RESEARCH COMMUNICATION

Dietary Patterns and Risk of Ductal Carcinoma of the Breast: A Factor Analysis in Uruguay

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Abstract

Breast cancer (BC) shows very high incidence rates in Uruguayan women. The present factor analysis of ductal carcinoma of the breast, the most frequent histological type of this malignancy both in Uruguay and in the World, was conducted at a prepaid hospital of Montevideo, Uruguay. We identified 111 cases with ductal BC and 222 controls with normal mammograms. A factor analysis was conducted using 39 food groups, allowing retention of six factors analyzed through logistic regression in order to obtain odds ratios (OR) associated with ductal BC. The low fat and non-alcoholic beverage patterns were inversely associated (OR=0.30 and OR=0.45, respectively) with risk. Conversely, the fatty cheese pattern was positively associated (OR=4.17) as well as the fried white meat (OR=2.28) and Western patterns (OR 2.13). Ductal BC shared similar dietary risk patterns as those identified by studies not discriminating between histologic type of breast cancer.

Keywords: Ductal carcinoma - epidemiology - factor analysis - dietary patterns - risk factors - prevention

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Introduction

Breast cancer (BC) is a major public health issue in developed societies and its incidence has been rising in several developing countries over the past years. International statistics (Ferlay et al., 2004) have located Uruguay among those with the highest rates in the world. Moreover, the capital city, Montevideo, has displayed the highest incidence rate for a city (Parkin et al., 2002). In fact, albeit Uruguay is a developing country, it shares some features of developed ones, i.e. a very high level of red meat consumption (FAO, 2010) and a high human development index (50º in the world ranking according to United Nations) (United Nations Organization, 2009). In other words, a developing country has shown a high occurrence of a disease typical of developed countries. Data from the National Cancer Registry of Uruguay strongly suggest that ductal carcinoma is by far the most frequent histologic type of this malignancy with a relative frequency close to 85 % of all microscopically confirmed cases of BC (unpublished studies).

The main risk factors of BC are alcohol drinking, body fatness, adult height, abdominal fatness, lack of lactation, and lack of physical activity (World Cancer Research Fund, 2007). Uruguayan population, and mainly females, is characterized by an unhealthy diet and overweight. In fact, the latter was a matter of research regarding its association to BC risk (Ronco et al., 2009). Besides, Uruguay is the major producer of beef in the World (Matos and Brandani, 2002) and accordingly Uruguayans are heavy consumers of red meat and low consumers of vegetables and fruits (Buiatti and Sorso, 1993). Thus, it is possible that the Uruguayan diet could be related with the etiology of BC.

Factor analysis is a statistical method used to reduce a large number of variables to a small number of factors for modeling purposes (Harman 1976, Kim and Mueller 1978, Kline 2002). The pioneer studies of Pearson (1901) and Spearman (1904) set the foundations of this widely employed method in 1901. Since then factor analysis has been employed in psychology, sociology, econometrics and rather recently in human epidemiology. Most precisely, Randall et al (1992) published the first study on diet and colon cancer. Since then numerous studies on diet and cancer have been published, and BC has been one of the focus of major interest (Terry et al., 2001; Sieri et al., 2004; Fung et al., 2005; Männistö et al., 2005; Velie et al., 2005; Ronco et al., 2006; Edefonti et al., 2008; Murtaugh et al., 2008; Agurs-Collins et al., 2009; Cottet et al., 2009; Wu et al., 2009; Brennan et al., 2010; Butler et al., 2010; Ronco et al., 2010).

For these reasons we decided to conduct a case-control

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study on ductal carcinoma of the breast in Montevideo, Uruguay, with the main objective of identifying the retained dietary patterns of interest for public health purposes.

Patients and Methods

A case-control study designed to study the relationship among environmental factors and BC within the Uruguayan private health system was conducted between 1999 and 2001 in Montevideo, the capital city of Uruguay where around 45% of the Uruguayan inhabitants live. The research was performed exclusively in IMPASA (Instituto Médico de Previsión, Asistencia y Servicios Afines), an Institution which is representative of the pre-paid system in the country. Around 15,000 women were affiliated with the Center, and a mean of 40 new cases of BC were diagnosed yearly.

During the study period, 116 cases of BC were collected. Cases were women with incident (i.e. diagnosed within two years before the interview) and histologically verified ductal carcinomas. In the same time period 223 healthy women with a normal control mammography (BIRADS 1) (American College of Radiology, 1998) performed no longer than one year before the interview, were selected as controls (2 controls per case). They were frequency-matched by age (± 5 years) and residence (Montevideo and its neighbour area), being mandatory requirements for the controls not to be hospitalized at the moment of the interview and not being afflicted by a cancer. Both cases and controls were women usually undergoing routine mammography testing and belonged to a mid-to-high socioeconomic class. One control and two cases rejected the interview and other three cases (0.9%) died during the study period, leading to a final number of 111 cases and 222 controls (response rate of 99.6% for controls and 95.7 % for cases respectively).

All interviews were conducted in the hospital and performed face-to-face by a trained nurse, who was blinded concerning major risk factors. The questionnaire included the following sections: 1. sociodemographic variables; 2. a section on occupation based on job titles and the duration of each activity; 3. history of cancer in first and second degree relatives; 4. self-reported height and weight 5 years before the interview, at 18 years old and the most frequent weight during the adulthood; 5. a tobacco smoking section; 6. a history on alcohol drinking (including type of beverage, age at start, age of quit, and average amount of alcohol drunk per day); 7. a history of “mate” drinking (“mate” is the folk name of a local infusion, which is highly prevalent in the Uruguayan population); 8. menstrual and reproductive events; and 9. a detailed food-frequency questionnaire (FFQ) on 120 items representative of the diet of the Uruguayan population, which asked about food consumption 5 years prior to diagnosis in cases and prior to the interview in controls, taking into account that within a period of few years diet may be recalled with acceptable levels of misclassification.

The current FFQ is a modification of a previous one, having added some details concerning selected items. It was further tested for reproducibility, showing high correlations (Ronco et al., 2006). Furthermore, it allowed the calculation of total energy intake of each subject. For each one of the dietary items, a serving size was estimated, based on the tables of nutrients we consulted. All dietary questions of our semi-quantitative questionnaire were open-ended. In order to calculate daily nutrients or energy, we compiled an analysis program which made the sum of all individual values, each one obtained after multiplying the number of servings/year by the ratio nutrient content or calories of the serving/100 g of each individual food, divided by 365 days. Most typical or average servings of solid foods are within the range of 100-150 grams, and fluid foods are included in a cup of 200 ml.

Statistical methods

Factor analysis was conducted among controls using the principal components method (Harman, 1976; Kim and Mueller, 1978; Kline, 2002). Factors were rotated through the varimax orthogonal method normalized by the Horst procedure (1965) and scores were obtained through the regression approach of Thomson (1951). After that, scores were categorized in tertiles, following the controls distribution. Correlations between dietary patterns and selected variables were performed by the method of Pearson and odds ratios of ductal carcinoma for scored patterns were obtained through the following model: age, education, family history of BC among first degree relatives, body mass index, smoking, drinking, age at menarche, parity, menopausal status, total energy. Since all patterns were conditional on each other, they were

Table 1. Distribution of Cases and Controls by Selected Variables

Variable	Categories	Controls n %	Cases n %	Global p-value
Age	≤49	31 (14.0)	15 (13.5)	
	50-59	74 (33.3)	29 (26.1)	
	60-69	77 (34.7)	41 (36.9)	
	≥70	4 (18.0)	26 (23.4)	0.48
Urban status	≤54	76 (34.2)	35 (31.5)	
	55-65	79 (35.6)	33 (29.7)	
	≥66	67 (30.2)	43 (38.7)	0.28
Education	≤10	81 (36.5)	40 (36.0)	
	11-14	68 (30.6)	25 (22.5)	
	>=15	73 (32.9)	46 (41.4)	0.20
BMI (kg/m^2)	≤22.51	69 (31.1)	41 (36.9)	
	22.52-25.39	77 (34.7)	32 (28.8)	
	≥25.40	76 (34.2)	38 (34.2)	0.46
Menopausal status	Pre	24 (10.8)	11 (9.9)	
	Post	198 (89.2)	100 (90.1)	0.80
Menarche	≤11	76 (34.2)	29 (26.1)	
	12	71 (32.0)	35 (31.5)	
	≥13	75 (33.8)	47 (42.3)	0.22
Nr. of live births	None	23 (10.4)	12 (10.8)	
	1	47 (21.2)	23 (20.7)	
	2	99 (44.6)	45 (40.5)	
	≥3	53 (23.9)	31 (27.9)	0.85
BC family history	No	180 (81.1)	77 (69.4)	
	Yes	42 (18.9)	34 (30.6)	0.016
Dietary energy, kcal	≤1761	73 (32.9)	15 (13.5)	
	1762-2064	74 (33.3)	46 (41.4)	
	≥2065	75 (33.8)	50 (45.0)	0.0008
Total Nr.		222 (100)	111 (100)	

introduced together in the model (Kim and Mueller, 1978). All the estimations were performed with the software STATA version 9 (2005).

Results

Table 1 shows the distribution of cases and controls by selected variables. Whereas both subsets displayed similarities for the socio-demographic and reproductive features, there were significant differences to remark: a more frequent family history of cancer in cases (p=0.016) and a higher energy intake also in cases (p<0.001).

The pattern matrix among controls is shown in Table 2. Factor 1 displayed high positive loadings for skinless poultry, skim milk, and low-fat yoghurt. This factor also showed negative loadings for poultry eaten with skin (fried chicken) and whole milk. Coffee intake had a high loading, probably due to the common habit among Uruguayans of drinking coffee and milk together. Since this diet was rich in foods impoverished in fats it was labeled as the *low-fat* pattern, explaining 7.4 % of the variance.

Factor 2 showed high positives loadings for chicken with skin, fried fish and common oil (sunflower and soybean), together with a strong negative loading for olive oil. This pattern explained 6.2 % of the variance and it was labeled as the *fried white meat* one.

Factor 3 displayed high positive loadings for whole yoghurt, soft drinks and tea intake, together with boiled egg consumption. Also *mate* (a very popular local herb infusion) and total grains were positively associated. This pattern, which was labeled as *beverages*, showed also a negative beef intake and explained 5.7 % of the variance.

The fourth factor was strongly associated with beef, lamb, processed meat and French fries. Also loadings for hamburgers, butter, fried eggs and desserts were high. All these loadings were positive and characteristic of a *Western* pattern, which explains 5.6 % of the variance.

The Factor 5 showed high loadings for creamy cheese, parmesan cheese, and a negative loading for ricotta cheese (the one with the lowest fat contents) and was labeled as the *fatty* cheese pattern, explaining 5.5 % of the variance.

Finally, the factor 6 presented high loadings for cooked vegetables, total grains, legumes, citrus fruits, and other fruits. It was labeled as the *prudent* pattern, explaining 5.4 % of the variance. The model was responsible of 35.8 % of the total variance.

Table 2. Factor-Loadings Matrix Among Controls [1, 2]

Food group	Factor 1 Low fat	Factor 2 Fried white meat	Factor 3 Non alcohol beverages	Factor 4 Western	Factor 5 Fatty cheese	Factor 6 Prudent
Beef	-0.20	-0.06	-0.35	0.63	0.16	0.01
Lamb	0.16	0.02	-0.01	0.58	0.05	-0.18
Milanesa	0.26	0.39	-0.04	0.20	-0.17	0.11
Hamburger	0.08	0.30	-0.05	0.34	-0.05	0.10
Poultry skin	-0.49	0.44	0.02	-0.01	0.10	0.32
Skinless poultry	0.52	-0.25	0.26	0.01	-0.06	-0.28
Fried fish	-0.04	0.61	0.06	0.09	0.14	0.00
Baked fish	0.21	0.34	0.29	-0.15	-0.12	0.20
Processed meat	-0.12	0.01	0.13	0.42	-0.14	0.05
Ricotta cheese	0.13	0.08	0.21	-0.21	-0.43	0.06
Low-fat Cheese	-0.04	-0.19	-0.19	-0.05	0.10	0.05
Quartirolo cheese	-0.10	-0.00	0.12	0.01	0.67	0.01
High-fat cheese	-0.17	-0.07	0.15	-0.07	0.70	-0.02
Parma cheese	0.10	0.06	-0.09	-0.07	0.49	0.07
Butter	0.30	0.23	0.14	0.33	0.28	0.03
Whole milk	-0.71	-0.09	0.19	0.16	-0.02	-0.03
Skim milk	0.73	0.14	-0.14	-0.10	0.08	0.01
Whole yoghurt	-0.05	0.24	0.45	-0.16	0.05	0.10
Low-fat yoghurt	0.38	-0.22	0.14	0.07	-0.08	-0.02
Boiled eggs	0.16	0.06	0.51	0.27	-0.11	-0.04
Fried eggs	-0.05	0.18	0.34	0.34	0.17	0.12
All desserts	0.12	-0.03	0.08	0.37	0.04	0.19
Olive oil	0.17	-0.56	0.14	0.02	0.20	0.23
Common oil	0.11	0.52	0.16	-0.02	-0.02	-0.06
Total grains	0.22	0.14	0.35	-0.08	0.06	0.46
Raw vegetables	-0.00	-0.34	-0.28	0.08	0.36	0.33
Cooked vegetables	-0.10	-0.07	-0.08	-0.07	0.04	0.61
Potatoes	-0.03	0.34	0.24	-0.04	-0.18	0.21
French fries	0.21	0.29	0.21	0.46	-0.24	0.10
Legumes	-0.05	-0.05	-0.15	0.28	-0.10	0.46
Citrus fruits	0.09	-0.04	0.08	0.18	0.00	0.47
Other fruits	-0.09	-0.31	-0.07	0.04	0.06	0.47
Soft drinks	0.00	0.01	0.51	0.03	0.05	-0.03
Coffee	0.40	0.05	0.07	-0.01	-0.10	0.04
Tea	-0.04	-0.11	0.55	0.15	0.00	-0.26
Mate	-0.05	0.04	0.31	-0.09	-0.12	0.25

Table 3. Correlations Between Selected Variables and Dietary Patterns

Food group	Factor 1 Low fat	Factor 2 Fried white meat	Factor 3 Non-alcoholic beverages	Factor 4 Western	Factor 5 Fatty cheese	Factor 6 Prudent
Age	-0.05	0.01	0.07	-0.10	0.04	-0.13
Education	-0.01	-0.07	0.17	-0.04	0.02	0.03
Height	0.10	0.15	0.11	-0.07	-0.10	0.01
Weight	0.02	0.21	0.26	-0.03	-0.05	-0.06
Physical exercise	0.04	-0.02	0.23	-0.04	0.01	0.02
Smoking	-0.10	-0.06	-0.11	-0.03	-0.07	0.08
Alcohol drinking	-0.08	-0.07	-0.20	0.06	0.15	0.07
Energy	-0.17	-0.01	0.11	0.43	-0.03	0.40
Menarche	-0.01	-0.10	-0.08	0.11	0.09	0.09
Breastfeeding	0.09	0.16	0.19	0.09	-0.11	0.03
Total fat	-0.38	-0.08	-0.25	0.61	0.19	-0.03
Cholesterol	-0.32	-0.11	-0.03	0.57	0.14	-0.00
β-carotene	-0.04	-0.06	-0.24	-0.01	0.17	0.33
Vitamin C	0.04	-0.12	-0.29	0.22	0.16	0.38
Calcium	-0.65	-0.15	0.14	0.14	0.21	-0.01

Values of Pearson's correlation coefficients.

Table 4. Odds Ratios of Ductal Carcinoma of the Breast for Scored Dietary Patterns

Dietary pattern	Cases/Controls	OR[1]	95 % CI	OR[2]	95 % CI
Low fat	58/74	1.0	reference	1.0	reference
	36/74	0.72	0.42-1.25	0.71	0.39-1.29
	17/74	0.32	0.17-0.62	0.30	0.16-0.60
	Continuous	0.72	0.58-0.90	0.73	0.58-0.93
	p-value for trend	0.001		0.001	
Fried white meat	26/74	1.0	reference	1.0	reference
	33/74	1.35	0.72-2.53	1.42	0.73-2.75
	52/74	2.01	1.13-3.57	2.28	1.22-4.25
	Continuous	1.30	1.03-1.64	1.40	1.09-1.81
	p-value for trend	0.02		0.009	
Non-alcoholic beverages	56/74	1.0	reference	1.0	reference
	32/74	0.55	0.32-0.95	0.72	0.39-1.31
	23/74	0.36	0.20-0.68	0.45	0.23-0.89
	Continuous	0.71	0.56-0.89	0.78	0.60-1.00
	p-value for trend	0.001		0.02	
Western	22/74	1.0	reference	1.0	reference
	36/74	1.53	0.82-2.85	1.93	1.01-3.70
	53/74	2.01	1.06-3.78	2.13	1.09-4.15
	Continuous	1.36	1.05-1.77	1.44	1.10-1.89
	p-value for trend	0.03		0.03	
Fatty cheese	14/74	1.0	reference	1.0	reference
	44/74	3.39	1.67-6.87	3.94	1.85-8.36
	53/74	3.82	1.91-7.67	4.17	1.95-8.90
	Continuous	1.63	1.26-2.09	1.64	1.24-2.16
	p-value for trend	<0.0001		<0.0001	
Prudent	36/74	1.0	reference	1.0	reference
	1/74	0.71	0.38-1.30	0.70	0.37-1.32
	44/74	0.95	0.53-1.69	0.90	0.48-1.66
	Continuous	0.97	0.76-1.24	0.95	0.75-1.21
	p-value for trend	0.91		0.77	

[1]Age and energy-adjusted; [2]Multivariate odds ratios adjusted for age, education, physical activity, family history of breast cancer among first-degree relatives, body mass index, smoking, drinking, age at menarche, parity, menopausal status, total energy intake, and scored patterns each for the others.

Pearson correlations between selected variables and dietary patterns are shown in Table 3. The *Low-fat* pattern was negatively correlated with total fat, calcium and cholesterol. The *Fried white meat* pattern was modestly and positively associated with height, weight and breastfeeding. The *Non-alcoholic beverages* pattern combined a positive correlation with weight and physical exercise, whereas a negative one with alcohol drinking, total fat and vitamin C. The *Western* pattern was positively correlated with total energy, total fat, and cholesterol. The *fatty cheese* pattern was directly associated with total fat, alcohol drinking, calcium and beta-carotene. Finally, the *prudent* pattern was directly associated with energy, beta-carotene and vitamin C intake.

Odds ratios of ductal carcinoma of the breast for scored patterns are shown in Table 4. The *Low-fat* pattern was negatively associated (OR 0.30, 95 % CI 0.16-0.60, p-value for linear trend 0.001). Also the *Non-alcoholic beverages* pattern was inversely associated with disease risk (OR=0.45, 95% CI 0.23-0.89). On the contrary, the *Fried white meat* pattern was positively associated (OR=2.28. 95% CI 1.22-4.25), as well as the *Fatty cheese* pattern (OR=4.17, 95% CI 1.95-8.90) and the Western pattern (OR=2.13, 95% CI 1.09-4.15) did. All the quoted factors displayed significant p-values for linear trend. Finally, the *prudent* pattern was not associated with risk of ductal type BC.

Discussion

Our study showed significant associations between 5 of the 6 dietary patterns and BC risk. In particular, the patterns labeled a*s Fried white meat*, *Western* and *Fatty cheese* displayed elevated risks, whereas the *Low-fat* and *Non-alcoholic beverages* were inversely associated with breast cancer risk. The *Prudent* pattern was not associated.

The pattern labeled as *Low-fat*, having an inverse association with BC risk, revealed a clear eating style: these women preferred skinless poultry and skimmed milk -this latter combined with coffee, a staple habit in the Uruguayan population-, whereas they were no consumers of poultry with skin and whole milk. Our own studies on dairy foods (Ronco et al., 2002) and white meat (Ronco et al., 2003) on the same population sample gave a basis to consider this pattern as derived from an election, much more than a circumstantial combination of foods.

The other protective pattern, labeled as *Non-alcoholic beverages* combine significant loadings of whole yoghurt and tea (together with boiled eggs and soft drinks). A positive loading for mate, a regional herbal infusion, confirms a strong and significant negative association we described recently for high consumers (Ronco et al., 2008).

The *Fried white meat* pattern, which was positively associated with BC risk, is based on a preferential intake of poultry and fish fatty preparations, already recognized as a risk combination (Ronco et al., 2003). Regarding oil intake, the negative loading for olive oil (which could be protective or not associated with BC risk) as well as the positive loading for common oil (which was associated with the risk) indicates again a defined eating style. Such difference in cooking methods could derive into an imbalance of Ω-6/Ω-3 polyunsaturated fatty acids(PUFAs), because fried fish usually belong to lean species (low Ω-3 contributors), and at the same time, the most common oils used to fry are sunflower and soy oil (high Ω-6 contributors). Hence, the result of this cooking method represents each time an intake of several Ω-6 grams which are not counterbalanced by dozens of Ω-3 milligrams (Ronco et al., 2005). Regarding poultry, associations could be based on the fat present in the skin, as well as the production of heterocyclic amines (HCAs) in the skin surface, due to the cooking method, as reported by Sinha (2002). It is not unlikely that despite the preparation form, potential protection might derive from skinless poultry meat as well a potential damage could derive from this meat having its skin.

Regarding the *Western* pattern, our study replicates in part findings reported by Terry et al (2001). Our *Western* factor is rather similar to the one reported by our group in a study on women coming from the public hospital healthcare system (Ronco et al., 2006), in particular because of the current high loadings for beef, lamb and processed meat. Taking into account the significant loadings of French fries and the high (although not significant) ones of fried eggs, hamburgers and desserts, this pattern is a high-meat and high-fat one. Our results show similarities also with other factor analysis studies on BC (Terry et al., 2001; Fung et al., 2005; Männistö et al., 2005; Sieri et al., 2005; Velie et al., 2005). The results of the Italian (Sieri et al., 2005) and Swedish (Männistö et al., 2005) studies were essentially null for the Western diet, at difference with the findings in our study. It is of interest to mention that a Uruguayan study (Ronco et al., 1996) reported a 4-fold increase in risk among the highest red meat consumers, after adjusting by calories. The increase of risk was even stronger for fried (OR=5.31, 95% CI 2.77-10.2) than for broiled meat (OR=2.21, 95% CI 1.18-4.14), however, there was no effect found for boiled meat, characteristic of stew. A further paper sustained the hypothesis of a possible effect of cooking at high temperatures, based on the estimation of HCAs produced in the cooking process (De Stéfani et al., 1997).

Factor number 5, labeled as *Fatty cheese*, shows again a defined eating style concerning dairy foods: whereas this pattern showed significant high loadings for high-fat, Parmesan and quartirolo cheese, there was a negative significant loading for Ricotta cheese (the variety with the lowest fat level), meaning that there are opposite trends in the consumption.

The *Prudent* pattern involved high loadings for total grains, cooked vegetables, legumes and fruits. Although the plants component is high, this factor was not associated with the risk of BC. The World Cancer Research Fund (2007) reported that vegetables and fruits probably decrease the risk of BC but a pooled analysis of cohort studies suggested that plant food consumption are not consistently associated with a reduction in risk of BC (5) Also, a recent study from the EPIC cohort reported essentially null results. In our *Prudent* pattern, the loading of vegetables and fruits was particularly high, nevertheless it displayed also high -but not significant- loadings for energy and poultry with skin, which could represent a counterbalance for the potentially protective effect of the plant-derived food items.

Factor analysis is considered as a powerful statistical method and it has been reported as more efficient than traditional reductionist approach (Slattery et al., 1998). Anyway, the use of factor analysis raises some concerns. The first problem is related with the construction and analysis of the FFQ. In other words, although the FFQ could be not adequate for the purposes of the study, we performed thorough analyses in order to construct our FFQ and we consider that it is representative of the usual diet among Uruguayans. Similarly with other previous studies (Terry et al., 2001; Fung et al., 2005; Sieri et al., 2005), we defined food groups based in current knowledge of diet and BC.

An important decision in factor analysis is the choice of the number of factors to be retained (Harman, 1976; Kim and Mueller, 1978; Kline, 2002). To retain the number of factors, which explains more of the variance than a single variable, we set an eigenvalue of 1.0. We have previously tried with eigenvalues greater than 1.0, but results were not satisfactory since we were not able to attain the best solution for our model. Then, we rotated our 6 factors by the varimax (orthogonal) method (Horst, 1965). We also tried with the promax (oblique) method, but results were mostly similar. It has been pointed out that the methods of rotation do not improve the fitness degree of the factor structure to the data (Thomson, 1951; Horst, 1965). The main goal of rotation is to improve the interpretability of the factors. Our model could be considered as satisfactory since it followed the law of parsimony (Kline, 2002). Essentially, our simple structure is characterized by factors which have a few high loadings and it maximizes the number of zeros per factor (Harman, 1976; Kim and Mueller, 1978; Kline, 2002). In fact, we obtained a matrix with factors, which present at least the same number of zeros than the total number of rotated factors (Kim and Mueller, 1978). According to Kline, (2002), simple structure factors are usually simple to interpret because they have only a few high loadings. Also, this simple structure factors are replicable or reproducible. We think that our model explained a rather high proportion of the total variance and also it presents rather high communalities. These properties, together with the ability to identify and reproduce factors presented in other studies, are reassuring about the reliability of the study.

Aside from the possibility of recall bias, our study has limitations. In first place, the sample size is small: a large set would be desirable in order to perform some stratified analyses. As other case-control studies, the present study is prone to selection bias. We have tried to minimize this bias by frequency matching cases and controls on age ± 5 years, all of them were residents in the city of Montevideo, they belong to the same healthcare system and were diagnosed at the same medical institution. Interviewer bias is unlikely taking into account that the only interviewer was unaware about the role of diet in cancer. Perhaps, the major limitation of this study is related with the lack of validation of our FFQ. Nevertheless, the instrument was tested for reproducibility and the correlations were high (Ronco et al., 2006). The study also has strengths. Perhaps, the high response rate for cases and controls is the major important strength. To be quoted also among the strengths, we selected as controls women with normal breasts according to mammogram, not only without cancer; thus, if benign breast diseases had any association with the analyzed dietary items, we avoided the possibility of biasing results due to this.

In summary, exploratory factor analysis generated six dietary patterns, which were labeled as *Low-fat, Fried white meat, Non-alcoholic beverages, Western, Fatty cheese and prudent*. Five of the 6 factors were significantly associated with BC risk. While there is no clear evidence that any specific dietary component can effectively reduce BC risk (Mahoney et al., 2008), the fact that several foods have convergence on a few dietary patterns -and probably beyond these latter could be even fewer nutrient patterns (Ronco et al.,2010b)- is something we could probably profit from, thinking of recommendations for potential nutritional prevention such as those we have recently proposed (Ronco et al., 2010a).

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