

Relative importance and profile of processed meat intake in relation to colon cancer death rates in Europe

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Abstract — The relation between consumption of red meat and colo-rectal cancer is more outspoken for processed than for total red meat. The presence of NaCl might indeed intensify the underlying DNA damage through increased formation of reactive chlorinating intermediates. About 50 % of pig meat is processed (involving curing e.g. adding salt and other additives) and it provides 80 % of processed meats. Death rates from malignant neoplasms of the colon (DRMNC)(2007) and pig meat intake (PMI) (2003 – 2005) in 29 European countries were therefore directly compared to assess the importance of (processed) meat consumption uncorrected for the many other interacting cancer risk factors involving genetics, nutrition, lifestyle, and optimal health. No relationship was apparent but the average 60 % increase in PMI between 1990-92 and 2003-05 within 7 countries was associated with a mean 12 % increase of DRMNC. On average, a 50 g/d increase of intake increased colon cancer death rate by ca. 10 %, analogous with other estimates. Associated death rates of other malignant neoplasms and ischemic heart disease were clearly decreased. The higher incidence of colorectal cancer in Northern compared to Southern Europe is associated with a higher intake of processed (cured) meat (38 vs. 20 g/p/d) containing a higher proportion of cooked and cured sausages (46 vs. 34 %) and of minced hamburger like products (13 vs. 4 %).

Keywords— Processed meats, colorectal cancer, pig meat

I. INTRODUCTION

Based on extensive epidemiological work, official dietary recommendations recognize that diets high in red meat are associated with an increased colorectal cancer risk, the risk per g eaten being higher for processed (cured) than for fresh red meat [1] [2]. Results from laboratory and intervention studies explain this association by the intestinal tumor promoting effect of heme and Fe-nitrosyl-heme in the gut, involving mainly lipid peroxidation and N-

nitrosation for fresh and cured meats respectively [3]. Lipid peroxidation is initiated by the formation of radical species and this may also involve myeloperoxidase catalyzed generation of reactive chlorinating intermediates in the gut. Myeloperoxidase activity is indeed involved in enhanced oxidative stress in neoplastic tissue of the colon [4], may induce DNA damage [5] and was found to be strongly dependent on extracellular chloride concentration in peripheral blood neutrophils [6]. It could therefore be speculated that salt in consumed processed meats increases plasma chloride levels stimulating myeloperoxidase catalyzed generation of reactive chlorinating intermediates in the gut. Other considerations concern the need for more precise identification of the processed (cured) meats involved as well as the evident difficulties in estimating the relative importance of (processed) meat consumption within the multifactorial causes of colorectal cancer risk including e.g. gene polymorphisms associated with carcinogen metabolism as we pointed out earlier [7].

II. AIM AND CALCULATIONS

It can be estimated that pig meat provides about 80 % of processed meats and that at least about 50 % of pig meat is processed [8], suggesting that pig meat consumption reflects to a considerable extent processed (cured) meat consumption. Inspired by an original report [9], we therefore argued that a significant importance of processed meat intake for colon cancer within the multifactorial causes involved should be reflected in the strength of a simple, uncorrected relationship between colon cancer death rates and pig meat intake (PMI). We related PMI (2003-05) [10] in 29 European countries to death rates from malignant neoplasms of the colon (DRMNC) (2007) [11], as well as changes in PMI to changes in

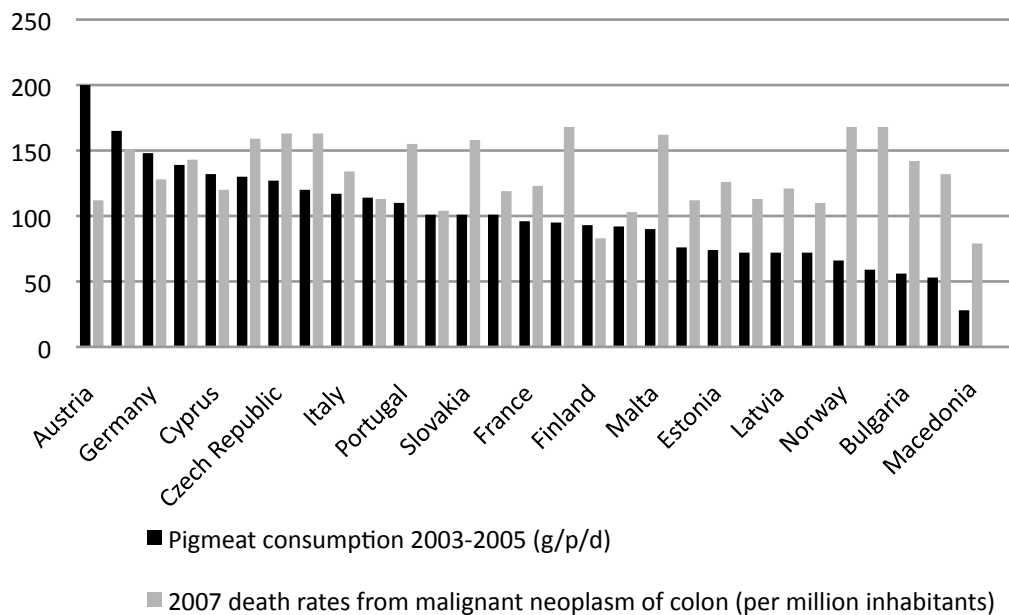


Fig. 1. Pigmeat consumption [10] and death rate from malignant neoplasms of colon [11] in EU countries

DRMNC between 1990-92 and 2003-05. It was further attempted to relate the well known difference between colorectal cancer death rates in Northern Europe and Mediterranean countries [12] to a difference in the consumption of specific processed meat classes between Northern and Southern European countries. The latter data were derived from the EPIC study [13].

III. RESULTS AND DISCUSSION

A. Pig meat intake and colon cancer death rate

Fig. 1 clearly illustrates the absence of any significant direct relation between recorded data for PMI (shown in descending order between 250 and 25 g/p/d) and DRMNC over 29 countries. This finding strongly suggests that differences in other causal factors for the disease and/or its mortality (e.g. effectiveness of diagnosis and/or medical intervention) are more important than the differences in pig meat consumption. It can be argued that other disease determining factors may be less variable within each country than between countries. Therefore, changes in DRMNC since 1990 were considered in countries

where PMI had increased by at least 20% over the same period. Table 1 shows that PMI in 2003-05 for 7 countries represented on average (\pm SE) 160 ± 14 % of the value for 1990-92 accompanied by an average

Table 1. Pig meat intake (PMI) in 2003-05 [10] and death rates from malignant neoplasms of colon (DRMNC) [11] in 2007 in selected EU countries

	PMI 2003-05 ^a	DRMNC in 2007 ^b
Lithuania	202.0	105.0
Iceland	189.3	120.0
Slovenia	173.0	137.0
Portugal	141.0	110.7
Italy	131.5	93.7
Spain	120.4	104.1
Mean	159.5	111.8
SE	13.6	6.2

^a% of values in 1990-92; ^b% of values in 1994

Table 2. Adjusted mean (\pm SE) daily intake of processed (cured) meat product classes in women as calculated from EPIC study data [13]

	Southern Europe (n=4) ^a	Northern Europe (n=5) ^b	UK
Total (g/day)	20 \pm 3.7	38.4 \pm 3.6	24.3
% of total			
Raw cured	32.8	14.4	4.5
Ham	15.5 \pm 4.7	7.8 \pm 1.7	0.8
Salami type	17.3 \pm 7.9	6.6 \pm 1.8	3.7
Cooked cured	52.2	58.9	30.9
Ham	19.4 \pm 6.0	12.7 \pm 1.6	21.4
Sausages	33.9 \pm 5.8	46.2 \pm 3.4	9.5
Main other	15.0	26.7	64.6
Bacon	3.6 \pm 0.1	3.6 \pm 1.0	24.8
Minced ¹	4.0 \pm 2.1	12.7 \pm 4.0	12.4
Cuts ²	5.0 \pm 2.3	9.6 \pm 2.9	1.7
Raw spreadable	0.6 \pm 0.4	0.7 \pm 0.3	25.7

^a Greece, Spain, Italy, Southern France; ^b Germany, The Netherlands, Denmark, Norway, Sweden; ¹ Hamburger, fricadel, meat balls; ² roasted meat in aspic, schnitzel, ..

increase of DRMNC to 112 ± 6 % over the period. It can be calculated that this represents on average a 10 % increase of colon cancer death rate for a 50 g/d increase of PMI analogous to other estimates derived from epidemiological work [14]. It is striking that over the same period, death rates due to total malignant neoplasms and to ischaemic heart diseases were respectively decreased to 91.8 ± 2.3 % and 65.0 ± 5.6 % of the 1990-92 values.

The data confirm that pig meat intake, a reflection of processed meat intake, is indeed associated with an increase in colon cancer risk. In contrast to original work on total meat [9] however, this association may be completely overshadowed by the variability of other disease determining factors, an indication of its limited importance

B. Intake of processed meat classes in Northern and Southern Europe.

Our comparison of individual processed meat product classes in the consumption data collected from the EPIC study [13] illustrates striking differences: women (slightly different only from data for men) in Northern Europe consume about twice the amount of processed meats (38 g/d) than in Southern Europe (20 g/d). The proportion of raw and cured products (e.g. raw ham and salami type) is about twice as important in Southern Europe (32 %) compared to Northern Europe (14 %). In Northern Europe a much higher proportion of cooked and cured sausages (46 vs. 34 %) and “minced” hamburger type products (13 vs. 4 %) is consumed. It can be calculated that the average consumption of the latter product classes known to be high in fat content amounts to 22.6 g/d and 7.6 g/d in Northern and Southern Europe respectively. It should also be taken into account that the Mediterranean processing of raw and cured ham is more characterized by the absence of nitrite and the presence of Zn-Protoporphyrin in the products, a compound known to inhibit hemin-induced DNA

damage and cell hyper proliferation [15]. These considerations are in line with the hypothesis that the higher incidence of processed meat induced colorectal cancer in Northern compared to Southern Europe mainly relates to a higher consumption of fatty meat products and Fe-nitrosyl-heme provoked lipid peroxidation in the gut.

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