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REVIEW

Cancer-related cognitive impairment in racial and ethnic minority groups: a scoping review

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Abstract

Purpose Disparities in cognitive function among racial and ethnic groups have been reported in non-cancer conditions, but cancer-related cognitive impairment (CRCI) in racial and ethnic minority groups is poorly understood. We aimed to synthesize and characterize the available literature about CRCI in racial and ethnic minority populations.

Methods We conducted a scoping review in the PubMed, PsycInfo, and Cumulative Index to Nursing and Allied Health Literature databases. Articles were included if they were published in English or Spanish, reported cognitive functioning in adults diagnosed with cancer, and characterized the race or ethnicity of the participants. Literature reviews, commentaries, letters to the editor, and gray literature were excluded.

Results Seventy-four articles met the inclusion criteria, but only 33.8% differentiated the CRCI findings by racial or ethnic subgroups. There were associations between cognitive outcomes and the participants' race or ethnicity. Additionally, some studies found that Black and non-white individuals with cancer were more likely to experience CRCI than their white counterparts. Biological, sociocultural, and instrumentation factors were associated with CRCI differences between racial and ethnic groups.

Conclusions Our findings indicate that racial and ethnic minoritized individuals may be disparately affected by CRCI. Future research should use standardized guidelines for measuring and reporting the self-identified racial and ethnic composition of the sample; differentiate CRCI findings by racial and ethnic subgroups; consider the influence of structural racism in health outcomes; and develop strategies to promote the participation of members of racial and ethnic minority groups.

Keywords Cancer · Race · Ethnicity · Cognitive function · Healthcare disparities

Introduction

Cancer-related cognitive impairment (CRCI) refers to cognitive dysfunction that affects the thinking processes, well-being, and functional independence of people diagnosed with cancer at different stages of the disease (Wefel et al. 2015; Pendergrass et al. 2018; Hardy et al. 2018). Some authors have reported that up to 30% of people diagnosed with cancer experience cognitive impairments before any treatment (Janelsins et al. 2014; Hshieh et al. 2018), but the incidence increases up to 75% during treatment (Janelsins et al. 2011). Cognitive impairment is associated with lower quality of life due to impact on the autonomy, ability to return to work, social relationships, and self-confidence of patients (Jim et al. 2012; Lange et al. 2019). Additionally, alterations in memory and executive function are related to nonadherence medication therapy, difficulties reporting

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complications (Becker et al. 2011), and self-management (Hshieh et al. 2018). Cognitive impairment has also been associated with lower survival rates (Robb et al. 2010; Libert et al. 2016). Nonetheless, not all population groups experience the disease and its treatment in the same way because there are multiple factors (i.e., discrimination, financial, behavioral, genetic, among others) that impact an individual's health status and the cancer continuum (Williams et al. 2016; Ellis et al. 2018; Minas et al. 2021). Consequently, cancer disparities may occur.

Cancer disparities are social, environmental, and economic factors that generate a disadvantage and disproportionate burden in certain groups (National Cancer Institute 2020). Systemic oppressors (e.g., structural racism, cisheteronormativity) have been proposed as factors that generate such disparities (Boyd et al. 2020; Franco-Rocha et al. 2023b). In particular, race and ethnicity are social constructs used to group human beings based on characteristics such as their physical appearance, social factors, and cultural backgrounds to classify, distinguish, and marginalize people (Bonham 2023). Racialization has privileged some groups (i.e., white racial identity in the Western world) throughout human history and it persists nowadays, influencing the well-being of the oppressed groups (Yee 2015). For instance, racial and ethnic minority groups are more likely to have low socioeconomic status and education level (Williams et al. 2016; Zahodne et al. 2017; Siegel et al. 2019), which may reduce access to health care (Williams et al. 2016) and health insurance (Yabroff et al. 2020).

In the United States, these disparities have resulted in late-stage diagnosis (Islami et al. 2017), low survival (Melkonian et al. 2019), and high cancer mortality (Ellis et al. 2018) in different racial and ethnic minority groups compared to their white counterparts. In addition, structural racism plays a crucial role in racial health inequities (Boyd et al. 2020) by limiting opportunities for socioeconomic advances and negatively impacting health outcomes (Churchwell et al. 2020). For instance, discrimination in housing (e.g., segregation and discrimination in renting) and everyday discrimination are related to symptoms of stress, depression (Albert et al. 2017), poor overall mental health outcomes (Mama et al. 2016), among other cancer disparities (Beyer et al. 2019) experienced by people from minoritized racial and ethnic groups.

Race and ethnic disparities in cognition have been reported over the life course (Manly and Mungas 2015) but information about the relationship between demographic characteristics and brain functioning is lacking (Dotson and Duarte 2020). Some studies have shown that African Americans are more likely to report lower scores on measures of global cognition compared to non-Hispanic whites (Castora-Binkley et al. 2015). This likelihood is associated with factors that also influence cancer disparities, such as income (Zahodne et al. 2017; Choi et al. 2018), education (Stern 2012; Zahodne et al. 2017), and psychosocial symptoms (Zahodne et al. 2017). But also with events of structural racism, like discrimination (Barnes et al. 2012; Zahodne et al. 2017) and cumulative stressful life events (Zuelsdorff et al. 2020). Although there are few models to test these associations (Dotson and Duarte 2020), our understanding is not generalizable due to the lack of representation of minoritized groups in research studies.

In a previous review, Husain et al. (2019) found that African American breast cancer survivors experience disparities in cognition. However, it is still unknown how cognitive function may be different in other racial and ethnic minority groups, and people with different cancer types. Thus, we aim to synthesize the available literature about cancer-related cognitive impairment in racial and ethnic minority populations. The following question guided the review: How being part of a racial and ethnic minority group is reported and analyzed in the existing literature on cognitive impairment related to cancer and its treatment?

Materials and methods

We conducted a scoping review following the methodological framework proposed by Arksey and O'Malley (2005). The Preferred Reporting Items for Systematic Reviews and Meta-Analysis for Scoping Reviews (PRISMA ScR; Tricco et al. 2018) guided the review.

Two historic searches were conducted. The first search was conducted in September 2021. A second search was conducted in May 2023 after consulting a health sciences librarian. Both searches were conducted in the PubMed, PsycInfo, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) electronic databases. The search equations are displayed in Table 1. This review does not have a registered protocol.

Primary research and secondary analysis articles were included in the final sample if they were published in English or Spanish from any date, measured cognitive functioning in adults diagnosed with any type of cancer, and reported the race or ethnicity of the participants in the results. Literature reviews, commentaries, letters to the editor, and gray literature were excluded. Studies conducted with pediatric populations or survivors of pediatric cancers were also excluded from the present review.

All articles were first screened by title by one author using Rayyan (Ouzzani et al. 2016). Then, the eligible publications were equally distributed among five reviewers who independently screened the abstract of the publications using a standardized screening guideline (see Table 2). This guideline was elaborated and validated by

Table 1 Search equations

Search	Step	Terms
First search	1	Cancer
	2	Minority groups
	3	Cognitive dysfunction OR chemotherapy-related cognitive impairment
	4	1 AND 2 AND 3
Second search	1	Cancer OR oncology OR neoplasms
	2	cogniti* OR memory OR attention OR executive function OR processing speed OR chemobrain OR brain fog OR chemotherapy related cognitive impairment OR cancer related cognitive impairment
	3	Ethnic and racial minorities OR minority groups OR race OR ethnicity OR racism OR healthcare disparities OR social determinants of health
	4	1 AND 2 AND 3

Table 2 Screening checklist

Question	Yes	No
1. Was the article written in English or Spanish?		
2. Was the design quantitative, qualitative, or mixed methods?		
3. Was the focus of the paper cognitive dysfunction in adults diagnosed with cancer?		
4. Are race/ethnicity reported in the results/analysis?		
5. Was the paper a literature review, opinion piece, or gray literature?		

Articles in which questions one to four were answered affirmatively, and question five negatively were retained for full review

all authors to verify that the manuscripts met the eligibility criteria and addressed our research question.

If a manuscript was considered eligible, it was retained for data extraction following the data-charting process proposed by Arksey and O'Malley (2005). Eligible publications were equally distributed among five authors for the data extraction. We stored the information about the authors, year and country of publication, study purpose, study design, clinical characteristics (type of cancer, cancer stage, type of treatment, CRCI measurement), sample demographics (age, sex, race, ethnicity, education, income, and employment status), and the specific findings regarding CRCI in racial or ethnic minority groups in an Excel spreadsheet for subsequent analyses. The first author verified the information extracted from each publication and when necessary, clarified the results with each reviewer.

To synthesize the literature, we present a summary of the study characteristics (year, country, and design) and an overview of the sociodemographic and clinical characteristics of the participants. Finally, we divided the publications in two groups, one that characterized the race and/or ethnicity of the participants and another that explored differences in CRCI by racial or ethnic subgroup. For the latter publication group, we synthesized the findings regarding differences in CRCI.

Results

An overview of the search is provided in Fig. 1. After deleting duplicates and applying inclusion and exclusion criteria, 74 articles were included in the review—22 included a non-cancer control group. The sample included 70 (94.6%) quantitative studies, three (4.1%) qualitative studies, and one mixed methods (1.3%; sequential explanatory design) study. Of the quantitative studies, 61 (87.1%) were non-experimental designs (31 prospective, 29 cross-sectional, and one retrospective studies), five (6.8%) were quasi-experimental designs, and four (5.4%) were experimental designs. The studies were conducted in the United States (81.1%), Singapore (8.1%), Denmark (2.7%), the United Kingdom, Brazil, Canada, China, Malaysia, and South Korea (1.4% each country). The number of publications reporting the race or ethnicity of the participants increased over time; 18.9% of articles included in the review were published in 2012 or earlier, 28.4% between 2013 and 2017, and 52.7% during 2018–2023.

Oncological characteristics

Most articles (95.9%) reported the type of cancer of their participants. Breast cancer was the most studied (70.3%),

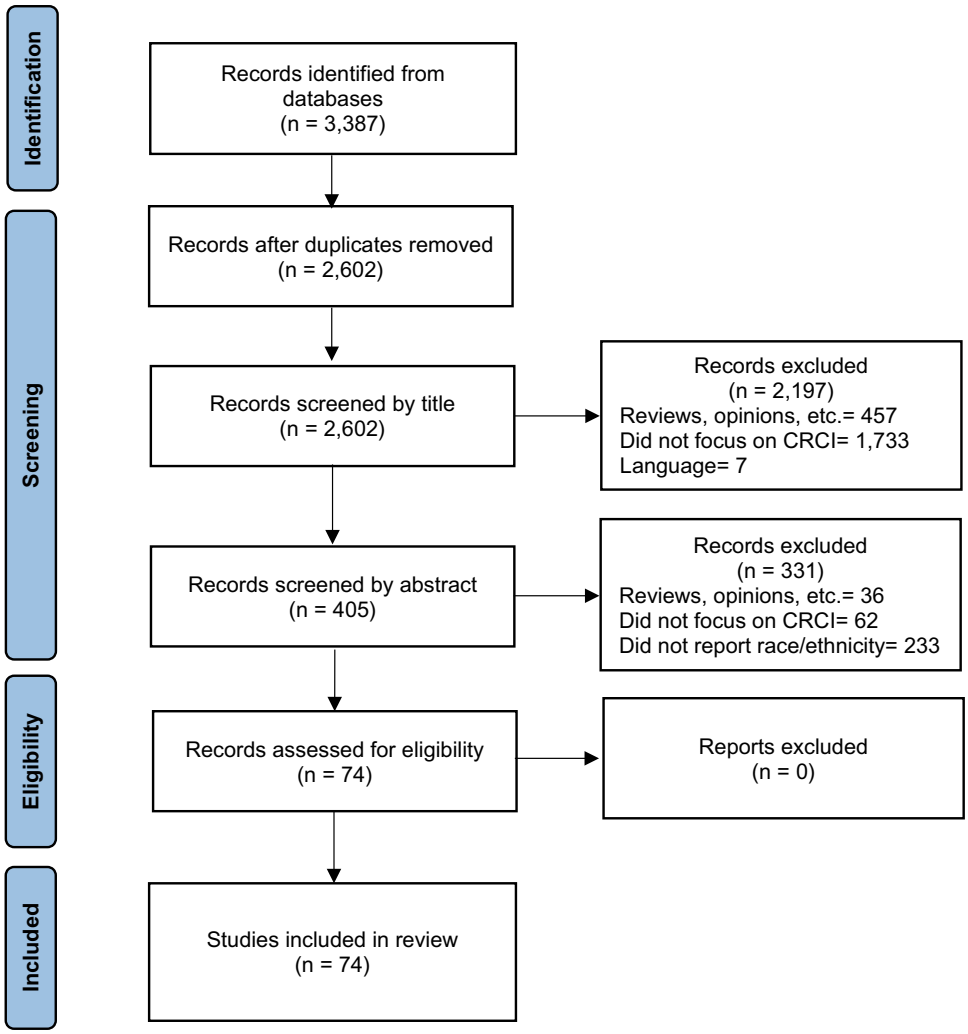

Fig. 1 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram. *CRCI* Cancer-related cognitive impairment

followed by hematologic (5.4%), gynecologic (4.1%), colorectal (2.7%), and brain cancers (2.7%). Few studies focused on head and neck, prostate, and testicular cancers (1.4% each). Finally, five studies (6.8%) included participants with different types of cancer, but breast cancer (4/5) was the most common in such studies.

The type of treatment the participants received was reported in 90.5% of the publications. Chemotherapy was the most commonly studied treatment (85.1%), followed by radiotherapy (44.8%), hormone therapy (35.8%), surgery (35.8%), and immunotherapy (4.5%). Cancer stage was reported by 66.2% of the studies, and most participants were diagnosed with stages I to III. Only 14 studies (18.9%) included participants with stage IV cancer. The final sample of the review included 68,453 participants, 43,809 individuals were diagnosed with cancer (breast = 35,626; gastrointestinal = 945; hematologic = 750; gynecologic = 667; lung = 331; glioma = 139; prostate = 110; testicular = 64; head and neck = 19; others = 557, unknown = 4601) and 24,644 were healthy controls.

In terms of CRCI measurement, most studies assessed cognition with neuropsychological testing only (40.5%), followed by studies that included measures of both objective and subjective cognitive functioning (29.7%), subjective cognitive functioning only (27.0%), and a medical diagnosis of cognitive dysfunction or dementia (2.7%). Lastly, 41.9% of studies included a biomarker in their examination. Most focused on genetic analyses (35.5%), differences in brain structure or functioning (32.3%), and changes in inflammatory cytokines (16.1%).

Demographic characteristics

Most of the studies reported the sex (100%), age (97.3%), and education level (83.8%) of the participants. The participants were predominantly women ($n = 54{,}709$, 79.9%), with mean/median ages ranging from 27 to 76 years of age (although in 53.3% studies, the participants' age was in the fifties) and more than 12 years of education. Regarding education, 26 studies reported this characteristic as mean

years (*n* mean years = 14.0, range 7–16 years) and 36 as the highest degree obtained (more than 70% of the participants completed high school or more in 31 of the 36 publications). Only 28.4% of studies informed the employment status, and most of them (57.1%) reported that at least 50% of their participants were employed. Income was the least reported demographic characteristic, with only 15 studies (20.3%; 5 conducted outside the USA) informing it.

Being part of a racial and ethnic minority group and the CRCI Literature

Only one study (1.4%) defined race and ethnicity, and based the definition on citizenship, immigrant, and descendant status (Amidi et al. 2015). Most publications (66.2%) reported how they obtained information about the race or ethnicity of their participants—all used self-reported questionnaires. Overall, most participants were white. In Asian countries, Chinese was the most commonly reported ethnicity. In studies conducted in North America, Hispanic/Latin American was the only ethnicity reported and representation of Native Americans with cancer was the lowest, as displayed in Table 3.

Among the 74 articles that reported race and ethnicity, most studies reported the participants' race and ethnicity (43.2%), followed by race only (39.2%), ethnicity only (14.9%, mainly reported in Asian countries), and "minority" or "non-White" status (2.7%). Only 25 publications (33.8%) reported differences in CRCI results by racial or ethnic subgroup (Table 4), the remaining 49 publications only characterized the race or ethnicity of their participants (Supplementary Table 1).

Among the 25 publications that analyzed CRCI between racial or ethnic subgroups, most (96%) found significant associations or differences between groups. Seven (28%) studies found that race or ethnicity were related to subjective (Calvio et al. 2009; Jean-Pierre et al. 2012; Seliktar et al. 2015; Tan et al. 2020) or objective (Patel et al. 2015; Lyon et al. 2016; Syed Alwi et al. 2021) cognitive problems—particularly the domains of complex attention, executive functioning, processing speed, visual and verbal memory.

Nine studies (36%) found that Black (Raji et al. 2009; Janelsins et al. 2017, 2018; Stabellini et al. 2023) or non-white individuals (Mandelblatt et al. 2014; Van Arsdale et al. 2016; Kesler et al. 2020; Kohler et al. 2020; Von Ah et al. 2023) were more likely to report cognitive problems after a cancer diagnosis compared to their white counterparts, even after controlling for factors such as age, education, psychosocial symptoms, comorbidities, treatment type, and tumor characteristics. However, one study (4.0%) found that

Table 3 Race and ethnicity of participants ($N = 68,453$) in the final sample of articles

	Studies without a control group	Studies with a control group	
	Cancer patients $n = 36,313$	Cancer patients $n = 7496$	Control group $n = 24,644$
Race			
White	27,120	6338	19,526
Black	4293	725	3168
Asian	451	24	8
Native American	20	0	0
Other, non-White, mixed, minority	1256	308	1068
Missing, not reported, unclear	77	61	
Ethnicity			
Hispanic/Latin American	203	69	781
Chinese[a]	588	0	0
Han[a]	198	0	0
Hui[a]	4	0	0
Malay[a]	124	0	0
Indian[a]	54	0	0
Korean[a]	0	32	32
Native Danish[b]	1836	0	0
Non-native Danish[b]	51	0	0
Other[a]	36	0	0
Missing, not reported, unclear	2	0	0

[a]Studies conducted in Asia

[b]Studies conducted in Denmark

Table 4 Studies that explored differences in cognitive functioning by racial or ethnic subgroup

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Alhareeri et al. (2020) USA	To longitudinally evaluate telomere length in women receiving treatment for breast cancer over a 2-year period	Quantitative, non-experimental, prospective study	Race: Self-reported Ethnicity: Self-reported Cognitive Assessment: CNSVS Biomarkers: Genomic telomere length	*N*: 72 Sex: Female, 100% Age: Median 52 years, range 23–71 years Race: White, 69.4%; Black, 30.6% Ethnicity: There were one Hispanic/Latina participant on each racial group. Further analyzes on ethnicity were not conducted due to small sample size Education: NR Employment: NR Income: Black: < $30,000, 55%; $30,000-$59,999, 37%; > $60,000, 8%. White: < $30,000, 14%; $30,000-$59,999, 12%; > $60,000, 12%	Cancer Type: Breast, 100% Cancer Stage: White: I, 30%; IIA, 38%; IIB, 16%; IIIA, 16%. Black: I, 22%; IIA, 50%; IIB, 28% Treatment Type: CH for both racial groups, 100%. Herceptin: White, 16%; Black, 27%. RT: White, 74%; Black, 87%	Blacks had larger T/S ratio values (longer telomeres) than Whites. Race was a significant predictor of the telomere length coefficient of the last four cognitive domains
Calvio et al. (2009) USA	To determine whether (i) perceived cognitive function differs in working malignant brain tumor survivors (MBTS) in contrast to healthy workers, (ii) time since diagnosis is related to level of cognitive limitations, and (iii) a differential pattern of demographics, symptom burden, and problem-solving orientation are observed in employees with and without MBTS	Quantitative, non-experimental, cross-sectional study	Race: NR Ethnicity: NR Cognitive Assessment: The Cognitive Symptom Checklist was modified for the study Biomarkers: None	*N*: 236 (cancer group $n = 113$) Sex: Cancer group: Female, 66%; Male, 35%. Control group: Female, 73%; Male, 27% Age: NR. Eligibility criteria between 20 and 70 years Race: Cancer group: Caucasian, 94%; Non-Caucasian, 6%. Control group: Caucasian, 89%; Non-Caucasian, 11% Education: Cancer group: Some college or less, 20%; Associate's or higher degree, 81%. Control group: Some college or less, 19%; Associate's or higher degree, 81% Employment: For both groups: Employed, 100% Income: NR	Cancer Type: Glioblastoma, 13%; Astrocytoma, 30%; Oligodendroglioma, 32%; Ependymoma, 4%; Other, 3% Cancer Stage: I, 16%; II, 45%; III, 27%; IV, 12% Treatment Type: CH alone, 4%; RT alone, 5%; S alone, 26%; Combination treatment, 65%	Race was related to cognitive limitations in both groups ($B = 5.2$, 95% CI = 0.6–9.8)

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Eastman et al. (2022) USA	To investigate whether an incident cancer diagnosis in mid-to-later life modifies Black/White racial disparities in memory aging in a population-based cohort of US adult aged above 50 years	Quantitative, non-experimental, prospective study	Race: Self-reported Cognitive Assessment: IQCODE, delayed recall of a 10-word list read out loud by the interviewer Biomarkers: None	*N*: 14,235 (cancer group $n = 3,216$) Sex: White cancer group: Female, 48.7%; Male, 51.3%. White comparison group: Female, 59.1%; Male, 40.9%. Black cancer group: Female, 50.0%, Male, 50.0%. Black comparison group: Female, 69.2%; Male, 30.8% Age: White cancer group, 65.8 ± 8.8 years; White comparison group, 66.1 ± 10.3 years. Black cancer group, 64.9 ± 9 years; Black comparison group, 65.1 ± 10.1 years Race: Cancer group: White, 85.9%; Black, 14.1%. Control group: White, 84.5%; Black, 15.5% Education: White cancer group, 12.7 ± 2.8 years; White comparison group, 12.6 ± 2.8 years. Black cancer group, 10.6 ± 3.5 years; Black comparison group, 10.8 ± 3.5 years Employment: NR Income: NR	Cancer Type: NR Cancer Stage: NR Treatment Type: NR	Black participants from the comparison group reported lower scores on memory function. However, there were no statistical differences by race in the cancer groups. In other words, an incidental cancer diagnosis did not influence memory between whites and Blacks

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Fowler et al. (2022) USA	Examine the association between cancer and longitudinal progression of dementia using data from the electronic health record from a large academic medical center in the Southeast	Quantitative, non-experimental, prospective study	Race/Ethnicity: NR Cognitive Assessment: Alabama Brief Cognitive Screener Biomarkers: None	*N*: 3809 (cancer group $n=672$) Sex: Cancer group: Female, 56.3%; Male, 43.8%. Control group: Female, 58.9%; Male, 41.1% Age (at dementia diagnosis): Cancer group, 76.4 ± 8.9 years; Control group, 73.2 ± 9.7 years Race/Ethnicity: Cancer group: Non-Hispanic White, 75.9%; Non-Hispanic Black, 18.3%, Other, 5.8%. Control group, Non-Hispanic White, 69.5%; Non-Hispanic Black, 16.7%; Other, 13.8% Education: NR Employment: NR Income: NR	Cancer Type: Breast, 9.8%; Prostate, 9.7%; Colorectal, 4.3%; Lung, 2.4%; other cancers, 53%; two or more cancers, 20.7% Cancer Stage: NR Treatment Type: NR	Regardless of cancer status, non-Hispanic Whites had better cognition scores than other racial and ethnic groups at baseline–the cancer group began higher and declined slower. There were no differences in cognition at baseline or decline among non-Hispanic Black with or without cancer. Non-Hispanic Blacks had lower cognitive scores at baseline than the other racial and ethnic groups, but their cognitive decline was not as fast

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Janelsins et al. (2017) USA	Investigate the impact of cancer and chemotherapy on perceived cancer-related cognitive impairment in female patients with breast cancer	Quantitative, non-experimental, prospective study	Race: Self-reported Ethnicity: Self-reported Cognitive Assessment: FACT-Cog Biomarkers: None	*N*: 945 (cancer group $n = 581$) Sex: Female, 100% Age: Cancer group: 53.4 years, range 22—81 years. Control group: 52.6 years, range 27–81 years Race: Cancer group: White, 89.1%; Black, 8.1%; Other, 2.8%. Control group: White, 94.2%; Black, 4.7%; Other, 1.1% Ethnicity: Cancer group: Hispanic or Latina, 1.2%; Not Hispanic or Latina, 97.4%; Unknown, 1.4%. Control group: Hispanic or Latina, 1.4%; Not Hispanic or Latina, 97.3%; Unknown, 1.3% Education: Cancer group: Some high school or less, 24.2%; GED, 22.5%; Part college, 33.4%; College, 24.1; Graduate, 18.1%. Control group, GED, 11.8%; Part college, 43.1%; College, 29.7%; Graduate, 15.4% Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: I, 27.2%; II, 49.1%; III, 18.6%; Unknown, 5.1% Treatment Type: CH, 100%; RT, 57.5%; HT, 34.0%	Black race was a predictor of lower FACT-Cog scores at baseline (prechemotherapy). Race was also a predictor of impairment in perceived cognitive abilities from prechemotherapy to post chemotherapy—Blacks had lower scores than whites

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Janelsins et al. (2018) USA	Assess longitudinal changes in visual memory in patients with breast cancer from pre- to 1-month post-chemotherapy, and from 1 month post- to 6 months post-chemotherapy	Quantitative, non-experimental, prospective study	Race: Self-reported Ethnicity: Self-reported Cognitive Assessment: DMS, TMT-A, TMT-B, COWA, RAVLT Biomarkers: None	*N*: 943 (cancer group $n = 580$) Sex: Female, 100% See age, race, and ethnicity from Janelsins et al. (2017) Education: Cancer group: < High school, 1.9%; High school or GED, 22.6%; College or grad school, 75.5%. Control group: High school or GED, 11.8%; College or grad school, 88.2% Employment: NR Income: NR	See Cancer Type, Stage and Treatment Type from Janelsins et al. (2017)	Black race (compared to white) was a predictor of cognitive decline. That is, Black race was significantly related to poorer DMS score

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Jean-Pierre et al. (2012) USA	We determined the prevalence of cancer-related cognitive dysfunction in a large, nationally representative sample of the US population	Quantitative, non-experimental, prospective study	Race: NR Ethnicity: NR Cognitive Assessment: Self-reported response to the question "Are you limited in any way because of difficulty remembering or because you experience periods of confusion?" Biomarkers: None	*N*: 9,810 (cancer group $n = 1305$) Sex: Cancer group: Female, 58.8%; Male, 41.2%. Control group: Female, 52.1%; Male, 48.0% Age: Cancer group: 40–44 years, 6.6%; 45–54 years, 22.0%; 55–64 years, 19.6%; ≥ 65 years, 51.8%. Control group: 40–44 years, 19.5%; 45–54 years, 36.0%; 55–64 years, 20.6%; ≥ 65 years, 23.9% Race/Ethnicity: Cancer group: non-Hispanic white, 89.9%; Non-Hispanic Black, 5.3%; Mexican American or other Hispanic, 2.6%; Other race, 2.2%. Control group: Non-Hispanic white, 75.3%; Non-Hispanic Black, 10.8%; Mexican American or other Hispanic, 9.1%; Other race, 4.8% Education: Cancer group: < High school, 18.4%; High school or GED, 26.3%; > High school, 55.3%. Control group: < High school, 19.0%; High school or GED, 26.1%; > High school, 54.9% Employment: NR Income (Federal poverty level based on household income): Cancer group: < 300, 44.2%; ≥ 300, 55.9%. Control group: < 300, 43.8%; ≥ 300, 56.2%	Cancer Type: NR Cancer Stage: NR Treatment Type: NR	Non-Hispanic background was significantly and independently associated with greater likelihood of reporting memory problems that affect daily functioning

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Jung and Cimprich (2014) South Korea	To examine differences in the occurrence and severity of cognitive deficits in Korean women treated with adjuvant chemotherapy for breast cancer as compared with a control group, and to examine the relationship of selected demographic and cultural factors with cognitive test performance	Quantitative, non-experimental, cross-sectional study	Race: NR Ethnicity: NR Cognitive Assessment: COWA, ANT, Digit Span Biomarkers: None	*N*: 64 (cancer group $n=32$) Sex: Female, 100% Age: Cancer group: 46 ± 8 years, range 31–61 years. Control group: 48 ± 8 years, range 31–59 years Nationality: Korean, 100% Education: Cancer group, 12 ± 3 years; Control group, 13 ± 3 years Employment: Cancer group: Employed outside home, 19%; Unemployed, 81%. Control group: Employed outside home, 62%; Unemployed, 38% Income: NR	Cancer Type: Breast, 100% Cancer Stage: I, 31%; II, 47%; IIIA, 22% Treatment Type: CH, 100%; RT, 16%; HT, 25%	Cultural characteristics (collectivism-based attitude toward women's role performance) contributed to poorer performance on attention and working memory in Korean women with breast cancer
Kesler et al. (2020) USA	Determine if there are distinct neural signatures in breast cancer survivors at risk for cancer related cognitive impairment	Quantitative, non-experimental, retrospective analysis	Race: NR Ethnicity: NR Cognitive Assessment: CTMT, RAVLT, DKEF System Letter Fluency test Biomarkers: Brain MRI	Validation sample *N*: 126 (Cancer group $n=23$) Sex: Female, 100% Age: Cancer groups: Biotype 1, 48 ± 9.6 years; Biotype 2, 52 ± 7.9 years; Control group, 49 ± 13 years Race (Reported as "Minority group"): Cancer groups: Biotype 1, 42%; Biotype 2, 0%. Control group, 16% Education: Cancer groups: Biotype 1, 16.1 ± 2.0 years; Biotype 2, 16.3 ± 8.9 years. Control group, 16.9 ± 2.5 years Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: I, 34.6%; II, 34.6%; III, 19.2% Treatment Type: RT, 88.5%; HT, 76.9%; CH, 88.5%	Consistent with the training sample (data not reported here), biotype 1 (which had the highest proportion of racial/ethnic minority participants) had the poorest perceived executive function ($p<0.01$, corrected, $d=0.50$–1.7)

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Kohler et al. (2020) USA	Evaluate variability in the trajectories of self-reported attentional function, and to determine which characteristics were associated from prior to 12 months after surgery	Quantitative, non-experimental, prospective study	Race: NR Ethnicity: NR Cognitive Assessment: AFI Biomarker: None	*N*: 396 Sex: Female, 100% Age: 54.9 ± 11.6 years Race: Non-White, 35.1% Education: 15.7 ± 2.6 years Employment: Working for pay, 23.7% Income: NR	Cancer Type: Breast, 100% Cancer Stage: 0, 18.4%; I, 38.4%; II, 34.8%; III-IV, 8.4% Treatment Type: CH, 33.6%; S, 100%; RT, 56.6%	Participants with less improvement in attentional function index scores over time were more likely to be non-White
Lyon et al. (2016) USA	Describe the longitudinal relationships between cancer-related cognitive impairment and systemic cytokines	Quantitative, non-experimental, prospective study	Race: Self-reported Ethnicity: Self-reported Cognitive Assessment: CNSVS Biomarkers: IL-1β, IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12, IL-13, IL-17, GM-CSF, IFNγ, MCP-1, MIP-1β, TNF-α (Blood sample)	*N*: 75 Sex: Female, 100% Age: 51.52 ± 10.34 years, range 23–71 years Race: White, 71%; African American, 29% Ethnicity: Non-Hispanic, 96%; Hispanic, 4% Education: Did not finish high school, 9%; High school, 12%; > High School, 79% Employment: Employed, 61.3%; Unemployed, 15%; Disabled, 8%; Retired, 15%; Student, 1% Income: < $30,000, 25%; $30,000–$59,999, 20%; $60,000-$89,999, 25%; ≥ 90,000, 29%	Cancer Type: Breast, 100% Cancer Stage: I, 27%; II, 62%; III, 11% Treatment Type: S, 92%; CH, 100%	Prior (T1), at the midpoint (T2), 6 (T3) and 12 (T4) months after CH, race was a significant predictor of executive function (T1, T2, T3), cognitive flexibility (T1, T2, T3), verbal memory (T1, T4, T5), visual memory (T2), complex attention (T3), psychomotor speed (T3), and reaction time (T3)

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Mandelblatt et al. (2014) USA	Identify the impact of cancer and systemic cancer treatments on cognition among older women with breast cancer	Quantitative, non-experimental, cross-sectional study	Race: NR Ethnicity: NR Cognitive Assessment: NAB, TMT-A, TMT-B, Digit Symbol, COWA, Boston Naming Test, FACT-Cog Biomarkers: APOE genotype	*N*: 346 (cancer group $n=164$) Sex: Female, 100% Age: Cancer group: 68.1 ± 6.7 years, range 60–98 years. Control group: 67.3 ± 6.5 years, range 60–90 years Race/Ethnicity: Cancer group: Non-Hispanic White, 80.2%; Nonwhite, 19.8%. Control group: Non-Hispanic White, 80.7%; Nonwhite, 19.3% Education: Cancer group, 15.1 ± 2.2 years; Control group, 15.7 ± 2.2 years Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: 0, 1.8%; I, 62.8%; II, 31.1%; III, 4.3% Treatment Type: S, 98.2% (Data was collected after surgery and before systemic or radiation therapies)	The adjusted odds of having cognitive impairment were not related to cancer status (having cancer or not), but they were significantly higher among nonwhite participants
Marín-Chollom et al. (2022) USA	To examine the relationship of physical activity, diet, BMI and WHR with cognitive functioning among Hispanic/Latina breast cancer survivors who previously received at least one form of adjuvant cancer treatment	Quantitative, non-experimental, cross-sectional analysis of a longitudinal study	Ethnicity: Self-reported Cognitive Assessment: DCCST, FICAT, PSMT, LSWMT, PCPST Biomarkers: BMI and WHR	*N*: 54 Sex: Female, 100% Age: 55.70 ± 9.40 years Ethnicity: Latina/Hispanic, 100% Education: Some high school or less, 24%; High school graduate or GED, 19%; Trade/technical school or Associate degree, 6%; Some college but not a graduate, 25%; College degree, 22%; Grad school, 4% Employment: Full-time, 25%; Part-time, 11%; Retired, 22%; Not employed—disabled, 15%; Household duties, 6%; Unemployed, 17%; Other, 2% Income: $0–15,000, 55%; $15,001–30,000, 19%; $30,001–60,000, 11%; $60,001–100,000, 11%	Cancer Type: Breast, 100% Cancer Stage: NR (all participants included in the study were diagnosed with stages 0-III) Treatment Type: At least one form of adjuvant treatment (CH $n=35$; RT $n=38$; and HT $n=32$) and 25% of the sample ($n=14$) received all three therapies as part of their cancer treatment	Controlling for clinical factors (type of treatment, cancer stage, time since diagnosis), physical activity, and diet, acculturation was not a significant predictor of cognitive flexibility, overall fluid abilities and processing speed

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Morse et al. (2023) USA	Evaluate for differences in global, cancer-specific, and cumulative life stress, as well as resilience and coping in oncology patients with distinct cognitive fatigue AND evening physical fatigue profiles	Quantitative, non-experimental, prospective study	Race/Ethnicity: Self-reported Cognitive Assessment: AFI Biomarkers: None	*N*: 1332 Sex: Female, 77.9%; Male, 22.1% Age: Low cognitive fatigue and evening physical fatigue, 60.3 ± 11.7 years; Moderate cognitive fatigue and evening physical fatigue, 56.5 ± 11.8 years; High cognitive fatigue and evening physical fatigue, 56.1 ± 12.9 years Race/Ethnicity: White, 68.6%; Asian or Pacific Islander, 12.4%; Black, 7.1%; Hispanic, Mixed, or Other, 10.6% Education: Low cognitive fatigue and evening physical, 15.9 ± 3.1 years; Moderate cognitive fatigue and evening physical fatigue, 16.6 ± 3.1 years; High cognitive fatigue and evening physical fatigue, 16.0 ± 2.9 years Employment: Currently employed, 34.8% Income: < $30,000 +, 16.4%; $30,000 to < $70,000, 18.9%; $70,000 to < $100,000, 15.2%; > $100,000, 38.9%	Cancer Type: Breast, 40.4%; Gastrointestinal, 30.4%; Gynecological, 17.4%; Lung, 11.8% Cancer Stage: NR Treatment Type: No prior treatment, 24.3%; Only surgery, CH, or RT, 40.8%; Surgery and CH, or Surgery and RT, or CH and RT, 19.4%; Surgery and CH and RT, 12.8%	Compared to Low cognitive and physical fatigue class, the moderate and high cognitive and physical fatigue classes were significantly younger, more likely to be female, more likely to be White, less likely to be Black, less likely to exercise on a regular basis, more likely to be diagnosed with breast cancer, less likely to be diagnosed with gastrointestinal cancer, more likely to self-report a diagnosis of depression, and more likely to have received previous cancer treatments

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Ng et al. (2016) Singapore	Evaluate the genetic association between BDNF Val66Met polymorphism (rs6265) and chemotherapy-associated cognitive impairment in Asian patients receiving chemotherapy for early-stage breast cancer	Quantitative, non-experimental, prospective cohort study	Race/Ethnicity: Self-reported Cognitive Assessment: FACT-Cog, Headminder Biomarkers: Genomic analysis (BDNF Val66Met polymorphism, rs6265)	*N*: 145 Sex: Female, 100% Age: 50.8 ± 8.8 years Nationality (reported as ethnicity): Chinese, 82.1%; Malay, 10.3%; Indian, 4.8%; Others, 2.8% Education: Primary school, 15.2%; Secondary school, 48.2%; Pre-university, 20.0%; Graduate/postgraduate, 16.6% Employment: Currently working, 56.6%; Currently not working, 43.4% Income: NR	Cancer Type: Breast, 100% Cancer Stage: I, 22.1%; II, 49.6%; III, 28.3% Treatment Type: CH = Anthracycline-based, 64.8%; Taxane-based, 35.2%	BDNF Val66Met polymorphism has the protective effect against chemotherapy-associated cognitive impairment in an Asian population with breast cancer
Ottati and Feuerstein (2013) USA	To develop a brief, reliable self-report measure of work-related cognitive limitations in occupationally active breast cancer survivors	Quantitative, non-experimental, cross-sectional study	Race: Self-reported Cognitive Assessment: CSC-W59; FACT-Cog Biomarkers: None	*N*: 228 Sex: Female, 100% Age: Group 1, 46.55 ± 9.44 years; Group 2, 47.19 ± 9.25 years Race: Caucasian, 88.6%; African American, 6.1%; Asian, 3.5%; Other, 1.8% Education: High school or less, 8.3%; Some college, 16.2%; Associate's or bachelor's degree, 31.6%; Some graduate school, 8.8%; Graduate degree, 35.1% Employment: Occupation reported but not included in this table Income: NR	Cancer Type: Breast cancer, 100% Cancer Stage: I, 38.2%; II, 44.3%; III, 16.2%; Missing respondents, 1.3% Treatment Type: Group 1: CH, 80.7%; RT 75.4%; S, 96.5%; Other, 35.1%; Group 2: CH, 80.7%; RT 66.7%; S, 93.9%; Other, 20.2%	An unexpected finding was the significant inverse correlation between race and the three cognitive limitation measures (i.e., CSC-W21, CSC-W59, FACT-Cog). These results may suggest that the measures are identifying more cognitive problems in Caucasians

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Patel et al. (2015) USA	To examine the association between neurocognitive functioning and a biologically plausible set of cytokines, selected a priori, in newly diagnosed breast cancer patients, prior to any treatment, including surgery	Quantitative, non-experimental, cross-sectional study	Race/Ethnicity: Self-reported Cognitive Assessment: DKEF-color-word inhibition and inhibition switching, HVLT-total and delayed recall, WAIS-IV-PSI Biomarkers: IL-6, IL-1ra, sTNF-RII	*N*: 262 (cancer group $n = 174$) Sex: Female, 100% Age: Cancer group, 60.48 ± 7.16 years; Control group, 61.82 ± 8.13 years Race/Ethnicity: Cancer group: Anglo American, 58.0%; Hispanic/Latina, 20.7%; African American, 7.1%; Asian, 14.2%. Control group: Anglo American, 80.5%; Hispanic/Latina, 8.0%; African American, 2.3%; Asian, 9.2% Education: Cancer group, 13.96 ± 1.92 years; Control group, 14.89 ± 1.48 years Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: 0, 15.5%; I, 44.3%; II, 31.0%; III, 9.2% Treatment Type: Data collection procedures were completed prior to any local or systemic cancer treatment	Race is a significant predictor of executive functioning, processing speed and verbal memory among newly diagnosed breast cancer patients
Raji et al. (2009) USA	To examine the incidence of dementia diagnoses in older women diagnosed with breast cancer, stratified by types of chemotherapy regimen	Quantitative, non-experimental, cross-sectional study	Race/Ethnicity: Obtained from SEER-Medicare linked database Cognitive Assessment: Diagnosis of dementia after chemotherapy Biomarkers: None	*N*: 6932 Sex: Female, 100% Age: 68–74 years, 65.6%; 74–84 years, 33.2%; 85 + years, 1.2% Race: White, 87.7%; Black, 7.0%; Other, 5.2% Education: NR Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: I, 17.1%; II, 66.1%; III, 16.8% Treatment Type: CH (Many patients received more than one agent) = Anthracycline, 50.7%: CMF, 44.1%: Taxane, 15.4%: Other, 12.4%; S, 97.5%	Significant predictors of incident dementia after chemotherapy included increasing age at diagnosis, black ethnicity, lower education level, and increasing number of comorbidities

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Rust and Davis (2013) USA	To explore the issues faced among underserved African American breast cancer survivors, their experiences with cognitive impairment from chemobrain, and the impact of chemobrain on their quality of life	Qualitative, descriptive study with analysis based on grounded theory	Race: Self-reported Cognitive Assessment: None Biomarkers: None	*N*: 24 Sex: Female, 100% Age: 46–60 years, 29%; > 60 years, 38%; Did not provide age, 33% Race: African American, 100% Education: High School, 50%; College-level, 13%; Graduate school, 4%; Did not respond, 33% Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: NR Treatment Type: CH, 100%; RT, 100%	Underserved African American women relied on their spirituality to cope with chemobrain, which contrasts with previous research studies. There was a lack of mention of healthcare professionals educating the participants about chemobrain
Seliktar et al. (2015) USA	To examine survivors' applied cognitive capacity and its association with hormone treatment, depression, and selected demographics	Quantitative, non-experimental, cross-sectional study	Race: NR Cognitive Assessment: PROMIS Applied Cognition—Abilities Biomarkers: None	*N*: 357 Sex: Female, 100% Age: 56.92 ± 10.83 years Race: Caucasian, 57.1%; African Americans, 42.9% Education: NR Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: in situ, 20.3%, I, 32.5%; II, 26.0%; III and IV, 12.7% Treatment Type: NR, inconsistencies in sample size when reporting treatment data	Applied cognitive ability is significantly associated with exposure to hormone treatment, level of depression, and race Altogether, 19.6% of the variability in applied cognitive was explained by these three Factors
Stabellini et al. (2023) USA	To perform a comprehensive analysis and provide an epidemiological report stratified by race accounting for treatment patterns and treatment adverse events in Non-Hispanic women with breast cancer	Quantitative, non-experimental, cross sectional	Race: Self-reported Cognitive Assessment: Medical diagnosis of cognitive decline/dementia after a cancer diagnosis Biomarkers: None	*N*: 17,454 Sex: Female, 100% Age: Black: Median 62 years, range 52–72 years. White: Median 63 years, range 53–73 years Race: Black, 18%; White, 82% Education: NR Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: 0, 8.7%; I, 29.2%; II, 17.6%; III, 6.6%; IV, 3.4%; Unknown, 34.5% Treatment Type: S, 51.5%; RT, 30.6%; CH, 26.4%; HT, 41.2%; IT, 3.1%	Found that NHB compared to NHW had a 19% lower risk of being diagnosed with a psychological disorder, but a 30% higher risk of being diagnosed with cognitive decline/dementia after breast cancer treatment

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Syed Alwi et al. (2021) Malaysia	Examine the prevalence of cognitive impairment one to three years post-chemotherapy among multi-ethnic early-stage breast cancer survivors	Quantitative, non-experimental, cross-sectional study	Race: NR Ethnicity: Self-reported Cognitive Assessment: MOCA, RAVLT, WAIS-IV Biomarkers: None	*N*: 160 Sex: Female, 100% Age: 51.51 ± 8.13 years Nationality (reported as ethnicity): Malay, 40.6%; Chinese, 42.5%; Indian, 16.9% Education: Primary school, 8.1%; Secondary school, 61.9%; Tertiary school, 30% Employment: NR Income: < $1148 USD/month, 66.9%; $1148–$2595 USD/month, 33.1%	Cancer Type: Breast, 100% Cancer Stage: I, 13.1%; II, 65%; III, 21.9% Treatment Type: CH, 100%; RT, 77.5%; HT, 71.9%	There were no significant mean group differences ($p > 0.05$) in cognitive performances. However, ethnicity was associated with cognitive performances. Pearson's correlations ranged from − 0.26 to − 0.23; $p < 0.01$
Tan et al. (2020) Singapore	Describe CRCI-associated trends and characteristics among adolescent and young adult cancer patients	Quantitative, non-experimental, secondary analysis from a longitudinal study	Race/Ethnicity: Self-reported Cognitive Assessment: FACT-Cog Biomarkers: None	*N*: 91 Sex: Male, 53.8%; Female, 46.2% Age: 28.4 ± 6.7 years Nationality (reported as ethnicity): Chinese, 70.3%; Malay, 8.8%; Indian, 6.6%; Others (Burmese, Filipino, Arabian), 14.3% Education: Primary/secondary education, 11.0%; Pre-university, 23.0%; Bachelor's degree, 31.9%; Postgraduate degree, 31.9%; Unreported, 2.2% Employment: NR Income: NR	Cancer Type: Sarcoma, 42.8%; Lymphoma, 33.0%; Germ cell tumor, 13.2%; Melanoma, 8.8%; Pancreatic neoplasm, 1.1%; Nasopharyngeal neoplasm, 1.1% Cancer Stage: I, 29.7%; II, 19.8%; III, 12.1%; IV, 25.3%; Not applicable, 13.2% Treatment Type: CH, 57.1%; S, 48.4%; RT, 27.5%	Demographic characteristics, such as female gender, ethnicity–particularly Indian descents, and smoking status were linked to poor self-reported cognitive function

Table 4 (continued)

Author, year, country	Purpose	Study design	Instrumentation	Sociodemographic characteristics	Clinical characteristics	Findings regarding race/ethnicity
Van Arsdale et al. (2016) USA	Evaluate the prevalence and risk factors associated with cognition in women with gynecologic malignancies	Quantitative, non-experimental, cross-sectional study	Race/Ethnicity: Self-reported Cognitive Assessment: MOCA Biomarkers: None	*N*: 165 (cognitive data from one participant is missing) Sex: Female, 100% Age: 58.4 ± 12.7 years Race/Ethnicity: African American, 25.5%; Hispanic, 24.9%; White, 46.7%; Other, 2.9% Education: Middle school or less, 6.7%; Any HS, 33.5%; College or higher, 59.8% Employment: Working/student, 24.2%; Retired, 44.2%; Unemployed/disability, 4.9%; Unknown, 26.7% Income: NR	Cancer Type: Gynecological: Uterus, 57.6%; Ovary/FT/peritoneum, 29.7%; Cervix or vulva, 12.7% Cancer Stage: I/II, 69.8%; III/IV, 26.0%; NR, 4.2% Treatment Type: S, 97.0%; CH, 47.3%; RT, 24.2%	Our data suggest that non-white women, with lower education background, older age and clinically relevant pain may be at risk for cognitive deficit
Von Ah et al. (2023) USA	Examine the relationship of cardiovascular disease on cognitive function controlling for known confounding factors of age, education, and race in breast cancer survivors	Quantitative, non-experimental, cross-sectional study	Race: Self-reported Cognitive Assessment: RBMT, WAIS-III Digit Span, SDMT- Oral Response version, COWA Biomarkers: None	*N*: 47 Sex: Female, 100% Age: 57.26 ± 8.05 years Race: Black or more than 1 race, 42.2%; White, 57.8% Education: Highest education, 15.66 ± 1.98 years Employment: NR Income: NR	Cancer Type: Breast, 100% Cancer Stage: I, 29.8%; II, 51.0%; III, 14.9%; Unsure, 4.3% Treatment Type: S, 91.5%; RT, 80.9%; HT (Tamoxifen), 51.2%; HT (Aromatase), 50.0%	White race ($\beta = -1.09$, $P \leq 0.05$) and not having cardiovascular disease ($\beta = 2.31$, $P \leq 0.05$) related to better immediate memory performance Interestingly, race (social construct) was significant only in association with 1 cognitive domain, such that White BCSs generally had better performance on a test of immediate memory

The labels of Race, Ethnicity, or Race/Ethnicity from each study are the same reported by the authors in the publication

GED General Education Diploma, *USD*, United States Dollars. *Clinical characteristics: CH* Chemotherapy, *HT* Hormone therapy, *IT* Immunotherapy, *S* Surgery, *RT* Radiotherapy. *Instrumentation: AFI* Attentional Function Index, *ANT* Attention Network Test, *CNSVS* CNS Vital Signs Computerized Neurocognitive Testing System, *COWA* Controlled Oral Word Association, *CSC-W59* Cognitive Symptom Checklist-Work-59, *CTMT* Comprehensive Trail Making Test, *DCCST* Dimensional Change Card Sort Test, *DKEF* Delis Kaplan Executive Function battery, *DMS* Delayed Match to Sample, *FACT-Cog* Functional Assessment of Cancer Therapy-Cognitive Function, *FICAT* Flanker Inhibitory Control and Attention Test, *HVLT* Hopkins Verbal Learning Test, *IQCODE* Informant Questionnaire for Cognitive Decline, *LSWMT* List Sorting Working Memory Test, *MOCA* Montreal Cognitive Assessment, *NAB* Neuropsychological Assessment Battery, *PCPST* Pattern Comparison Processing Speed Test, *PROMIS* Patient-Reported Outcomes Measurement Information System, *PSI* Processing Speed Index, *PSMT* Picture Sequence Memory Test, *RAVLT* Rey Auditory Verbal Learning Test, *RBMT* Rivermead Behavioral Memory Test, *SDMT* Symbol Digit Modalities Test, *TMT-A* Trail making test-part A, *TMT-B* Trail making test-part B, *WAIS* Wechsler Adult Intelligence Scale. *Biological markers: APOE* Apolipoprotein E, *BDNF* Brain-derived neurotrophic factor, *BMI* Body Mass Index, IL Interleukin, *GM-CSF* Granulocyte–macrophage colony-stimulating factor, *IFNγ* Interferon γ, *MCP-1* Monocyte chemoattractant protein-1, *MIP-1β* Macrophage inflammatory protein-1β, *MRI* Magnetic Resonance Image, *sTNF* Soluble tumor necrosis factor receptor, *TNF-α* Tumor necrosis factor α, *WHR* Waist-to-Hip Ratio

whites compared to Blacks were more likely to experience moderate and high cognitive and physical fatigue (Morse et al. 2023). Similarly, another study (4.0%) reported that non-Hispanic Blacks with cancer experienced slower cognitive decline than non-Hispanic whites and people from other races/ethnicities (Fowler et al. 2022).

Three studies (12%) analyzed sociocultural factors that may influence cognitive functioning. One found that collectivism-based attitude toward women's role performance contributed to poorer attention and working memory in Korean women (Jung and Cimprich 2014). Conversely, one study (4.8%) conducted with Hispanic/Latina women found that acculturation was not a significant predictor of objective cognitive functioning (Marín-Chollom et al. 2022). Finally, one qualitative study informed that underserved African American women did not mention being educated by healthcare professionals about the cognitive effects of cancer and relied on spirituality to cope with the symptoms (Rust and Davis 2013).

Two studies (8%) reported differences in biomarkers. One found that the BDNF Val66Met polymorphism may have a protective effect against CRCI in Asian women with breast cancer (Ng et al. 2016) and the other found that Black women with breast cancer had longer telomeres (shorter telomeres have been associated with the pathogenesis of cognitive decline) than their white counterparts (Alhareeri et al. 2020). Although the latter study controlled for age, the authors indicated that the age difference (Black participants were significantly younger than whites) may contribute to the difference in telomere lengths.

One study (4.0%) focused on instrumentation and found an inverse correlation between race and the Cognitive Symptom Checklist Work (CSC-W) 21, CSC-W59, and the Functional Assessment of Cancer Therapy-Cognition (FACT-Cog), which the authors interpreted as these instruments being more likely to identify cognitive problems among white people (Ottati and Feuerstein 2013). Finally, one population study (4%) found that an incidental cancer diagnosis did not influence memory outcomes between whites and Blacks (Eastman et al. 2022).

Discussion

The results of this scoping review demonstrate associations and differences in cognitive outcomes between racial and ethnic groups after a cancer diagnosis. Although the cause for such differences is unclear, some studies found that biological (e.g., telomere length) and sociocultural factors (e.g., attitude toward women's role performance) may influence CRCI in certain population groups (Rust and Davis 2013; Jung and Cimprich 2014; Ng et al. 2016; Alhareeri et al. 2020). Additionally, a significant body of evidence suggested that racial and ethnic minoritized individuals were more likely to experience poorer cognitive outcomes than their counterparts (Raji et al. 2009; Mandelblatt et al. 2014; Van Arsdale et al. 2016; Janelsins et al. 2017, 2018; Kesler et al. 2020; Kohler et al. 2020; Tan et al. 2020; Stabellini et al. 2023; Von Ah et al. 2023). Despite this, none of the studies included in the review analyzed the impact of structural racism on CRCI, even though the literature on cognitive health has reported that discrimination (Barnes et al. 2012; Zahodne et al. 2017; Ozier et al. 2019) and cumulative stressful life events (Zuelsdorff et al. 2020) are associated with cognitive health.

We also found that characterization methods of race and ethnicity were unstandardized and inconsistent across studies. When synthesizing studies conducted in diverse countries, it is often unclear whether the investigators report nationality, ethnicity, race, or other sociocultural factors. Standardization of the concepts, such as the proposed by Bhopal (2007) or Flanagin et al. (2021), would improve our ability to synthesize findings from diverse countries. Further, self-reported race and ethnicity are social constructs and may be more representative of the contribution of environmental influences, social privilege, patterns of oppression, traditions, beliefs, and health behaviors (National Research Council Panel 2004). As a result, more effort should be made to include measures with standardized definitions of self-identified race and ethnicity, to analyze the intersection between culture, health behaviors, and health outcomes.

The inclusion of racially and ethnically diverse populations are still extremely low in CRCI studies, which is consistent with findings about research studies overall (Meyers et al. 2000; Hess et al. 2010; Galantino et al. 2012; Piccirillo et al. 2015; Lawrence et al. 2016; Lyon et al. 2016; Amidi et al. 2017; Janelsins et al. 2017; Williams et al. 2018, 2020; Chen et al. 2018a, b; Guerrero et al. 2018; Henneghan et al. 2018b; Moore et al. 2019; Nakamura et al. 2019; Rodriguez-Wolfe et al. 2019; Anderson et al. 2020; Franco-Rocha et al. 2023a). This may limit the generalizability of study findings to the population at large. Thus, it is essential to implement methods that promote participation of diverse groups that are representative of the general population. Best practices for precision health research involve the inclusion and active participation of members of minority groups in research teams, training research staff in cultural sensitivity, and development of dynamic strategies to disseminate the results to the population (University of California San Francisco 2017; Lewis et al. 2021).

Specifically, research staff should be exposed to information and practical exercises designed to address their biases and stereotypes, as well as specific training in working with diverse populations. They should be given opportunities to learn about the healthcare perspectives of the various groups that will be recruited; this will allow research staff

to understand the attitudes and beliefs of the individuals they are working with and will provide tools for explaining research findings later on. Training should be included in regular team meetings as an ongoing process of increasing understanding and refining one's skills to work effectively with the diverse groups enrolled in the study.

Second, methods should focus on building trust with racial and ethnic minority communities including consulting with family members regarding the study, allowing participants to bring family members to study appointments, working closely with healthcare providers involved in participant care to ensure accurate information is available regarding the study, engaging key community members, providing informational seminars within the community regarding the research and disseminating follow-up information regarding the study throughout the project period (Areán and Gallagher-Thompson 1996; Moreno-John et al. 2004).

Neuropsychological tests are the current "gold standard" for assessing CRCI. However, health disparities and the bias against minorities inherent in cognitive testing are often not addressed in cognitive studies (Rivera Mindt et al. 2010; Ottati and Feuerstein 2013; Cory 2021). Most neuropsychological tests require English fluency and do not provide race/ethnicity-specific normative scores. Even nonverbal, "culture-free" neuropsychological tests are not sufficiently free of bias against minority groups (Statucka and Cohn 2019; Lozano-Ruiz et al. 2021). Consideration should be given to administration of tests in languages other than English based on participant preference and then conducting analyses using raw scores to reduce the bias in normalized standard scores.

More than a quarter of the studies we reviewed included a biomarker as part of their assessments, with genetic analyses and brain MRI examinations being the most frequent. Several reports show differences in brain structures between racial and ethnic groups. For instance, in a study conducted in adults without dementia, (Zahodne et al. 2015) found that in comparison to non-Hispanic whites, white matter hyperintensity was a stronger predictor of language and executive functioning among African Americans and hippocampal volume was a weaker predictor of memory in Hispanic/Latin Americans. Similarly, (Gavett et al. 2018) reported that global gray matter change was the strongest predictor of cognitive decline in whites and African Americans, but white matter hyperintensity volume was the strongest predictor of cognitive decline among Hispanic/Latin Americans. Research exploring differences in biomarkers between racial and ethnic groups is needed to guide clinical practice and promote precision when working with members of diverse racial and ethnic groups.

This review was limited to three databases and only included publications in English and Spanish, so findings from other sources and different languages may be missing. Additionally, we did not consult a librarian for the first search, and we lacked a second reviewer at the title screening stage. Finally, psychosocial outcomes such as anxiety, stress, depressive symptoms, among others, are also linked to CRCI (Cheung et al. 2013; Henneghan et al. 2018a) but were beyond the scope of the present review. Further research is needed to study how healthcare disparities influence the relationship between psychosocial functioning and cognition in racial and ethnic minority populations with cancer.

Conclusion

Most studies descriptively characterized the race or ethnicity of their participants. Only 33.8% studies differentiated CRCI outcomes by racial or ethnic group and overall found that racial and ethnic minoritized individuals were more likely to experience poorer cognitive outcomes. Although biological differences and sociocultural factors were linked to cognitive health, further explorations that consider the role of systemic racism in CRCI are necessary. Finally, it is crucial for translational, precision health to conduct studies that specifically assess differences in CRCI between ethnic or racial groups using measures and methods that reduce bias in these populations.

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Data availability All data analyzed for this study are included in this published article.

Declarations

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