NUTRITIONAL INFLUENCES ON FALL RISK AMONG A COHORT OF WOMEN WITH AND WITHOUT BREAST CANCER

by

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ABSTRACT

Falls are an important area of interest for the prevention of fractures, injury and disability, but the risk factors for falls are incompletely understood. In evaluating the potential reasons for a fall to occur, various aspects of the diet may play influential roles. Specifically, differential dietary intake of macronutrients such as protein and fat may lead to an increased or decreased risk of falls. Overall diet quality may also be important to fall risk. The purpose of this study is to assess the relationship between dietary intake and falling in women, utilizing a retrospective cohort design. This is a secondary analysis of an existing dataset of 87 women, which was previously utilized to evaluate fall and fracture risk between breast cancer survivors and breast cancer free controls. As such, a large portion (56 / 87, 64%) of this cohort consists of recent breast cancer survivors. Breast cancer survivors were 3-15 months post-chemotherapy at enrollment, and all women were pre-menopausal at either diagnosis or enrollment. No new information was gathered for the purpose of this analysis.

The primary outcome of interest in this study is self-reported falls over the course of one year, recorded monthly. Dietary information was obtained at enrollment using the Block98 Food Frequency Questionnaire (FFQ). Various demographic, laboratory, and history information were also taken for evaluation of potential confounders. Cross-tabulation and multivariate regression procedures were used to evaluate the associations of interest. In order to obtain relative risk (RR) estimates, log-binomial regression was utilized in the SAS software package. Variables of interest, potential covariates, and potential confounders were all analyzed through the model-building process. Separate

models were built for fat, protein, carbohydrates, and a measure for overall diet quality, the Healthy Eating Index score (HEI score).

Several trends were evident after modeling, though none reached statistical significance. For percentage of calories from fat, the women who consumed the highest tertile of percentage of calories from fat were at greater risk of falling compared to the lowest tertile (RR 1.45, 95% Confidence Interval (CI): 0.89 – 2.36), while the women who consumed the middle tertile had the same risk of falling compared to those in the lowest tertile (RR 1.01, 95% CI: 0.56 – 1.80). The women who consumed the highest tertile of percentage of calories from protein were at a slightly increased risk of falling compared to those in the lowest tertile (RR 1.06, 95% CI 0.60 – 1.85), while the women who consumed the middle tertile were at a reduced risk compared to the women in the lowest tertile (RR 0.84, 95% CI 0.52 – 1.33). Thus it appears that women who consume greater than 42.5% of their calories from fat are at increased risk of falls, while those who eat a moderate amount of protein (14.5-16.5% of calories) are at decreased risk. These trends may be useful in providing a basis for future research where a larger sample size may provide more statistically significant results.

SPECIFIC AIMS

As women age, falls become an increasingly serious health risk, potentially leading to injury, fractures, and disability. There are many factors that may lead to a fall, and various aspects of the diet may play influential roles in this risk. Specifically, macronutrient intake may be an important part of whether or not a fall occurs. Fall risk may also be influenced by health events such as breast cancer or chemotherapy treatment that prematurely alter menopausal status. This study offers the opportunity to evaluate these variables by analyzing data from a previously completed study in which women completed a food-frequency questionnaire (FFQ) at baseline and were subsequently followed for one year to measure the occurrence of falls. This cohort of women included two groups: a larger group comprised of women who had recently completed treatment for breast cancer, and a smaller group of women who did not have a history of breast cancer.

This study will evaluate various levels of macronutrient consumption reported on the previously collected FFQ data. Specifically, the macronutrients of interest are fat and protein, along with an overall diet quality measure given by the Healthy Eating Index (HEI) score. This analysis will assess potential covariates such as body mass index, physical activity levels, age, and other factors as well. Cross-tabulation and log-binomial regression methods will be among the statistical tools utilized, with the goal of developing a model for the one year risk of falling among this cohort of women. Results of this study may assist clinicians in providing improved dietary guidance to women in order to better reduce fall risk. Results may also help to generate hypotheses for future areas of research. This is important because the prevention of falls, and by extension

preventing the many negative outcomes of falls, can improve the future health and quality of life among women at risk for falls.

As such, the specific aims of this study are to:

1 - Determine if there is an association between fat intake and risk of falls. We hypothesize that diets higher in fat will be associated with an increased risk of falls.

2 - Determine if there is an association between protein intake and risk of falls. We hypothesize that diets higher in protein will be associated with a decreased risk of falls.

3 - Determine if overall diet quality is associated with risk of falls. We hypothesize that poorer diets will be associated with an increased risk of falls.

For completeness, the third macronutrient, carbohydrates, will be evaluated as well. However, this analysis is primarily focused on fat and protein, and has no a priori hypothesis for any association with carbohydrate intake and fall risk.

INTRODUCTION

Falls can be a serious health concern as people age. Indeed, more than one third of adults 65 years of age and older fall each year (1), and falls are recurrent in over half of these individuals (2). Of those who fall, 20 – 30% suffer moderate to severe injuries that make it hard to get around or live alone and increase the chance of early death (3). Approximately 95% of hip fractures, another health concern among the elderly, are caused by falls (4). Falls are a problem among younger populations as well: in one study 18% of those 20-45 years of age and 21% of those 46-65 years of age reported falling in the previous two years, with higher rates in women than men (5). In a large prospective cohort study in Britain, 72% of all fractures reported resulted from a fall (6). As such, preventing falls is important as an intermediary step to preventing further negative health outcomes.

The total direct cost of all fall injuries for people 65 and older in 2000 was slightly more than $19 billion: $179 million for fatal falls, and $19 billion for nonfatal falls (7). These direct costs do not account for the long-term effects of these injuries, such as disability, dependence on others, lost time from work and household duties, or reduced quality of life (1). By 2020, the annual direct and indirect cost of fall injuries is expected to reach $43.8 billion (8). By 2040, the estimated total annual cost of hip fracture in the United States could reach $82 - $240 billion (4). These costs are potentially higher in younger populations, due to lengthy periods of lost productivity or disability. Clearly, falls are a serious health issue, both by themselves and for their associated health consequences.

Various avenues of research have been followed to evaluate the risk factors for falls, but these risk factors are still incompletely understood. Likely, there are a multitude of reasons for falls, which may be further complicated by individual activity patterns. Currently established risk factors for falls include increasing age, muscle weakness, functional limitations, environmental hazards, use of psychoactive medications, and a history of falls (4). Most research on fall risk factors has focused on the elderly, likely because of their increased risk of fall and fracture compared to younger persons (5). However, little work has focused on those younger populations at potentially increased risk, despite the potentially more dramatic cost of falls in younger individuals due to lost productivity or chronic disability. This analysis provides a unique opportunity to evaluate fall risk in a younger population (mean age 43.8 +/- 5.7), who are potentially placed at greater risk due to correspondent health issues. This study is also primarily concerned with women, since women tend to fall more often, have higher costs, and experience more serious outcomes as a result of falls than men (1, 4, 5).

While progress has been made in identifying several risk factors for falls, there are likely still other risk factors which have not been studied or identified. Nutritional intake, particularly macronutrient intake, is the potential risk factor for falls which this analysis will seek to evaluate. Such an analysis is not entirely unique, though in general most research has focused on micronutrients and/or fracture risk rather than macronutrients or fall risk. To this end, several studies have implicated vitamin D and calcium as important micronutrients for reducing fracture risk (6, 9). Such micronutrient intake influences on fracture risk may or may not similarly affect fall risk. Interestingly, a recent meta-analysis has also shown that vitamin D-3 is also associated with the

prevention of falls, though when stratified by menopausal status this reduction in risk became non-significant among post-menopausal women (10). Very little, if any, research has been done regarding macronutrient level intakes and fall risk. Thus while vitamin D and calcium intake will be considered as potential covariates, it is on macronutrient intake which this analysis is primarily focused.

The three key macronutrients are fat, protein, and carbohydrates. Protein, as a vital nutrient for the building and maintenance of body tissues, is likely to be an influential factor for fall risk. Lean muscle mass is important for coordination, strength and stability. Further, muscle power of the lower extremities and lateral postural stability have both been shown as independent risk factors for non-syncopal falls (11). Combined with an active lifestyle, increased levels of protein intake may lead to improved muscle mass and a body composition which is lower in body fat and higher in lean muscle (12). This may be of further importance as people age since sarcopenia—the age-related decrease in skeletal muscle-mass (13)—leads to a greater predisposition to falls (14). In the prevention of sarcopenia, protein may be an important component in the retention of muscle mass (15). So those who obtain more protein from their diet may be able to move about with more ease and control through the development or maintenance of muscle mass. Since coordination and stability are important in influencing fall risk (16), more lean muscle mass and better coordination should be beneficial for reducing fall risk.

Fat intake is also likely to be an influential factor for fall risk. Increased fat intake can often lead to an increase in body storage of fat, increased BMI and a body composition composed of more fatty tissue (12). As this excess fat builds up, body

control and coordination may become more difficult and reaction ability may decrease (such as from a trip or stumble), due to the increased mass the muscles need to move in order to be effective. Fat and lean mass have both been shown to be independent predictors for poor performance on postural stability (17). Such findings indicate that greater fat mass may compromise stability and thus increase fall risk in heavier individuals (17, 18). This increased risk seems reversible, as it has been shown that weight loss improves balance control in obese men (19). Increased body fat may also influence balance and gait, dysfunctions of which are risk factors for falling (4, 20). Thus fall risk may be influenced by various levels of fat intake.

Overall diet quality is a measure that can be determined from food frequency questionnaires (FFQ) based on micro- and macro-nutrient intakes, calculated as a Healthy Eating Index (HEI) score. First created by the U.S. Department of Agriculture in 1995, the current HEI is a measure of diet quality that assesses conformance to the 2005 Dietary Guidelines for Americans (22). The score ranges from 0 – 100, with diets scored as "good" (81 – 100), "needs improvement" (51 – 80), and "poor" (0 – 50) (21). The components and the scoring standards for the HEI score can be found in Appendix 1. This HEI score can serve as a proxy measure for both macro- and micro-nutrient intake and their cumulative effect on fall risk. Since nutrient deficiencies can have effects on overall health, both physically and psychologically, those who consume a poorer diet may have an increased risk of falling compared to their healthier-eating counterparts.

Study specifics

Evaluating the association of each of these three dietary measures with fall risk will be the focus of this study. The study subjects come from a previous study conducted at Oregon Health & Science University (OHSU) that evaluated differences in fall and fracture risk among women with and without a history of breast cancer. The study population is composed of breast cancer survivors, who were pre-menopausal at diagnosis, along with cancer-free pre-menopausal women of similar age. Both cases and controls completed a Block98 Food Frequency Questionnaire (FFQ) at baseline and were then followed for one year. A copy of this FFQ is shown in Appendix 2. Cases were 3-15 months post-chemotherapy when they completed their baseline measures. Falls were self reported via monthly postcards by both cases and controls, and were defined as 'coming to an abrupt stop after an unintended descent of the body'. This previous study found a higher proportion of falls in breast cancer survivors than the control women, but did not analyze the FFQ data (23). The current study will utilize this FFQ data to analyze the associations mentioned above.

A unique aspect of this dataset is the makeup of the study population, as very few studies focus on breast cancer survivors—and even fewer on falls or nutrition within this group. Such a population can be a complication, due to the many physiological changes that often occur surrounding the development, treatment, and recovery from breast cancer. As the majority of the cohort consists of breast cancer survivors, this will need to be taken into account in the analysis. Several of the women in the study developed early menopause as a result of the chemotherapy. This is of particular interest because of

studies which have shown increasing risks of fracture in postmenopausal women (24). Other studies have also shown an increased risk of fractures among breast cancer survivors (25).

While these studies are considering fracture, it is probable that hormonal changes surrounding the menopausal transition affect fall risk as well. Indeed, it has been shown that there is a perimenopausal increase in the risk of falling (26). Thus this group of women, the majority of whom are post- or perimenopausal, provide another unique analysis opportunity. Since Follicle-Stimulating Hormone (FSH) measurement is advocated frequently as a useful diagnostic tool in perimenopausal patients, FSH level will need to be considered as a potential covariate (27). Additionally, the rigors of chemotherapy can influence diet, weight gain, and activity patterns (28, 29). These combined factors will also need to be evaluated in order to properly assess fall risk among this cohort.

Many studies have been performed analyzing the role of diet on fracture risk, and it is likely that some factors that are important for fracture risk are also important for fall risk. Protein intake has been implicated in reducing fracture risk (30), along with vitamin D and calcium (9). Outside of diet, there are many other potential influences to fracture risk which are likely to be contributory to fall risk as well. For example, age has been established as a risk factor for both falls and fractures (4). Advancing age is associated with profound changes in body composition. One of the most prominent of these changes is sarcopenia, which results in decreased strength and aerobic capacity and thus functional capacity. Sarcopenia is also closely linked to age-related losses in bone

mineral, basal metabolic rate and increased body fat content (31). Any of these factors could be influential on fall risk as well. Dietary intake and physical activity levels influence these physiological changes (31), and so may be important for fall risk for their impact on these age-related changes.

Certainly there are many potential influences on fall risk that are as yet unknown. It may turn out that fall risk is not singularly dependent on any one pathway, but on a causal web of factors and influences that are related in some complex fashion. This study should provide a novel opportunity to evaluate the association of macronutrient intake on fall risk, in a relatively young group of women, within the context of breast cancer treatment. Results from this study, regardless of significance, should provide additional information that may be of use to patients, healthcare workers, researchers, and the public health field.

MATERIALS AND METHODS

Setting and Participants

This study is a secondary analysis of an existing cohort that was recruited and followed by Dr. Kerri Winters, Ph.D. The original purpose of this study was to evaluate fracture risk among premenopausal breast cancer survivors, with breast cancer free controls as a comparison group. The setting for this research was the OHSU School of Nursing Cancer FIT laboratory in the city of Portland, Oregon. Recruitment occurred through the Oregon State Cancer Registry, advertising at local community events and OHSU, and word of mouth. Also utilized were established recruitment networks for

breast cancer patients and survivors, which had successfully enrolled breast cancer patients in several ongoing studies at OHSU.

Breast cancer survivors were recruited into the study within one year of completion of a chemotherapy regimen that included doxorubicin or methotrexate, and glucocorticoids to prevent nausea, vomiting, fluid retention and hypersensitivity reactions. Inclusion criteria for breast cancer survivors included: [1] histologically confirmed breast cancer stage I-III; [2] completion of a chemotherapy regimen containing doxorubicin or methotrexate, and glucocorticoids in antiemetic regimen; [3] premenopausal status (9 – 12 menstrual cycles/year) at the initiation of chemotherapy; and [4] greater than or equal to 21 years of age. Control women were recruited within the same time frame as patients. Inclusion criteria for controls was confirmation of premenopausal status (9 – 12 menstrual cycles/year; Follicle Stimulating Hormone (FSH) < 30 mlU / ml) (23).

Women were excluded from participation because of the documented affects of the following conditions on the study's dependent variables: [1] documented metastasis; [2] currently receiving chemotherapy/radiation treatment; [3] previous or current use of bisphosphonates; [4] smoking; [5] irregular menses (less than 9 menstrual cycles / year) at time of diagnosis; [6] conditions known to affect bone metabolism (e.g., diabetes mellitus, hyperparathyroidism, hypothyroidism); [7] current use of medications known to affect bone metabolism (e.g., thiazide diuretics, glucocorticoids, hormone/estrogen replacement therapy); and [8] conditions known to disrupt postural stability (e.g., multiple sclerosis, Parkinson's disease). Control subjects were excluded if they met

exclusion criteria 3 – 7 and/or were lactating. After recruitment and exclusion, 56 breast cancer survivors and 31 controls were recruited (87 total). For this study, two observations were discarded because they had neither FFQ nor fall information. Four other observations had FFQ data but no fall data—these were retained for demographic information but were excluded from regression analysis. Thus the sample size utilized for the secondary analysis was 85 women (81 for regression).

Measurements

Women completed laboratory and physical functioning tests at baseline, along with providing demographic information. Participants also completed the Block98 FFQ and the Kaiser Physical Activity Survey (KPAS) at baseline. Bone-free lean mass and fat mass were determined from whole body scans measured via dual x-ray absorptiometry (Hologic Discovery Wi). The cohort was provided with postcards on which they could record, and return to the investigators, the number of falls and fractures experienced each month. This follow-up period lasted for one year. The primary outcome of interest for this study was falling status. Falls were self-reported, and were defined as a subject's unintentionally coming to rest on the ground or at some other lower level, not as a result of a major intrinsic event (e.g., stroke or syncope) or overwhelming hazard (32). The responses from the postcards were condensed into a dichotomous variable which described faller status. Persons were classified as either a non-faller (no falls in the 12 month follow-up period) or a faller (at least one fall reported).

Nutritional information for the current study was taken from the results of the FFQ, which assessed the habitual nutrient intake over the previous year. The FFQ used is

a validated dietary assessment measure that was developed from National Health and Nutrition Examination Survey III data (33, 34, 35). Physical activity was measured by the KPAS, an adaptation of the Baecke usual physical activity survey designed specifically to assess activity in women (36). It uses Likert-scale questions in four summary activity indexes: sports/exercise, active living, occupational, and household/caregiving (37). These four indexes are then combined to provide a continuous measure of physical activity levels (range 4 – 20). This survey has demonstrated good reliability and is reasonably accurate in detecting regular activities among women with a broad range of physical activity habits (36). A copy of the KPAS is shown in Appendix 3.

Data Management & Statistical Methods

All analysis was performed using SAS version 9.1.3 (SAS Institute Inc.). Because the outcome of falls is not rare (>10%), the odds ratio that would be provided by using logistic regression would not be a good approximation of the relative risk (RR) (38). Thus, a log-binomial regression was chosen to provide RR estimates directly. However, with some variables the algorithm would not converge in SAS. To overcome this obstacle, the Poisson approximation of the log-binomial method was utilized (39). To keep the analysis consistent, this approximation was then used for all regression procedures. Because the sample size was previously established, post-hoc power analyses were performed using an online calculator (40). Power, minimum detectable difference, and necessary sample size were computed for each association of interest.

The primary risk factor variables for this study were measures of fat, protein, and a Healthy Eating Index (HEI) score, which was calculated for each person by the Block service using the scoring method shown in Appendix 1. Protein and fat intake were both provided in relative and absolute measures by the FFQ, and thus several potential variables to assess the associations of interest were possible. For each participant, fat and protein were reported both in grams per day and percentage of calories from fat/protein per day. Categorical variables were also created around cutoff values represented in the literature and data-derived tertiles. Variable distributions and cross-tabulation tables were assessed to explore their relationships further. Carbohydrate intake was similarly reported and assessed.

To determine the best way in which to evaluate an association between nutrient intake and fall risk, regressions were run between each variable iteration and faller status. For fat, continuous variables assessed were grams of fat per day and percentage of calories from fat per day. Categorical variables assessed were grams of fat per day (more or less than 65 g), grams of fat per day (tertiles), percentage of calories from fat per day (more or less than 30%), percentage of calories from fat per day (more or less than 35%), and percentage of calories from fat per day (tertiles). For protein, continuous variables assessed were grams of protein per day and percentage of calories from protein per day. Categorical variables assessed were grams of protein per day (more or less than 60 g), grams of protein per day (tertiles), percentage of calories from protein per day (more or less than 15%), and percentage of calories from protein per day (tertiles).

This was also the case for carbohydrates, which had continuous variables for grams of carbohydrates per day and percentage of calories from carbohydrates. Categorical variables were created for grams of carbohydrates per day (more or less than 130 g), grams of carbohydrates per day (tertiles), and percentage of calories from carbohydrates per day (tertiles). For HEI score, categorical variables were created as well, one following the established categories (poor, needs improvement, good), and another of tertiles of HEI score. For each of the markers of interest, the variable iteration which had the most significant p-value was the variable retained for further testing. The variables chosen to be used were tertiles of percentage of calories from fat, protein, and carbohydrates, and the categorical HEI score variable with literature defined cutoffs.

A similar process was used for the creation of variables to be assessed as potential covariates or confounders. These variables were often recorded continuously, and so new categorical variables were created using literature-defined cutoff values as well as tertile variables. Regression and p-values were again used to determine which coding of each variable would be utilized. The potential covariates evaluated were: FSH level (categorical, more or less than 30 mIU / ml), FSH level (continuous, in mIU / ml), KPAS score (categorical, tertiles), Body Mass Index (BMI, categorical, tertiles), age (continuous), age (more or less than 43, data driven), percentage body fat (tertiles), calories per day (more or less than 2000), falls at baseline (continuous), breast cancer status (categorical, breast cancer survivor or breast cancer free control), vitamin D (categorical, more or less than 400 IU daily), calcium (categorical, more or less than 1000 mg daily), total lean body mass (tertiles, in grams), total fat body mass (tertiles, in grams), and total body mass (tertiles, in grams).

To build the models, the unadjusted relative risk (RR) estimate was obtained for each of the three primary variables of interest. Potential covariates were then added to the model one at a time. Those variables which were significant at the 0.10 level were then placed concurrently into a large main effects model. A backwards stepwise variable elimination procedure was then used to remove any variable which was not significant at a p-value cutoff of 0.05. The model remaining after this step was considered the main effects model. Potential confounders were then added singly to see if they changed the RR estimate of the primary variable of interest by 10% or more. Those variables which did change the RR by 10% or more were retained into the final model. Due to the size of the dataset, interaction effects were not assessed. From these final models the RR estimate and 95% CI were reported for each primary risk factor.

RESULTS

Table 1 shows demographic and nutritional distributions for the study population, offering measures both overall and by faller status. Table 2 shows mean values for each variable as well. From these tables, several interesting things are noticeable about this group of women. First, most of these women are consuming a high amount of calories from fat. While most sources call for an upper limit of 30 or 35 percent of calories from fat, these women are consuming an average of 40 percent. At the same time, all women consumed at least the lower bound of the recommended amount of protein of 10-15% of calories and below the upper bound of 35%. With an average intake of 44.6% (+/- 8.9), many of these women fell below the recommended 45 – 65% of calories from

carbohydrates daily. These recommendations come from the Acceptable Macronutrient Distribution Range (AMDR) and the 2005 Dietary Guidelines for Americans (12, 42, 43).

Looking at overall intake, it is suggested for women to consume a diet of 1800 to 2000 calories a day (42). However, these women consumed only 1587 (+/- 470) on average, with fallers consuming an average 70 calories fewer than non-fallers. This departure from dietary recommendations is further seen in the HEI score, where the average score for these women (65 +/- 12) resides in the middle of the "needs improvement" category (51-80). For micronutrient intake, most women seem to be meeting recommendations for daily calcium intake of 1000 mg with an average of 1277 mg, but are not meeting the recommended daily intake of vitamin D of 400 IU with an average intake of 302 IU (with fallers consuming an average 44 IU fewer per day than non-fallers). For all these mean measures, the standard deviations are large enough that differences between means for fallers and non-fallers are not likely to be statistically significant.

Another interesting distinction for this population is that their average FSH levels place them into the perimenopausal range of at least 30 mIU/ml, with an average of 42.36. However, this was also differentiated by faller status, as fallers had an average FSH level of 53.1 whereas non-fallers had an average of 30.3, a difference of 22.8 mIU/ml. A chi-square test between FSH level (more or less than 30 mIU/ml) and falls was statistically significant ($p = 0.0119$). FSH was also significantly correlated with falls (0.59, $p < 0.0001$). Whether or not a women was a breast cancer survivor or a cancer-free control was another variable shown to be statistically significant in a chi-square test

($p = 0.0270$). Other marginally significant chi-square tests involved age more or less than 43 ($p = 0.0731$) and calorie intake more or less than 2000 daily ($p = 0.0527$).

The distributional spread of protein was fairly narrow, and thus the women in this group seem to be replacing carbohydrates in their diets with fats while keeping protein intake consistent. Indeed, percentage of calories from carbohydrates was most highly correlated with percentage of calories from fat (-0.85, $p < 0.0001$), and less so with percentage of calories from protein (-0.48, $p < 0.0001$) (Table 3). This trend was also seen by running cross-tabular analyses on tertiles of intake. By adjusting for the intake of one macronutrient, the distributions of the other two nutrients are evident. For example, among women with the lowest tertile intake of fat, the majority (71%) had the highest tertile intake of carbohydrates, while protein intake was evenly distributed across the three tertiles. This trend was reversed for women with the highest intake of fat.

When adjusting for protein intake levels, the other distributions pulled towards the corners of the distribution table, where the combinations of high fat/low carbohydrates and low fat/high carbohydrates were located. When adjusting for carbohydrate intake levels, a trend similar to fat was seen. When adjusting for the lowest intake of carbohydrates, the majority of women (86%) had the highest fat intake, while protein was fairly evenly distributed. When adjusting for the middle amount of carbohydrate intake, the majority of women were in the middle tertile of fat intake. When adjusting for the highest intake of carbohydrates, the majority (69%) were in the lowest tertile of fat intake, with most also in the lowest tertile of protein intake. From such tables, it can be seen that for these women the percentage of calories from fat and carbohydrates move in

opposite directions concurrently, while protein intake remains fairly constant. A graphical example of this trend can be seen in Figure 1. Statistical significance of these trends was not looked at due to the occurrence of cells with zero observations.

Results of the regression procedures can be found in Table 4. All models retained the continuous variable for FSH level as a covariate, and each retained at least one confounder that altered the RR estimate by 10% or more. For fat, the variable most significantly associated with falls was the percentage of calories from fat per day, split into tertiles. The categories for this variable were 0 – 36.66, 36.67 – 42.53, and 42.54 or more percentage of calories from fat per day, respectively. Along with FSH level, the variable for tertiles of total body fat mass in grams was retained in the model as a confounder. This model demonstrated a threshold effect, although no RR estimate proved statistically significant. After adjustment, the women who consumed the highest tertile of percentage of calories from fat were at greater risk of falling compared to the lowest tertile (RR 1.45, 95% CI: 0.89 – 2.35), while the women who consumed the middle tertile percentage of calories of fat had essentially the same risk of falling compared to those in the lowest tertile (RR 1.01, 95% CI: 0.56 – 1.80).

For protein, the variable most significantly associated with falls was also the percentage of calories from protein per day, split into tertiles. The categories for this variable were 0 – 14.45, 14.46 – 16.50, and 16.51 or greater percentage of calories from protein per day, respectively. Along with FSH level, the variables for consuming at least 2000 calories, consuming at least 400 IU of vitamin D, and age were included as confounders. This model showed an interesting potential for a j-shaped trend, though

also provided no statistically significant RR estimate. The women who consumed the highest tertile of percentage of calories from protein were at a very slightly increased risk of falling compared to those in the lowest tertile (RR 1.06, 95% CI 0.60 – 1.85), while the women who consumed the middle tertile were at a somewhat reduced risk compared to the women in the lowest tertile (RR 0.84, 95% CI 0.52 – 1.33).

For completeness, carbohydrates were also analyzed. Again tertiles of percentage of calories was the most significant representation for this macronutrient. Along with FSH level, the variable for consuming at least 2000 calories was included as a confounder. This model proved similar to the others, demonstrating a potential threshold effect but providing no statistically significant result. Compared to the lowest tertile group, those women who consumed the highest tertile and middle tertile had a similarly reduced risk of falling (RR 0.86, 95% CI 0.53-1.40; RR 0.84, 95% CI 0.52-1.37, respectively).

For HEI score, the variable most significantly associated with falls was the tertile categorical variable. However, since this was only marginally more significant than the variable categorized by the literature defined cutoff values, the variable representing the established categories was used. The categories for this variable were scores of 0-50 as "poor", 51-80 as "needs improvement", and 81-100 as "good". Along with FSH level, the variable for consuming at least 2000 calories and the variable for consuming at least 400 IU of vitamin D were included as confounders. This model also showed potential for a threshold effect, but did not provide any statistically significant RR estimate. Those women who had a HEI score of "needs improvement" had a decreased risk of falling

compared to women with a score of "good" (RR 0.78, 95% CI: 0.39 – 1.48), while those women who had a score of "poor" had a similarly decreased risk compared to women with a score of "good" (RR 0.76, 95% CI: 0.33 – 1.77).

Each of these models was adjusted differently. All models had FSH level included as a covariate. While breast cancer status was itself significant in some models, when included in the model with FSH it always lost this significance. Therefore breast cancer status may have been serving as a proxy measure of FSH level for the purpose of evaluating fall risk. For fat intake, the model was also adjusted for total body fat mass. For protein intake, the model was adjusted for age, vitamin D, and calories. For carbohydrates, the model was adjusted for calories. For HEI score, the model was adjusted for calories and vitamin D. Thus the most common confounders were calories and vitamin D, while age and body fat were also included. RR estimates and 95% CIs of the covariate and confounder variables within the final models can be found in table 5.

DISCUSSION

These models provided several interesting trends which call for further attention, despite their lack of statistical significance. For fat, it appears that consuming high percentages of calories from fat increases a woman's risk of falling. However, it is interesting that this effect was only seen for those with a very high percentage of intake (greater than 42.53%) and not for those in the middle tertile who were also over recommendations. This may result from the fact that the majority of the women in the study consumed a high percentage of their calories from fat, as the comparison group is still elevated above recommended levels of 20-35% (12, 41 - 45). Thus even though

recommendations limit percentage of calories from fat, the threshold for where additional intake begins to influence fall risk may be higher. Therefore if women make an effort to consume fat at levels below current recommendations, they may have a buffer before additional calories from fat noticeably increase their risk for falls. It should also be noted that other fat cutoffs at the recommended levels of 30 percent, 35 percent, and 65 grams were evaluated and found to be less significant than the tertile variable used. Therefore current recommendations may be overly conservative in their relation to fall risk. However, staying below these levels is important for other health considerations, and so women should still strive to meet them.

There are several potential mechanisms through which increased fat intake may increase fall risk. One mechanism, mentioned previously, would involve the increased levels of fat intake leading to increased fat mass, which could lead to increased fall risk. However, since our model for fat includes body fat and the association remains, there is likely another pathway in which increased fat intake is influencing fall risk, and body fat may have some mediating effect. One such mechanism may involve energy balance, of which adipose tissue plays an active role (46). Adipose tissue releases a multiplicity of protein hormones, signals, and factors which have a range of physiological actions (47). Since dietary fat intake influences adipose tissue metabolism, different levels of fat intake would likely have an impact on these actions (48). Such changes might potentially influence fall risk by changing a person's alertness, response time to stumbles, activity levels, or a number of other body processes. Certainly there are many potential ways in which fall risk can be influenced by diet, and many of them appear to be interrelated.

Therefore there may not be any one singular mechanism for fat increasing falls, but a causal web of risk factors for falls through which fat intake influences fall risk.

For protein, there seems to be a potential j-shaped trend in the association of protein intake and falls, though this result was not statistically significant. Compared to the lowest tertile, those who consumed the middle tertile of percentage of calories from protein had a decreased risk of falling. At the same time, those who ate the largest percentages of calories from protein had a slight increase in fall risk. However, it should be noted that overall this group of women ate a fairly similar percentage of calories from protein, and so the cut-points for the tertiles are fairly close. It is generally recommended that women consume 10-35% of their calories from protein (43), though some report a lower range of 10-15% (45). However, these values are mainly set to complement the intake recommendations for fat and carbohydrates, as no defined intake level at which potential adverse effects of protein have been identified. The lower end of 10% is set at approximately the Recommended Daily Allowance (RDA) value. Other considered variables with cutoffs of 60 grams per day or 15 percent of calories from protein were less significant than the tertile variable. From the results of this study, it appears that for the purpose of reducing fall risk women should strive to meet the recommended percentage of calories from protein.

There may be several reasons for these findings regarding protein. First, there may be an actual j-shaped curve in which increased protein intake may lead to increased risk of falls. Since excess protein is converted and stored as body fat (12), this may have some similar mechanisms for influencing fall risk as increased fat intake. Alternatively,

the trend that was evident in this study could also be a spurious finding that is simply a result of a small dataset and a narrow distribution of protein intake. In this scenario, the RR estimates are merely revolving around unity, and any assigned trend may be ambitious. However, the potential for such a trend still exists, as there are many potential mechanisms in which protein intake could influence fall risk. As mentioned previously, protein intake can influence muscle mass, which can have influences on balance, body control, postural stability, reaction time, and coordination. Also, protein has been identified as being both detrimental and beneficial to bone health depending on other dietary factors (49). Thus different levels of protein intake in these women may be affecting bone mass, which could influence their fall risk through increased frailty, development of osteoporosis, or decreased skeletal muscle. Rather than one mechanism, there are likely many different but interrelated processes through which protein intake could be influential for fall risk.

Percentage of calories from carbohydrates also showed an interesting threshold effect, though it was not a primary variable of interest for this study. Compared to the lowest tertile, women who consumed the highest and middle tertiles of percent of calories from carbohydrates were at similarly decreased risk of falling. The cutoff for this effect occurs just below the lower bound of the recommended percentage of calories from carbohydrates of 45%. Since fat and carbohydrate intake were correlated, it makes sense that the RR estimates for each would show threshold effects in opposite directions. The mechanism for reducing fall risk could be similar to fat intake, but in the reverse. By eating more carbohydrates, the consumed percentage of calories from fat is likely to go down, reducing the effects of fat intake. It is likely that many of the biological

mechanisms through which these macronutrients influence fall risk are interrelated in a causal web of factors.

For HEI score, the surprising trend found was that women whose diets scored as needing improvement and poor were actually at a decreased risk for falling over the course of the year. This is the opposite of what was expected, in that poorer diets actually may decrease falling risk compared to good diets. However, this could be a result of the low numbers of women in the good category, as the majority (65 / 85) of the diets were scored as needing improvement. Since there were only 8 women in the comparison group of "good" diets, these RR estimates are highly vulnerable to variability within this group. If one less or one more woman reported falling, these estimates would likely change considerably. This is a limitation that was addressed by using tertiles in the other variables, but for consistency with the literature was not utilized for this variable. For this reason, the relative risk estimates reported for HEI score are more likely to be spurious than the other variables.

However, since the trend was shown, it is important to evaluate its potential mechanism. One explanation would be the scoring of the variable. If, for example, women ate more food than necessary in an attempt to meet all the guidelines, over time this could lead to weight gain. In such a case a poorer HEI score may be serving as a proxy measure for overeating. However, the model did include a dichotomous variable for caloric intake, so this may not be the case. Alternatively, this HEI score may not be measuring aspects of the diet which are important for fall risk, and there may be no difference between those who score as "good" and those who do not. Of course, the

other option is that this is a real trend, and that dietary intake which scores well on this HEI influences fall risk positively. Because of the sample size and distribution of the women's scores, the answer is not clear. As such, this is a finding that would greatly benefit from additional study where women consumed diets that would have a better distribution of scores.

Because of the makeup of the study population, there are many factors which must be addressed. Firstly, research has shown that breast cancer survivors may be at increased risk of falling due to physiological effects of treatment. This increased risk may be due to treatment related declines in musculoskeletal function, ovarian function, or drug reactions. In patients on glucocortocoid therapy, a shift from fat to protein oxidation leads to gains in fat mass, loss of muscle mass and muscle weakness (50). Higher body mass, and specifically higher fat mass, is associated with poorer stability that may increase fall risk (17). Weight gain and increased percent body fat are common during chemotherapy, and are greater in premenopausal women treated with tamoxifen (51). If the breast cancer survivors in this study remained at higher levels of body fat after treatment then they would likely remain at increased risk for falls. However, breast cancer status was considered in the analysis as both a covariate and confounder candidate, but was never retained according to statistical criteria. Therefore it is unlikely that breast cancer itself is responsible for the results seen.

Furthermore, while all the women were premenopausal at diagnosis, many of the women became menopausal due to their treatment and were menopausal at enrollment. Menopausal status has been previously implicated as a risk factor for falling, with

postmenopausal women more likely to fall than premenopausal women (26). Other research has also shown an increase in the risk of falling for women who are perimenopausal (24). In this study, the average FSH level for the entire group was elevated above 30 mIU/ml, a generally used threshold for perimenopausal status. Therefore it is likely that this group of women as a whole is at an increased risk of falling. FSH levels were also highly correlated with Breast cancer status (0.59, $p < 0.0001$). While both were initially included as covariates, breast cancer status always proved less significant than FSH level. Thus breast cancer status may be acting as a proxy for FSH level in this group, and it is actually the hormonal changes associated with menopause, marked by FSH levels, which are responsible for influencing fall risk. If this is the case, then breast cancer is important in this study for its impacts on menopausal status rather than the disease itself. By including FSH levels in all the models as a covariate, the influence of breast cancer status is assumed to be accounted for.

The largest limitation of this analysis was the small sample size of the study population. While several interesting trends were found, there was insufficient power to find statistically significant results. The association of fat intake with falls (highest vs. lowest tertile), as the most significant of the models, still only had 33% power to detect a statistically significant difference, with a minimum detectable difference of 0.58 (40). This relationship would have needed a sample size of at least 136 women in order to reach statistical significance. The other models had considerably less power, and would have needed a much larger group. With a larger sample size, it is likely that different categories of nutrient intake may have had a larger distribution, and so the use of tertiles would not have been necessary. Additional study would be very useful in determining

whether the trends found in this study are a true finding or are simply a function of chance.

While several options were available for analysis, the use of regression and relative risk estimates was determined to be the best option for the dataset. While the use of hazard analysis was a possible approach, the time-to-fall data was not complete enough in the dataset to warrant this method. Also, as self-reported data, falls were assumed to not have occurred if a postcard was not returned for any month. This may have not always been the case, but the potential impacts of a person not reporting a fall for any given month was lessened by using an aggregate approach. At the end of follow-up, all twelve months were combined into a single variable rather than evaluated as time-to-event data. Since the exposure of interest was also not so much a particular time point as a representative marker of long-term intake, hazard analysis did not seem as appropriate a method for this analysis.

The results of this study, though not significant, are still useful in furthering the understanding of nutrition and falls. Very little research has been done in this area, particularly in either breast cancer survivors or women below the age of 65. Furthermore, most research tends to focus on fracture risk rather than fall risk. However, the prevention of falls is a worthwhile effort, as it can in turn prevent the many negative health outcomes resultant from falling. The wide-ranging effects of falls and the potentially high cost of these effects necessitate identification and targeting of those persons at greatest risk of falling (20). Personal nutrition is an area in which people generally have some control, and so may be an effective area in which to elicit change.

While specific to this study population, the results from this study show that meeting dietary recommendations may be a worthwhile goal for women who wish to prevent falls. Future studies should further evaluate these relationships in other populations in order to make more specific recommendations.

SUMMARY AND CONCLUSIONS

Falls are a serious health concern as people age. Injury, fracture, disability, and death are all potential results from falls. As such, preventing falls is important as a proactive step to preventing further negative health outcomes. In this cohort of women, increased percentages of calories from fat were associated with increased risk of falling over one year. Medium levels of percentage of calories from protein were associated with decreased risk of falling over one year, while increased levels showed a slightly elevated risk. Higher percentages of calories from carbohydrates were associated with decreased falling risk. Lower scores on the Healthy Eating Index were associated with decreased risk of falling. None of these associations were statistically significant at the 0.05 level. However, the trends and threshold effects are interesting and the lack of significance can likely be attributed to the low sample size used in this analysis. Future studies with better power to find significant associations should be performed to better evaluate these relationships. In the meantime, women should continue to strive to meet dietary recommendations. While this may or may not statistically decrease a woman's risk for falling, doing so is likely to confer many other health benefits which are likely to improve overall quality of life.

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Table 1 - Frequency measures

Counts and percentages of women for several categorical variables. Gives overall numbers and numbers stratified by faller status. Chi-square test measures difference between faller and non-faller.

		n	%
Falls over one year	0	37	46
	1	18	22
	2+	26	32
Falls over one year	0	37	46
	1+	44	54

				non-fallers		fallers		
		n	%	n	%	n	%	χ2 test
Age	<43	31	39	18	50	13	30	0.07
	43+	48	61	18	50	30	70	
BMI	<25	47	57	21	57	23	55	0.88
	25-30	19	23	8	22	11	26	
	30+	17	20	8	22	8	19	
Falls at baseline	0	51	60	22	60	28	64	0.92
	1	19	22	8	22	9	50	
	2+	15	18	7	19	7	16	
Fractures at baseline	0	79	93	34	92	41	93	0.83
	1	6	7	3	8	3	7	
Breast Cancer survivor	no	29	36	18	62	19	37	0.03
	yes	52	64	11	38	33	63	
FSH level	<30	37	49	23	64	14	35	0.01
	30+	39	51	13	36	26	65	
Calories	2000+	11	14	8	22	3	7	0.05
	<2000	70	86	29	78	41	93	
Total vitamin D intake	400+	33	41	18	49	15	34	0.18
	<400	48	59	19	51	29	66	
Total Calcium intake	1000+	50	62	24	65	26	59	0.59
	<1000	31	38	13	35	18	51	

Table 2 - Mean measures

Mean values for factors utilized in this study. Gives mean values and standard deviations for both the overall group of women and stratified by faller status.

	total		non-fallers		fallers	
Factor	mean	std. Dev.	mean	std. Dev.	mean	std. Dev.
Falls over 1 year	1.48	2.2	-	-	2.7	2.3
Falls at baseline	0.9	2.0	1.1	2.6	0.8	1.4
Fractures at baseline	0.1	0.3	0.1	0.3	0.07	0.3
Protein per day (g)	62.5	21.1	66.0	24.7	61.0	17.3
Carbohydrates per day (g)	178.1	66.3	184.2	83.6	175.2	49.9
Total Fat per day (g)	70.3	22.7	70.8	20.9	71.3	23.6
HEI score (0 - 100)	65.1	12.2	64.8	13.1	65.1	12.0
% calories from fat	40.1	7.4	40.0	8.2	40.4	6.9
% calories from protein	15.8	2.5	16.1	2.6	15.6	2.5
% calories from carbohydrates	44.6	8.9	43.6	10.3	44.8	7.6
Calories per day	1,587	470	1,642	544	1,572	390
Age (years)	43.8	5.7	42.4	6.6	44.6	4.7
BMI	25.6	5.0	25.5	4.2	25.6	5.4
% Body Fat	34.1	6.9	33.6	6.9	34.3	7.0
Total Fat mass (g)	24,688	9,485	24,125	8,749	24,765	9,906
Total Lean mass (g)	43,305	5,418	43,449	5,362	43,019	5,078
Total Mass (g)	70,250	13,765	69,839	12,814	70,026	13,906
KPAS score (4 - 20)	11.4	1.9	11.3	1.7	11.4	2.0
FSH level (mIU/ml)	42.4	37.7	30.3	31.3	53.1	40.8
Vitamin D (IU)	302.3	226.5	331.2	238.5	287.1	218.9
Calcium (mg)	1,277	564	1,330	589	1,264	548

Table 3 - Correlations of variables of interest

Provides correlations of several variables, along with the associated p-value.

Correlation of falls over one year, percentage of calories from carbohydrates/fat/protein, and HEI score.

	Falls	% carbohydrates	% fat	% protein	HEI score
falls2	1	0.07	0.03	-0.10	0.01
		0.54	0.82	0.37	0.92
% carbohydrates		1	-0.85	-0.48	0.63
			<0.0001	<0.0001	<0.0001
% fat			1	0.19	-0.68
				0.08	<0.0001
% protein				1	-0.07
					0.53
HEI score					1

Correlation of falls over one year, breast cancer status, and FSH level.

	Falls	Breast Cancer	FSH level
Falls	1	0.2457	0.5892
		0.027	<0.0001
Breast Cancer		1	0.3
			0.0085
FSH level			1

Table 4 - Relative Risk estimates for primary risk factors

For each primary risk factor, provides the categories used, the number of women in each category both overall and stratified by faller status, the unadjusted and adjusted relative risk estimates and 95% confidence intervals (CI). Adjustment variables are listed below.

		total		non-fallers		fallers		Unadjusted		Adjusted		
	Category	n	%	n	column %	n	column %	RR	95% CI	RR	95% CI	
Tertiles of	<36.67	28	33	14	38	13	30	1		1		
Percent of Calories	36.67-42.53	28	33	14	38	12	27	0.96	0.54-1.70	1.01	0.56-1.80	i
from Fat	>42.53	29	34	9	24	19	43	1.41	0.88-2.25	1.45	0.89-2.36	
Tertiles of	<14.46	26	32	9	24	17	39	1		1		
Percent of Calories	14.46-16.50	27	33	14	38	13	30	0.74	0.46-1.19	0.84	0.52-1.33	ii
from Protein	>16.50	28	35	14	38	14	32	0.76	0.48-1.22	1.06	0.60-1.85	
Tertiles of	<43.08	29	34	11	30	18	41	1		1		
Percent of Calories	43.08-49.21	27	32	12	32	13	30	0.84	0.53-1.34	0.86	0.53-1.40	iii
from Carbohydrates	>49.21	29	34	14	38	13	30	0.78	0.48-1.26	0.84	0.52-1.37	
Healthy Eating	Good	8	9	3	8	5	11	1		1		
Index Score	Needs Improvement	65	76	28	76	33	75	0.87	0.48-1.55	0.78	0.39-1.48	iv
	Poor	12	14	6	16	6	14	0.80	0.37-1.75	0.76	0.33-1.77	

The above models are adjusted for:

i	FSH, Body fat	iii	FSH, calories
ii	FSH, calories, vitamin D, age	iv	FSH, calories, vitamin D

Variable	Variable Description
FSH	continuous FSH level
Body fat	tertiles of total body fat mass (g)
Calories	dichotomous above or below 2000 calories daily
Age	continuous age
Vitamin D	dichotomous above or below 400 IU vitamin D daily

Table 5 - Full relative risk estimates

For each primary risk factor, provides the Relative Risk (RR) estimate and 95% Confidence Interval (CI) for all variables in the regression model. Variables are defined below.

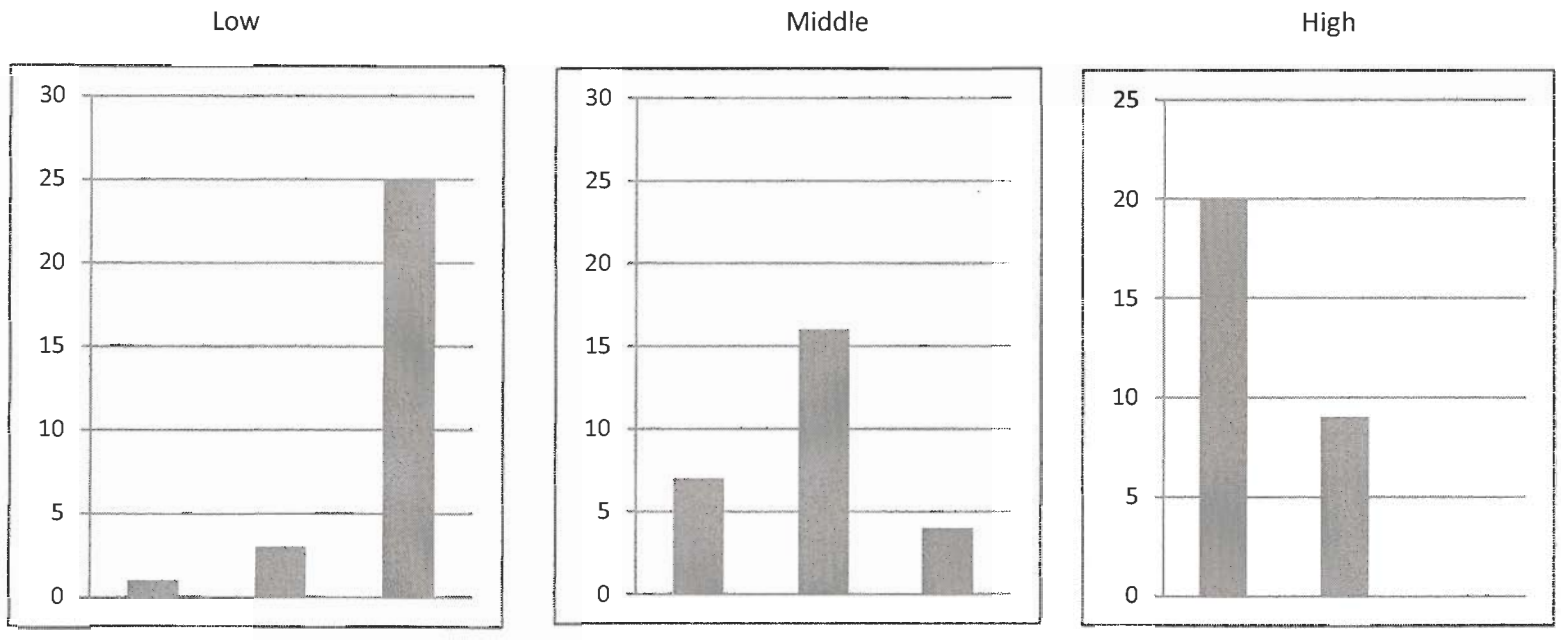
	Variable	Categories	RR	95% CI	
				Lower	Upper
Fat	% calories fat	Mid vs Low	1.01	0.56	1.8
	% calories fat	High vs Low	1.45	0.89	2.36
	Body fat	Mid vs Low	1.36	0.86	2.15
	Body fat	High vs Low	0.83	0.48	1.45
	FSH		1.01	1	1.01
Protein	% cal protein	Mid vs Low	0.84	0.52	1.34
	% cal protein	High vs Low	1.06	0.6	1.85
	FSH		1.01	1	1.01
	Age		1.03	0.99	1.08
	Calories		2.96	0.93	9.47
	Vitamin D		1.5	0.96	2.33
Carbohydrates	% cal carbs	Mid vs Low	0.86	0.53	1.4
	% cal carbs	High vs Low	0.84	0.52	1.37
	FSH		1.01	1	1.01
	Calories		2.86	0.82	9.98
HEI score	HEI score	Needs Imp. vs Good	0.76	0.39	1.48
	HEI score	Poor vs Good	0.76	0.33	1.77
	FSH		1.01	1	1.01
	Calories		2.96	0.9	9.8
	Vitamin D		1.26	0.82	1.91

Variable	Variable Description
% calories fat	tertiles of percentage of calories from fat
% cal protein	tertiles of percentage of calories from protein
% cal carbs	tertiles of percentage of calories from carbohydrates
HEI score	HEI score: Good, Needs improvement, Poor
FSH	continuous FSH level
Body fat	tertiles of total body fat mass (g)
Calories	dichotomous above or below 2000 calories daily
Age	continuous age
Vitamin D	dichotomous above or below 400 IU vitamin D daily

Figure 1 - Macronutrient distribution example

Graphical representation of the distributional association of fat and carbohydrate intake. Each graph shows the number of women in the low/middle/high tertile of percentage of calories from fat intake for a given tertile of percentage of calories from carbohydrates. The count is also listed below each graph.

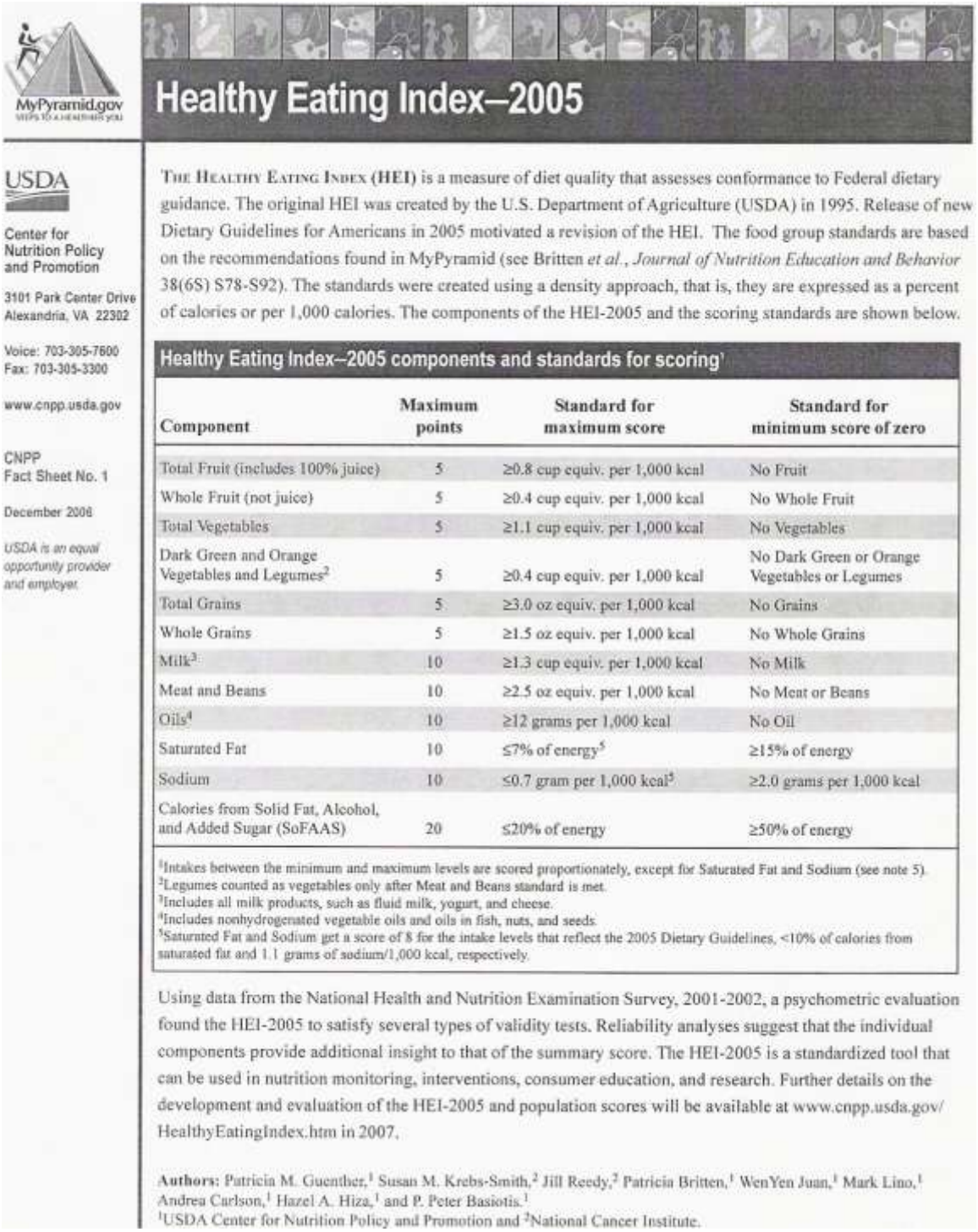
Tertile of percentage of calories from carbohydrates:



Tertile of fat intake:

	Low	Middle	High	Low	Middle	High	Low	Middle	High
Count:	1	3	25	7	16	4	20	9	0

Appendix 1 – HEI scoring sheet (52).



MyPyramid.gov

Healthy Eating Index–2005

USDA

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CNPP
Fact Sheet No. 1

December 2006

The Healthy Eating Index (HEI) is a measure of diet quality that assesses conformance to Federal dietary guidance. The original HEI was created by the U.S. Department of Agriculture (USDA) in 1995. Release of new Dietary Guidelines for Americans in 2005 motivated a revision of the HEI. The food group standards are based on the recommendations found in MyPyramid (see Britten *et al.*, *Journal of Nutrition Education and Behavior* 38(6S) S78-S92). The standards were created using a density approach, that is, they are expressed as a percent of calories or per 1,000 calories. The components of the HEI-2005 and the scoring standards are shown below.

Healthy Eating Index–2005 components and standards for scoring[1]

Component	Maximum points	Standard for maximum score	Standard for minimum score of zero
Total Fruit (includes 100% juice)	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit (not juice)	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetables	5	≥1.1 cup equiv. per 1,000 kcal	No Vegetables
Dark Green and Orange Vegetables and Legumes[2]	5	≥0.4 cup equiv. per 1,000 kcal	No Dark Green or Orange Vegetables or Legumes
Total Grains	5	≥3.0 oz equiv. per 1,000 kcal	No Grains
Whole Grains	5	≥1.5 oz equiv. per 1,000 kcal	No Whole Grains
Milk[3]	10	≥1.3 cup equiv. per 1,000 kcal	No Milk
Meat and Beans	10	≥2.5 oz equiv. per 1,000 kcal	No Meat or Beans
Oils[4]	10	≥12 grams per 1,000 kcal	No Oil
Saturated Fat	10	≤7% of energy[5]	≥15% of energy
Sodium	10	≤0.7 gram per 1,000 kcal[5]	≥2.0 grams per 1,000 kcal
Calories from Solid Fat, Alcohol, and Added Sugar (SoFAAS)	20	≤20% of energy	≥50% of energy

[1]Intakes between the minimum and maximum levels are scored proportionately, except for Saturated Fat and Sodium (see note 5).
[2]Legumes counted as vegetables only after Meat and Beans standard is met.
[3]Includes all milk products, such as fluid milk, yogurt, and cheese.
[4]Includes nonhydrogenated vegetable oils and oils in fish, nuts, and seeds.
[5]Saturated Fat and Sodium get a score of 8 for the intake levels that reflect the 2005 Dietary Guidelines, <10% of calories from saturated fat and 1.1 grams of sodium/1,000 kcal, respectively.

Using data from the National Health and Nutrition Examination Survey, 2001-2002, a psychometric evaluation found the HEI-2005 to satisfy several types of validity tests. Reliability analyses suggest that the individual components provide additional insight to that of the summary score. The HEI-2005 is a standardized tool that can be used in nutrition monitoring, interventions, consumer education, and research. Further details on the development and evaluation of the HEI-2005 and population scores will be available at www.cnpp.usda.gov/HealthyEatingIndex.htm in 2007.

Authors: Patricia M. Guenther,[1] Susan M. Krebs-Smith,[2] Jill Reedy,[2] Patricia Britten,[1] WenYen Juan,[1] Mark Lino,[1] Andrea Carlson,[1] Hazel A. Hiza,[1] and P. Peter Basiotis.[1]
[1]USDA Center for Nutrition Policy and Promotion and [2]National Cancer Institute.

Appendix 2 – Block 98 Food Frequency Questionnaire.

FOOD QUESTIONNAIRE

RESPONDENT ID #

TODAY'S DATE

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

DAY

2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

ABOUT THIS SURVEY

This form is about the foods you usually eat.
It will take about 30 - 40 minutes to complete.
Please answer each question as best you can.
Estimate if you aren't sure.

- **USE ONLY A NO. 2 PENCIL.**
- **Fill in the circles completely, and erase completely if you make any changes.**

Please write your name in this box.

ABOUT YOU

SEX
Male
Female

If female, are you pregnant or breast feeding?
No
Yes
Not female

AGE

WEIGHT pounds

HEIGHT ft. in.

INSTRUCTIONS

There are usually two kinds of questions to answer for each food:

1. **HOW OFTEN,** on average, did you eat the food during the past year?
   *Please DO NOT SKIP any foods. Mark "Never" if you didn't eat any of the food in the question.
2. **HOW MUCH** did you usually eat of the food?
   *Sometimes we ask how many you eat, such as 1 egg, 2 eggs, etc., ON THE DAYS YOU EAT IT.
   *Sometimes we ask "how much" as A, B, C or D. **LOOK AT THE ENCLOSED PICTURES.**
   For each food, pick the picture (bowls or plates) that looks the most like the serving size you usually eat. (If you don't have pictures: A=1/4 cup, B=1/2 cup, C=1 cup, D= 2 cups.)
3. **EXAMPLE:** This person drank apple juice twice a week, and had one glass each time. Once a week he ate a "C"-sized serving of rice (about 1 cup).

	HOW OFTEN IN THE PAST YEAR									HOW MUCH ON THOSE DAYS (SEE PORTION SIZE PICTURES FOR A-B-C-D)				
	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY					
Apple juice	○	○	○	○	○	●	○	○	○	How many glasses each time	1 ●	2 ○	3 ○	4 ○
Rice	○	○	○	○	●	○	○	○	○	How much each time	A ○	B ○	C ●	D ○

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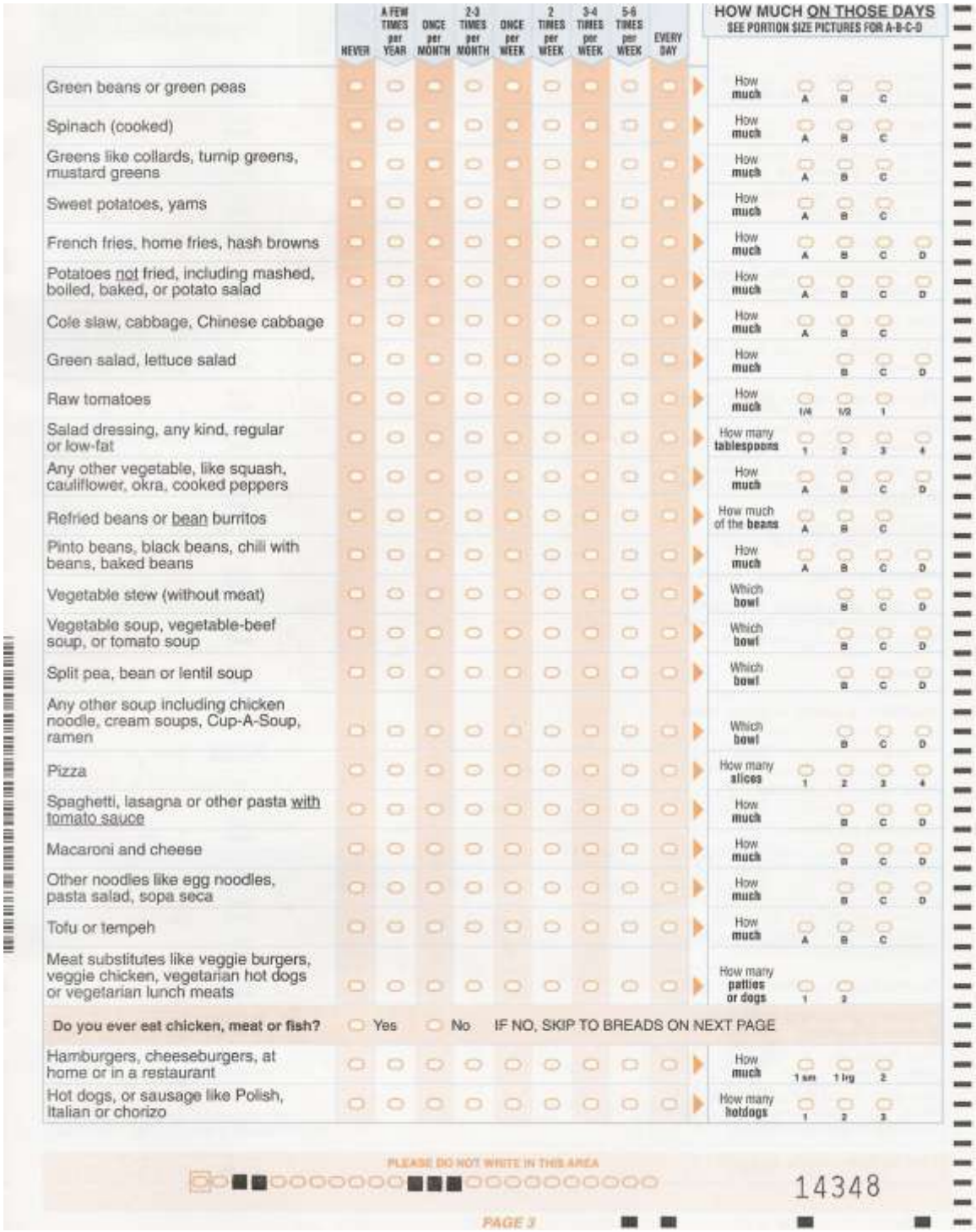
Block 2005.1 ©2005 BDDS Phone 510-704-8514 www.nutritionquest.com

This section is about your usual eating habits in the past year or so. This includes all meals or snacks, at home or in a restaurant or carry-out. We will ask you about different TYPES (low-fat, low-carb) at the end of the survey. Include all types (like low-fat, sugar-free). Later you can tell us which type you usually eat.

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS? SEE PORTION SIZE PICTURES FOR A-B-C-D
Breakfast sandwiches with eggs, like Egg McMuffins	○	○	○	○	○	○	○	○	○	How many sandwiches in a day: 1 2
Other eggs like scrambled, boiled or omelets (not egg substitutes)	○	○	○	○	○	○	○	○	○	How many eggs a day: 1 2 3
Breakfast sausage, including in sausage biscuits, or in breakfast sandwiches	○	○	○	○	○	○	○	○	○	How many pieces: 1 2 3
Bacon	○	○	○	○	○	○	○	○	○	How many pieces: 1 2 3 4
Pancakes, waffles, French toast or Pop Tarts	○	○	○	○	○	○	○	○	○	How many pieces: 1 2 3
Cooked cereals like oatmeal, grits or cream of wheat	○	○	○	○	○	○	○	○	○	Which bowl: B C D
Cold cereals, ANY KIND, like corn flakes, fiber cereals, or sweetened cereals	○	○	○	○	○	○	○	○	○	Which bowl: B C D
Milk or milk substitutes on cereal	○	○	○	○	○	○	○	○	○	
Yogurt or frozen yogurt	○	○	○	○	○	○	○	○	○	Which bowl: B C
Cheese, sliced cheese or cheese spread, including on sandwiches	○	○	○	○	○	○	○	○	○	How many slices: 1 2 3
How often do you eat the following foods all year round? Estimate your average for the whole year.										
Bananas	○	○	○	○	○	○	○	○	○	How many each time: 1/2 1
Apples or pears	○	○	○	○	○	○	○	○	○	How many each time: 1/2 1 2
Oranges or tangerines	○	○	○	○	○	○	○	○	○	How many each time: 1/2 1 2
Grapefruit	○	○	○	○	○	○	○	○	○	How much: A little 1/2 1
Peaches or nectarines, fresh	○	○	○	○	○	○	○	○	○	How many: 1/2 1 2
Other fresh fruits like grapes, plums, honeydew, mango	○	○	○	○	○	○	○	○	○	How much: A B C
Canned fruit like applesauce, fruit cocktail, canned peaches or canned pineapple	○	○	○	○	○	○	○	○	○	How much: A B C
How often do you eat each of the following 3 fruits, just during the summer months when they are in season?										
Cantaloupe, in season	○	○	○	○	○	○	○	○	○	How much: 1/8 1/4 1/2
Strawberries or other berries, in season	○	○	○	○	○	○	○	○	○	How much: A B C
Watermelon, in season	○	○	○	○	○	○	○	○	○	How much: A B C D
How often do you eat each of the following vegetables all year round, including fresh, frozen, canned or in stir-fry, at home or in a restaurant?										
Broccoli	○	○	○	○	○	○	○	○	○	How much: A B C
Carrots, or mixed vegetables with carrots	○	○	○	○	○	○	○	○	○	How much: A B C
Corn	○	○	○	○	○	○	○	○	○	How much: A B C

PAGE 2



	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS (SEE PORTION SIZE PICTURES FOR A-B-C-D)
Green beans or green peas	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C
Spinach (cooked)	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C
Greens like collards, turnip greens, mustard greens	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C
Sweet potatoes, yams	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C
French fries, home fries, hash browns	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C ○ D
Potatoes not fried, including mashed, boiled, baked, or potato salad	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C ○ D
Cole slaw, cabbage, Chinese cabbage	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C
Green salad, lettuce salad	○	○	○	○	○	○	○	○	○	How much: ○ B ○ C ○ D
Raw tomatoes	○	○	○	○	○	○	○	○	○	How much: ○ 1/4 ○ 1/2 ○ 1
Salad dressing, any kind, regular or low-fat	○	○	○	○	○	○	○	○	○	How many tablespoons: ○ 1 ○ 2 ○ 3 ○ 4
Any other vegetable, like squash, cauliflower, okra, cooked peppers	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C ○ D
Refried beans or bean burritos	○	○	○	○	○	○	○	○	○	How much of the beans: ○ A ○ B ○ C
Pinto beans, black beans, chili with beans, baked beans	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C ○ D
Vegetable stew (without meat)	○	○	○	○	○	○	○	○	○	Which bowl: ○ B ○ C ○ D
Vegetable soup, vegetable-beef soup, or tomato soup	○	○	○	○	○	○	○	○	○	Which bowl: ○ B ○ C ○ D
Split pea, bean or lentil soup	○	○	○	○	○	○	○	○	○	Which bowl: ○ B ○ C ○ D
Any other soup including chicken noodle, cream soups, Cup-A-Soup, ramen	○	○	○	○	○	○	○	○	○	Which bowl: ○ B ○ C ○ D
Pizza	○	○	○	○	○	○	○	○	○	How many slices: ○ 1 ○ 2 ○ 3 ○ 4
Spaghetti, lasagna or other pasta with tomato sauce	○	○	○	○	○	○	○	○	○	How much: ○ B ○ C ○ D
Macaroni and cheese	○	○	○	○	○	○	○	○	○	How much: ○ B ○ C ○ D
Other noodles like egg noodles, pasta salad, sopa seca	○	○	○	○	○	○	○	○	○	How much: ○ B ○ C ○ D
Tofu or tempeh	○	○	○	○	○	○	○	○	○	How much: ○ A ○ B ○ C
Meat substitutes like veggie burgers, veggie chicken, vegetarian hot dogs or vegetarian lunch meats	○	○	○	○	○	○	○	○	○	How many patties or dogs: ○ 1 ○ 2
Do you ever eat chicken, meat or fish?	○ Yes	○ No	IF NO, SKIP TO BREADS ON NEXT PAGE							
Hamburgers, cheeseburgers, at home or in a restaurant	○	○	○	○	○	○	○	○	○	How much: ○ 1 sm ○ 1 lrg ○ 2
Hot dogs, or sausage like Polish, Italian or chorizo	○	○	○	○	○	○	○	○	○	How many hotdogs: ○ 1 ○ 2 ○ 3

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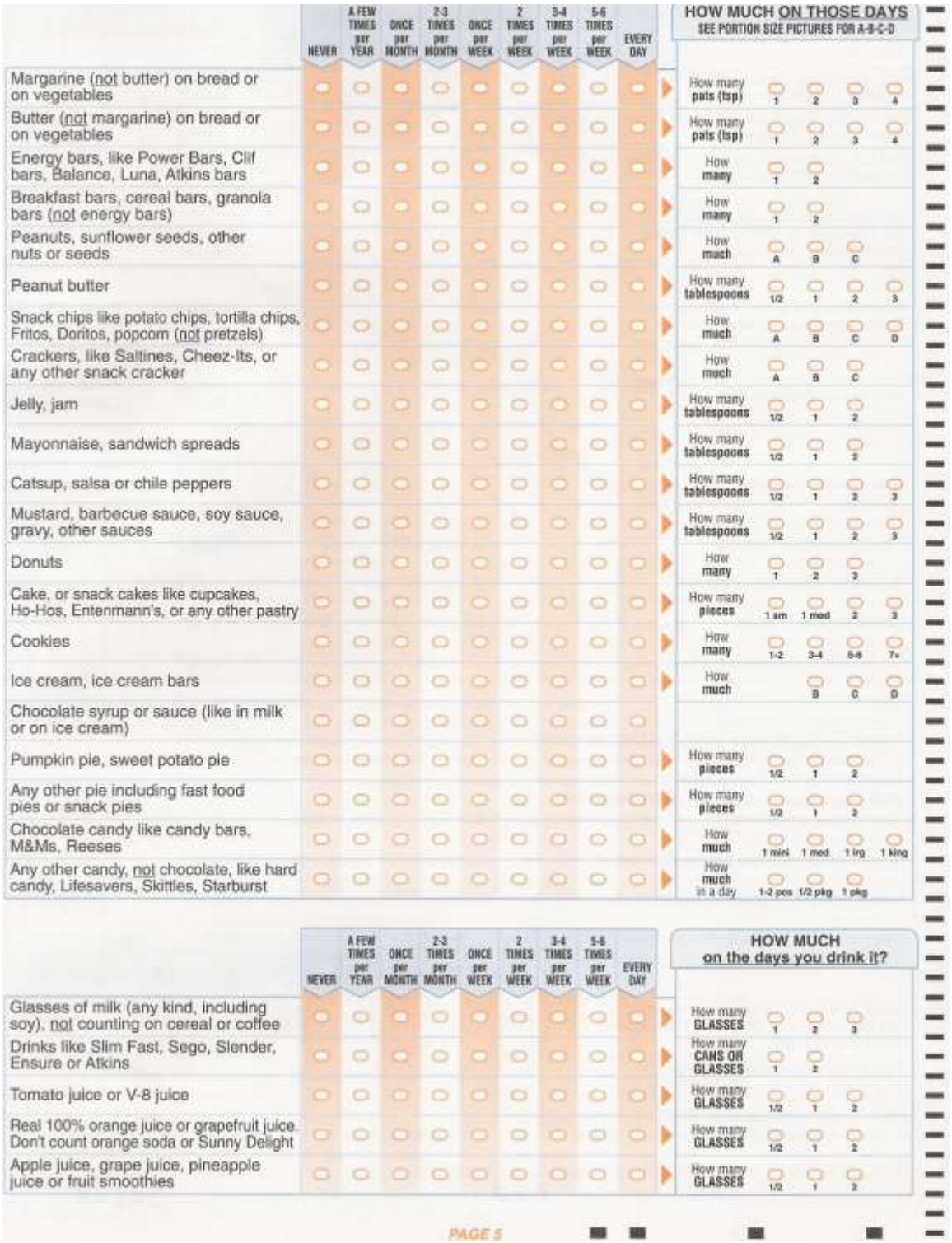
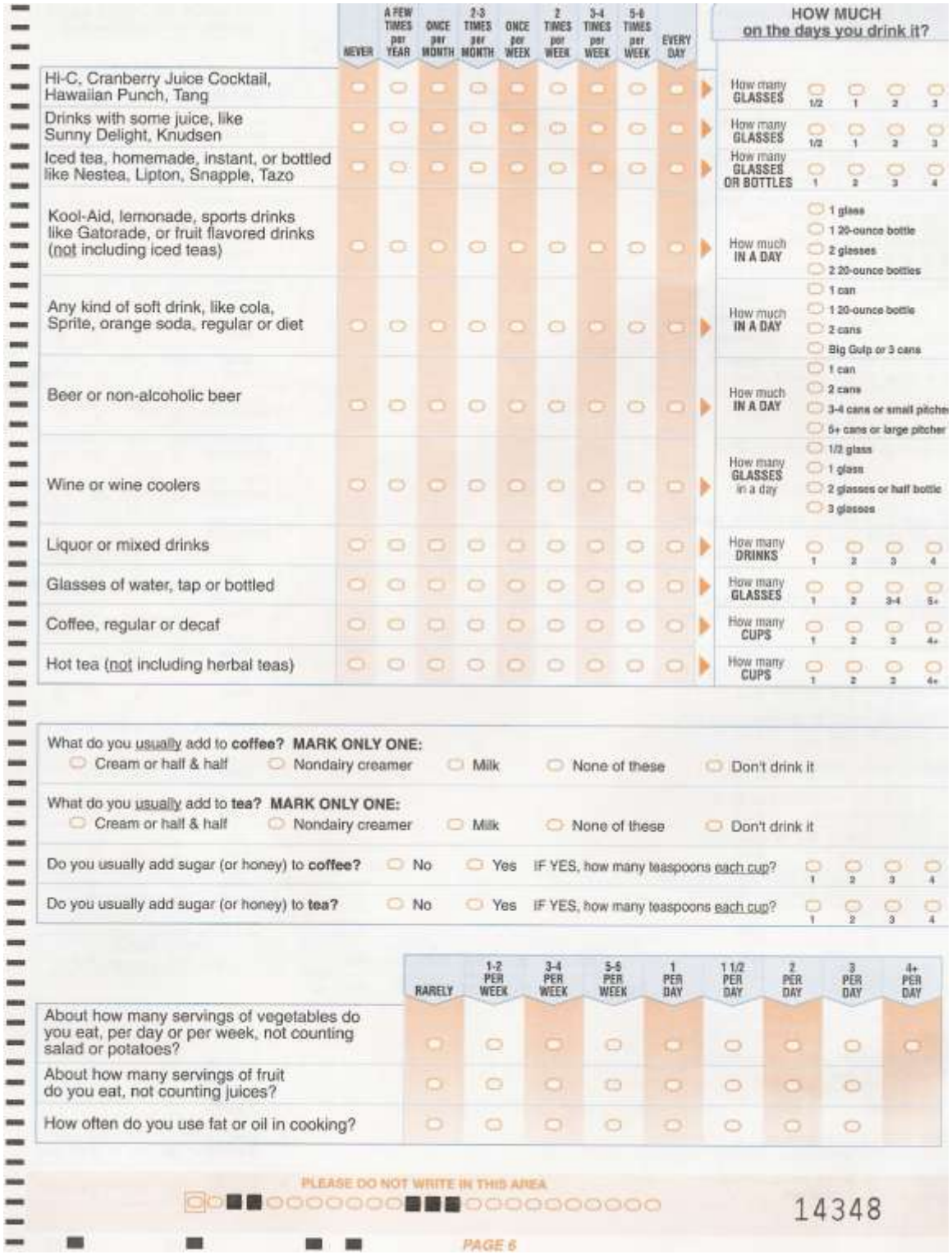
	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS (SEE PORTION SIZE PICTURES FOR A-B-C-D)
Lunch meat like bologna, sliced ham, turkey bologna, or any other lunch meat										How many slices: 1 2 3 4
Meat loaf, meat balls										How much: B C D
Steak, roast beef, or beef in frozen dinners or sandwiches										How much: A B C D
Tacos, burritos, enchiladas, tamales, with meat or chicken										How much: A B C D
Ribs, spareribs										How much: A B C D
Pork chops, pork roasts, cooked ham (including for breakfast)										How much: A B C D
Veal, lamb, deer meat										How much: A B C
Liver, including chicken livers or liverwurst										How much: A B C
Pigs feet, neck bones, oxtails, tongue										How much: A B C
Menudo, pozole, caldo de res, sancocho, ajiaco										Which bowl: B C D
Any other beef or pork dish, like beef stew, beef pot pie, corned beef hash, Hamburger Helper										How much: B C D
Fried chicken, including chicken nuggets, wings, chicken patty										How many medium pieces: 1 2 pcs/5 nugts 3
Roasted or broiled chicken or turkey										How much: A B C
Any other chicken dish, like chicken stew, chicken with noodles, chicken salad, Chinese chicken dishes										How much: B C D
Oysters										How much: A B C
Shellfish like shrimp, scallops, crabs										How much: A B C D
Tuna, tuna salad, tuna casserole										How much of the tuna: A B C
Fried fish or fish sandwich										How much: A B C
Other fish, not fried										How much: A B C
BREADS										
Biscuits, muffins, croissants (not counting breakfast sandwiches with eggs)										How many: 1 sm 1 med 2
Hamburger buns, hotdog buns, hoagie buns, submarines										How many: 1 2
Bagels, English muffins, dinner rolls										How many: 1/2 1
Tortillas (not counting those eaten in tacos or burritos)										How many in a day: 1 2 3 4
Corn bread, corn muffins, hush puppies										How many pieces in a day: 1/2 1 2
Any other bread or toast, including white, dark, whole wheat, and what you have in sandwiches										How many slices in a day: 1 2 3 4
Rice, or dishes made with rice										How much in a day: B C D


NEVER
A FEW TIMES per YEAR
ONCE per MONTH
2-3 TIMES per MONTH
ONCE per WEEK
2 TIMES per WEEK
3-4 TIMES per WEEK
5-6 TIMES per WEEK
EVERY DAY
HOW MUCH ON THOSE DAYS
SEE PORTION SIZE PICTURES FOR A-B-C-D
Margarine (not butter) on bread or on vegetables
How many pats (tsp) 1 2 3 4
Butter (not margarine) on bread or on vegetables
How many pats (tsp) 1 2 3 4
Energy bars, like Power Bars, Clif bars, Balance, Luna, Atkins bars
How many 1 2
Breakfast bars, cereal bars, granola bars (not energy bars)
How many 1 2
Peanuts, sunflower seeds, other nuts or seeds
How much A B C
Peanut butter
How many tablespoons 1/2 1 2 3
Snack chips like potato chips, tortilla chips, Fritos, Doritos, popcorn (not pretzels)
How much A B C D
Crackers, like Saltines, Cheez-Its, or any other snack cracker
How much A B C
Jelly, jam
How many tablespoons 1/2 1 2
Mayonnaise, sandwich spreads
How many tablespoons 1/2 1 2
Catsup, salsa or chile peppers
How many tablespoons 1/2 1 2 3
Mustard, barbecue sauce, soy sauce, gravy, other sauces
How many tablespoons 1/2 1 2 3
Donuts
How many 1 2 3
Cake, or snack cakes like cupcakes, Ho-Hos, Entenmann's, or any other pastry
How many pieces 1 sm 1 med 2 3
Cookies
How many 1-2 3-4 5-6 7+
Ice cream, ice cream bars
How much B C D
Chocolate syrup or sauce (like in milk or on ice cream)
Pumpkin pie, sweet potato pie
How many pieces 1/2 1 2
Any other pie including fast food pies or snack pies
How many pieces 1/2 1 2
Chocolate candy like candy bars, M&Ms, Reeses
How much 1 mini 1 med 1 lrg 1 king
Any other candy, not chocolate, like hard candy, Lifesavers, Skittles, Starburst
How much in a day 1-2 pcs 1/2 pkg 1 pkg
NEVER
A FEW TIMES per YEAR
ONCE per MONTH
2-3 TIMES per MONTH
ONCE per WEEK
2 TIMES per WEEK
3-4 TIMES per WEEK
5-6 TIMES per WEEK
EVERY DAY
HOW MUCH on the days you drink it?
Glasses of milk (any kind, including soy), not counting on cereal or coffee
How many GLASSES 1 2 3
Drinks like Slim Fast, Sego, Slender, Ensure or Atkins
How many CANS OR GLASSES 1 2
Tomato juice or V-8 juice
How many GLASSES 1/2 1 2
Real 100% orange juice or grapefruit juice Don't count orange soda or Sunny Delight
How many GLASSES 1/2 1 2
Apple juice, grape juice, pineapple juice or fruit smoothies
How many GLASSES 1/2 1 2
PAGE 5



	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on the days you drink it?
Hi-C, Cranberry Juice Cocktail, Hawaiian Punch, Tang	○	○	○	○	○	○	○	○	○	How many GLASSES: ○ 1/2 ○ 1 ○ 2 ○ 3
Drinks with some juice, like Sunny Delight, Knudsen	○	○	○	○	○	○	○	○	○	How many GLASSES: ○ 1/2 ○ 1 ○ 2 ○ 3
Iced tea, homemade, instant, or bottled like Nestea, Lipton, Snapple, Tazo	○	○	○	○	○	○	○	○	○	How many GLASSES OR BOTTLES: ○ 1 ○ 2 ○ 3 ○ 4
Kool-Aid, lemonade, sports drinks like Gatorade, or fruit flavored drinks (not including iced teas)	○	○	○	○	○	○	○	○	○	How much IN A DAY: ○ 1 glass ○ 1 20-ounce bottle ○ 2 glasses ○ 2 20-ounce bottles
Any kind of soft drink, like cola, Sprite, orange soda, regular or diet	○	○	○	○	○	○	○	○	○	How much IN A DAY: ○ 1 can ○ 1 20-ounce bottle ○ 2 cans ○ Big Gulp or 3 cans
Beer or non-alcoholic beer	○	○	○	○	○	○	○	○	○	How much IN A DAY: ○ 1 can ○ 2 cans ○ 3-4 cans or small pitcher ○ 5+ cans or large pitcher
Wine or wine coolers	○	○	○	○	○	○	○	○	○	How many GLASSES in a day: ○ 1/2 glass ○ 1 glass ○ 2 glasses or half bottle ○ 3 glasses
Liquor or mixed drinks	○	○	○	○	○	○	○	○	○	How many DRINKS: ○ 1 ○ 2 ○ 3 ○ 4
Glasses of water, tap or bottled	○	○	○	○	○	○	○	○	○	How many GLASSES: ○ 1 ○ 2 ○ 3-4 ○ 5+
Coffee, regular or decaf	○	○	○	○	○	○	○	○	○	How many CUPS: ○ 1 ○ 2 ○ 3 ○ 4+
Hot tea (not including herbal teas)	○	○	○	○	○	○	○	○	○	How many CUPS: ○ 1 ○ 2 ○ 3 ○ 4+

What do you usually add to **coffee?** **MARK ONLY ONE:**
○ Cream or half & half ○ Nondairy creamer ○ Milk ○ None of these ○ Don't drink it

What do you usually add to **tea?** **MARK ONLY ONE:**
○ Cream or half & half ○ Nondairy creamer ○ Milk ○ None of these ○ Don't drink it

Do you usually add sugar (or honey) to **coffee?** ○ No ○ Yes IF YES, how many teaspoons each cup? ○ 1 ○ 2 ○ 3 ○ 4

Do you usually add sugar (or honey) to **tea?** ○ No ○ Yes IF YES, how many teaspoons each cup? ○ 1 ○ 2 ○ 3 ○ 4

	RARELY	1-2 PER WEEK	3-4 PER WEEK	5-6 PER WEEK	1 PER DAY	1 1/2 PER DAY	2 PER DAY	3 PER DAY	4+ PER DAY
About how many servings of vegetables do you eat, per day or per week, not counting salad or potatoes?	○	○	○	○	○	○	○	○	○
About how many servings of fruit do you eat, not counting juices?	○	○	○	○	○	○	○	○	
How often do you use fat or oil in cooking?	○	○	○	○	○	○	○	○	

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If you eat the following foods, what type do you usually eat? MARK ONLY ONE ANSWER FOR EACH QUESTION

Milk	○ Whole milk ○ Reduced-fat 2% milk	○ Low-fat 1% milk ○ Non-fat milk	○ Soy milk ○ Rice milk	○ Don't drink
Slim Fast, Sego, Slender or Ensure		○ Low-Carb like Atkins	○ Regular	○ Don't drink
Orange juice	○ Calcium-fortified	○ Not calcium-fortified	○ I don't know	○ Don't drink
Soda or pop	○ Diet soda, low-calorie	○ Regular	○ Don't drink	
Iced tea	○ Homemade, no sugar	○ Homemade, w/sugar	○ Bottled, no sugar	○ Bottled, regular ○ Don't drink
Beer	○ Regular beer	○ Light beer	○ Low-Carb beer	○ Non-alcoholic beer ○ Don't drink
Hamburgers or cheeseburgers		○ Hamburgers	○ Cheeseburgers	○ Don't eat
Hot dogs	○ Low fat or turkey dogs	○ Regular hot dogs	○ Don't eat	
Lunch meats	○ Low-fat or turkey lunch meats	○ Regular lunch meats	○ Don't eat	
Spaghetti or lasagna	○ Meatless	○ With meat sauce or meatballs		○ Don't eat
Cheese	○ Low Fat	○ Not Low Fat	○ Don't eat	
Salad dressing	○ Low-Carb	○ Low-fat	○ Regular	○ Don't use
Energy bars like Power Bar, Clif, Atkins	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Breakfast bars, cereal bars, or granola bars	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Bread	○ 100% whole wheat	○ Low-Carb	○ Regular	○ Don't eat
Tortillas	○ Corn	○ Flour	○ Don't know or don't eat	
Chocolate candy or chocolate candy bars	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Cookies	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Cake, snack cakes, and other pastries	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Ice cream	○ Low-Carb, low sugar	○ Low-fat or ice milk	○ Regular	○ Don't eat
Jelly or jam	○ Low-Carb, low sugar	○ Regular	○ Don't use	
Beef or pork	○ Avoid eating the fat	○ Sometimes eat the fat	○ Often eat the fat	○ Don't eat
Chicken or Turkey	○ Avoid eating the skin	○ Sometimes eat the skin	○ Often eat the skin	○ Don't eat

What kinds of **fat or oil** do you usually use in cooking? **MARK ONLY ONE OR TWO**

○ Don't know, or Pam	○ Stick margarine	○ Corn oil, vegetable oil	○ Lard, fatback, bacon fat
○ Butter	○ Soft tub margarine	○ Olive oil or canola oil	○ Crisco
○ Butter/margarine blend	○ Low-fat margarine		

If you eat **cold cereals**, what do you eat? Choose one or two that you eat most often. (If you usually just eat one kind, just choose one.)

○ Low-carb cereals like Atkins, Low-Carb Special K	○ Total	○ Other fiber cereals like Raisin Bran, Fruit-n-Fiber
○ Cheerios, Grape Nuts, Shredded Wheat, Wheaties, Wheat Chex	○ Fiber One	○ Sweetened cereals like Frosted Flakes, Froot Loops
	○ Product 19, Complete	○ Other cold cereals, like Corn Flakes, Rice Krispies, Special K
	○ All Bran, Bran Buds	

What vitamin supplements do you take fairly regularly?

Multiple Vitamins. Did you take...	HOW OFTEN: DIDN'T TAKE	A FEW DAYS per MONTH	1-3 DAYS per WEEK	4-6 DAYS per WEEK	EVERY DAY	FOR HOW MANY YEARS?: LESS THAN 1 YEAR	1 YEAR	2 YEARS	3-4 YEARS	5-9 YEARS	10+ YEARS
Prenatal vitamins	○	○	○	○	○	○	○	○	○	○	○
Regular Once-A-Day, Centrum, Theragran, "senior" vitamins or house brands of multiple vitamins	○	○	○	○	○	○	○	○	○	○	○
Stress-tabs or B-Complex type	○	○	○	○	○	○	○	○	○	○	○
Single Vitamins, not part of multiple vitamins											
Vitamin A (not beta-carotene)	○	○	○	○	○	○	○	○	○	○	○
Beta-carotene	○	○	○	○	○	○	○	○	○	○	○
Vitamin C	○	○	○	○	○	○	○	○	○	○	○
Vitamin E	○	○	○	○	○	○	○	○	○	○	○
Folic Acid, Folate	○	○	○	○	○	○	○	○	○	○	○
Calcium or Tums	○	○	○	○	○	○	○	○	○	○	○
Vitamin D, alone or combined with calcium	○	○	○	○	○	○	○	○	○	○	○
Zinc	○	○	○	○	○	○	○	○	○	○	○
Iron	○	○	○	○	○	○	○	○	○	○	○
Selenium	○	○	○	○	○	○	○	○	○	○	○
Omega-3, fish oil, flax seed oil	○	○	○	○	○	○	○	○	○	○	○

If you took Once-a-day, Centrum or Thera-type multiple vitamins, did you usually take types that
○ contain minerals, iron, zinc, etc. ○ do not contain minerals ○ Don't know

If you took vitamin C, how many milligrams of **vitamin C** did you usually take, on the days you took it?
○ 100 ○ 250 ○ 500 ○ 750 ○ 1000 ○ 1500 ○ 2000 ○ 3000+ ○ Don't know

If you took vitamin E, how many IUs of **vitamin E** did you usually take, on the days you took it?
○ 100 ○ 200 ○ 300 ○ 400 ○ 600 ○ 800 ○ 1000 ○ 2000+ ○ Don't know

Did you take any of these supplements at least once a week?
○ Ginkgo ○ St. John's Wort ○ Echinacea ○ DHEA ○ Didn't take these
○ Ginseng ○ Kava Kava ○ Melatonin ○ Glucosamine/Chondroitin

SOME LAST QUESTIONS ABOUT YOU

Would you say your health is ○ Excellent ○ Very good ○ Good ○ Fair ○ Poor

Are you currently trying to lose weight? ○ Yes ○ No

Was there ever a time in your life when you often drank more beer, wine or liquor than you do now? ○ Yes ○ No

Do you smoke cigarettes now? ○ Yes ○ No
IF YES, On average about how many cigarettes a day do you smoke now? ○ 1-5 ○ 6-14 ○ 15-24 ○ 25-34 ○ 35+

Are you ○ Hispanic or Latino ○ Not Hispanic or Latino

What race do you consider yourself to be? (MARK ALL THAT APPLY)
○ White ○ Asian ○ Native Hawaiian or Other Pacific Islander
○ Black or African American ○ American Indian or Alaska Native ○ Do not wish to provide this information

Thank you very much for filling out this questionnaire.
Please take a minute to go back and fill in anything you may have skipped.

PLEASE DO NOT WRITE IN THIS AREA

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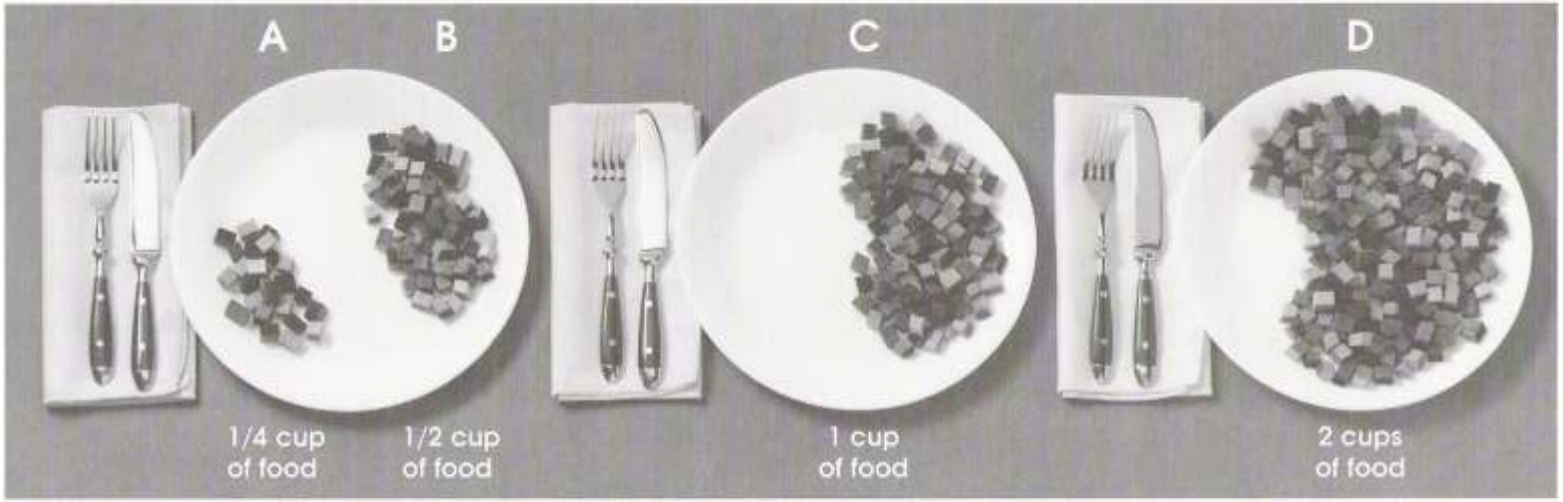
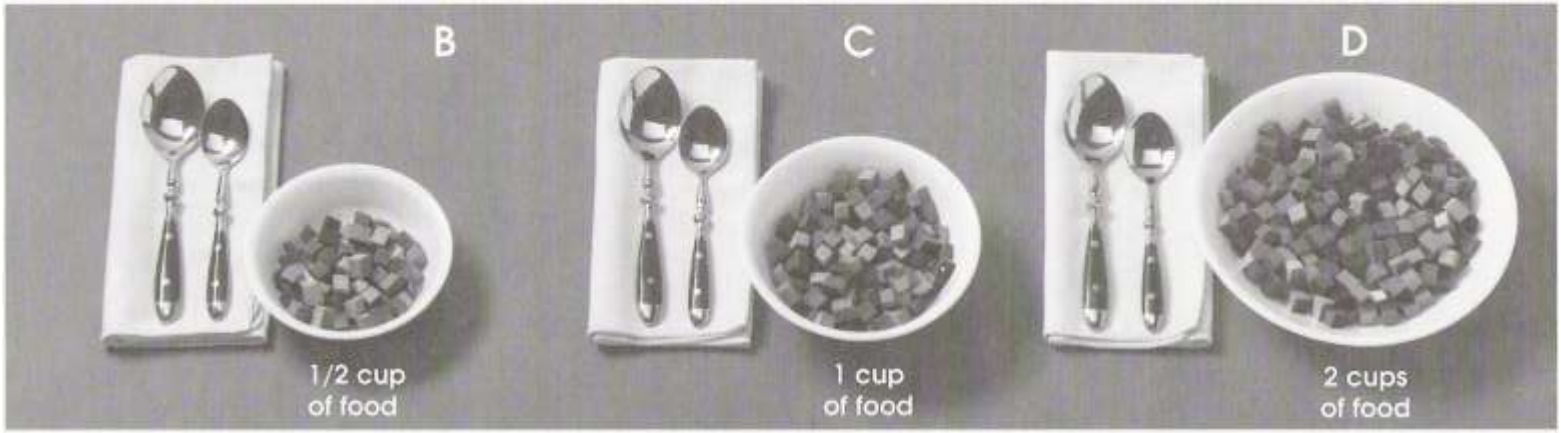
Serving Size Choices

Keep this in front of you while you are filling out The Food Questionnaire. You may use either the plates or the bowls to help you choose your serving size.

Choose A, B, C or D: **A** = 1/4 Cup of Food **B** = 1/2 Cup of Food **C** = 1 Cup of Food **D** = 2 Cups of Food





Appendix 3 – Kaiser Physical Activity Survey and scoring mechanism (36).

KAISER PHYSICAL ACTIVITY SURVEY

SECTION I. HOUSEHOLD AND FAMILY CARE ACTIVITIES

First, we want to know about your activities at home, not including activities you may do at your home or other people's home for pay. During the past year (12 months back from today), how much time did you spend...

1. Caring for a child or children under 2 years of age — 1-3-5
   (None or <1 hour a week/≥ 1 hour but <20 hours a week/≥20 hours a week)
2. Caring for a child or children between 2 and 5 years of age — 1-3-5
   (None or <1 hour a week/≥ 1 hour but <20 hours a week/≥20 hours a week)
3. Caring for a disabled child or elderly person (only count time actually spent in feeding, dressing, moving, etc.) — 1-3-5
   (None or <1 hour a week/≥ 1 hour but <20 hours a week/≥20 hours a week)
4. Preparing meals or cleaning up from meals on weekdays? — 1-2-3-4-5
   (None or <½ hour a day/≥½ hour but <1 hour a day/≥1 hour but <1½ hours a day/≥1½ hours but <2 hours a day/ ≥2 hours a day)
5. Preparing meals or cleaning up from meals on weekends? — 1-2-3-4-5
   (None or <½ hour a day/≥½ hour but <1 hour a day/≥1 hour but <1½ hours a day/≥1½ hours but <2 hours a day/ ≥2 hours a day)
6. Doing major cleaning, such as shampooing carpets, waxing floors, or washing walls or windows? — 1-2-3-4-5
   (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)
7. Doing routine cleaning such as dusting, laundry, vacuuming, or changing linens? — 1-2-3-4-5
   (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)
8. Going grocery shopping and pushing a shopping cart? — 1-2-3-4-5
   (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)
9. Doing gardening or yard work, such as mowing lawn or raking leaves? — 1-2-3-4-5
   (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)
10. Doing heavy outdoor work, such as chopping wood, tilling soil, shoveling snow, or baling hay? — 1-2-3-4-5
   (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)
11. Doing major home decoration or repair, such as plumbing, tiling, painting or building? — 1-2-3-4-5
   (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)

Household/caregiving index = Σ(q4-q11, caregiving subindex)/9; caregiving subindex = 1 if q1, q2, and q3 = 1; 3 if q1, q2, or q3 = 3; 5 if q1, q2 or q3 = 5)

SECTION II. OCCUPATIONAL ACTIVITIES [Study investigators to decide if this section is to be completed by individuals working part-time as well as full-time.]
Now, some questions about your employment situation.

12. What is your occupation? (if more than one job, describe your occupation for the job with the most hours worked per week)
_____
13. What is the name of your employer, business or company?
_____
14. What kind of business or industry is this? (For example, hospital, newspaper publishing, mail order house, auto engine manufacturing, etc.) _____
15. What are your most important specific activities or duties? (For example, selling cars, keeping account books, etc.)
    1._____
    2._____
    3._____
16. Which best describes your current occupation:
    (Employee of private company, business or individual for wages, salary, or commissions/Employee of Federal government/ Employee of state or local government/Self employed in own business, professional practice or farm/Working without pay in home, family business or farm)
17. In comparison with other women your age, do you think your work is physically... 1-2-3-4-5
    (much lighter/lighter/the same as/heavier/much heavier)
18. After work, are you physically tired.. 1-2-3-4-5
    (Never/Seldom/Sometimes/Often/Always)
19. When you are working at your current occupation, how often do you do each of the following: 1-2-3-4-5
    (Never/Seldom/Sometimes/Often/Always, for each item)
    a. Sit
    b. Stand
    c. Walk
    d. Lift heavy loads
    e. Sweat from exertion

Occupational Index = Σ(q17, q18, q19b-e, (6-q19a), occupational intensity code)/8; occupational intensity code comes from Questions 12-16 which are used to code occupation according to Department of Labor Occupational Codes; intensity code of 1 = low, 3 = medium, and 5 = high is then assigned to occupational code depending on physical demands of occupation

SECTION III. ACTIVE LIVING HABITS

This next section asks about the general level of physical activity involved in your daily routine during the past year.

20. How many minutes a day do you usually walk and/or bicycle to and from work, school or errands? 1-2-3-4-5
    (<5/≥5 but <15/≥15 but <30/≥30 but <45/≥45)
21. Did you watch television? 1-2-3-4-5
    (<1 hour a week/≥ 1 hour a week but <1 hour a day/≥1 hour a day but <2 hours a day/
    ≥2 hours a day but <4 hours a day/≥4 hours a day)
22. Did you walk (for at least 15 minutes at a time)? 1-2-3-4-5
    (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)
23. Did you bike (for at least 15 minutes at a time)? 1-2-3-4-5
    (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)

Active Living Index = Σ(q20, q22, q23, (6-Q21))/4

SECTION IV. PARTICIPATION IN SPORTS AND EXERCISE:

Finally, we want to ask about your participation in sports and exercise during the past year.

24. In comparison with other women of your own age, do you think your recreational physical activity is... 1-2-3-4-5
    (Much less/Less/Same as/More/Much more)
25. Did you play sports or exercise? 1-2-3-4-5
    (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)
26. Did you sweat from exertion during sports or exercise? 1-2-3-4-5
    (Never or less than once a month/Once a month/2-3 times a month/Once a week/More than once a week)

[Provide list of specific sports and exercises relevant to study population for reference in answering following questions]

27. During the past year, did you participate in any of these activities or in any other similar activities not included in the list?
    (yes/no)

[If yes, respondent continues with following questions]

28 Which sport or exercise did you do most frequently? (Specify only one) _____ Intensity :0.76-1.26-1.76
    (code specified activity as <4 METs/4-6 METs/>6 METs)
29. How many months in this past year did you do this activity? Proportion: 0.5-1.3-2.5-3.5-4.5
    (<1/1-3/4-6/7-9/>9)
30 How many hours a week did you usually do this activity? Time: 0.04-0.17-0.42-0.67-0.92
    (<1/≥1 but <2/≥2 but <3/≥3 but <4/ ≥4
31. Did you do any other exercise or play any other sport in this past year?
    (yes/no)

[If yes, respondent continues with following questions]

32 What was the second most frequent sport or exercise you did ? (Specify only one) _____ Intensity :0.76-1.26-1.76
(code specified activity as <4 METs/4-6 METs/>6 METs)

33. How many months in this past year did you do this activity? Proportion: 0.5-1.3-2.5-3.5-4.5
(<1/1-3/4-6/7-9/>9)

34 How many hours a week did you usually do this activity? Time: 0.04-0.17-0.42-0.67-0.92
(<1/≥1 but < 2/≥2 but <3/≥3 but <4/ ≥4

35. Did you do any other exercise or play any other sport in this past year?
(yes/no)

[If yes, respondent continues with following questions]

36 What was the third most frequent sport or exercise you did ? (Specify only one) _____ Intensity :0.76-1.26-1.76
(code specified activity as <4 METs/4-6 METs/>6 METs)

37. How many months in this past year did you do this activity? Proportion: 0.5-1.3-2.5-3.5-4.5
(<1/1-3/4-6/7-9/>9)

38 How many hours a week did you usually do this activity? Time: 0.04-0.17-0.42-0.67-0.92
(<1/≥1 but <2/≥2 but <3/≥3 but <4/ ≥4)

Sports and Exercise Index = Σ(q24-26, simple sport score)/4; simple sport score is calculated by multiplying intensity by proportion by time for each specified activity and summing over number of activities (q28, q32 and q36); if no activities are specified, the sum will be 0; simple sport score will take on value of 1-2-3-4-5 corresponding to scores of 0/0.01-<4/4-<8/8-<12/>12.

NOTE: The numbers in the right-hand column are the numerical values to be assigned to respective response categories specified in parantheses below each question.