



# NUTRITIONAL FACTORS AND NEOPLASIA IN DOGS: A DATA ASSOCIATION STUDY ON THE ROLE OF EARLY AGE DIET

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## Introduction

## Materials and methods

## Results

Food components and inflammation are two of the three main causes of human cancers, along with cigarette smoking<sup>1,2</sup>. Closely living with humans, dogs share the same environment, food and life style with them, and suffer from the same cancers<sup>3,4</sup>.

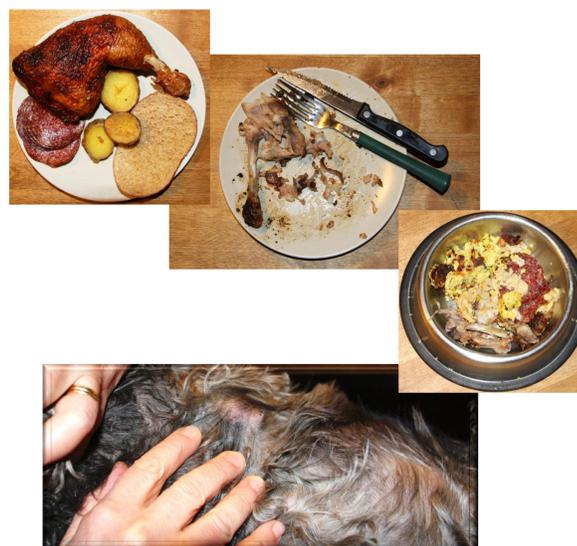
Based on the following reasoning we have conducted this case-control study on diet and neoplasia:

- Food-borne mutagenic agents as additives<sup>2</sup> or derived from processing<sup>5,6</sup>, besides agroindustrial residues<sup>1</sup>, are associated with the occurrence of diverse neoplasias<sup>7</sup>.
- The development of infectious and metabolic conditions are both intrinsically dependent on the quality of nutrition<sup>1,2</sup>.
- Inflammation is an essential component in the course of infections, obesity or oxidative stress states, and there is convincing evidence that inflammation plays a critical role in tumorigenesis<sup>7</sup>.
- Evidences have been obtained that immune imbalance and autoimmunity, often resulting from underlying chronic inflammatory processes, precedes tumor development, as in the example of inflammatory bowel disease (IBD), which greatly increases the risk of colorectal cancer<sup>8</sup>.
- The balance of the immune system defines its competence to eliminate malignant cells by means of cytokines, chemokines, growth factors, prostaglandins, reactive oxygen and nitrogen species<sup>7</sup>.
- Containing the largest immunological tissue in the body, the gastrointestinal tract is colonized with a complex microbial population that induces cytokine production by regulatory T cells (Th3 and Th1 cells) that will help to guide a balanced T helper 1 (Th1) and T helper 2 (Th2) response<sup>9</sup>.
- It has been shown that dietary components have a crucial impact on the gut microbiome and thus on the local and systemic immune competence<sup>10, 11, 12, 13, 14</sup>; altering the diet has a direct effect on the microbial community residing in the gut – for better or worse<sup>15</sup>.
- At early ages, the gut composition has a fundamental role in the establishment of immune competence in humans<sup>9</sup> and animals<sup>16</sup>.
- In dogs, a recent publication showed that cancers were the 5<sup>th</sup> most frequent reason for searching veterinary care in Sweden, presenting the second rate of mortality<sup>17</sup>.
- Some heterocyclic aromatic amines (HAAs) have been described as carcinogens and are present in cooked / processed human food<sup>18</sup> as well as in commercial dog foods<sup>6, 19</sup>.

The internet-based DOGRISK<sup>20</sup> owner questionnaire data was used for the analyses: it includes questions about the dog's descriptions, diseases and nutrition at different life stages.

- **Case group:** dogs divided into three age-groups (1-4, 5-8 and above 9 years of age) suffering from neoplastic diseases and whose owners had completed the questionnaire properly (n=1028, 11.9%). Diseases are only reported by owners and not checked.
- **Control group:** all ditto non-neoplastic dogs (n=7583, 88.1%)
- **Analyses:** associations between neoplasia and 13 food "groups" that were constructed by principal component analysis from 54 food items given to dogs at the age of 2-6 months. The food items were reported as frequencies.
- **Statistical methods:** All food groups were first constructed as maximum variables (maximum value of any item in the group) and then only the extreme values were used where 0= never and 1= at least once a week. The analysis made Spearman's correlation test, fisher exact test and from there an odds ratio was calculated. Confounding variables were analyzed by an answer tree approach.

The age range analyzed was 1-21 years. The most frequent neoplasias were lipoma (81.3%), skin (6.6%), and mammary (6.4%) and with all in all 33 different neoplasias reported. In this population eating cooked or processed homemade or commercial foods or treats were significantly associated with more neoplasia whereas there was a significant negative association between being fed nutraceutical oil products as well as raw animal protein, and neoplasia (Table 1). There were no statistical associations between neoplasia and eating raw vegetables or fruits, dried animal protein products, table oils or outdoor eating behaviour (grass, feces, mud, insects or carcasses, water from puddles). The main confounding variables were age, cleanliness in the house, number of dogs in the house, being born in the same house and gender.



## Conclusions

We can conclude that raw food and nutraceutical oils seem to decrease the odds of neoplasia development when provided at young age, while processed foods seem to increase the odds. Both our nutrition based variables and the other significantly associated confounding variables might be a piece in the pathophysiological puzzle of neoplasia. It would be intrinsically related with early gut health, at a time when the immune system is having its initial contacts with antigens and forming its microbiota. As dogs and humans both suffer from similar cancers we hypothesize that for both, the development of neoplasia may have a fundamental relation with their diet.

Table 1. Significant (\*) associations between food groups (fed after weaning) and occurrence of neoplasias in dogs

DIET AT 2 – 6 MONTHS	Association with neoplasia over one year of age				
FOOD ITEM	R <sub>s</sub>	n	P-value	OR	95% CI
Cooked human food left-overs	0.063	3,142	<0.001**	2.32	1.44-3.74
Commercial baked dog snacks	0.032	4,113	0.044*	2.18	1.01-4.69
Home cooked food for dogs	0.070	2,925	<0.001**	2.06	1.41-3.03
Dairy products	0.050	3,426	0.003*	1.60	1.16-2.20
Processed wet commercial dog food	0.041	3,373	0.020*	1.36	1.06-1.77
Dry commercial dog food	0.024	5,644	0.079	1.49	0.96-2.32
Homemade raw animal proteins	-0.044	3,578	0.020*	0.73	0.57-0.94
Commercial raw dog food products	-0.063	3,789	<0.001**	0.64	0.50-0.80
Nutraceutical omega oil products	-0.076	3,781	<0.001**	0.44	0.31-0.63

r<sub>s</sub> = Spearman correlation coefficient, n=number of cases, OR = odds ratio, CI= confidence interval. \*P<0.050 and \*\*P<0.001

The aim of this study was to see if there was association between what the dogs eat at young age and the incidence of neoplastic diseases.

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