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Invited Commentary

Dietary pattern predicts breast cancer risk – evidence from the EPIC-Potsdam study

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Diet in relation to disease has most often been described in terms of food groups, single foods or nutrients. The single-food or -nutrient approach may be inadequate to examine associations with disease for a number of reasons. These include the complex combinations of nutrients consumed, the inability to account for synergy adequately because of interaction among some nutrients, and the effect of a single nutrient may be too small to detect. As a result, nutritional epidemiologists proposed the dietary pattern approach[1,2], whereby food in relation to disease is investigated as it is actually consumed, with its various characteristics and combinations.

The most common methods that are used to construct dietary patterns include the diet quality index[1,2], cluster analysis and factor analysis[2]. Using the diet quality index approach, scores are awarded and indices created on the basis of previous knowledge of a ‘healthy’ diet based on dietary guidelines or recommendations. The diet quality score is therefore an indicator of the degree to which an individual or a population’s dietary intake conforms to specific dietary guidelines. The approaches of cluster and factor analyses are exploratory; the eating patterns are derived through statistical modelling of foods or dietary data. In cluster analysis, individuals instead of food are aggregated into relatively homogeneous subgroups with similar diets. Factor analysis, on the other hand, aggregates food items or food groups on the basis of the degree to which the food items in the dataset are correlated with one another. A summary score for each pattern is derived and used in correlation or regression analysis to examine relationships between the derived eating patterns and the outcome of interest (e.g. nutrient intake, disease outcome or other biochemical indicators of health)[3,4]. Factor analysis, in particular principal component analysis, is the most widely used method of deriving dietary patterns. It produces linear combinations of foods with the goal of identifying patterns that explain the largest variation in consumption patterns of these foods. However, the patterns derived from principal component analysis do not necessarily explain much of the response variation.

In 2004, reduced rank regression (RRR) was introduced to nutritional epidemiology by Hoffmann *et al.* [5]. This method combines the ‘exploratory’ approach of factor analysis with the ‘previous knowledge’ approach of the diet quality index. However, in RRR the ‘previous knowledge’ is not based on dietary guidelines but on dietary or non-dietary ‘risk factors’ or ‘biomarkers’ in the pathway between food intake and the disease of interest. Schulz *et al.*, in this issue of the *British Journal of Nutrition*, have applied the RRR method to derive a food pattern that explains variation in intake of four different fatty acids which may be associated with breast cancer risk[6].

Dietary factors are implicated in breast cancer development but evidence for an association between high-fat diets and breast cancer risk remains conflicting[7]. Results of previous observational studies have been inconsistent, with strong support for a positive association from case–control studies, and a null association from cohort studies[8]. The Women’s Health Initiative randomised controlled dietary modification trial of low fat intake in relation to invasive breast cancer risk did not provide evidence for a significant reduction of breast cancer risk in women who were randomised to the low-fat diet regimen[9], although results from this trial suggested a protective effect of low-fat diet for women who had the highest levels of fat intake before the study and variation of the effect by hormone receptor characteristics of the tumours. Comparison of dietary instruments shows that dietary fat intake assessed by food records[10] and food diaries[11] shows positive associations with breast cancer risk while dietary fat intake assessed using FFQ shows null associations.

In view of these inconsistencies, Schulz *et al.* [6] set out to investigate the association between dietary fat intake and breast cancer risk by identifying a specific dietary pattern

Abbreviation: RRR, reduced rank regression.

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which explained the most variation in a set of dietary markers of fat intake. They employed the RRR which other authors have hitherto not used in studies investigating the association between dietary patterns, dietary fat intake and breast cancer risk. The use of RRR ensured the derivation of a risk factor-related dietary pattern, thereby associating the multi-dimensionality of food with risk factors (fatty acid intake in the study by Schulz *et al.*) that may lie in the causal pathway between food intake and the disease (invasive breast cancer). Principal component analysis produces linear combinations of foods but does not necessarily predict patterns that correspond to physiological responses such as risk factors or biomarkers.

Using the RRR methodology, Schultz *et al.* reported a two-fold increased risk of breast cancer for women who habitually consumed a diet characterised by processed meat, fish, butter and other animal fats, and margarine(6). This dietary pattern was positively associated with all four fatty acid classes that were selected as response variables (SFA, MUFA, *n*-3 PUFA and *n*-6 PUFA). As the authors indicate, this is likely to be due to the fact that increased intake of total fat is expected to lead to increased intake of all four fatty acid groups. The authors may have been able to avoid this problem by considering more specific indicators of fatty acid intake such as intake adjusted for total fat intake, or the ratio of *n*-3 to *n*-6 fatty acids. Thus while conclusions about specific fatty acids could not be made from this study, the results indicate that a dietary pattern that is indicative of high fat intake (irrespective of type of fat) is associated with a doubling of breast cancer risk in German women.

Because the response variables that are used for RRR can include not only dietary factors but also biomarkers or any other risk factor for the disease of interest, future approaches may include use of biomarkers such as plasma fatty acid concentrations or other biomarkers(12). In the light of these potential wider applications of the RRR method, the method used by Schulz *et al.* may become more relevant in nutritional epidemiology.

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