What You Do Not Know Could Hurt You: What Women Wish Their Doctors Had Told Them About Chemotherapy Side Effects on Memory and Response to Alcohol

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ABSTRACT: For many patients, a cancer diagnosis is followed by chemotherapy treatment, which works by attacking cells that are growing and dividing throughout the body. Although cancer cells grow and divide more quickly than healthy cells, both are targets. The loss of healthy cells is associated with side effects, such as memory loss and altered response to a variety of food and drugs. In this pilot study, we use the “Survey of female cancer treatments, effects on memory and alcohol awareness” to explore trends in female experience and awareness of side effects associated with chemotherapy. We examined 79 female cancer patients, 46 Spanish–speaking women in Puerto Rico and 33 English–speaking women in the continental United States, and compared the rates of a reported memory loss or an altered ethanol response following chemotherapy, whether or not potential side effects were discussed with a medical professional, and whether they experienced changes in alcohol consumption after treatment. A majority of participants reported having experienced short-term memory loss postchemotherapy. Changes in response to alcohol and an altered sensitivity to alcohol were also reported by 25%–47% of the respondents. Additionally, more than half of all female cancer patients reported that they wished they would have received information on the side effects of chemotherapy and secondary medications prior to treatment. The survey results suggest that medical professionals are not adequately informing women of common, potentially harmful side effects of chemotherapy. Women do wish to be more educated about potential side effects related to memory and alcohol and be given the opportunity to discuss potential outcomes with a medical professional prior to treatment to reduce the negative impact of treatment-related side effects on posttreatment quality of life.

KEYWORDS: alcohol, memory, breast cancer

Introduction

Cancer affects an estimated 12 million women of every race and ethnicity around the world with a significant impact on their health and overall well-being.¹,²,³ Breast cancer is the most commonly diagnosed cancer and the second leading cause of cancer death for women in the United States (US), with a total of 246,660 new invasive breast cancer patients and 40,890 breast cancer deaths expected in 2016.³ However, the frequencies of different types of cancer vary based on race, ethnicity, and geographical location. Hispanics within US mainland have lower rates of the most common cancers (breast, prostate, lung, and colorectal) and higher rates of cancers related to infectious agents (liver, stomach, and uterine cervix).¹ In Puerto Rico (PR), breast cancer has the highest incidence and death rate among women.⁴,⁵ Statistics from the Division of Epidemiology, Department of Health, Puerto Rico, indicate that approximately 1540 women are diagnosed with breast cancer annually with a survival rate of 76.4%.⁶,⁷ This means one out of every eight women in PR can expect to have breast cancer at some point in her life.⁵,⁷ The differences among ethnic groups may arise from the prevalence of culturally associated risk factors for cancer, such as obesity, alcohol use, tobacco use, and lack of exercise.⁶

After a diagnosis of cancer, women can react in various ways, because this condition can affect their life holistically—the impact they suffered after having diagnosis and the side effects they encountered when having chemotherapy treatment. Evidence from preclinical model system research suggests that most chemotherapy drugs affect healthy cells, including neurons, progenitor cells, and neurotransmitters by crossing the blood–brain barrier leading to neuronal adaptations.⁹,¹² Specifically, long-term neurological side effects have been seen with methotrexate and 5-flourouracil, the most common chemotherapy drugs used to treat gynecological cancers.⁹,¹²,¹³ Even a single intravenous injection of methotrexate resulted in a sustained reduction in hippocampal
cell proliferation. Another study suggests that the size of gray and white matters in the parahippocampal gyrus and prefrontal regions was reduced following a year-long course of chemotherapy treatment. The most commonly affected regions are involved in attention and memory processes and correlate with neurocognitive impairments reported by the patients.

Reviews of self-report studies that include neurocognitive assessments summarize the evidence that chemotherapy causes long-term (effects lasting more than three to five years) cognitive dysfunction in 20%–60% of patients reducing the survivor’s working memory, spatial ability, and capacity to recall memories. Different types of chemotherapy drugs and duration of treatments result in damage to different areas of the brain. Patient’s experience of impaired working memory and spatial ability is shown to correlate with an individual’s coping strategies that suggest the potential utility of therapeutic approaches that facilitate an improved cognitive performance. Indeed, cognitive therapy protocols exist that reduce the acute effects of chemotherapy treatment on verbal memory, attention, and processing speed when initiated immediately after patients are stabilized. However, patients cannot request a preventative or post-chemotherapy treatment if that they do not know whether it exists or that it might be necessary that underscores the essential importance of educating patients about the possibility of memory loss due to chemotherapy.

Though alcohol intake differs among cultures and genders, the relation between alcohol intake and higher risk of breast cancer appears to be universal. In a 2007 publication, the World Cancer Research Fund and the American Institute for Cancer Research reported that the association between an increased risk of breast cancer and an increased alcohol intake is one of the steadiest findings among the many hypothesized relationships between dietary factors and risk for breast cancer. A number of studies have demonstrated a monotonic increase in the risk of breast and ovarian cancers with an increased alcohol consumption, supporting the claim that the risk of breast cancer increases with alcohol intake. According to the Center for Disease Control’s Behavioral Risk Factor Surveillance System survey, Hispanics self-report frequent alcohol consumption (three or more drinks per week) at lower rates than non-Hispanic whites. Hispanic women are less likely to report frequent alcohol consumption than Hispanic men (5% of women vs 21% of men). The lower incidence of frequent alcohol consumption among Hispanic women is a possible factor in their lower incidence of cancer.

Independent of its role as a risk factor, consumption of a small amount of alcohol is associated with lower reports of chemotherapy side effects in patients with head and neck cancers. Cancer patients who reported drinking at least once a week also had improved physical health and ability to function overall with reduced fatigue, pain, dry mouth, swelling, and loss of appetite. Evidence suggests that a priming dose of alcohol increases an individual’s appetite. The Study of Epidemiology and Risk Factors in Cancer Heredity, which examined 4529 breast cancer patients, found that increasing alcohol consumption by 2% improved survival and prognosis. However, excessive drinking (>13 g/d) has adverse effects on survival for female cancer patients, and in patients with tumors, excessive drinking is associated with poor prognosis. The potentially helpful consequences of low or moderate doses of alcohol are not well known by members of the general public and should be included in research studies to help us understand the potential benefits.

Alcohol intake and chemotherapy treatment exist in the culture of both the continental US and PR. The purpose of this study was to explore the incidence of alcohol and memory-related side effects of chemotherapy in female cancer patients in US and PR. Additionally to determine whether patients were informed, prior to treatment, of potential side effects of chemotherapy. Survey results show that many patients did report changes in memory function and alcohol responses, and a majority reported that they did not receive such information prior to treatment but would have liked to have known about potential side effects of chemotherapy before undergoing treatment. For clinicians, the primary concern is treatment of the cancer, and the side effects may often be accepted as the unpleasant but inevitable result of treating a deadly disease. However, the overall quality of life for the patient, as a potential survivor, should not be overlooked, especially when a small change in the delivery of care can reduce the impact of unavoidable side effects on the quality of life. We highlight the need for medical providers to make their patients aware of the potential for side effects and adverse reactions associated with chemotherapy, such as memory loss and changes in alcohol response, before the beginning of treatment.

Methods

Research design and participants. The conducted research design is a quantitative, nonexperimental, cross-sectional study. The sample consists of 79 women between 21 and 85 years old that had been diagnosed with cancer, 46 women in PR and 32 women in the continental US. The participants were recruited upon receiving a diagnosis of breast and/or gynecological cancers, undergoing chemotherapy treatment, or receiving care following chemotherapy for this condition. Within PR, participants were recruited at cancer walks or support groups by senior-level graduate psychology students and asked to complete a paper version of the survey. Additionally, email invitations to complete a web-based survey (http://freeonlinesurveys.com/s.asp?id=evhm175o2kggb136235) were sent to individuals who posted blogs on breast cancer survivorship and to patients in the breast cancer cohort study database.
Survey of female cancer treatments, alcohol awareness, and effects on way-finding. This survey, developed by Dr. Summer Acevedo in consultation with cancer survivors, neuropsychologists, and medical doctors, is a 42-item questionnaire designed to gather information about patterns of treatment for female cancers that can be used to inform the delivery of health care. The questionnaire consists of 42 questions related to side effects of treatment including memory loss and changes in response to alcohol with response options presented as yes/no answers with additional questions on the quality of alcohol consumption. In order for the questionnaire to be used for English- and Spanish-speaking participants, the questionnaire was back translated using a normative method by two different qualified bilingual clinical psychologists. This was done to help guarantee conceptually equivalent versions of a measure when two languages are needed for cross-cultural research.

Procedures. The study protocol was submitted to the Institutional Review Board of the Ponce School of Medicine and Health Sciences, and found to be exempt from the requirement for full approval. The research was conducted in accordance with the Declaration of Helsinki. The selection process was conducted through the availability of comparative sample. The groups were recruited with the intention of matching for age, education level, and socioeconomic factors. Each participant agreed to participate through verbal consent or submission of the online survey. Potential subjects were recruited by the researchers, volunteers, and medical personnel. Those who meet the inclusion criteria for the study were offered the opportunity to participate. Following informed consent, participants completed the questionnaire in either a pen and paper format or an online survey. Testing took place at hospitals, cancer walks, charity events, and support groups; all of the information from each participant was collected in a single session and transferred to the Neuropsychological Laboratory in the Clinical Psychology building for long-term storage.

Statistical analysis. All data were collected using standard data forms and entered or downloaded into a Microsoft Excel (2010) spreadsheet for analysis using the Statistical Package for the Social Sciences software (version 20). Survey information (except for demographics) takes the form of yes/no questions. Descriptive statistics was used to calculate demographic variables. Survey responses for each item were reported as a percentage or an average response. Nonparametric methods (Wilcoxon matched-pair signed-rank test or paired t-test) were used to examine different characteristics of cancer interventions, frequency of alcohol consumption, and memory loss following chemotherapy. Chi-square tests of association were used as appropriate to analyze sample characteristics (eg, race/ethnicity, drinking levels, coping styles, memory loss, and other response factors) to establish the strength of association. Odd ratios (ORs) were then performed to find the effect size for the associations that were significant in order to summarize a focused comparison.

Results

Demographic characteristics of cancer survivors. Table 1 summarizes the sample consisting of 79 female participants (46 PR and 33 US) of various socioeconomic statuses and an education level equivalent to high school or greater. Pearson’s chi-square tests were conducted to assess the relation between demographic characteristics among PR and US cancer survivors. Most of the PR survivors were unemployed at the time of the study (52.2%) in contrast to US survivors who were unemployed (36.4%), which explains the discrepancy between groups with respect to income (Table 1, P < 0.001).

Characteristics of cancer diagnosis. Breast cancer was the most common diagnosis among the survivors (PR 89.1% and US 63.0%) followed by ovarian cancer (PR 4.3% and US 18.2%). Survivors were most commonly diagnosed more than three years before this study was conducted (Table 2). More
than half of the participants had metastatic cancer (PR 50% and US 51.5%), and stage II diagnoses were the most common (PR 30.4% and 39.4%) (Table 2).

**Treatment medications.** Adjuvant chemotherapy was the most common reported type of treatment among PR and US cancer survivors. Paclitaxel (Taxol) was the most common chemotherapy medication administered to female cancer patients in US, and doxorubicin (Adriamycin and Rubex) was the most common in PR (Table 3). Overall, a wide range of medications was given to treat female cancers (Table 3). A greater number of PR survivors (27.3%) did not remember which medications they took during chemotherapy treatment compared to the US survivors (Table 3).

**Treatment conditions.** Most participants did not present a cancer recurrence at the time of completion of the survey (Table 4). The most common duration of chemotherapy and other cancer interventions is six months to one year among US survivors and three years among PR survivors (Table 4). It is interesting to highlight that 30.4% of survivors from the PR sample had a hysterectomy as a consequence of chemotherapy compared to only 12.1% in the US sample (Table 4).

**Reported memory loss and awareness of side effects.** One aim of the study was to understand whether women experienced impaired memory postchemotherapy treatment. Fewer PR participants (58.7%) reported short-term memory loss postchemotherapy compared to US women (90.9%) (Table 5). Half as many PR survivors (21.7%) as US participants (48.6%) reported having difficulty finding their way around (Table 5, \( P, 0.002 \)). These results suggest that US participants perceived impaired short-term memory at a higher rate than PR participants, \( OR = 7.04 \). We found an association between groups in reported postchemotherapy way-finding (Table 5, \( P, 0.01 \)). This suggests that US survivors perceived difficulty in finding their way around at a higher rate than PR survivors, equal to \( OR = 3.35 \).

When combined and stratified based on time since diagnosis, the data indicate that 77.8% participates less than 1 year postchemotherapy reported short-term memory loss (Table 6). The percentage of reported short-term memory loss declined based on the time since treatment after three years (64.6%). When asked about way-finding, the results were opposite with only 22.2% of those with less than...
one year postchemotherapy reporting more difficulty and those with greater than one year reporting 33%–36% of the time (Table 6). This is consistent with numerous reports of long-term spatial learning and memory impairments reported postchemotherapy.13

Fewer PR women (34.8%) compared to US women (54.5%) reported that a medical professional discussed the cognitive side effects of chemotherapy with them (Table 5). The majority (PR 73.9% and US 78.8%) of participants wished that they had received information about how chemotherapy and other medications can affect memory (Table 5), which did not significantly correlate with whether an individual reported an impairment (data not shown).

Reported alcohol use before, during, and postchemotherapy. Another aim of the study was to understand differences between populations in alcohol consumption and postchemotherapy changes in alcohol consumption. In our sample, there were differences in prechemotherapy consumption with more than half of PR participants, but less than a quarter of US females reported that they did not drink alcohol prior to chemotherapy (Table 7). Pearson’s chi-square was performed to assess the relation between alcohol intake frequency and quantity before chemotherapy among PR and US participants (Table 7). There was a significant association between ethnicity (PR/US) and whether women consumed alcohol before their diagnosis of female cancer (Table 7, \( P, 0.001 \)). US women consumed alcohol before the diagnosis of cancer at a higher rate than PR women, equal to OR = 7.63. Also, there was a significant association between groups and frequency of alcohol consumption (Table 7, \( P, 0.001 \)) and quantity (Table 7, \( P, 0.001 \)).

![Table 4. Additional medical information.](image)

|                         | PR             | US             | \( P \)-VALUES |
|-------------------------|----------------|----------------|----------------|
| **Recurrence**          |                |                |                |
| Yes                     | 10 (21.7%)     | 4 (12.1%)      |                |
| No                      | 36 (78.3%)     | 29 (87.9%)     |                |
| **Duration of chemotherapy?** |              |                |                |
| <6 months               | 8 (17.4%)      | 10 (30.3%)     |                |
| 6 months to 1 yr.       | 6 (13.0%)      | 15 (45.5%)     |                |
| 1–2 yrs.                | 10 (21.7%)     | 6 (18.2%)      |                |
| 3+ yrs.                 | 22 (47.8%)     | 2 (6.1%)       |                |
| **Time since last treatment?** |            |                |                |
| <6 months               | 17 (37.0%)     | 9 (27.3%)      |                |
| 6 months to 1 yr.       | 4 (8.7%)       | 2 (6.1%)       |                |
| 1–2 yrs.                | 6 (13.0%)      | 10 (30.3%)     |                |
| 3+ yrs.                 | 19 (41.3%)     | 12 (36.4%)     |                |
| **Chemotherapy administered orally?** |          |                |                |
| Yes                     | 28 (60.9%)     | 15 (45.5%)     |                |
| No                      | 18 (39.1%)     | 18 (54.5%)     |                |
| **In menopause at the time of diagnosis?** |       |                |                |
| Yes                     | 10 (21.7%)     | 8 (24.2%)      |                |
| No                      | 36 (78.3%)     | 25 (75.8%)     |                |
| **Menopause as a consequence?** |            |                |                |
| Yes                     | 10 (21.7%)     | 12 (36.4%)     |                |
| No                      | 22 (47.8%)     | 17 (51.5%)     |                |
| **Hysterectomy**        | 14 (30.4%)     | 4 (12.1%)      |                |

![Table 5. Memory.](image)

|                         | PR N | %  | US N | %  | \( P \)-VALUES |
|-------------------------|------|----|------|----|----------------|
| **Do you feel like you have reduced short term memory or a loss of focus after going through chemotherapy?** |      |    |      |    |                |
| Yes                     | 27   | 58.7% | 30   | 90.9% | 0.002**        |
| No                      | 19   | 41.3% | 3    | 9.1%  |                |
| **Do you have difficulty in finding your way around (i.e. driving or finding a location)?** |      |    |      |    |                |
| Yes                     | 10   | 21.7% | 16   | 48.6% | 0.02**         |
| No                      | 36   | 78.3% | 17   | 51.5% |                |
| **Did any medical professional ever tell you about possible memory loss as a side effect of chemotherapy?** |      |    |      |    |                |
| Yes                     | 16   | 34.8% | 18   | 54.5% | 0.08           |
| No                      | 30   | 65.2% | 15   | 45.5% |                |
| **Do you wish you had received information how chemotherapy and other medications may affect your memory?** |      |    |      |    |                |
| Yes                     | 34   | 73.9% | 26   | 78.8% | 0.62           |
| No                      | 12   | 26.1% | 7    | 21.2% |                |
| **Do you have a family history of Alzheimer’s disease?** |      |    |      |    |                |
| Yes                     | 13   | 28.3% | 6    | 18.2% | 0.30           |
| No                      | 33   | 71.7% | 27   | 81.8% |                |

Notes: Pearson’s chi-square \( (P\)-value); **\( P < 0.01 \), statistically significant.
Table 6. Relationship between time postchemotherapy and reported memory loss.

|                      | YES |   | NO  |   |
|----------------------|-----|---|-----|---|
|                      | N   | % | N   | % |
| Do you feel like you have reduced short term memory or a loss of focus after going through chemotherapy? |     |   |     |   |
| <6 months            | 4   | 100% | 0 | 0% |
| 6 months to 1 yr.    | 3   | 60.0% | 2 | 40.0% |
| 1–2 yrs.             | 10  | 86.4% | 3 | 13.6% |
| 3+ yrs.              | 31  | 64.6% | 17 | 35.4% |
| Do you have difficulty in finding your way around (i.e. driving or finding a location)? |     |   |     |   |
| <6 months            | 1   | 25.0% | 3 | 75.0% |
| 6 months to 1 yr.    | 1   | 20.0% | 4 | 80.0% |
| 1–2 yrs.             | 8   | 36.4% | 14 | 63.6% |
| 3+ yrs.              | 16  | 33.3% | 32 | 66.7% |

Table 7. Alcohol usage.

|                        | PR US |   |   |   |
|------------------------|-------|---|---|---|
|                        | N %  | N % |   |   |
| Did you consume alcohol prior to beginning your chemotherapy treatment? |     |   |     |   |
| Yes                    | 17   | 37.0% | 27 | 81.8% | 0.001*** |
| No                     | 29   | 63.0% | 6  | 18.2% |
| If yes, how often?     |     |   |     |   |
| Daily                  | 1    | 2.2% | 3  | 9.1% | 0.001*** |
| Weekly                 | 1    | 2.2% | 9  | 27.3% |
| Monthly                | 2    | 4.3% | 1  | 3.0% |
| Occasionally           | 13   | 28.3% | 14 | 42.4% |
| How much did you drink at a setting? |     |   |     |   |
| 1 glass of wine/beer/other alcohol | 10  | 21.7% | 11 | 33.3% | 0.001*** |
| 2 glasses of wine/beer/other alcohol | 3   | 6.5% | 11 | 33.3% |
| >2 glasses of wine/beer/other alcohol | 4  | 8.7% | 5  | 15.2% |
| Did you drink alcohol during chemotherapy treatment? |     |   |     |   |
| Yes                    | 6    | 13.0% | 8  | 24.2% | 0.20 |
| No                     | 40   | 87.0% | 25 | 75.8% |
| If yes, how often?     |     |   |     |   |
| Daily                  | 0    | 0%  | 0  | 0% | 0.27 |
| Weekly                 | 0    | 0%  | 1  | 3.0% |
| Monthly                | 0    | 0%  | 1  | 3.0% |
| Occasionally           | 6    | 13.0% | 6  | 18.2% |
| How much did you drink at a setting? |     |   |     |   |
| 1 glass of wine/beer/other alcohol | 4   | 10.9% | 4  | 18.2% | 0.04* |
| 2 glasses of wine/beer/other alcohol | 0  | 0%  | 4  | 12.1% |
| >2 glasses of wine/beer/other alcohol | 2  | 4.3% | 0  | 0% |
| Do you drink alcohol after completion of chemotherapy treatment? |     |   |     |   |
| Yes                    | 15   | 32.6% | 28 | 84.8% | 0.001*** |
| No                     | 31   | 67.4% | 5  | 15.2% |
| If yes, how often?     |     |   |     |   |
| Daily                  | 0    | 0%  | 1  | 3.0% | 0.001*** |
| Weekly                 | 1    | 2.2% | 5  | 15.2% |
| Monthly                | 1    | 2.2% | 2  | 6.1% |
| Occasionally           | 13   | 28.3% | 20 | 60.6% |
| How much do you drink at a setting? |     |   |     |   |
| 1 glass of wine/beer/other alcohol | 11  | 23.9% | 13 | 39.4% | 0.001*** |
| 2 glasses of wine/beer/other alcohol | 2   | 4.3% | 9  | 27.3% | 0.001*** |
| >2 glasses of wine/beer/other alcohol | 2  | 4.3% | 6  | 18.2% |

Notes: Correlation coefficient (P-value); *P < 0.05 and **P < 0.001, statistically significant.
The majority in each group did not drink alcohol during chemotherapy (PR 87.0% and US 75.8%), and those participants who did consume alcohol during chemotherapy reported drinking once a week or less (Table 7). No differences were seen when Pearson’s chi-square was used to assess the relation between alcohol intake frequency during chemotherapy among PR and US participants (Table 7).

Another goal of this study was to explore alcohol usage postchemotherapy. More than half of US participants consumed alcohol postchemotherapy with a total of 84.8%. Of those, a majority reported drinking at an occasional frequency and reported consuming one glass of wine or beer at a sitting (Table 7). In contrast, few PR participants drank alcohol postchemotherapy with a total of 32.6% (Table 7). Pearson’s chi-square indicated that there was a significant association between groups and consumption of alcohol postchemotherapy (Table 7, \( P < 0.001 \)). US women consumed alcohol postchemotherapy at a higher rate than PR women, equal to OR 11.67 (Table 7).

There was a significant difference between consumption of alcohol before and after cancer treatment (Table 7, \( P < 0.002 \)). The PR women reported a higher rate of consumed alcohol posttreatment, OR = 7.80. For US women, there were no significant associations between consumption of alcohol before or after the diagnosis of cancer (Table 7).

Reported alcohol response postchemotherapy and awareness of side effects. Another aim of this study was to explore whether there were changes in the response to alcohol postchemotherapy among US and PR participants. When asked about taste perception, many of the cancer survivors who drink alcohol (PR 50% and US 35.7%) showed a change in their taste for alcohol postchemotherapy (Table 8). Also, 46.7% of PR survivors who reported alcohol use showed that they were more sensitive to lower doses of alcohol (Table 8). In contrast, only 28.6% of US participants reported an increased sensitivity (Table 8). Table 8 indicates that the majority (PR 93.3% and US 95.8%) of participants experienced a posttreatment decrease in the amount of alcohol they could consume without feeling its effects.

Pearson’s chi-square was used to assess the relation between alcohol responses postchemotherapy among PR and US participants. There was no significant association between groups in taste or sensitivity for lower levels of alcohol after the treatment of cancer. However, there was a significant association in the tolerance of alcohol levels after the treatment of cancer (Table 8, \( P < 0.001 \)), with alcohol tolerance being lower after cancer treatment. We examined whether there was association between alcohol use and memory loss, but no significant associations were found (data not shown).

| Do you feel your taste for alcohol has changed? | PR | % | US | % | P-VALUES |
|-----------------------------------------------|----|---|----|---|----------|
| Yes                                          | 7  | 50.0% | 10 | 35.7% | 0.39     |
| No                                           | 7  | 50.0% | 18 | 64.3% |          |
| Do you feel that you are more sensitive to the effects of low doses of alcohol? | | | | | |
| Yes                                          | 7  | 46.7% | 8  | 28.6% | 0.28     |
| No                                           | 8  | 53.3% | 19 | 67.9% |          |
| Do you feel you can drink more than before your chemotherapy treatment without feeling effects? | | | | | |
| Yes                                          | 1  | 6.7%  | 1  | 4.2%  | 0.74     |
| No                                           | 14 | 93.3% | 23 | 95.8% |          |
| Did any medical professional (doctor, nurse or nutritionist) discuss alcohol consumption during chemotherapy treatment? | | | | | |
| Yes                                          | 22 | 47.8% | 16 | 48.5% | 0.95     |
| No                                           | 24 | 52.2% | 17 | 51.5% |          |
| Did any medical professional (doctor, nurse or nutritionist) suggest you drink a glass of wine during or after the completion of chemotherapy treatment? | | | | | |
| Yes                                          | 6  | 13.0% | 4  | 12.1% | 0.90     |
| No                                           | 40 | 87.0% | 29 | 87.9% |          |
| Have you ever been asked about your alcohol consumption before, during or post-chemotherapy treatment by a medical professional? | | | | | |
| Yes                                          | 29 | 63.0% | 19 | 57.6% | 0.62     |
| No                                           | 17 | 37.0% | 14 | 42.4% |          |
| Do you wish you had received information about how chemotherapy and other medications may effect on your response to alcohol? | | | | | |
| Yes                                          | 27 | 58.7% | 12 | 36.4% | 0.05**   |
| No                                           | 19 | 41.3% | 21 | 63.6% |          |

Notes: Pearson’s chi-square (P-value); **P < 0.01, statistically significant.
Participants in each group reported that a majority of medical professional did not talk to them about alcohol consumption during chemotherapy (PR 52.2% and US 51.5%) (Table 8). The participants reported that medical professionals asked them about alcohol consumption before, during, or postchemotherapy (PR 63.0% and 57.6%) (Table 8). Compared to US female cancer patients (36.4%), more PR participants (58.7%) wished that they had received information about how chemotherapy and other medications affect alcohol response (Table 8).

Discussion
The results of our study are consistent with other research findings and yield new information specific to similarities and differences of experience among female cancer patients in US and PR. It is important to mention that there are no significant differences in the amounts of medications currently used to treat female cancer patients, including secondary medications during chemotherapy. A larger amount of US women perceived loss of short-term memory and reported greater difficulty in finding their direction when compared to PR women. This is in accordance with findings that give clear evidence that chemotherapy affects neurons, causing cognitive dysfunction in a large portion of survivors. Indeed, a reduction in hippocampal cell proliferation is evident following a single intravenous injection of the chemotherapy drug methotrexate in animal models, and 5-flourouracil treatment leads to encephalopathy in humans. The majority of the US participants report a diminished memory regardless of time postchemotherapy and a reduced way-finding particularly in those with greater than one year postchemotherapy, which is consistent with previous studies. Although fewer PR women report short-term memory loss and way-finding, >20% reported a decline in both. This study was limited in what type of memory loss patients were asked to report; consequently, a difference in reporting of a specific type of memory loss may not represent an actual difference in memory loss overall. One detailed study has been conducted in PR breast cancer patients suggesting only working memory and way finding where impaired postchemotherapy, both correlating with coping style. It is important to highlight that a significant portion of patients reported that medical professional did not discuss memory loss as a possible side effect of chemotherapy. Retrospectively, most of the PR and US participants wished that they had been given more information about how chemotherapy treatment and other medications affect memory.

Trends related to alcohol consumption are more straightforward. Both the US and PR women perceived differences in alcohol response postchemotherapy. Taste perception and sensitivity to alcohol did change in our sample as it has in other studies, despite high variability in medication use and types of alcohol consumed. Changes in taste are associated with a decreased quality of life for patients postchemotherapy, though patients who were aware of taste-related side effects of medications before beginning treatment were less likely to experience negative effects.

Although there was no apparent increase in alcohol consumption among US participants following treatment, they consumed alcohol at a higher rate compared to PR participants. Less US participants reported wished they had received information about the potential for chemotherapy and other medications to affect alcohol response; however, this could be related to their higher rate of drinking levels prechemotherapy. PR participants had slightly increased alcohol consumption postchemotherapy.

Most participants reported that they did not receive information regarding implications of alcohol consumption, but the majority were asked by their medical providers about alcohol consumption before, during, and postchemotherapy. Although low doses of alcohol have been reported to increase appetite, reduce fatigue, and improve prognosis and likelihood of survival; only a few medical professionals suggested to patients that drinking a glass of wine during or after completing chemotherapy would be beneficial. In general, alcohol consumption is rarely talked about with cancer patients, possibly due to stigma or the belief suggesting that alcohol use can lead to excess drinking as a potential coping mechanism. Cancer diagnosis can also affect cognitive and emotional functions leading to the development of psychological distress and maladaptive coping strategies, such as excessive alcohol consumption. Excess drinking and alcohol use disorders are associated with poor prognosis and survival.

Results of this study show that the major differences between PR and US participants are related to alcohol consumption rates before and after chemotherapy treatment. Reports from PR and US participants show similarities in the use of medical protocols, including secondary hormones treatments. The absence of pretreatment information from a medical professional related to alcohol consumption and decreased alcohol tolerance postchemotherapy was also consistent between groups. This suggests regardless of ethnicity that all these facts are not addressed by medical professionals as a part of recommended treatment protocols. Patients who are not educated on the potential therapeutic effects of low-dose alcohol consumption, including increased appetite, reduced fatigue, improved prognosis, and likelihood of survival, may assume that they ought to avoid alcohol and miss an opportunity to improve both their chance of survival and quality of life.

Limitations and Future Studies
In this study design, sample size is the major limitation that could affect results. The results should be taken as a part of a pilot study, the purpose of which was to determine whether doctors were discussing potential side effects of chemotherapy with their patients and whether patients wished that they had known more about the consequences of treatments before.
treatment. The majority of the participants in the sample were breast cancer patients; some participants had other types of gynecological cancers that involve different treatment regimens reducing the statistical power to associate specific treatments with side effects. Another limitation was the study design, since cross-sectional studies only consider one site finding, which could be affected by contextual or situational variables. Several participants reported that they did not remember what medications they had taken or characteristics of their diagnosis, and the lack of information makes it more difficult to determine correlations in treatment and changes in memory or alcohol response.

Furthermore, it is unclear whether participants forgot these pieces of information in the interim since chemotherapy or never had the information in the first place. Future studies will need to be more comprehensive and more homogenous to address specific treatment effects. Social desirability phenomena and cultural differences among reporting alcohol consumption could affect these results. A longitudinal study would clarify associations between the use of alcohol and survival. Future studies should include a larger sample size in order to generalize these findings. A similar study that uses the same design and questionnaires and includes a social desirability scale and stigma assessment may give additional context to the effects of cultural phenomena on the reporting of alcohol use. The addition of a clinically validated neuropsychological measure to future studies would give a more comprehensive picture of the relations among awareness of potential side effects of treatment and measures of depression, resilience, and executive function. This study could also be done with the same characteristics and design, taking in consideration other types of male and general types of cancers.

**Recommendations**

This research not only helps with the identification of variables that attenuate the impact of side effects of chemotherapy on the quality of life of cancer survivors but also offers a recommendation that medical professionals can use to immediately and positively enhance patient prognosis. Additionally, providing patients more information about potential consequences of medications could contribute to the development of primary, secondary, and tertiary preventions. Excessive alcohol consumption is a risk factor for cancer onset and recurrence; however, moderate consumption can have positive effects to counteract chemotherapy side effects during treatment. The key is moderation and education on use vs abuse. Medical and other health professionals should help patients diagnosed with cancer in this process, by discussing how alcohol is related to cancer with patient.

It is known that cancer and chemotherapy could affect a patient’s cognitive abilities, and therefore, patients should be informed of potential side effects in order to develop compensatory skills to cope with the diagnosis and the adverse effects of therapeutic intervention. There are a variety of treatments available to help patients’ cope, including medical treatments, such as use of ginkgo biloba, nonmedical cognitive therapy protocols (memory and attention behavioral training or computerized training), restorative therapies (choosing calming experiences or Tibetan meditations), and coping strategy therapies (relaxation, self-awareness, or compensatory strategies). All have been successful in improving patient outcomes. Interventions will vary by location based on availability and regional cultural practice, but local American Cancer Society chapters are established throughout US, and PR will provide support groups and information to patients. An increase in awareness among health care professionals and patients is needed to encourage the development of interventions that can help cancer patients manage medication side effects and long-term consequences in order to improve their outcome and overall well-being.

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**Author Contributions**

Conceived and designed the experiments: SFA and CEC. Analyzed the data: SFA and CEC. Wrote the first draft of the manuscript: CEC. Contributed to the writing of the manuscript: SFA, CEC, and RD. Agree with manuscript results and conclusions: SFA, CEC, and RD. Jointly developed the structure and arguments for the paper: SFA and CEC. Made critical revisions and approved final version: SFA and RD. All authors reviewed and approved of the final manuscript.

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