A New PATH to Progress®: Unleashing the Pet Dog Population as a National Resource to Study Aging and Cancer

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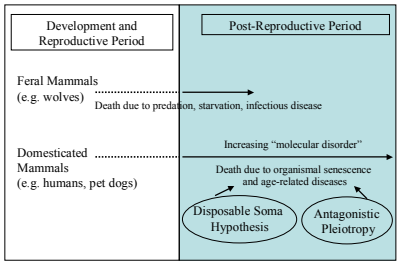
Abstract

Pet dogs living in the same environment as humans experience a high lifetime risk for the development of spontaneous cancers, and many of these cancers mimic their human counterparts in terms of biological behavior and response to treatment. In addition to informative genetic studies, the relatively compressed life span of pet dogs enables investigators to collect detailed information on lifestyle factors, such as diet and physical activity, throughout the life course beginning at a very young age. To date, our research findings suggest that pet dogs offer a unique opportunity to probe key aspects of the complex relationship between aging and cancer. These aspects include: age as a predictor of cancer prognosis; the impact of early life events on adult cancer incidence; and the paradoxical observation that the oldest-old individuals (centenarians) are apparently cancer resistant. Unleashing the power of this comparative approach adds a vital dimension that directly complements current research approaches used within the interdisciplinary field of biogerontology.

Domestication's Curse: The Cancer Epidemic in Pets and People



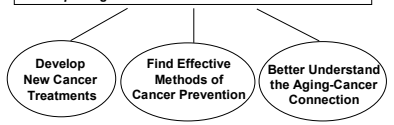
Comparative Oncology

The study of the similarities and differences between the spontaneous cancers of man and animals

PATH to Progress®

Gerald P. Murphy Cancer Foundation

We're putting man's best friend on the trail of a killer™



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Do Early Life Events Influence Adult Cancer Risk?

Data from Humans

Adolescent Soy Intake is Inversely Associated with Adult Breast Cancer Risk (Shu XO et al, *Cancer Epidemiol Biomark Prev* 2001, 10: 483)

	Adjusted OR (95% CI) by quintile of soy intake					*P* trend
	1 (lowest)	2	3	4	5 (highest)	
Soy Intake	1.0	.75 (.60-.93)	.69 (.55-.87)	.69 (.55-.86)	.51 (.40-.65)	< .01

Data from Dogs

Nutritional Factors Early in Life May Influence Risk of Mammary Cancer in Dogs (Sonnenschein et al, *Am J Epidemiol* 1991, 13: 694)

Juvenile Body Condition	Risk for Adult Mammary Cancer
Thin	0.04 (0.004-0.40)
Not Thin	1.0

Early Gonadectomy Increases Bone Sarcoma Risk in Rottweiler Dogs (Cooley et al, *Cancer Epidemiol Biomarkers Prev* 2002, 11: 1434)

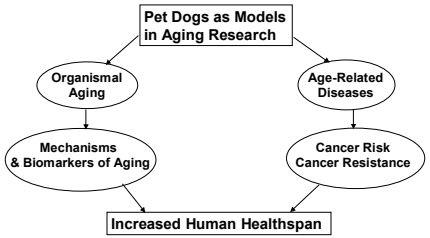
Data from 388 Female Dogs

	Spay < 1yr	Spay 1 – 5yr	Spay > 5yr	Intact
Total # of dogs	75	122	122	69
# of bone tumors (prevalence)	18 (24%)	14 (11%)	14 (11%)	5 (7%)
Dog months at risk	7,176	12,612	12,856	6,144
Bone tumors per 10,000 dog months (95% CL)	25.1 (13.5 – 36.7)	11.1 (5.3 – 16.9)	9.4 (4.5 – 14.3)	8.1 (1.0 – 15.3)
Hazards ratio (95% CL)	3.1 (1.1 – 8.3)	1.4 (0.5 – 3.8)	1.2 (0.4 – 3.2)	1.0
P-value	.02			*P* trend: .006

Data from 294 Male Dogs

	Castration < 1yr	Castration 1 – 3.5yr	Castration > 3.5yr	Intact
Total # of dogs	34	65	65	130
# of bone tumors (prevalence)	9 (26%)	8 (12%)	8 (12%)	10 (8%)
Dog months at risk	3,186	6,228	7,632	13,212
Bone tumors per 10,000 dog months (95% CL)	28.4 (9.8 – 47.0)	12.8 (3.9 – 21.8)	10.5 (3.3 – 17.8)	7.6 (2.9 – 12.3)
Hazards ratio (95% CL)	3.8 (1.5 – 9.2)	1.7 (0.7 – 4.3)	1.4 (0.6 – 3.5)	1.0
P-value	.002			*P* trend: .008

Will Pet Dogs Become Biogerontology's New Workhorse?



Do Young Hosts Develop More Aggressive Cancers than Old Hosts?

Data from Humans

Age at Diagnosis Influences the Biological Aggressiveness of Stomach Cancers in Humans (Inoshita et al, *Jpn J Cancer Res* 1998, 89: 1087)

Age group in years	Stage	Well-diff.	Mixed type w>p	Mixed type w<p	Poorly diff.
30-39	Early	1 (1/0): 3%	2 (2/0): 7%	11 (9/2): 36%	16 (9/7): 54%
n=54	Advanced	0	1 (1/0): 4%	8 (3/5): 33%	15 (8/7): 63%
(33/21)					
65-69	Early	15 (12/3): 50%	9 (7/2): 30%	3 (1/2): 10%	3 (1/2): 10%
n=69	Advanced	1 (1/0): 3%	12 (9/3): 31%	18 (10/8): 46%	8 (2/6): 20%
(43/26)					
≥85	Early	18 (10/8): 51%	16 (7/9): 46%	1 (0/1): 3%	0
n=69	Advanced	3 (2/1): 9%	14 (7/7): 41%	15 (5/10): 44%	2 (1/1): 6%
(32/37)					

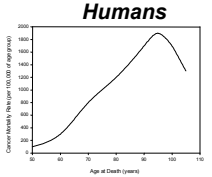
Data from Dogs

Age at Diagnosis Influences Risk for Skeletal Metastases in Dogs with Spontaneous Prostate Carcinoma (Waters et al, *The Gerontologist* 1998, 38:110)

	Relative Risk (95% CI)	*P* value
Chronologic Age (years):		
<8	6.80 (0.97-47.86)	0.01
9-10	4.43 (0.59-33.50)	0.10
11-12	3.72 (0.50-27.78)	0.15
>12	1.00 (reference)	-
Physiologic Age (human year equivalents):		
<52	4.90 (1.13-21.16)	0.02
53-61	5.60 (1.35-23.15)	0.004
62-70	2.67 (0.54-13.21)	0.20
>70	1.00 (reference)	-

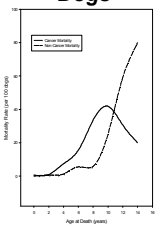
Are the Oldest-Old Cancer Resistant?

Humans



Age-specific Cancer Mortality Rate in Humans (Smith, *Cancer* 1996, 77:1367)

Dogs



Age-specific Cancer and Non-Cancer Mortality Rates for 345 Rottweiler Dogs (Cooley et al, *J Gerontol* 2003, 58A:1078)

Comparison of Extreme Aged Rottweiler Dogs and Human Centenarians(Cooley et al, *J Gerontol* 2003, 58A:1078)

Factor	Extreme Aged Rottweiler Dogs	Human Centenarians
Age at Death	≥13.3 years	≥ 100 years
Gender		
Female	67%	80.0%
Cause of Death		
Cancer	19%	4.0%
Non-cancer	81%	96.0%
Delay in Onset of Major Diseases*		
Survivor	24%	38%
Delayer	19%	43%
Escaper	57%	19%

*Survivor: onset of at least one major disease prior to median age at death for the population;
Delayer: free of all major diseases until after median age at death;
Escaper: free of all major diseases until after reaching extreme age.