazahiah et al., 2020; Schofield et al., 2018). Although sedentary time was not always significantly associated with quality of life, it highlights the need for regular assessment of the relationship between sedentary time and quality of life (Côté et al., 2024). A review of the literature found that physical activity participation among Korean breast cancer patients was associated with reduced fatigue and pain, as well as improved sexual function (Shin et al., 2017). Another study reported that very few ovarian cancer patients met public health physical activity guidelines; however, those who did had significantly better quality of life (Stevinson et al., 2007). A more sedentary lifestyle has also been associated with reduced physical function and increased insomnia, fatigue, and pain scores (Yan et al., 2021). Although sedentary time was not included in the measured outcomes of our study, our findings suggest that patients with lung cancer and other types of cancer (i.e., head and neck, uterine, bone, lymphoma, liver, stomach, esophageal cancer) may experience lower physical, emotional, and global health status alongside increased symptoms of fatigue, insomnia, and appetite loss possibly due to more sedentary behavior patterns. Consistent with our study findings, the literature indicates that patients with breast and colon cancer have higher physical activity levels than those with lung cancer, while lung cancer patients exhibit higher fatigue levels (Usgu &

Ozbudak, 2022). These results emphasize the clinical relevance of monitoring sedentary behavior in oncology care. Healthcare professionals – particularly oncologists, nurses, and physiotherapists – should integrate sedentary time assessments into routine follow-up visits and identify barriers such as lack of energy or time that prevents patients from being more active. By addressing these challenges and providing individualized, low-intensity physical activity recommendations, clinicians can help patients maintain functional capacity, improve treatment tolerance, and enhance overall quality of life during cancer treatment.

4.4 Differences in physical activity and quality of life among cancer patients according to demographic and disease characteristics

When the literature was examined, it was found that there was no significant difference between groups in physical activity and quality of life among cancer patients when analyzed by demographic and disease-related factors (Pirincci et al., 2024). Another study found that participation in insufficient physical activity in all patients receiving cancer treatment negatively affected the quality of life in terms of demographic and that these negative effects may be greater in female patients than in male patients (Atli & Duger, 2020). In contrast, our study found no significant relationship between physical activity levels and quality of life when analyzed by demographic characteristics, including gender. Given these conflicting findings in the literature, the discrepancies may be attributed to differences in measurement tools, study designs, or individual participant characteristics. These variations highlight the need for more comprehensive studies to better understand the relationship between physical activity and quality of life across different demographic groups, including gender. Clinically, this finding suggests that demographic characteristics alone may not be sufficient indicators of who is at risk for low physical activity during treatment. Therefore, multidisciplinary healthcare and oncology teams should consider a holistic approach that evaluates individual symptoms, treatment side effects, psychological factors, and social support when developing physical activity recommendations for patients.

Our study had several limitations. First, we were unable to assess physical activity levels using objective measurement tools such as wearable devices (e.g., pedometers, heart rate monitors, or accelerometers). The IPAQ-SF method used in our study is widely used for

assessing physical activity; however, it may include subjective limitations such as participants' inaccurate recall. Second, many of the cancer patients had been undergoing treatment for an extended period, and we lacked baseline data on their physical activity levels and quality of life at the start of treatment. Finally, our sample group consisted of patients receiving cancer treatment in a hospital in one of our metropolitan cities, which limits the generalizability of our findings to a broader population of cancer patients nationwide.

Future studies should aim to incorporate longitudinal designs to track changes in physical activity and quality of life throughout the course of treatment. Randomized controlled trials evaluating the effects of structured exercise interventions – such as supervised aerobic and resistance programs – across different cancer types and treatment phases are particularly warranted. Moreover, the integration of objective physical activity monitoring tools (e.g., accelerometers, wearable sensors) could provide more precise data and help identify the optimal level and type of exercise needed to improve quality of life during active cancer therapy.

5. Conclusion

This study demonstrated that cancer patients undergoing active treatment generally exhibit low levels of physical activity, which are associated with reduced quality of life – particularly in the physical, emotional, and global health domains. The key contribution of this study is its focus on patients receiving active treatment rather than survivors, providing new insight into the direct relationship between physical activity and quality of life during the most demanding phase of cancer care.

Acknowledgements

We would like to thank Bursa Ali Osman Sonmez Oncology Hospital Chief Physician Dr. Halil Karahan and Health Care Services Manager Julide Kilic for their support during the data collection process. These findings emphasize that maintaining physical activity – even at low or moderate levels – plays a crucial role in preserving patients' functional capacity and psychological well-being throughout treatment. Integrating personalized physical activity counseling and light, feasible exercise recommendations into oncology practice may improve both treatment tolerance and overall quality of life. Therefore, physical activity

should be regarded as a core component of comprehensive cancer care, not as an optional supplement.

Funding information

The work did not receive any external funding.

Author contributions

All authors contributed equally to the preparation of this study.

Conflict of interest statement

Regarding this study, the authors and/or their family members do not have any scientific or medical committee memberships or affiliations with their members, consultancy, expertise, employment in any company, shareholding, or similar situations that may have a potential conflict of interest.

Data availability statement

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

- Al Maqbali, M., Al Sinani, M., Al Naamani, Z., & Al Badi, K. (2021). Prevalence of fatigue in patients with cancer: A systematic review and meta-analysis. *Journal of Pain and Symptom Management*, 61(1), 167–189. doi: 10.1016/j.jpainsymman.2020.07.037.
- Albrecht, T. A., & Taylor, A. G. (2012). Physical activity in patients with advanced-stage cancer: A systematic review of the literature. *Clinical Journal of Oncology Nursing*, 16(3), 293. doi: 10.1188/12.cjon.293-300.
- Al-Mhanna, S. B., Wan Ghazali, W. S., Mohamed, M., Rabaan, A. A., Santali, E. Y., Alestad, J. H., Arshad, S., Ahmed, N., & Afolabi, H. A. (2022). Effectiveness of physical activity on immunity markers and quality of life in cancer patient: A systematic review. *PeerJ*, 10, e13664. doi: 10.7717/peerj.13664.

- Andersen, H. H., Vinther, A., Lund, C. M., Paludan, C., Jørgensen, C. T., Nielsen, D., & Juhl, C. B. (2022). Effectiveness of different types, delivery modes and extensiveness of exercise in patients with breast cancer receiving systemic treatment—A systematic review and meta-analysis. *Critical Reviews in Oncology/Hematology*, 178, 103802. doi: 10.1016/j.critrevonc.2022.103802.
- Atli, A., & Duger, T. (2020). An evaluation of quality of life and muscle strength in adult cancer patients receiving treatment. *Turkish Journal of Physiotherapy and Rehabilitation*, 31(3), 288–297. doi: 10.21653/tjpr.495603.
- Buffart, L. M., Kalter, J., Sweegers, M. G., Courneya, K. S., Newton, R. U., Aaronson, N. K., Jacobsen, P. B., May, A. M., Galvão, D. A., Chinapaw, M. J., & Steindorf, K. (2017). Effects and moderators of exercise on quality of life and physical function in patients with cancer: An individual patient data meta-analysis of 34 RCTs. *Cancer Treatment Reviews*, 52, 91–104. doi: 10.1016/j.ctrv.2016.11.010.
- Caetano, A. F. P., Silva, D. A. S., Martins, P. C., & Toscano, J. J. D. O. (2020). Impact of physical activity on fatigue and quality of life of cancer patients. *Revista Brasileira de Medicina do Esporte*, 26(6), 498–502. doi: 10.1590/1517-8692202026062019_0045.
- Campbell, K. L., Winters-Stone, K. M., Wiskemann, J., May, A. M., Schwartz, A. L., Courneya, K. S., Zucker, D. S., Matthews, C. E., Ligibel, J. A., Gerber, L. H., Morris, G. S., Patel, A. V., Hue, T. F., Perna, F. M., & Schmitz, K. H. (2019). Exercise guidelines for cancer survivors: Consensus statement from international multidisciplinary roundtable. *Medicine and Science in Sports and Exercise*, 51(11), 2375–2390. doi: 10.1249/mss.0000000000002116.
- Chapman, E. J., Martino, E. D., Edwards, Z., Black, K., Maddocks, M., & Bennett, M. I. (2022). Practice review: Evidence-based and effective management of fatigue in patients with advanced cancer. *Palliative Medicine*, 36(1), 7–14. doi: 10.1177/02692163211046754.
- Côté, A., Miquelon, P., & Trudel-Fitzgerald, C. (2024). Physical activity, sedentary time, and psychosocial functioning among adults with cancer: A scoping review. *International Journal of Environmental Research and Public Health*, 21(2), 225. doi: 10.3390/ijerph21020225.
- Courneya, K. S., Segal, R. J., McKenzie, D. C., Dong, H., Gelmon, K., Friedenreich, C. M., Yasui, Y., Reid, R. D., Crawford, J. J., & Mackey, J. R. (2014). Effects of exercise during adjuvant chemotherapy on breast cancer outcomes. *Medicine & Science in Sports & Exercise*, 46(9), 1744–1751. doi: 10.1249/MSS.0000000000000297.
- Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise*, 35(8), 1381–1395. doi: 10.1249/01.mss.0000078924.61453.fb.
- Fayers, P., Bottomley, A., & EORTC Quality of Life Group. (2002). Quality of life research within the EORTC – the EORTC QLQ-C30. *European Journal of Cancer*, 38, 125–133. doi: 10.1016/s0959-8049(01)00448-8.
- Furmaniak, A. C., Menig, M., & Markes, M. H. (2016). Exercise for women receiving adjuvant therapy for breast cancer. *Cochrane Database of Systematic Reviews*, 9(9), CD005001. doi: 10.1002/14651858.CD005001.pub3.
- Guzelant, A., Goksel, T., Ozkok, S., Tasbakan, S., Aysan, T., & Bottomley, A. (2004). The European Organization for Research and Treatment of Cancer QLQ-C30: An examination into the cultural validity and reliability of the Turkish version of the EORTC QLQ-C30. *European Journal of Cancer Care*, 13(2), 135–144. doi: 10.1111/j.1365-2354.2003.00435.x.
- Han, X., Robinson, L. A., Jensen, R. E., Smith, T. G., & Yabroff, K. R. (2021). Factors associated with health-related quality of life among cancer survivors in the United States. *JNCI Cancer Spectrum*, 5(1), pkaa123. doi: 10.1093/jncics/pkaa123.
- Henson, L. A., Maddocks, M., Evans, C., Davidson, M., Hicks, S., & Higginson, I. J. (2020). Palliative care and the management of common distressing symptoms in advanced cancer: Pain, breathlessness, nausea and vomiting, and fatigue. *Journal of Clinical Oncology*, 38(9), 905–914. doi: 10.1200/jco.19.00470.
- Hojman, P., Gehl, J., Christensen, J. F., & Pedersen, B. K. (2018). Molecular mechanisms linking exercise to cancer prevention and treatment. *Cell Metabolism*, 27(1), 10–21. doi: 10.1016/j.cmet.2017.09.015.
- Kalra, R., Anand, B., Shree, S., Chauhan, H., & Sharma, H. (2021). Association of physical activity and quality of life among cancer patients. *International Journal of Medical Science and Clinical Investigation*, 8(6), 5463–5468. doi: 10.18535/ijmsci/v8i06.06.
- Leach, M. J., Barber, G., Monacella, S., Jamieson, P., Trinh, T., Vo, N., Schmidt, U., Byrne, A., & Ristevski, E. (2023). Physical activity, obesity, and quality of life among rural Australian cancer survivors: A cross-sectional study. *Supportive Care in Cancer*, 31(4), 222. doi: 10.1007/s00520-023-07691-w.
- Lipsett, A., Barrett, S., Haruna, F., Mustian, K., & O'Donovan, A. (2017). The impact of exercise during adjuvant radiotherapy for breast cancer on fatigue

- and quality of life: A systematic review and meta-analysis. *The Breast*, 32, 144–155. doi: 10.1016/j.breast.2017.02.002.
- Martínez-Vizcaino, V., Caverro-Redondo, I., Reina-Gutiérrez, S., Gracia-Marco, L., Gil-Cosano, J. J., Bizzozero-Peroni, B., Rodríguez-Artalejo, F., & Ubago-Guisado, E. (2023). Comparative effects of different types of exercise on health-related quality of life during and after active cancer treatment: A systematic review and network meta-analysis. *Journal of Sport and Health Science*, 12(6), 726–738. doi: 10.1016/j.jshs.2023.01.002.
- Matthews, C. E., Moore, S. C., Arem, H., Cook, M. B., Trabert, B., Håkansson, N., Larsson, S. C., Wolk, A., Gapstur, S. M., Lynch, B. M., & Milne, R. L. (2020). Amount and intensity of leisure-time physical activity and lower cancer risk. *Journal of Clinical Oncology*, 38(7), 686–697. doi: 10.1200/jco.19.02407.
- Mishra, S. I., Scherer, R. W., Snyder, C., Geigle, P. M., Berlanstein, D. R., & Topaloglu, O. (2012). Exercise interventions on health-related quality of life for people with cancer during active treatment. *Cochrane Database of Systematic Reviews*, 2012(8), CD008465. doi: 10.1002/14651858.CD008465.pub2.
- Nurnazahiah, A., Shahril, M. R., Nor Syamimi, Z., Ahmad, A., Sulaiman, S., & Lua, P. L. (2020). Relationship of objectively measured physical activity and sedentary behaviour with health-related quality of life among breast cancer survivors. *Health and Quality of Life Outcomes*, 18, 1–10. doi: 10.1186/s12955-020-01478-x.
- Ozturk, M. (2005). *Research on reliability and validity of international physical activity questionnaire and determination of physical activity level in university students (Mester Thesis)*. Hacettepe University, Institute of Health Sciences.
- Pekmezci, H., Kose, B. G., Akbal, Y., Ozdemir, V. A., & Col, B. K. (2022). Uses of complementary therapy in symptom management of cancer patients who receive chemotherapy. *Health Care Academics Journal*, 9(3). doi: 10.52880/sagakaderg.1045498.
- Pirincci, C. S., Gokce, E., & Goksen, A. (2024). Comparison of physical activity level and quality of life of patients who developed lymphedema in the lower and upper extremities after cancer surgery. *SPORMETRE*, 22(1), 113–122. doi: 10.33689/spormetre.1399970.
- Ramírez-Vélez, R., Zambom-Ferraresi, F., García-Hermoso, A., Kievisiene, J., Rauckiene-Michealsson, A., & Agostinis-Sobrinho, C. (2021). Evidence-based exercise recommendations to improve mental wellbeing in women with breast cancer during active treatment: A systematic review and meta-analysis. *Cancers*, 13(2), 264. doi: 10.3390/cancers13020264.
- Rendeiro, J. A., Rodrigues, C. A. M. P., de Barros Rocha, L., Rocha, R. S. B., da Silva, M. L., & da Costa Cunha, K. (2021). Physical exercise and quality of life in patients with prostate cancer: Systematic review and meta-analysis. *Supportive Care in Cancer*, 29, 4911–4919. doi: 10.1007/s00520-021-06095-y.
- Robertson, M. C., Lyons, E. J., Song, J., Cox-Martin, M., Li, Y., Green, C. E., Pinto, B. M., Carmack, C. L., Harrison, C., Baum, G., & Basen-Engquist, K. M. (2019). Change in physical activity and quality of life in endometrial cancer survivors receiving a physical activity intervention. *Health and Quality of Life Outcomes*, 17(1), 91. doi: 10.1186/s12955-019-1154-5.
- Rock, C. L., Thomson, C. A., Sullivan, K. R., Howe, C. L., Kushi, L. H., Caan, B. J., Neuhaus, M. L., Bandera, E. V., Wang, Y., Robien, K., & Basen-Engquist, K. M. (2022). American Cancer Society nutrition and physical activity guideline for cancer survivors. *CA: A Cancer Journal for Clinicians*, 72(3), 230–262. doi: 10.3322/caac.21719.
- Rodríguez-Cañamero, S., Cobo-Cuenca, A. I., Carmona-Torres, J. M., Pozuelo-Carrascosa, D. P., Santacruz-Salas, E., Rabanales-Sotos, J. A., Cuesta-Mateos, T., & Laredo-Aguilera, J. A. (2022). Impact of physical exercise in advanced-stage cancer patients: Systematic review and meta-analysis. *Cancer Medicine*, 11(19), 3714–3727. doi: 10.1002/cam4.4746.
- Sarich, P., Canfell, K., Egger, S., Banks, E., Joshy, G., Grogan, P., & Weber, M. F. (2021). Alcohol consumption, drinking patterns and cancer incidence in an Australian cohort of 226,162 participants aged 45 years and over. *British Journal of Cancer*, 124(2), 513–523. doi: 10.1038/s41416-020-01101-2.
- Schofield, C., Newton, R. U., Cohen, P. A., Galvão, D. A., McVeigh, J. A., Mohan, G. R., Tan, J., Salfinger, S. G., Straker, L. M., & Peddle-McIntyre, C. J. (2018). Health-related quality of life and pelvic floor dysfunction in advanced-stage ovarian cancer survivors: Associations with objective activity behaviors and physiological characteristics. *Supportive Care in Cancer*, 26(7), 2239–2246. doi: 10.1007/s00520-018-4069-5.
- Shapiro, C. L. (2018). Cancer survivorship. *New England Journal of Medicine*, 379(25), 2438–2450. doi: 10.1056/nejmra1712502.
- Shin, W. K., Song, S., Jung, S. Y., Lee, E., Kim, Z., Moon, H. G., Noh, D. Y., & Lee, J. E. (2017). The association between physical activity and health-related quality of life among breast cancer survivors. *Health and Quality*

- of *Life Outcomes*, 15(1), 132. doi: 10.1186/s12955-017-0706-9.
- Siegel, R. L., Miller, K. D., Wagle, N. S., & Jemal, A. (2023). Cancer statistics, 2023. *CA: A Cancer Journal for Clinicians*, 73(1), 17–48. doi: 10.3322/caac.21763.
- Sohn, W., Lee, H. W., Lee, S., Lim, J. H., Lee, M. W., Park, C. H., & Yoon, S. K. (2020). Obesity and the risk of primary liver cancer: A systematic review and meta-analysis. *Clinical and Molecular Hepatology*, 27(1), 157. doi: 10.3350/cmh.2020.0176.
- Soones, T., Ombres, R., & Escalante, C. (2022). An update on cancer-related fatigue in older adults: A narrative review. *Journal of Geriatric Oncology*, 13(2), 125–131. doi: 10.1016/j.jgo.2021.07.006.
- Stevinson, C., Faught, W., Steed, H., Tonkin, K., Ladha, A. B., Vallance, J. K., Capstick, V., Schepansky, A., & Courneya, K. S. (2007). Associations between physical activity and quality of life in ovarian cancer survivors. *Gynecologic Oncology*, 106(1), 244–250. doi: 10.1016/j.ygyno.2007.03.033.
- Stone, P., Candemli, D. E., Kandola, K., Montero, L., Smetham, D., Suleman, S., Fernando, A., & Rojí, R. (2023). Management of fatigue in patients with advanced cancer. *Current Treatment Options in Oncology*, 24(2), 93–107. doi: 10.1007/s11864-022-01045-0.
- Stout, N. L., Santa Mina, D., Lyons, K. D., Robb, K., & Silver, J. K. (2021). A systematic review of rehabilitation and exercise recommendations in oncology guidelines. *CA: A Cancer Journal for Clinicians*, 71(2), 149–175. doi: 10.3322/caac.21639.
- Sweegers, M. G., Altenburg, T. M., Chinapaw, M. J., Kalter, J., Verdonck-de Leeuw, I. M., Courneya, K. S., Newton, R. U., Aaronson, N. K., Jacobsen, P. B., Brug, J., & Buffart, L. M. (2018). Which exercise prescriptions improve quality of life and physical function in patients with cancer during and following treatment? A systematic review and meta-analysis of randomised controlled trials. *British Journal of Sports Medicine*, 52(8), 505–513. doi: 10.1136/bjsports-2017-097891.
- Thraen-Borowski, K. M., Trentham-Dietz, A., Edwards, D. F., Koltyn, K. F., & Colbert, L. H. (2013). Dose–response relationships between physical activity, social participation, and health-related quality of life in colorectal cancer survivors. *Journal of Cancer Survivorship*, 7, 369–378. doi: 10.1007/s11764-013-0277-7.
- Usgu, S., & Ozbudak, O. (2022). The investigation of quality of life, physical activity and fatigue levels in patients with different cancer types and caregiver. *KSU Medical Journal*, 17(2), 123–133. doi: 10.17517/ksutfd.939552.
- Wilkinson, R., & Smith, L. (2023). Physical activity levels in female breast cancer patients and survivors in Ekurhuleni, South Africa. *South African Journal of Sports Medicine*, 35(1), 1–7. doi: 10.17159/2078-516X/2023/v35i1a16001.
- Yan, R., Che, B., Lv, B., Wu, P., Lu, X., Zhang, Y., Wang, J., & Yu, J. (2021). The association between physical activity, sedentary time and health-related quality of life in cancer survivors. *Health and Quality of Life Outcomes*, 19, 1–12. doi: 10.1186/s12955-020-01575-x.
- Zhu, C., Ma, H., He, A., Li, Y., He, C., & Xia, Y. (2022). Exercise in cancer prevention and anticancer therapy: Efficacy, molecular mechanisms and clinical information. *Cancer Letters*, 544, 215814. doi: 10.1016/j.canlet.2022.215814.