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Cognitive dysfunction and depression in chemotherapy patients: a cross-sectional study from Turkey

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Abstract

Objective This study investigates the relationship between cognitive function and depression in cancer patients receiving chemotherapy.

Methods A cross-sectional study design was employed, involving 80 cancer patients undergoing chemotherapy. Data were collected using the Socio-Demographic Information Form, the Functional Assessment of Cancer Therapy–Cognitive Function (FACT-Cog), and the Beck Depression Inventory (BDI). Assessments were conducted prior to the second cycle of chemotherapy.

Results Among participants, 72.8% were female and 47.5% aged 40–50. Moderate depressive symptoms were most common (45%). Cognitive dysfunction was inversely correlated with depression ($r = -0.525$, $p < 0.001$). Low income significantly predicted lower cognitive scores ($p = 0.01$).

Conclusion Chemotherapy patients exhibit cognitive decline and elevated depression levels. Socioeconomic status exacerbates these effects. Psychosocial interventions should be integrated into oncological rehabilitation.

Keywords Cancer, Chemotherapy, Depression, Cognitive function, Rehabilitation

Introduction

Cancer, which is known as one of the most important mortality and morbidity causes in the world, constitutes a serious disease group with the uncontrolled proliferation of a cell clone, invasion, and metastasis to the organ where it reproduces and to other organs [1]. With the increasing life expectancy of cancer patients, greater emphasis has been placed on effectively managing the disease process. This includes coping with the diagnosis, minimizing drug-related side effects, alleviating common symptoms—particularly fatigue and pain—and ultimately enhancing the quality of life for individuals living with cancer [2]. Cancer-related cognitive impairment may affect the working abilities, social and occupational functions, and daily lives of cancer survivors negatively, and ultimately reduce their quality of life, increasing susceptibility to depression [3, 4].

Having a diagnosis of cancer increases the rate of psychiatric diseases at varying degrees in the future of patients. The most common psychopathology is major depression in cancer patients [4]. Conditions such as hopelessness, reluctance, unhappiness, guilt, social isolation, sleep

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problems, and decreased attention and concentration are common symptoms in depressed individuals [5]. Since the symptoms of depression and side effects that occur because of immunosuppressive agents show similar symptoms, it is very important to distinguish between the symptoms caused by the disease and the treatment [6]. It is already known that there are some risk factors regarding the incidence of depression in cancer patients. Conditions such as any psychiatric disease before the diagnosis of cancer, emotional stress at the stage of diagnosis, insufficient social support, poor physical condition, adverse effects on quality of life because of inadequacies in cognitive areas with the side effects of the drugs used, low self-esteem, and loss of a relative are some of the risk factors causing depression in cancer patients [4]. Depression is not a normal condition of the disease and must be treated in cancer patients [7]. The integrated combination of physical, cognitive, and psychosocial methods in this difficult process experienced by cancer patients will increase the success of treatment significantly [8].

Chemotherapy, as a systemic treatment, is known to induce neurotoxic effects that can negatively affect several cognitive domains, including memory, attention, executive function, and processing speed [9]. Studies have shown that cancer patients undergoing chemotherapy often experience difficulties in daily functioning due to cognitive decline, which can persist long after treatment has ended [10]. In addition, cancer patients often report increased levels of depression, which can exacerbate cognitive dysfunction. Depression is common among individuals diagnosed with cancer, with research suggesting a bidirectional relationship between psychological distress and cognitive deficits [11]. Furthermore, individual characteristics such as age, gender, education level, cancer type, and treatment duration have been found to influence the severity of cognitive decline and depression levels [12]. These findings highlight the need for further research to explore the complex interplay between chemotherapy, cognitive function, and depression in cancer patients. Building on this, the present study aims to investigate the extent of cognitive impairment in cancer patients receiving chemotherapy, assess their levels of depression, and examine how demographic and clinical characteristics influence these outcomes. The following hypotheses were formulated: Cancer patients' cognitive functions are negatively affected by the disease process (H1). Their level of depression will be significantly higher than that of the general population (H2). In addition, there will be a significant relationship between cancer patients' cognitive functions, depression levels, and their descriptive characteristics such as age, gender, education level, duration of diagnosis, and type of treatment received (H3).

Methods

Type of study and permission

The study had a cross-sectional design. An ethics approval certificate was obtained from Gaziantep Islamic Science and Technology University Non-Interventional Clinical Research Ethics Committee for the study (Protocol number = 2021/59). Written informed consent was obtained from the participants in the framework of the Declaration of Helsinki.

Place and time of the study

The study was conducted with adult patients who applied to Gaziantep Sanko Hospital Oncology Department and received chemotherapy treatment between March 2021 and November 2021.

Strength of the Study

The sampling size of the study was based on the G-power 3.0 statistical program at the level of significance of Type-1 error 0.05, Type-2 error 0.20 (0.80% power), and it was found sufficient to include 72 individuals. This value indicates that the sampling is adequate. In the present study, 80 male and female individuals were included in the sampling.

Participants

The inclusion criteria for participation in the study required individuals to be 18 years of age or older, to volunteer for the study, and to have no prior diagnosis of any chronic psychiatric disorder. Additionally, participants should not have been receiving psychiatric medication or therapy, must have been diagnosed with any type of cancer, and needed to possess adequate communication skills.

Measures

Participants were assessed one day prior to the second cycle of chemotherapy. This timing was selected to allow for clearer observation of cognitive and psychological changes that may emerge during the early phase of treatment. It also aimed to minimize the potential impact of side effects, which tend to become more pronounced in later stages of chemotherapy. Therefore, assessing patients at an earlier stage was deemed appropriate to better understand the initial effects of treatment. Moreover, the second cycle was chosen rather than later cycles to ensure that patients had experienced chemotherapy at least once, while still limiting the confounding effects of cumulative exposure. Data were collected using the Socio-Demographic Information Form, developed by the researchers in accordance with the literature, the Functional Assessment of Cancer Therapy–Cognitive Function (FACT-Cog) scale, and the Beck Depression Inventory (BDI).

Socio-demographic information form

A semi-structured form was designed by the researchers to collect data relevant to the objectives of this study (Appendix 1). There were a total of 6 questions in this form on age, sex, education level, income level, diagnosis, and disease duration.

Data collection

The data were collected by the researchers with the face-to-face questionnaire method. Before starting the study, individuals who had cancer were informed verbally about the purpose and content of the study by the researchers.

Functional assessment of cancer treatment (FACT-COG)

This scale is a self-administered questionnaire completed by patients, assessing behavioural cognitive impairments and treatment-related effects of chemotherapy over the past seven days. Developed through interviews with oncology patients and field experts, the scale evaluates parameters such as cognitive acuity, attention and coordination, memory, verbal fluency, functional confusion, external observations about the patient, changes in functionality compared to the pre-treatment period, and overall quality of life.

The scale comprises four subsections and a total of 37 questions. Items related to perceived cognitive impairment, others' comments, perceived cognitive abilities, and impact on quality of life are rated on a 0–4 scale (0 = Many times a day, 4 = Never). In the perceived cognitive abilities subsection, nine questions are scored on a scale where 0 = Not at all and 4 = Very much. Some items in the perceived cognitive impairment and perceived cognitive abilities subsections are reverse scored. The final two questions are excluded from scoring.An increased total score indicates the improvement of the situation in terms of cognitive functions [13].

Table 1 Socio-demographic characteristics of participants (*N*=80)

Variable	n	%
Sex		
Men	17	21.2
Women	63	72.8
Age (year)		
18-28	2	2.5
29-39	16	20.0
40-50	38	47.5
51-60	17	21.5
60+	7	8.8
Education Level		
Primary education	40	50.0
High School	22	27.5
University	15	18.8
Postgraduate	3	3.8
Working		
Unemployed	11	13.8
Housewife	42	52.5
Officer	15	18.8
Worker	12	14.1
Economic Status		
Lower income	17	21.2
Middle income	63	78.8
Diagnosis		
Breast cancer	46	57.5
Other cancers	34	42.5

Beck Depression Inventory (BDI)

BDI is a 21-item scale measuring vegetative, emotional, cognitive, and motivational symptoms in depression. Each of the 21 items determines a behavioral pattern specific to depression and includes self-evaluation sentences with four options, ranging from less to most (0–3). It is one of the most widely used tools in the world to evaluate the severity of depressive symptoms in psychiatric patients and normal sampling. A two-factor solution consisting of the first factor assessing cognitive symptoms was proposed in this respect (12 items) and the second factor assessing somatic-affective symptoms (9 items). Two factors explain 42.6% of the total variance in the sampling. The Cronbach's Alpha Value of the BDI was 0.90, the Cronbach's Alpha value of the cognitive dimension was 0.87, and the Cronbach's Alpha Value of the somatic-affective dimension was 0.76 in the entire sampling. Minimal depression was determined as 0–9, Mild depression 10–16, Moderate depression 17–29, and Severe depression 30–63 points [14].

Statistical methods

The data were evaluated in SPSS 24.0 (Statistical Package for Social Sciences for Windows) statistical program. The conformity of the data to the normal distribution was calculated with the Kolmogorov Smirnov Test in the statistical analysis. Student t and One-Way Anova Test were used to compare the independent variables along with descriptive statistics (percentage, frequency, mean, standard deviation, minimum, maximum) in the evaluation of the data. Pearson Correlation Test was used to measure the relations between cognitive function and depression scores.

Results

A total of 80 individuals who were diagnosed with cancer and undergoing chemotherapy were included in the study. The demographic and medical data of the individuals are given in Table 1. A total of 72.8% of the individuals who participated in the study were women, 47.5% had a mean age of 40–50 years, 50.0% were primary school graduates, 52.5% were housewives, 78.8% had a moderate income level, and 57.5% had breast cancer (Table 1).

The mean BDI total score of the individuals was found to be 18.58 ± 10.68, and the mean FACT-COG Scale score was 75.97 ± 35.32. Among FACT-COG Scale sub-dimensions, the mean score of Perceived Cognitive Disorder was 45.55 ± 20.65, Other People's Comments 12.17 ± 4.33, Perceived Cognitive Skills 11.55 ± 10.14, and the effect on Quality of Life sub-dimension was 6.70 ± 5.88 (Table 2).

Mild, moderate, and severe depressive symptoms were found in 77.5% of the individuals (Table 3).

No statistically significant differences were detected between the sociodemographic characteristics of the individuals and their mean BDI scores (Table 4).

When the relations between the sociodemographic characteristics of the individuals and the FACT-COG total score were examined, individuals with low economic status had a low FACT-COG total score ($p = 0.01$) (Table 5).

A negative and statistically significant relation was detected between individuals' BDI and FACT-COG total scores ($p < 0.001$; $r = -0.525$) (Table 6).

Table 2 Depression and cognitive status scores

	Min-Max	Median	$\bar{X} \pm SS$
BDI Total	0-63	19	18.58 ±10.68
FACT-COG Total	0-132	80	75.97±35.32
Perceived Cognitive Impairments	0-72	50	45.55±20.65
Comments from Others	0-16	13.50	12.17±4.33
Perceived Cognitive Abilities	0-28	7.50	11.55±10.14
Impact of Perceived Cognitive Impairments on QoL	0-16	6	6.70±5.88

BDI Beck Depression Inventory, *FACT-COG* Functional Evaluation of Cancer Treatments-Cognitive Function Scale

Table 3 Subsection of beck depression inventory (*N*=80)

n	%
0-9 No depression	18
10-16 Mild depression	14
17-29 Moderate depression	36
30-63 Severe depression	12
Total	80

Table 4 Comparison of sociodemographic characteristics and BDI scores (*N*=80)

Variable	*n*	$\bar{X} \pm SS$	t/F	*p*
Sex			***t*=−0.254**	***p*=0.80**
Men	17	18.00 ± 12.41		
Women	63	18.74 ± 10.26		
Age (years)			***F*=0.493**	***p*=0.74**
18-28	2	12.50 ± 7.77		
29-39	16	19.25 ± 13.05		
40-50	38	17.55 ± 9.66		
51-60	17	19.47 ± 8.68		
60+	7	22.28 ± 15.82		
Education Level			***F*=0.452**	***p*=0.71**
Primary education	40	18.02 ± 11.40		
High School	22	20.54 ± 11.03		
University	15	16.80 ± 9.08		
Postgraduate	3	20.66 ± 5.68		
Job			***F*=1.740**	***p*=0.15**
Unemployed	11	16.81 ± 11.10		
Housewife	42	20.47 ± 11.07		
Officer	15	15.33 ± 8.82		
Worker	12	24.60 ± 9.60		
Economic Status			***t*=0.972**	***p*=0.33**
Lower income	17	20.82 ± 11.58		
Middle income	63	17.98 ± 10.43		
Diagnosis			***t*=−0.022**	***p*=0.98**
Breast cancer	46	18.56 ± 10.49		
Other cancers	34	18.61 ± 11.08		

Discussion

Many physical, mental, and psychosocial changes are recorded in cancer patients as of the date of diagnosis. The most common psychopathology is major depression in cancer patients [15, 16]. In the study, it was found that cognitive functions were affected negatively and depression levels increased in individuals receiving chemotherapy. The diagnosis of cancer, difficult treatment and fear of death can cause various biopsychosocial problems in individuals. In addition, the active ingredients of the drugs used in chemotherapy can cause cognitive dysfunction. The type and stage of cancer, the patient's age, and physical and environmental factors may all contribute to the increase in biopsychosocial needs [17, 18]. There is a need for studies that elucidate treatment processes and subsequent outcomes in oncological rehabilitation, and that comprehensively examine the relationships between cognitive functions and other related parameters. We believe that the present study will contribute to all healthcare professionals working in the field of oncological rehabilitation, patients, and their relatives.

There is a substantial body of literature examining physical and social problems in cancer patients. In particular, cancer-related cognitive dysfunction has been extensively studied among breast cancer survivors, making it one of the most researched cancer types in this domain. However, there remains a gap in comparative studies that examine cognitive impairment across different cancer types. Our study contributes to this gap by exploring cognitive functioning in patients with breast and non-breast cancers. While cognitive dysfunction was observed in both groups, no significant cancer type–specific differences were found.

In the present study, most participants were breast cancer patients, likely due to the accessibility of this patient group in the under-resourced region where the cross-sectional data collection was conducted. Although our findings cannot be generalised across all cancer types,

Table 5 Comparison of FACT-COG mean scores and sociodemographic characteristics (*N*=80)

Variable	*n*	FACT-COG $\bar{X} \pm SS$	t/F	*p*
Sex			***t*=0.690**	***p*=0.49**
Men	17	81.23 ± 35.95		
Women	63	74.55 ± 35.30		
Age (years)			***F*=0.253**	***p*=0.90**
18-28	2	84.00 ± 2.82		
29-39	16	77.56 ± 39.27		
40-50	38	76.31 ± 34.93		
51-60	17	77.88 ± 34.24		
60+	7	63.57 ± 41.17		
Education Level			***F*=0.598**	***p*=0.61**
Primary education	40	73.25 ± 37.24		
High School	22	77.04 ± 36.86		
University	15	84.86 ± 30.36		
Postgraduate	3	60.00 ± 19.15		
Job			***F*=0.698**	***p*=0.59**
Unemployed	11	74.54 ± 31.72		
Housewife	42	70.90 ± 37.12		
Officer	15	83.20 ± 37.39		
Worker	12	78.80 ± 28.01		
Economic Status			***t*=−2.412**	***p*=0.01**
Lower income	17	58.17 ± 39.62		
Middle income	63	80.77 ± 32.77		
Diagnosis			***t*=0.663**	***p*=0.51**
Breast cancer	46	73.71 ± 36.22		
Other cancers	34	79.02 ± 34.36		

Table 6 The relationship between individuals'BDI and FACT-COG total scores

BDI	r	*p*
FACT-COG	−0.525	<0.001

$p < 0.05$, r = Pearson correlation test

they highlight the need for randomized controlled trials including balanced samples from diverse cancer populations. Such studies would strengthen the evidence base for cancer-related cognitive dysfunction beyond breast cancer.

While the mechanisms of cognitive impairment in breast cancer have been relatively well explored, factors such as educational background continue to influence post-treatment cognitive outcomes. Perrier et al. reported that lower education levels may negatively impact cognitive performance during the recovery phase following chemotherapy. In our study, a high proportion of participants had low income and education levels, and these individuals exhibited more pronounced cognitive difficulties along with elevated depressive symptoms.

Depression-related symptoms—such as low energy, reluctance, unhappiness, sadness, negative perception of events, crying, decreased libido, forgetfulness, inattentiveness, guilt, social withdrawal, sleep disturbances, loss of interest, suicidal ideation, and impaired concentration—were commonly reported [5]. In the current study, the mean BDI score indicated moderate depression, with 77.5% of participants exhibiting depressive symptoms. Similar findings have been reported in previous studies, where low socioeconomic status was associated with lower quality of life and higher depression scores [16]. Therefore, addressing depressive symptoms is as important as managing physical health in cancer care. A multidisciplinary team approach is essential to help patients navigate this process with greater comfort and improved quality of life.

It is already known that there are some risk factors regarding the incidence of depression in cancer patients. Cognitive deficiencies can be detected in these patients because of any psychiatric illness before the diagnosis, emotional stress at the stage of diagnosis, insufficient social support, poor physical conditions, and side effects of the drugs used in the process. Conditions such as negatively affecting the quality of life of patients and low self-esteem are among the risk factors causing depression in cancer patients [4]. As a professional healthcare team member, it is very important to empathize and understand the patient, interpret and analyze the way s/he copes with the disease and his/her reactions correctly in the treatment process. A holistic approach to the physical, cognitive and psychosocial problems experienced by cancer patients will increase the success of treatment significantly. In this respect, one of the important parameters of oncological rehabilitation is psycho-oncological approaches. With these approaches, raising the low self-esteem of cancer patients, detecting faulty thoughts on the disease and replacing them with correct ones, supporting them to express their tension, anxiety, and fears verbally, and ensuring that cancer and some obstructive situations regarding the disease are accepted by the patient. The purpose is to eliminate the cognitive deficiencies of the patient by supporting cognitive functions and to help the patient cope with feelings of loss and disease [8]. It was reported in a prospective study that was conducted with breast cancer patients who received chemotherapy that patients had mild and moderate depressive symptoms and decreased cognitive functions [19]. In the present study, the cognitive function scores of the individuals were found to be moderate. A moderately significant relation was detected between depression and cognitive functions.

A prior systematic review investigated the association between cognitive function and psychological conditions—such as anxiety and depression—among breast cancer patients, concluding that those experiencing psychological distress exhibited poorer cognitive performance [20].

Consistent with these findings, the current study identified a link between cognitive impairment and

depressive symptoms, underscoring the need for personalized rehabilitation interventions tailored to individual patient needs.

It was reported in the literature that a multidisciplinary team including patients, patient relatives, and healthcare professionals must be included in the rehabilitation program planned for the individual [19]. The individual's age, occupation, economic situation, communication with family, and environment are among the factors affecting the rehabilitation program and the treatment process related to the disease. In the study, it was found that individuals who had low economic status were more prone to cognitive impairment and depression. We believe that a patient-centered rehabilitation program can reduce the negative impacts associated with the disease and support the individual's gains in terms of physical, cognitive, and psychosocial aspects.

Clinical implications

The importance of evaluating psychosocial needs as well as physiological and systematic changes in cancer patients was emphasized. The results of our study showed the positive contribution of cognitive functions to the treatment process.

Study limitations

One of the limitations of the present study is the scarcity of comprehensive and standardised cognitive function assessment tools in the literature, which made it challenging to elaborate on the discussion in greater detail. Additionally, the study was conducted in the post-COVID-19 pandemic period, during which many patients had difficulty attending their follow-up appointments due to ongoing health problems or disruptions in access to healthcare services. These factors contributed to delays in data collection and difficulties in ensuring consistent participation. Due to the heterogeneity of chemotherapy protocols and limited sample size, regimen-specific analyses could not be performed. Future studies with larger and more homogeneous samples are needed to address this limitation.

Conclusions

Cancer patients experience impairments in cognitive function and reduced quality of life. In addition, they demonstrate an increased need for professional psychosocial support. Therefore, it is essential to promote psychosocial care services for cancer patients in order to support their mental well-being and enhance their overall quality of life.

Abbreviations

FACT	Cog–Functional Assessment of Cancer Therapy–Cognitive Function
BDI	Beck Depression Inventory
H1	Hypotheses 1
H2	Hypotheses 2
H3	Hypotheses 3
SPSS	Statistical Package for Social Sciences

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12885-025-14655-2.

Supplementary Material 1.

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Authors' contributions

Concept/idea development: DK, MYData collection/processing (Responsible for reporting experiments, tests, evaluations, patient care, organization, or data): MÖ,Sİ,Data analysis/interpretation (responsible for statistical analysis, evaluation and demonstration of results): SPO, DKLiterature research (carrying out the literature search): ED, DK, MÖ,Sİ,SPOWriting: ED, DK, Sİ,SPOCritical review: ED, MY.

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Data availability

The data used in the research cannot be publicly shared but are available upon request.

Declarations

Ethics approval and consent to participate

All procedures performed in studies involving human participants were conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. An ethics approval certificate was obtained from Gaziantep Islamic Science and Technology University Non-Interventional Clinical Research Ethics Committee for the study (Protocol number = 2021/59). Data for this study were collected from individuals who voluntarily participated in the research. Prior to data collection, an informed consent form was presented and signed by each participant. All individuals provided their consent to take part in the study and agreed that the data they provided could be used solely for the purposes of this research.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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