Association between Grain and Legume Intakes and Breast Cancer Risk among Women

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Abstract
Background: Breast cancer (BrC) is the most commonly diagnosed cancer and a prominent cause of cancer deaths in women worldwide. The main objective of this study was to evaluate the association of grain and legume intakes and BrC risk among Jordanian women.
Methods: A case-control design was used in this study. All BrC patients were taken from the main two hospitals in Jordan that offer cancer therapy. A total of 400 Jordanian women with 20–65 years of age were recruited in this case-control study. About 200 recently diagnosed BrC women were matched in age, income and marital status to 200 BrC-free women. Dietary data were gathered through in-person interview using a validated food frequency questionnaire between October 2016 and September 2017.
Results: The weekly consumption of 1–6 servings of whole wheat bread showed >70% protected odds of having BrC, while the consumption of bulgur was significantly associated with great likelihood of having BrC (OR: 2.33, CI: 1.25–4.32). The consumption of 1–6 servings weekly of breakfast cereals had 72% lower risk of having BrC (p-trend: <0.001). The consumption of more than one serving per day of cooked white rice was detected to be associated with 7 folds higher chance of having BrC. The findings of this study also showed 90% protective odds of the consumption of 1–6 servings per week of cooked beans. Daily consumption of more than one serving of fried foods increased the risk of BrC; daily consumption of “Falafel” and fried potatoes had 256% and 515% higher risks of having BrC. Similar results were detected among overweight and obese participants.
Conclusion: This study detected a few food items that may modify the risk of BrC. The findings highlighted the importance of quality of dietary choices and the significance of healthy foods in reducing disease risk.
Keywords: Legumes; Grains and Cereals; Breast Cancer; Fried Food.

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Introduction
Breast cancer (BrC) is characterized by a multifactorial etiology where genetics, behavioral factors and environmental exposure are involved1. Dietary factors stand out among the potential modifiable risk factors and have thus been investigated widely, however, literature provides, on the whole, inconclusive conclusions regarding the influence of dietary factors on BrC risk2–4.
American Institute for Cancer Research recommendations are to increase consumption of legumes and whole grains but to limit the consumption of refined carbohydrate5. The association between the consumption of whole grains and BrC risk, however, generally marginally protective, is debatable thus far6,7.

The main difference between whole and refined grains that might be associated with the cancer risk is phytochemicals where it abundant in whole grains but present in shortage in refined grains8. The consumption of whole grains of more than 7 times/week was found to be linked to lower likelihood of having BrC9, such protective effect of whole grains intake against BrC risk has been further supported10,11. Obesity, another diet-related risk factor, has been directly and significantly associated BrC risk and inversely associated with survival after BrC12,13.
Recognizing the relationships between dietary factors and BrC risk may help in the prevention of this type of cancer that account for more than 37% of cancer cases among females in Jordan14. Since the consumption pattern varies across the globe, it is important to conduct national studies to detect the association between dietary intake and BrC risk in order to appraise national and regional nutrition recommendations. The evaluation of the intake of the most commonly consumed food, separately, is required as the cancer risk may not be equally
influenced by different food items. Thus, the present study aimed at assessing the intake of whole grains and legumes as a protective factor against developing BrC.

Methods

Study design and participants:
The main aim of this case-control study was to determine the association between BrC risk and pattern of consumption of grains and legumes. The methodology of this study is presented in details elsewhere; however, briefly, 200 patients diagnosed with BrC were enrolled from King Hussein Cancer Center (KHCC) and Al-Basheer Hospitals; the main two hospitals in Jordan that offer cancer therapy.

The control group included 200 BrC-free participants as confirmed by a mammogram or clinical examination. Cases and controls were matched based on age, income categories and marital status. Participants were included in the study if they fulfilled the following criteria: Jordanian, recently diagnosed with BrC (≤3 months from diagnosis), aged 20–65 years, and able to communicate verbally in Arabic. Patients were excluded if they were critically ill, hospitalized, suffering from other types of cancer and other diseases require specific diet, patients who given unrealistic answers during the interview and recently diagnosed patients who were older than 65 years. The proposal was revised and approved by the Institutional Review Board of the two participating hospitals. The purpose and requirements of the study were explained for each participant during the first meeting. All participants read the consent form before signing it, and understood that they can withdraw from the study at any time they want without constraint. All collected data were treated confidentially.

Data Collection:
A trained researcher operated a face-to-face interview for each participant to complete personal information sheet and a validated food frequency questionnaire (FFQ). The personal information sheet consisted of questions related to age, marital status, education, employment, family income/month, residency area and house condition, smoking status, medication and previous and current health problems. Dietary data was collected using Arabic validated FFQ that included 109 questions on food and beverages. Response categories provided in the FFQ were “< 1/month, 2–3/month, 1–2/week, 3–4/week, 5–6/week, 1/day, 2–3/day, 4–5/day, or 6/day”. Standardized food models and measuring tools were used to help participants in estimating the consumed portion size.

Weight was measured using a calibrated portable scale with minimal clothing and without shoes. Standing height was measured, without shoes, using a calibrated portable measuring rod. Body mass index (BMI) was calculated as the ratio of weight in kilograms to the square of height in meters.

Statistical analysis:
Logistic regression was used to calculate odds ratio OR and CI, while linear regression was used to calculate p-trend. The significance level was set at p < 0.05. Analyses were adjusted for age, marital status, education, income, BMI, total physical activity, smoking, member of family diagnosed with cancer. All analyses were repeated for a subset of participants who had BMI ≥25 kg/m² using the same model. All statistical analyses were conducted in SPSS version 24.0 (IBM SPSS Statistics for Windows, IBM Corporation).

Results

Participants’ characteristics are presented elsewhere. The associations between BrC risk and the frequency of intake of grains and legumes among all participants are displayed in Table 1. All data are presented in reference to the category of infrequent consumption (<1 serving per week). The consumption of 1–6 servings per week of whole wheat bread showed >70% protected odds of having BrC (OR: 0.29, CI: 0.12–0.68, p-trend: <0.0001), while the consumption of bulgur was significantly associated with great likelihood of having BrC (OR: 2.33, CI: 1.25–4.32). The consumption of 1–6 servings per week of breakfast cereals had 72% lower risk of having BrC (OR: 0.28, CI: 0.11–0.72, p-trend: <0.0001).

The consumption of >1 serving per day of cooked white rice was detected to be associated with 7 folds higher risk of having BrC (OR: 7.34, CI: 2.41–22.40, p-trend: <0.0001). Similarly the consumption of 1–6 servings per week of corn, during corn season, augmented the odds of BrC by 3 times (OR: 3.00, CI: 1.59–5.65, p-trend: 0.017) compared to infrequent consumption.

The findings of this study also showed 90% protective odds of the consumption of 1–6 servings per week of cooked beans (OR: 0.10, CI: 0.02–0.57, p-trend: 0.011). However, daily consumption of >1 serving of fried foods increased the risk of BrC; daily consumption of “Falafel” and fried potatoes had 256% (OR: 2.56, CI: 1.05–6.25, p-trend: 0.015) and 515% (OR: 5.15, CI: 2.08–12.8, p-trend: <0.0001) higher risks of having BrC. For fried potatoes, even the lower rate of consumption (1–6 servings per week) showed >2 folds higher risk of BrC (OR: 2.04, CI: 1.27–3.30, p-trend: <0.0001). No associations were detected for any of the remaining food items analyzed in this study. Table 2 shows the associations between breast cancer risk and the frequency of intake of grains and legumes among overweight and obese participants; all results resembled the above mentioned associations detected in the overall study sample.
Table 1  The associations between breast cancer risk and the frequency of intake of grains and legumes among all participants

| Grains and Legumes          | Cases | Control | OR (95%CI)               | p-trend |
|-----------------------------|-------|---------|--------------------------|---------|
| White Bread                 |       |         |                          |         |
| #Cases                      | 11    | 25      | 1.00 (0.33–4.00)         | 0.002   |
| #Control                    | 7     | 17      | 2.14 (0.94–4.83)         |         |
| OR (95%CI)                  | 1.00  | 1.15    |                          |         |
| Whole wheat bread           |       |         |                          |         |
| #Cases                      | 163   | 131     | 0.29 (0.12–0.68)         | <0.0001 |
| #Control                    | 15    | 25      | 0.58 (0.31–1.11)         |         |
| OR (95%CI)                  | 1     | 0.29    |                          |         |
| Cooked Rice                 |       |         |                          |         |
| #Cases                      | 5     | 23      | 2.19 (0.71–6.80)         | <0.0001 |
| #Control                    | 53    | 83      | 7.34 (2.41–22.4)         |         |
| OR (95%CI)                  | 1     | 2.19    |                          |         |
| Macaroni                    |       |         |                          | 0.046   |
| #Cases                      | 158   | 146     | 0.94 (0.55–1.62)         |         |
| #Control                    | 42    | 47      |                          |         |
| OR (95%CI)                  | 1     | 0.94    |                          |         |
| Bulgur                      |       |         |                          | 0.223   |
| #Cases                      | 157   | 168     | 2.33 (1.25–4.32)         |         |
| #Control                    | 41    | 26      |                          |         |
| OR (95%CI)                  | 1     | 2.33    |                          |         |
| Cooked beans                |       |         |                          | 0.011   |
| #Cases                      | 198   | 189     | 0.1 (0.02–0.57)          |         |
| #Control                    | 2     | 11      |                          |         |
| OR (95%CI)                  | 1     | 0.10    |                          |         |
| Falafel                     |       |         |                          | 0.015   |
| #Cases                      | 83    | 100     | 1.29 (0.81–2.05)         |         |
| #Control                    | 93    | 90      | 2.56 (1.05–6.25)         |         |
| OR (95%CI)                  | 1     | 1.29    |                          |         |
| Hummus                      |       |         |                          | 0.934   |
| #Cases                      | 81    | 80      | 1.25 (0.78–2.01)         |         |
| #Control                    | 105   | 102     | 0.91 (0.37–2.23)         |         |
| OR (95%CI)                  | 81    | 102     |                          |         |
| Popcorn                     |       |         |                          | 0.378   |
| #Cases                      | 169   | 161     | 1.08 (0.57–2.06)         |         |
| #Control                    | 26    | 32      | 0.83 (0.19–3.56)         |         |
| OR (95%CI)                  | 1     | 1.08    |                          |         |
| Peas                        |       |         |                          | 0.271   |
| #Cases                      | 166   | 157     | 0.87 (0.49–1.55)         |         |
| #Control                    | 33    | 40      | 0.55 (0.08–3.81)         |         |
| OR (95%CI)                  | 1     | 0.87    |                          |         |
| Corn (Total)                |       |         |                          | 0.064   |
| #Cases                      | 165   | 151     | 0.74 (0.41–1.34)         |         |
| #Control                    | 53    | 42      | 0.7 (0.19–3.86)          |         |
| OR (95%CI)                  | 1     | 0.74    |                          |         |
| Corn (at season)            |       |         |                          | 0.017   |
| #Cases                      | 114   | 169     | 3.0 (1.59–5.65)          |         |
| #Control                    | 50    | 20      | 0.91 (0.29–2.87)         |         |
| OR (95%CI)                  | 1     | 3.00    |                          |         |
| Corn flakes                 |       |         |                          | <0.0001 |
| #Cases                      | 192   | 169     | 0.28 (0.11–0.72)         |         |
| #Control                    | 7     | 25      | 0.11 (0.01–1.86)         |         |
| OR (95%CI)                  | 1     | 0.28    |                          |         |
| Legumes soup (at winter)    |       |         |                          | 0.961   |
| #Cases                      | 160   | 156     | 0.85 (0.47–1.55)         |         |
| #Control                    | 34    | 38      | 0.96 (0.22–4.2)          |         |
| OR (95%CI)                  | 1     | 0.85    |                          |         |
| Stuffed vegetables          |       |         |                          | 0.147   |
| #Cases                      | 156   | 136     | 1.66 (0.90–3.06)         |         |
| #Control                    | 41    | 25      | 0.03 (0.001–1.04)        |         |
| OR (95%CI)                  | 1     | 1.66    |                          |         |
| Carrot                      |       |         |                          | 0.684   |
| #Cases                      | 131   | 135     | 1.35 (0.81–2.25)         |         |
| #Control                    | 55    | 52      | 1.26 (0.48–3.27)         |         |
| OR (95%CI)                  | 1     | 1.35    |                          |         |
| Sweet potato                |       |         |                          | 0.285   |
| #Cases                      | 174   | 182     | 1.81 (0.84–3.90)         |         |
| #Control                    | 23    | 15      | 1.05 (0.13–8.64)         |         |
| OR (95%CI)                  | 1     | 1.81    |                          |         |
| Fried potato                |       |         |                          | <0.0001 |
| #Cases                      | 66    | 104     | 2.04 (1.27–3.30)         |         |
| #Control                    | 104   | 87      | 5.15 (2.08–12.8)         |         |
| OR (95%CI)                  | 1     | 2.04    |                          |         |
| Boiled potato               |       |         |                          | 0.199   |
| #Cases                      | 164   | 152     | 0.93 (0.53–1.63)         |         |
| #Control                    | 34    | 45      | 1.27 (0.14–11.13)        |         |
| OR (95%CI)                  | 1     | 0.93    |                          |         |
Table 2 The associations between breast cancer risk and the frequency of intake of grains and legumes among overweight and obese participants

|                        | less than 1 serving weekly | 1-6 serving weekly | 1 and more serving daily | p-trend |
|------------------------|----------------------------|--------------------|--------------------------|---------|
| **White Bread**        |                            |                    |                          |         |
| #Cases                 | 11                         | 4                  | 156                      | 0.004   |
| #Control               | 20                         | 10                 | 111                      |         |
| OR (95%CI)             | 1                          | 0.72 (0.16–3.30)   | 1.93 (0.81–4.63)         |         |
| **Whole wheat bread**  |                            |                    |                          |         |
| #Cases                 | 140                        | 13                 | 18                       |         |
| #Control               | 89                         | 20                 | 32                       | <0.0001 |
| OR (95%CI)             | 1                          | 0.30 (0.12–0.77)   | 0.51 (0.25–1.07)         |         |
| **Cooked Rice**        |                            |                    |                          | 0.000   |
| #Cases                 | 5                          | 45                 | 121                      |         |
| #Control               | 16                         | 56                 | 69                       |         |
| OR (95%CI)             | 1                          | 2.43 (0.68–8.60)   | 8.11 (2.30–28.6)         |         |
| **Macaroni**           |                            |                    |                          |         |
| #Cases                 | 136                        | 35                 |                          |         |
| #Control               | 105                        | 31                 | 5                        | 0.104   |
| OR (95%CI)             | 1                          | 1.05 (0.55–1.99)   |                          |         |
| **Bulgur**             |                            |                    |                          |         |
| #Cases                 | 134                        | 35                 |                          |         |
| #Control               | 118                        | 19                 | 3                        | 0.328   |
| OR (95%CI)             | 1                          | 3.10 (1.46–6.58)   | 0.23 (0.02–3.05)         |         |
| **Cooked beans**       |                            |                    |                          |         |
| #Cases                 | 169                        | 2                  |                          |         |
| #Control               | 130                        | 11                 |                          | 0.003   |
| OR (95%CI)             | 1                          | 0.09 (0.02–0.54)   |                          |         |
| **Falafel**            |                            |                    |                          |         |
| #Cases                 | 71                         | 80                 | 20                       | 0.144   |
| #Control               | 58                         | 68                 | 8                        |         |
| OR (95%CI)             | 1                          | 1.15 (0.67–1.98)   | 2.20 (0.80–6.05)         |         |
| **Hummus**             |                            |                    |                          |         |
| #Cases                 | 80                         | 78                 | 13                       | 0.734   |
| #Control               | 55                         | 72                 | 12                       |         |
| OR (95%CI)             | 1                          | 1.05 (0.60–1.82)   | 0.82 (0.30–2.25)         |         |
| **Popcorn**            |                            |                    |                          |         |
| #Cases                 | 143                        | 24                 | 4                        | 0.369   |
| #Control               | 112                        | 23                 | 5                        |         |
| OR (95%CI)             | 1                          | 1.44 (0.68–3.04)   | 0.69 (0.12–4.03)         |         |
| **Pecas**              |                            |                    |                          |         |
| #Cases                 | 138                        | 32                 | 1                        |         |
| #Control               | 109                        | 29                 | 2                        | 0.457   |
| OR (95%CI)             | 1                          | 0.996 (0.52–1.91)  | 0.61 (0.09–4.33)         |         |
| **Corn (total)**       |                            |                    |                          |         |
| #Cases                 | 138                        | 31                 | 2                        |         |
| #Control               | 102                        | 34                 | 4                        | 0.078   |
| OR (95%CI)             | 1                          | 0.83 (0.43–1.61)   | 0.25 (0.03–1.86)         |         |
| **Corn (at season)**   |                            |                    |                          |         |
| #Cases                 | 115                        | 47                 | 9                        |         |
| #Control               | 115                        | 15                 | 11                       | 0.080   |
| OR (95%CI)             | 1                          | 3.70 (1.79–7.67)   | 0.95 (0.30–3.00)         |         |
| **Breakfast cereals**  |                            |                    |                          |         |
| #Cases                 | 165                        | 6                  |                          |         |
| #Control               | 122                        | 15                 | 4                        | 0.001   |
| OR (95%CI)             | 1                          | 0.34 (0.11–1.08)   |                          |         |
| **Legumes soup (at winter)** |            |                    |                          |         |
| #Cases                 | 138                        | 28                 | 5                        | 0.512   |
| #Control               | 107                        | 28                 | 4                        |         |
| OR (95%CI)             | 1                          | 0.81 (0.40–1.64)   | 0.63 (0.14–2.94)         |         |
| **Stuffed vegetables** |                            |                    |                          |         |
| #Cases                 | 134                        | 36                 | 1                        | 0.363   |
| #Control               | 119                        | 19                 | 3                        |         |
| OR (95%CI)             | 1                          | 1.79 (0.88–3.63)   | 0.03 (0.001–0.94)        |         |
| **Carrot**             |                            |                    |                          |         |
| #Cases                 | 109                        | 49                 | 13                       | 0.688   |
| #Control               | 88                         | 40                 | 13                       |         |
| OR (95%CI)             | 1                          | 1.31 (0.72–2.35)   | 0.95 (0.35–2.60)         |         |
| **Sweet potato**       |                            |                    |                          |         |
| #Cases                 | 149                        | 19                 | 3                        | 0.925   |
| #Control               | 124                        | 14                 | 3                        |         |
| OR (95%CI)             | 1                          | 1.25 (0.54–2.89)   | 0.88 (0.11–7.24)         |         |
| **Fried potato**       |                            |                    |                          | <0.0001 |
| #Cases                 | 58                         | 88                 | 25                       |         |
| #Control               | 72                         | 65                 | 4                        |         |
| OR (95%CI)             | 1                          | 1.96 (1.13–3.41)   | 10.74 (2.89–39.88)       |         |
| **Boiled potato**      |                            |                    |                          | 0.149   |
| #Cases                 | 140                        | 29                 | 2                        |         |
| #Control               | 103                        | 37                 | 0                        |         |
| OR (95%CI)             | 1                          | 0.93 (0.49–1.75)   |                          |         |
Discussion

The findings of the current study are in accordance with previous studies in regards to the association between the consumption of whole grains and BrC risk. Further, our findings suggest significant negative effect of the traditional food “Falafel” on the risk of BrC. Several studies revealed negative association between whole grain consumption and breast cancer risk\(^6,7\). Although the consumption of whole grains in this study for more than one serving per a day had no significant relationship with BrC risk, the significant \(p\)-trend (<0.0001) and the marginal CI (0.31–1.11) for the daily intake support the tendency toward possible protective effect of whole grains consumption.

Whole wheat bread is the most common example of whole grains in the diet in Jordan where the nutritious germ and bran, two components of the kernel, are present, unlike the refined grains where only the starchy endosperm is exist; the third component of the kernel\(^6\). The consumption of whole grains was found to have an inverse association with several chronic diseases and has been promoted by the dietary guidelines for its beneficial health effects\(^7,8\). Nicodemus \textit{et al.} (2001) examined the effect of whole grains consumption on nine-years incidence rate of BrC among a large sample of postmenopausal women and found an inverse but not statistically significant relationship\(^6\). Farvid \textit{et al.} (2016) analyzed the data from Nurses’ Health Study II to assess the influence of whole grain consumption during adolescence, early adulthood, and premenopausal periods on subsequent BrC risk later on life, and found a protective effect of whole grain consumption\(^7\). This study found significant >70% (CI: 0.12–0.68) protective effects of the consumption of 1–6 servings per week of whole wheat bread on BrC risk. Nevertheless, the consumption of bulgur; another example of whole grain, was found to increase the risk of BrC by more than 2 folds (OR: 2.33, CI: 1.25–4.32). This finding may be influenced by the low number of consumers compared to participants who consumed bulgur less frequently. Similar to the findings of this study, Nicodemus \textit{et al.} (2001) failed to find an association between refined grain intake and breast cancer risk\(^6\).

The protective effects of whole grains on the risk of BrC have been explained by several suggested mechanisms including the presence of generous amounts of fiber and several antioxidant nutrients in the whole grains which can, respectively, reduce the absorption and nullify the effects of carcinogenic agents\(^6,8\). Additionally, lignans are phytoestrogens that are found in a good amount in whole grains and may have antiestrogenic properties\(^6,16\) and have been suggested to reduce breast cancer risk by the inhibition of breast cancer cell line in vitro\(^7\).

Acrylamide is found in carbohydrate-rich foods that are treated with heat and it is considered a genotoxic substance\(^16,19\). Even though the consumption of acrylamide has been linked to receptor-positive breast cancer risk in postmenopausal women\(^20\), the evidence is not consistent\(^20,21\). Although several studies supported the lack of evidence on the association between dietary acrylamide and BrC risk\(^21-23\), other studies supported the negative influence of acrylamide-rich foods on BrC risk\(^24,25\). Additionally, prospective assessment of the influence of acrylamide on the risks of breast, ovarian and endometrial cancers showed positive associations between the intakes of acrylamide-rich foods and risks of developing ovarian and endometrial cancers but not BrC risk\(^20\).

Based on the current knowledge regarding the influence of fried foods on health, the positive associations detected this study between fried potato and “Falafel” intakes and BrC risk support the importance of following the health recommendations by limiting fried food consumption. The significant augmentation of BrC risk (OR: 2.56, CI: 1.05–6.25) associated with daily consumption of “Falafel”; a traditional fried food made mainly of chick-peas, indicates that the method of preparation has significant influence on the effects of foods on health, in which in the case of “Falafel”, higher levels of acrylamide countered the possible benefits of legumes on health.

Legumes, in general, are substantial sources of several phytoestrogens and their consumption was suggested to be associated with lower risk of BrC mainly in postmenopausal women\(^26\). The findings of this study indicated that the consumption of cooked bean was associated with more than 90% BrC risk reduction.

The detected 72% protective association of breakfast cereal intake on BrC risk may elucidate the preferred consumption of home-prepared breakfast and lower rate of consumption of prepared away-from-home meals. Eating away-from-home meals more often could results in lower rate of exposure to nutrients and phytochemicals, thus, higher risk of poorer health and disease risk compared to home-prepared eating pattern\(^27\). Likewise, white rice is an energy-dense starchy food and the consumption of more than one serving per day could indicate overall nutrient-deficient, less healthy food choices which could explain the significant, tremendously negative association of daily rice intake with BrC risk (OR: 7.34, CI: 2.41–22.4). Besides, consumption of starchy foods has been previously found to have positive relationship to BrC risk\(^28,29\), which may further clarify the association between rice intake and BrC and may also explain the higher odds of BrC associated with corn consumption (OR: 3.21, CI: 1.68–6.14).

The findings of sub-analyses of overweight and obese participants were compatible with the findings of the overall population, and revealed greater and stronger associations between BrC risk and the consumption of...
grains and legumes. Although the associations detected among overall study sample were adjusted for BMI, the stronger associations identified among overweight and obese participants could suggest a major contribution of body weight in the pathogenesis of BrC. Obesity has been identified to be associated with a significant direct relationship with the risk of BrC and showed an inverse association with survival rate after BrC\textsuperscript{11, 12, 30, 31}.

Despite its strengths, this study has several limitations. Nevertheless, the calculated sample size was representative considering the incidence rate of BrC in both sexes that had been reported by Jordanian Cancer Registry in 2014\textsuperscript{32}, the sample size is considered small as compared to larger scale studies. Thus, the findings of this study should be treated with caution and warrant replication studies. Another limitation of this study was the possible errors inherited with FFQ technique such as possible estimation errors of food intake, which have been reduced by the use of a validated FFQ along with food models and measuring tools for accurate estimation of portion sizes. Additionally, this study possibly reduced the recall bias by including recently diagnosed participants. Further, a trained nutritionist conducted in-person interviews to collect all the required data and to minimize missing data.

The complex nature of the diet with many synergic interactions, in addition to the presence of only weak to moderate relationship between a food item or a single nutrient with BrC are two important factors that can hinder the ability to detect a true or strong significant associations between dietary factors and breast cancer. Identifying the associations between single food items and disease risk is important mainly when the dietary pattern cannot be recognized as a common and predefined dietary pattern. Dietary pattern has not been able to change fundamentally to western diet for example. Here, we have identified that a few food items were associated with their possible association with BrC risk and that lower risk of BrC was associated with higher nutrient-density and better diet quality.

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