

Salted meat consumption and risk of squamous cell carcinoma of the oesophagus: a case-control study in Uruguay

Research Article

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Summary

A case-control study was conducted in Montevideo, Uruguay in the time period 1996-2003, in order to elucidate the role of meat consumption in oesophageal carcinogenesis. The study included 200 cases with squamous cell oesophageal carcinoma and 400 age- and sex-matched controls. Salted meat consumption was significantly associated with an increased risk for this malignancy (OR 2.34, 95 % CI 1.21-4.53). On the other hand, high intake of white meat was inversely associated with risk of oesophageal cancer (OR 0.55, 95 % CI 0.36-0.84). Also boiled meat, frequent component of stews, increased the risk of oesophageal cancer. The remaining types of meat were not related with the risk of squamous cell carcinoma of oesophagus.

I. Introduction

The role of meat consumption has been considered controversial in its relationship with squamous cell carcinoma of the oesophagus. Whereas several studies reported an inverse association with this malignancy (Potter et al, 1981; Tuyns et al, 1987; Gao et al, 1994; Launoy et al, 1998), other reports suggested a positive association with oesophageal cancer (Victoria et al, 1987; De Stefani et al, 1990; Cheng et al, 1992; Rolón et al, 1995). Since meat industry is the main industry in Uruguay, this country is particularly well suited for studying the role of meat, more precisely red meat, in the aetiology of squamous cell oesophageal cancer. In fact, Uruguay is the leading country in the World regarding beef consumption (Matos and Brandani, 2002).

A previous Uruguayan study reported that salted meat and meat from lamb were positively associated with the risk of oesophageal cancer (De Stefani et al, 1999).

This study suffered of a low statistical power since it included only 82 cases (67 men and 15 women). Since then our database has been considerably enlarged. Also, our previous study compared the risks of different types of meat categorized in tertiles. This comparison was not entirely adequate, since different amounts of intake were used for it. In fact, for a reliable comparison it is necessary to calculate all OR using the same fixed amount of intake.

We decided to conduct a new case-control study on the relationship between meat consumption and risk of squamous cell carcinoma of the oesophagus. In this study we will calculate the risk of several sets of meat categorized in quartiles. Furthermore, OR's for the same subsets of meat will be calculated as continuous variables after adding a fixed amount of consumption (10 grams per day).

II. Material and methods

A. Selection of cases

In the period 1996-2003, 208 patients with newly diagnosed and microscopically confirmed squamous cell oesophageal carcinoma were identified in the four major public hospitals located in Montevideo, Uruguay. Since hospitals located outside the capital city of Montevideo lacked facilities for diagnosis and treatment of cancer, almost all patients are admitted in hospitals of Montevideo. Three patients were diagnosed as adenocarcinoma of the oesophagus and five patients refused the interview. These eight patients were excluded from the study, leaving a final total of 200 cases with squamous cell carcinoma of the oesophagus (response rate 96.1 %). The case series included 162 males (81 %) and 38 females (19 %).

B. Selection of controls

In the same time period and in the same hospitals, 723 patients with diseases not related with tobacco smoking or alcohol drinking and without recent changes in their diets were considered eligible for the study. Twenty patients refused the interview leaving a final total of 703 potential controls (response rate 97.2 %). From this pool, 400 controls were frequency matched to the cases on age (in ten-years intervals) and sex. The patients presented the following diseases: abdominal hernia (103 patients, 25.7 %), eye disorders (88, 22.0 %), diseases of the skin (12.0 %), acute appendicitis (37, 9.2 %), urinary stones (29, 7.3 %), varicose veins (29, 7.3 %), injuries (26, 6.5 %), hydatid cyst (20, 5.0 %) and blood disorders (20, 5.0 %).

C. Questionnaire

All participants were submitted to a questionnaire shortly after admittance. The interviews were conducted by two trained social workers in the hospitals. No proxy interviews were accepted. The questionnaire included the following sections: sociodemographics, an occupational history based in the job titles and its duration, a family history of cancer among first-degree relatives, a complete tobacco smoking history (including age at start, age at quit, average number of cigarettes smoked per day, type of tobacco, type of cigarette), a history of alcohol drinking (including number of drinks per day or week for beer, wine and hard liquor), a complete history of maté drinking (maté is the folk name of a local herbal tea which is drunk hot or very hot), menstrual and reproductive events and a food frequency questionnaire (FFQ) on 64 food items. This FFQ allowed the calculation of total energy intake and was tested for reproducibility with good results.

D. Definition of food groups

All queries concerned the consumption of foods five years before the date of questionnaire. The following types of meat were included in the FFQ: fried beef, broiled beef, boiled beef, fried lamb, broiled lamb, boiled lamb, poultry, fish, bacon, sausage, blood pudding, liver, mortadella, salami, saucisson, hot dog, ham, salted meat (consumption in the adolescence and current intake). These items were selected on the basis of the consumption of the Uruguayan population. From these individual items, the following food groups were created: red meat (beef, lamb), white meat (poultry, fish), processed meat (bacon, sausage, blood pudding, mortadella, salami, saucisson, hot dog, ham, salted meat), fried meat (fried beef, fried lamb), broiled meat (broiled beef, broiled lamb), boiled meat (boiled beef, boiled lamb) and total meat (red meat, processed meat, white meat). In order to compare the odds ratios for these nested food groups, each variable was treated as continuous and the fixed

amount of 10 grams per day was added to each one. Each food item was calculated in grams per day by multiplying the frequency of consumption per the portion size for a middle age participant.

E. Statistical analysis

Relative risks of squamous cell oesophageal cancer for foods, approximated by the odds ratios, were estimated by multiple unconditional logistic regression (Breslow and Day, 1980). The following variables were included in all models: age (categorical, 5 strata), sex, county of residence (dichotomized as Montevideo and other), birthplace (categorical, 3 strata), education (categorical, 3 strata), average number of cigarettes smoked per day (categorical, 5 strata), years since quit (categorical, 5 strata), smoking status (categorical, 3 strata), alcohol drinking (categorical, 5 strata), maté temperature (categorical, 4 strata), total energy intake (continuous) and total vegetables and fruits (categorical, 4 strata). Tests for trend were performed after entering categorical variables as ordinal in the same model. Departure from the multiplicative model was determined by assessing the likelihood ratio test statistic. An alpha of 0.05 was used as the indicator of statistical significance and, accordingly, 95 % CI s were reported. All p-values were derived from two-sided statistical tests. All the calculations were done with the STATA programme (1999).

III. Results

As expected for the frequency matched design, age and sex were identical (**Table 1**). There was a higher proportion of dwellers living outside Montevideo, of rural residents and of subjects born in the Northern part of the country among cases than among controls. Cases were significantly less educated than controls (OR 0.6, 95 % CI 0.4-0.9). Income (in US dollars) was rather similar in both series of participants. Cases were significantly leaner than controls (OR 0.5, 95 % CI 0.3-0.8). The consumption of total energy was slightly higher in cases than in controls. Heavy smoking was associated with an increased risk of 4.8 (95 % CI 2.6-9.1). There was no difference between smoking of black tobacco and of blond tobacco cigarettes (OR 1.2, 95 % CI 0.7-1.8). On the other hand, smoking of hand-rolled cigarettes displayed an OR of 1.7 (95 % CI 1.1-2.7) compared with commercial cigarettes. Heavy drinking of alcohol was associated with a four-fold increase in risk and drinking of very hot maté displayed an OR of 4.0 (95 % CI 1.5-10.3) compared with drinking of warm maté.

Odds ratios of squamous cell esophageal carcinoma for different types of meat are shown in **Table 2**. Total meat, red meat and preserved meat were not associated with risk of esophageal carcinoma. Similarly, different types of red meat (beef and lamb) were not associated with this malignancy. On the other hand, white meat consumption (poultry plus fish) was associated with a significant reduction in risk (OR 0.46, 95 % CI 0.25-0.85, p-value for trend=0.005). When red meat was analyzed by the cooking method, neither fried nor barbecued meat were associated with risk. In fact, barbecued meat showed reductions in risk which were close to the significance level of 0.05. On the other hand, boiled meat was associated with positive gradient (OR for high consumption of boiled meat 1.90, 95 % CI 1.05-3.46, p-value for trend=0.01).

Table 1. Distribution of controls and cases for sociodemographics and selected risk factors

| Variable | Cases | | Controls | | OR | 95 % CI | |
|-----------------------------|----------------------------------|-----------|-----------|--------|----|----------------|-------------|
| | Category | N° % | N° % | N° % | | | |
| Age (years) | 40-49 | 15 7.5 | 30 7.5 | | | | |
| | 50-59 | 40 20.0 | 80 20.0 | | | | |
| | 60-69 | 69 34.5 | 138 34.5 | | | | |
| | 70-79 | 61 30.5 | 122 30.5 | | | | |
| | 80-89 | 15 7.5 | 30 7.5 | | | Not applicable | |
| Sex | Males | 162 81.0 | 324 81.0 | | | Not applicable | |
| | Females | 38 19.0 | 76 19.0 | | | Not applicable | |
| Residence | Montevideo | 76 38.0 | 167 41.8 | | | 1.0 | |
| | Other counties | 124 62.0 | 233 58.2 | | | 1.2 0.8-1.6 | |
| Urban/rural status | Urban | 149 74.5 | 321 80.3 | | | 1.0 | |
| | Rural | 51 25.5 | 79 19.7 | | | 1.4 0.9-2.1 | |
| Birthplace | Montevideo | 47 23.5 | 135 33.8 | | | 1.0 | |
| | South | 69 34.5 | 171 42.7 | | | 1.1 0.7-1.8 | |
| | North | 84 42.0 | 94 23.5 | | | 2.6 1.6-4.0 | |
| Education (yrs) | 0-2 | 69 34.5 | 124 31.0 | | | 1.0 | |
| | 3-5 | 84 42.0 | 131 32.8 | | | 1.1 0.8-1.7 | |
| | 6+ | 47 23.5 | 145 36.2 | | | 0.6 0.4-0.9 | |
| Income (dollars) | <=146 | 67 33.5 | 173 43.3 | | | 1.0 | |
| | 147+ | 79 39.5 | 158 39.5 | | | 1.3 0.9-1.9 | |
| | Unknown | 54 27.0 | 69 17.2 | | | - - | |
| Family history | No | 194 97.0 | 391 97.8 | | | 1.0 | |
| | Yes | 6 3.0 | 9 2.2 | | | 1.3 0.5-3.8 | |
| Body mass index | <=23.1 | 75 37.5 | 101 25.2 | | | 1.0 | |
| | 23.2-25.3 | 52 26.0 | 101 25.2 | | | 0.7 0.4-1.1 | |
| | 25.4-27.3 | 34 17.0 | 98 24.6 | | | 0.5 0.3-0.8 | |
| | 27.4+ | 39 19.5 | 100 25.0 | | | 0.5 0.3-0.8 | |
| Total calories | <=1851 | 39 19.5 | 100 25.0 | | | 1.0 | |
| | 1852-2260 | 56 28.0 | 100 25.0 | | | 1.4 0.9-2.3 | |
| | 2261-2644 | 47 23.5 | 100 25.0 | | | 1.2 0.7-2.0 | |
| | 2645+ | 58 29.0 | 100 25.0 | | | 1.5 0.9-2.4 | |
| Tobacco smoking | Never smokers | 40 20.0 | 140 35.0 | | | 1.0 | |
| | Ex-smokers (years) | 20+ | 15 7.5 | 33 8.3 | | | 1.6 0.8-3.2 |
| | | 10-19 | 13 6.5 | 32 8.0 | | | 1.4 0.7-2.9 |
| | | 1-9 | 29 14.5 | 38 9.5 | | | 2.7 1.4-4.9 |
| | Current smokers (cigarettes/day) | 1-9 | 6 3.0 | 20 5.0 | | | 1.1 0.4-2.8 |
| 10-19 | | 21 10.5 | 61 15.2 | | | 1.2 0.6-2.2 | |
| 20-29 | | 36 18.0 | 47 11.8 | | | 2.7 1.5-4.7 | |
| 30+ | | 40 20.0 | 29 7.2 | | | 4.8 2.6-9.1 | |
| Type of tobacco | Blond | 77 48.1 | 119 45.8 | | | 1.0 | |
| | Mixed | 26 16.3 | 65 25.0 | | | 0.6 0.4-1.1 | |
| | Black | 57 35.6 | 76 29.2 | | | 1.2 0.7-1.8 | |
| Type of cigarette | Manufactured | 41 25.6 | 94 36.2 | | | 1.0 | |
| | Mixed | 21 13.1 | 37 14.2 | | | 1.3 0.7-2.5 | |
| | Hand-rolled | 98 61.3 | 129 49.6 | | | 1.7 1.1-2.7 | |
| Alcohol drinking (1) | Never drinkers | 62 31.0 | 195 48.8 | | | 1.0 | |
| | 1-60 | 37 18.5 | 85 21.2 | | | 1.4 0.8-2.2 | |
| | 61-120 | 41 20.5 | 61 15.2 | | | 2.1 1.3-3.5 | |
| | 121-240 | 34 17.0 | 39 9.8 | | | 2.7 1.6-4.8 | |
| | 241+ | 26 13.0 | 20 5.0 | | | 4.1 2.1-8.0 | |
| Maté temperature | Warm | 11 5.8 | 25 7.4 | | | 1.0 | |
| | Hot | 144 75.8 | 295 86.8 | | | 1.1 0.5-2.5 | |
| | Very hot | 35 18.4 | 20 5.8 | | | 4.0 1.5-10.3 | |
| N° patients | | 200 100.0 | 400 100.0 | | | | |

1-In milliliters of ethanol per day

Table 2. Odds ratios of squamous cell esophageal carcinoma for different types of meat, categorized in quartiles (1)

| Type of meat | Intake (grams/day) | Cases/Controls | OR | 95 % CI |
|-----------------------|--------------------|----------------|-------|-----------|
| Total meat | <=160.5 | 49/100 | 1.0 | |
| | 160.6-203.0 | 40/100 | 0.48 | 0.26-0.89 |
| | 203.1-251.9 | 44/100 | 0.56 | 0.31-1.01 |
| | 252.0+ | 67/100 | 0.96 | 0.54-1.70 |
| | p-value for trend | | 0.80 | |
| Red meat | <=114.3 | 42/100 | 1.0 | |
| | 114.4-160.2 | 42/100 | 0.65 | 0.35-1.20 |
| | 160.3-192.7 | 41/100 | 0.65 | 0.35-1.19 |
| | 192.8+ | 75/100 | 1.14 | 0.64-2.05 |
| | p-value for trend | | 0.49 | |
| Processed meat | <=7.9 | 46/100 | 1.0 | |
| | 8.0-19.1 | 50/100 | 1.12 | 0.64-1.99 |
| | 19.2-39.7 | 57/100 | 1.11 | 0.63-1.96 |
| | 39.8+ | 47/100 | 1.15 | 0.63-2.07 |
| | p-value for trend | | 0.68 | |
| White meat | <=6.6 | 86/100 | 1.0 | |
| | 6.7-17.1 | 50/100 | 0.64 | 0.38-1.08 |
| | 17.2-30.0 | 33/100 | 0.48 | 0.26-0.86 |
| | 30.1+ | 31/100 | 0.46 | 0.25-0.85 |
| | p-value for trend | | 0.005 | |
| Beef | <=85.4 | 60/100 | 1.0 | |
| | 85.5-146.3 | 43/100 | 0.69 | 0.39-1.21 |
| | 146.4-171.3 | 37/100 | 0.46 | 0.25-0.84 |
| | 171.4+ | 60/100 | 0.77 | 0.45-1.34 |
| | p-value for trend | | 0.25 | |
| Lamb | 0 | 85/195 | 1.0 | |
| | 0.1-21.3 | 48/101 | 0.93 | 0.56-1.54 |
| | 21.4+ | 67/104 | 1.08 | 0.65-1.81 |
| Fried meat | p-value for trend | | 0.80 | |
| | <=21.3 | 62/100 | 1.0 | |
| | 21.4-42.7 | 47/100 | 0.69 | 0.39-1.21 |
| | 42.8-64.1 | 48/100 | 0.78 | 0.45-1.37 |
| | 64.2+ | 43/100 | 0.73 | 0.41-1.28 |
| Barbecued meat | p-value for trend | | 0.35 | |
| | <=10.8 | 65/100 | 1.0 | |
| | 10.9-26.3 | 42/100 | 0.56 | 0.31-0.99 |
| | 26.4-53.4 | 44/100 | 0.62 | 0.35-1.09 |
| | 53.5+ | 49/100 | 0.58 | 0.33-1.03 |
| Boiled meat | p-value for trend | | 0.09 | |
| | <=32.0 | 33/100 | 1.0 | |
| | 32.1-74.7 | 37/100 | 1.02 | 0.54-1.94 |
| | 74.8-96.1 | 49/100 | 1.38 | 0.75-2.55 |
| | 96.2+ | 81/100 | 1.90 | 1.05-3.46 |
| p-value for trend | | 0.01 | | |

1-Adjusted for age, sex, residence, urban/rural status, birthplace, education, body mass index, smoking status, number of cigarettes smoked per day, years since quit, alcohol drinking, maté temperature and total energy intake.

The analysis of types of meat as continuous variables after the addition of 10 g/day is shown in **Table 3**. Total meat consumption was not associated with risk of oesophageal cancer. When total meat was dissected in red meat, preserved meat and white meat, the last group was significantly and inversely associated with risk of squamous cell oesophageal cancer (OR 0.57, 95 % CI 0.38-0.86, p-value for trend=0.008). In model 3, red meat was partitioned in beef and lamb; preserved meat and white meat were retained in this model. Neither beef nor lamb meat were associated with risk of oesophageal

cancer. In model 4, red meat was dissected in fried, barbecued and boiled meat, according with the cooking method. Again preserved meat and white meat were retained in the model. Whereas fried and barbecued meat were not associated with risk, boiled meat displayed a modest increased risk which was non-significant (OR 1.29, 95 % CI 0.92-1.81, p-value for trend=0.14). In model 5, white meat was examined according to its nested components poultry and fish. Poultry intake was inversely associated with risk of oesophageal cancer (OR 0.65, 95 % CI 0.39-1.07, p-value for trend=0.09), whereas fish

Table 3. Odds ratios of squamous cell esophageal carcinoma for types of meat included in the models as continuous variables after the addition of 10 g/day (1).

| Model | OR | 95 % CI | p-value for linear trend |
|-----------------------|------|-----------|--------------------------|
| 1 Total meat | 1.26 | 0.66-2.40 | 0.40 |
| 2 Red meat | 1.10 | 0.68-1.79 | 0.70 |
| Processed meat | 1.10 | 0.81-1.49 | 0.55 |
| White meat | 0.57 | 0.38-0.86 | 0.008 |
| 3 Beef | 0.88 | 0.63-1.24 | 0.48 |
| Lamb | 1.01 | 0.77-1.32 | 0.94 |
| Processed meat | 1.08 | 0.79-1.47 | 0.63 |
| White meat | 0.57 | 0.38-0.86 | 0.007 |
| 4 Fried meat | 0.91 | 0.68-1.21 | 0.51 |
| Barbecued meat | 0.78 | 0.58-1.05 | 0.11 |
| Boiled meat | 1.29 | 0.92-1.81 | 0.14 |
| Processed meat | 1.12 | 0.82-1.53 | 0.47 |
| White meat | 0.57 | 0.38-0.86 | 0.008 |
| 5 Red meat | 1.12 | 0.69-1.81 | 0.66 |
| Processed meat | 1.11 | 0.81-1.50 | 0.51 |
| Poultry | 0.65 | 0.39-1.07 | 0.09 |
| Fish | 0.74 | 0.44-1.24 | 0.26 |
| 6 Red meat | 1.16 | 0.70-1.91 | 0.57 |
| Bacon | 1.38 | 0.44-4.34 | 0.58 |
| Sausage | 0.68 | 0.37-1.26 | 0.32 |
| Blood pudding | 0.81 | 0.41-1.61 | 0.55 |
| Liver | 0.68 | 0.38-1.23 | 0.21 |
| Mortadella | 0.95 | 0.61-1.47 | 0.81 |
| Salami | 0.94 | 0.56-1.59 | 0.83 |
| Saucisson | 0.99 | 0.43-2.28 | 0.99 |
| Hot dog | 1.34 | 0.80-2.21 | 0.26 |
| Ham | 1.26 | 0.69-2.28 | 0.45 |
| Salted meat | 2.34 | 1.21-4.53 | 0.01 |
| White meat | 0.55 | 0.36-0.84 | 0.006 |

1-Adjusted for age, sex, residence, urban/rural status, birthplace, education, body mass index, smoking status, number of cigarettes smoked per day, years since quit, alcohol drinking, maté temperature, total energy intake and total vegetables and fruits.

consumption displayed a modest reduction in risk. Finally, in model 6 preserved meat was dissected into its 10 components. Red meat and white meat were retained in this last model. Only salted meat (OR 2.34, 95 % CI 1.21-4.53, p-value for trend=0.01) and white meat (OR 0.55, 95 % CI 0.36-0.84, p-value for trend=0.006) were significantly associated with risk of squamous cell carcinoma of the oesophagus.

IV. Discussion

According to the results of our study boiled meat, salted meat and white meat were significantly associated with risk of oesophageal carcinoma. The remaining varieties of meat were not related with oesophageal carcinogenesis.

Previous epidemiological studies reported similar results (Tavani et al, 1994; Bosetti et al, 2000; De Stefani et al, 2003). In particular, the role of salted meat in the development of oesophageal carcinoma has been considered a consistent finding (Cheng et al, 1992; De Stefani et al, 1999, 2003). According to Cheng et al, (1992), salted fish is an important factor in oesophageal

carcinogenesis. Also, previous studies conducted in Uruguay reported similar findings (De Stefani et al, 1999, 2003) for salted red meat. In fact before the advent of the refrigeration, red meat was preserved in rural areas of Uruguay by salting and air-drying ("charque"). These areas displayed very high incidence rates of oesophageal cancer, close to 60 cases per 100,000 inhabitants. The consumption of "charque" has declined in the last 30-40 years, paralleling the decline in the incidence and mortality of oesophageal carcinoma (Zheng et al, 1993; De Stefani et al, 1994). Salted meat is probably more active in the adolescence (Cheng et al, 1992) and is suspected as a rich source of nitrosamines and salt. Both agents (nitrosamines and salt) have been considered as important determinants in the process of oesophageal carcinogenesis (Craddock, 1992; Castellsagué et al, 2000).

Other studies suggested that heterocyclic amines could be important aetiologic factors for oesophageal cancer (Ward et al, 1997). Barbecued and fried meat are precisely a rich source of HCA and in previous studies high consumption of barbecued meat was associated with a high risk of oesophageal carcinoma (De Stefani et al, 1990; Castelletto et al, 1994). In the present study, neither

fried nor barbecued meat were risk factors for this malignancy.

Boiled meat, a main component of stew, was significantly associated with an increased risk of squamous cell oesophageal cancer in our study. The role of boiled meat was specially evident when this meat was analyzed as a categorical variable. When boiled meat was entered into the model as a continuous term, this type of meat was no longer significant. It is possible that boiled meat acted in the process of oesophageal carcinogenesis through thermal injury of oesophageal mucosa, since stews are ingested very hot by the Uruguayan population. This could induce chronic oesophagitis, considered as the first step in the development of oesophageal carcinoma (Muñoz et al, 1987).

White meat, that is poultry plus fish meat, was the only protective type of meat in our study. This type of meat is characterized by a lower amount of saturated fat when compared with red meat. Unfortunately, our questionnaire did not discriminate cooking methods for poultry and fish. It has been reported that, whereas low-fat types of white meat (skinless chicken and unfried fish) are protective, high-fat types of this meat are associated with risk of other malignancies (Ronco et al, 2003). Thus, it is possible that our participants consumed mainly low-fat types of white meat. It is not possible to discard the fact that white meat consumption could be a marker of a healthy diet. Previous studies reporting OR's of oesophageal carcinoma for white meat consumption, consistently showed inverse associations (De Stefani et al, 2003). Further studies on mechanisms of white meat consumption in oesophageal carcinogenesis are needed.

Residual confounding of our results from tobacco smoking, alcohol drinking, maté consumption and diet could result in severe distortions of the estimates. For these reasons we included terms for tobacco smoking (8 strata), alcohol drinking (5 strata), maté temperature (4 strata) and total vegetables and fruits (4 strata).

As other hospital-based case-control studies, the present study has limitations. In first place, selection bias is almost impossible to exclude. We tried to minimize this bias by frequency matching cases and controls on age and sex. Also, residence and urban/rural status were rather similar. Recall bias, which is almost non-existent in prospective studies, is also a major drawback. We tried to minimize recall bias asking about the consumption five years before the date of the interview. Nevertheless, since the process of oesophageal carcinogenesis is of long duration, it is possible that cases experienced difficulties in eating foods like meat, more difficult to swallow. This could lead to differential misclassification. Since the role of diet in oesophageal carcinoma is mostly unknown in Uruguay, it is unlikely that both interviewers and participants of the study could be affected in its attitudes during the interviews. Probably, the major limitation of our study was the lack of validation of our FFQ. Aside from this drawback the FFQ was comprehensive and included queries on 64 food items, representative of the usual diet of the Uruguayan population. On the other hand, our study has strengths. Perhaps the major strength is related with the high response rate observed in both series

of patients. Also, the exclusion of proxy interviews is another strength of the study. Finally, the restriction of the study to patients afflicted by squamous cell carcinoma of the oesophagus is a strength.

In summary, our study replicates previous findings showing that salted meat is a major risk factor for squamous cell carcinoma of the oesophagus. On the other hand white meat intake was a protective factor, even after allowing for the effect of plant foods and other major confounders. Public health measures resulting in a lower intake of salt and in a substitution of red meat by white meat could prevent the risk of development of squamous cell oesophageal carcinoma.

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