



# Changes in Overall Diet Quality in Relation to Survival in Postmenopausal Women with Breast Cancer: Results from the Women's Health Initiative

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## ARTICLE INFORMATION

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## ABSTRACT

**Background** Lifestyle factors are important for cancer survival. However, empirical evidence regarding the effects of dietary changes on mortality in breast cancer survivors is sparse.

**Objective** The objective was to examine the associations of changes in overall diet quality, indicated by the Healthy Eating Index (HEI)-2010 score, with mortality in breast cancer survivors.

**Design** This was a prospective cohort study from September 1993 through September 30, 2015.

**Participants/setting** This study included 2,295 postmenopausal women who were diagnosed with invasive breast cancer and completed a food frequency questionnaire both before and after the diagnosis of breast cancer in the Women's Health Initiative.

**Main outcome measures** The HEI-2010 score (maximum score of 100) was calculated based on consumption of 12 dietary components. The outcomes were mortality from all causes, breast cancer, and causes other than breast cancer.

**Statistical analyses performed** Multivariable Cox proportional hazards models were used to estimate adjusted hazard ratios of mortality from all causes, breast cancer, and other causes.

**Results** Over 12 years of follow-up, 763 deaths occurred. Compared with women with relatively stable diet quality ( $\pm 14.9\%$  change in HEI-2010 score), women who decreased diet quality ( $\geq 15\%$  decrease in HEI-2010 score) had a higher risk of death from breast cancer (adjusted hazard ratio 1.66, 95% CI 1.09 to 2.52). Increased diet quality ( $\geq 15\%$  increase in HEI-2010 score) was not significantly associated with lower risk of death. These associations persisted after additional adjustment for change in body mass index.

**Conclusions** Among women with breast cancer, decreased diet quality after breast cancer diagnosis was associated with higher risk of death from breast cancer.

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**B**REAST CANCER IS THE MOST COMMON MALIGNANCY in women worldwide.<sup>1</sup> In the United States, it is estimated that 252,710 women will be diagnosed with breast cancer (30% of all cancers) and 40,610 women will die from breast cancer (14% of all cancer deaths) in 2017.<sup>2</sup> The overall 5-year relative survival rate for women diagnosed with all breast cancers is around 90%;<sup>2</sup> however, longer-term survival rates vary widely for women with invasive breast cancer.<sup>3</sup>

Better diet quality has been associated with better health and less death.<sup>4,5</sup> However, most of the nutritional studies on diet quality have been focused on the comparison between people with different diet quality at one point in time.<sup>4</sup> Evidence on how one's changes in diet quality affects long-term

health or mortality is limited. There is emerging evidence showing that dynamic changes toward a better diet quality have been associated with lower risk of all-cause and cause-specific mortality, possibly due to the beneficial effects of improvements in whole grains, vegetables, fruits, and fish or n-3 fatty acids.<sup>5</sup> Several previous studies have investigated the association of overall diet quality, either before or after breast cancer diagnosis, with breast cancer survival.<sup>6-10</sup> However, the associations of changes in diet quality after breast cancer diagnosis with breast cancer survival have not been investigated.

Some women diagnosed with breast cancer are highly motivated to make lifestyle changes,<sup>11</sup> including increased vegetable and fruit consumption and decreased dietary fat

## RESEARCH

consumption.<sup>12</sup> Furthermore, those with knowledge about cancer prevention are more likely to make changes in their diet.<sup>13</sup> However, it remains unclear whether and how women might change their diet quality after breast cancer diagnosis and subsequently whether and how these changes in diet quality might affect breast cancer survival.

The objective of this study was to examine the associations of pre- and postdiagnosis changes in overall diet quality, measured by the Healthy Eating Index (HEI)-2010<sup>14</sup> score with breast cancer survival, by using data from a large, prospective cohort of postmenopausal breast cancer survivors.

## MATERIALS AND METHODS

### Study Population

The Women's Health Initiative (WHI) has been previously described in detail.<sup>15</sup> Briefly, between 1993 and 1998, postmenopausal women aged 50 to 79 years at study entry were recruited through 40 clinical centers into either a clinical trials component (n=68,132) or an observational study (OS) component (n=93,676 women). The clinical trials consisted of three trials including the dietary modification (DM), hormonal therapy, and calcium and vitamin D clinical trial. The clinical trials and OS were closed in 2004 to 2005, and the participants were invited to continue being followed in the WHI Extension Study since 2005. Briefly, the DM component of the WHI was a randomized controlled evaluation of a low-fat diet that was high in fruits, vegetables, and grains.<sup>16</sup> In the WHI, only the WHI-DM and OS had multiple food frequency questionnaires (FFQs). Therefore, this study included women in the intervention and comparison arms of the DM trial (DM-I and DM-C) and women in the OS who were diagnosed with invasive breast cancer during the course of follow-up and who completed an FFQ both before and after being diagnosed with invasive breast cancer (overall=2,403; OS=1,157; DM=1,246). Of these, 2,297 women (OS=1,088 [94%]; DM=1,209 [97%]) had valid FFQ data defined by reported energy intake in the range of 600 to 5,000 kcal/day. Two women from the OS had missing data on postmenopausal hormone therapy use and were excluded from this analysis. The final sample included 2,295 women (OS=1,086; DM-I=465; DM-C=744). Written informed consent was obtained from each subject. Institutional review board approval was obtained from all participating institutions.

### Dietary Assessment

A standardized written protocol, centralized training of staff, and quality assurance visits by the Clinical Coordinating Center were used to ensure uniform data collection procedures.<sup>15</sup> Diet was measured in the WHI using a self-administered FFQ developed and validated with characteristics described for the study,<sup>17</sup> adapted from the Health Habits and Lifestyle Questionnaire.<sup>18</sup> The three sections of the WHI FFQ included 122 composite and single food line items asking about frequency of consumption and portion size, 19 adjustment questions related to type of fat intake, and 4 summary questions asking about the usual intake of fruits and vegetables and added fats for comparison with information gathered from the line items. In the WHI-DM, all participants completed an FFQ at baseline and year 1 of

## RESEARCH SNAPSHOT

**Research Question:** Is a change in diet quality after breast cancer diagnosis associated with overall and cause-specific mortality?

**Key Findings:** In this cohort study, among women with breast cancer, decreased diet quality after breast cancer diagnosis was associated with a significantly higher risk of death from breast cancer. Increased diet quality was not significantly associated with risk of death in this population.

follow-up, and one-third of WHI-DM participants completed an FFQ each year on a rotating basis thereafter from years 2 to 9. In the OS, participants completed an FFQ at baseline and at year 3 of follow-up. For the current analysis, FFQs administered the closest in time to before and after breast cancer diagnosis were identified. The WHI-FFQ was designed to capture foods relevant for multiethnic and geographically diverse population groups. The reliability of the FFQ has been previously assessed. The mean correlation of 30 nutrients estimated by FFQ and 8 days of dietary intake from a 4-day food record and four 24-hour dietary recalls was 0.57. The correlations of energy, percent energy from fat, carbohydrate, and protein estimated from FFQ and 4-day food records were 0.37, 0.62, 0.41, and 0.36, respectively.<sup>17</sup> These estimates are similar to the estimates in other cohorts.<sup>19,20</sup> The nutrient database used to analyze the WHI-FFQ is derived from the Nutrition Data Systems for Research (NDS-R),<sup>21</sup> which provides nutrient information for >140 nutrients and compounds, including energy, saturated fat, sodium, and others.<sup>21-23</sup>

Changes in diet quality were assessed by calculating changes in the HEI-2010 score, comparing the closest FFQs after and before invasive breast cancer diagnoses. The HEI-2010<sup>14</sup> score was created by the US Department of Agriculture and the National Cancer Institute. It is calculated using dietary data in units of MyPyramid equivalents and measures conformance with the Dietary Guidelines for Americans 2010.<sup>24</sup> A higher HEI-2010 score indicates better diet quality. Specifically, the HEI-2010 score contains 12 components, using a density approach to set standards (eg, per 1,000 calories). Six adequacy components (total fruit; whole fruit; total vegetables; green vegetables and beans; total protein foods; and seafood and plant proteins) receive 0 to 5 points and three adequacy components (whole grains; dairy; and fatty acids) receive 0 to 10 points, with greater points assigned for greater consumption. Two moderation components (refined grains and sodium) receive 0 to 10 points and one moderation component (empty calories) receives 0 to 20 points with lesser points assigned for greater consumption. For each participant, each component was scored and a total score was calculated. Higher scores represent greater conformance with the 2010 Dietary Guidelines for Americans. The changes of HEI-2010 score were classified into three groups: worsening dietary quality defined as  $\geq 15\%$  (one standard deviation in changes of diet quality) decrease in the score, relatively stable dietary quality defined as  $\pm 14.9\%$  change in the score, and improved dietary quality defined as  $\geq 15\%$  increase in the score.

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