

SPATIAL AND TEMPORAL CLUSTERING AND RISK FACTORS FOR CALCIUM OXALATE COMPARED TO STRUVITE UROLITHS IN DOGS

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OUTLINE

- **PATHOPHYSIOLOGY & EPIDEMIOLOGY**
- **STUDY # 1:
SPATIAL AND TEMPORAL
CLUSTER ANALYSES**
- **STUDY # 2:
RISK FACTOR ANALYSIS**
- **DISCUSSION**



**PATHOPHYSIOLOGY
& EPIDEMIOLOGY
OF CANINE
UROLITHIASIS**

Burden of illness

- **Proportional morbidity - 0.05 - 1.2 %**
- **95% occur in the lower urinary tract**
- **Calcium oxalate & magnesium ammonium phosphate (struvite) - 92% of submissions**
- **Require surgery, other assisted voiding, or medical (struvite-only) therapy**

Development of uroliths

➤ **supersaturated solution**

spontaneous crystal formation

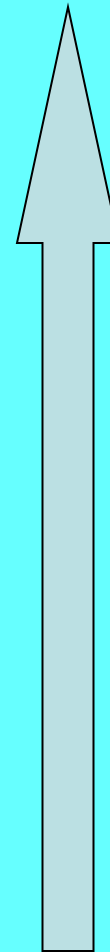
➤ **saturated solution**

crystal aggregation

inhibitors and promoters

➤ **under saturated solution**

some crystals will dissolve
(struvite)



**urine
ionic
concentration
gradient**

Contrasting struvite and CaOx uroliths

- also a function urine pH
(alkaline urine - struvite; neutral to acidic - CaOx)
- Struvite – bacterial infection
- CaOx – low dietary levels: minerals, protein & moisture
(Lekcharoensuk et al., 2002)
- Small breeds vs. other pure breeds



Demographic risk factors

Risk Factors	CaOx	Struvite
Age	Mean > 7 years	Mean < 7 years
Sex	Males	Females

CaOx – neutering and obesity increased risk
(Lekcharoensuk et al., 2000)

Contextual risk factors

➤ **City vs. farm dogs - CaOx**

(Lekcharoensuk et al., 2000)

➤ **Affluence and meat consumption
(human)**

➤ **Water hardness (human)**

CVUC

- **Canadian Veterinary Urolith Centre**
free service to veterinarians
- **32,000 canine uroliths submitted to the CVUC from across Canada**
- **Quantitative analysis**



Overall study objectives

- **Identify contextual variables**
- **Evaluate complex interactions among individual level demographic and dietary risk factors**

STUDY # 1

SPATIAL AND TEMPORAL CLUSTER ANALYSES

Objectives

Study # 1

- **Spatial clustering:**
 1. **environmental (water, diet, clinic)**
 2. **socioeconomic**

- **Temporal clustering:**
 1. **trends in diet**
 2. **trends in therapy**

Methods & Materials

Data

Study # 1

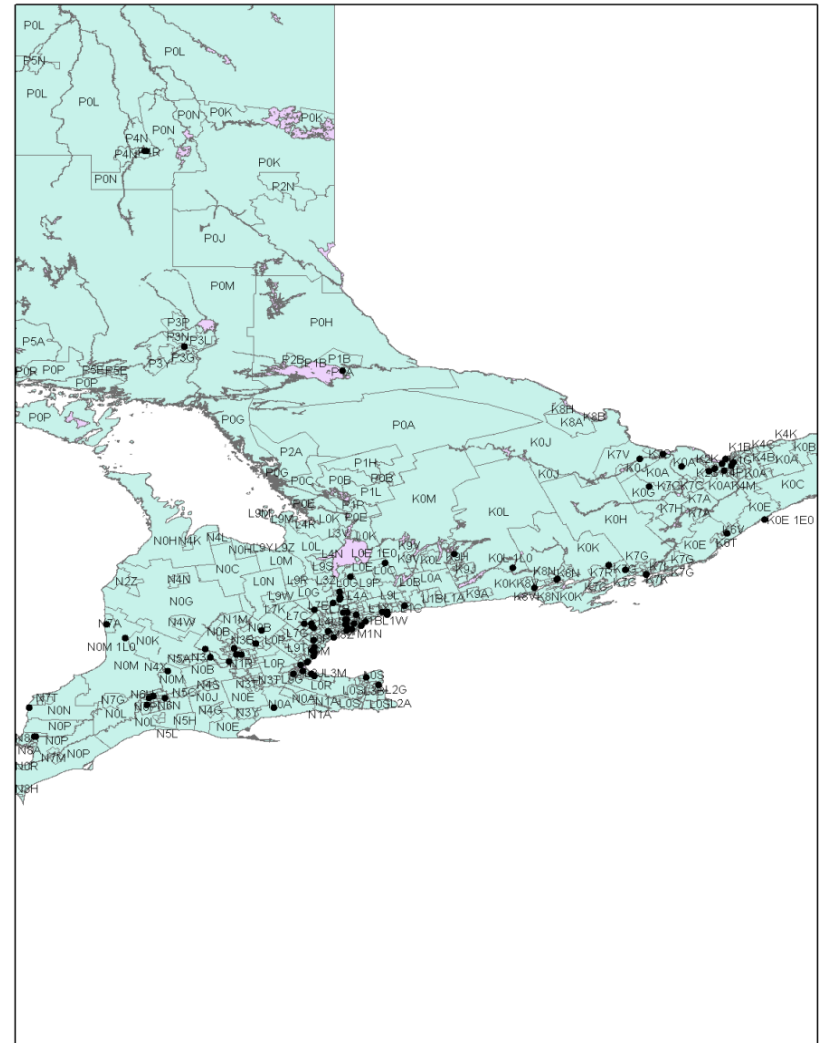
	Incident Cases	CaOx & Struvite	Geo-coded	Total
Ontario	11,414	92%	93%	9,735

➤ **Geo-coded cases:**

- 1. 52% CaOx**
- 2. 48% struvite**

Geo-coding to latitude and longitude coordinates with Geopoint Suite 5.4 v.2006.2 DMTI spatial

- Geocoding was done using owner address information
- Geocoding assessment done with a random sample of 100 locations in ArcGIS 9.2 (ESRI)
- Visual comparison to 2001 forward sortation area (FSA)
- Geographic Coordinate System Datum 1983 projection



Biases resulting from matching addresses to geocoded locations

➤ Positional inaccuracies

- ❖ Addresses are assigned locations unacceptably far from their actual position (Oliver, et.al., 2005)
- ❖ 100% of our sample was within or within adjacent FSAs

➤ Differential match rate – non-random unmatched locations

- ❖ Risk factors related to “missingness” are also the same risk factors for the disease (Oliver, et. al., 2005). In this study, population density related factors could be potential confounders
- ❖ High match rate in our study, 93%

Data analysis

Study # 1

- **Spatial scan statistic with SaTScan™ v.7.0.3 (Kulldorff and Information services)**

- **Bernoulli model –
calcium oxalate compared to struvite urolith submissions**
 1. spatial scan - household location
 2. temporal scan - date received

- **Max. scanning window: 50% of population and/or study period**

- **999 Monte Carlo simulations**

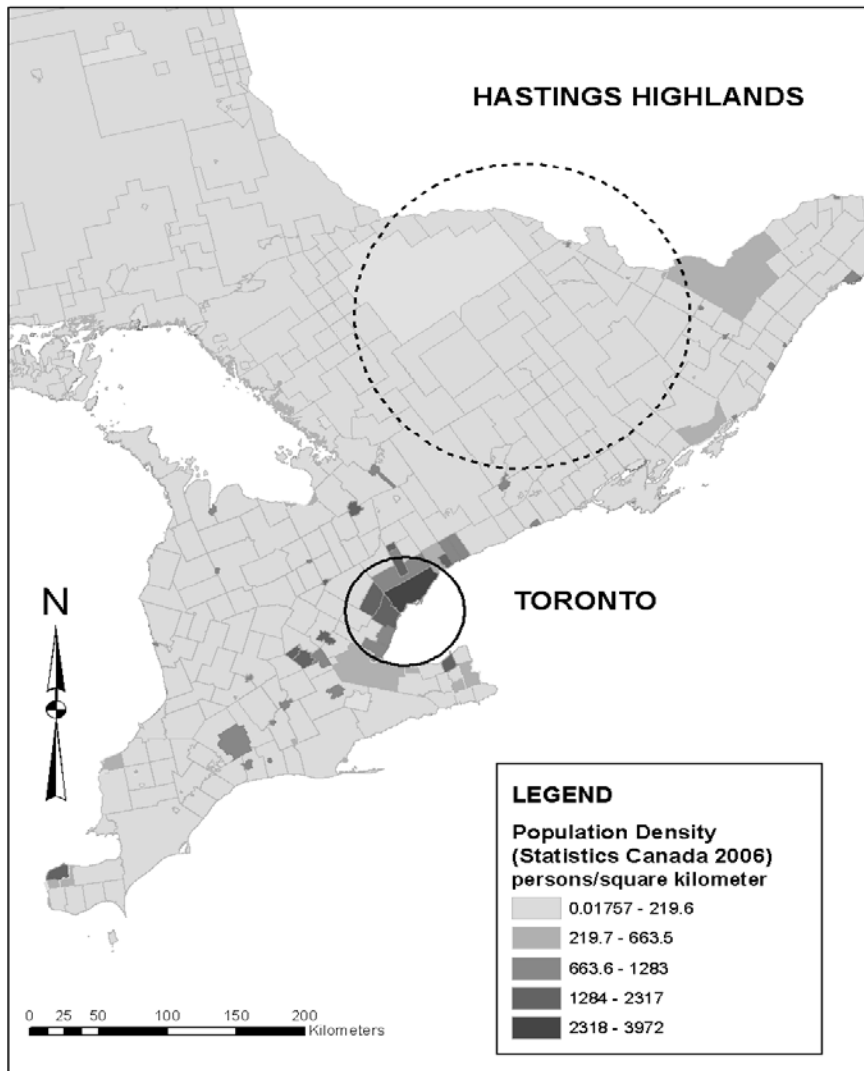
Data analysis (cont.)

Study # 1

- **Adjusted analysis using multiple datasets option (8):**
 - 1. Age (< 7 yrs : 7 + years)**
 - 2. Sex**
 - 3. Breed (small breed : non-small breed)**

Results

Adjusted spatial analysis



- **Calcium oxalate:**
Toronto
O/E - 1.06
p-value - 0.001
- **Struvite:**
Hastings Highlands
O/E - 1.33
p-value - 0.02

Discussion

Study # 1

- **Significant clustering in space**
- **Spatial and temporal clusters reflect:**
 - 1. Contextual risk factors (biologic/socioeconomic)**
 - 2. Submission bias**
- **Subsequent statistical modeling will account for diet, clinic, and regional socio-economic factors**

STUDY # 2

RISK FACTOR ANALYSIS

Objectives

Study # 2

- **Identify animal level risk factors**
(demographic, dietary)
- **Identify community level contextual variables**
(distance, statistical area classification (SAC), cluster, income)

Statistical methods

Study # 2

- **Multi-level modeling in a mixed logistic regression model with STATA v.10**
- **Owner census subdivision (CSD) as the random intercept (n=302)**
- **Demographic, dietary, community-level variables (median family income, statistical area classification, distance between owner and clinic locations) and year**
- **n = 7,297 observations**

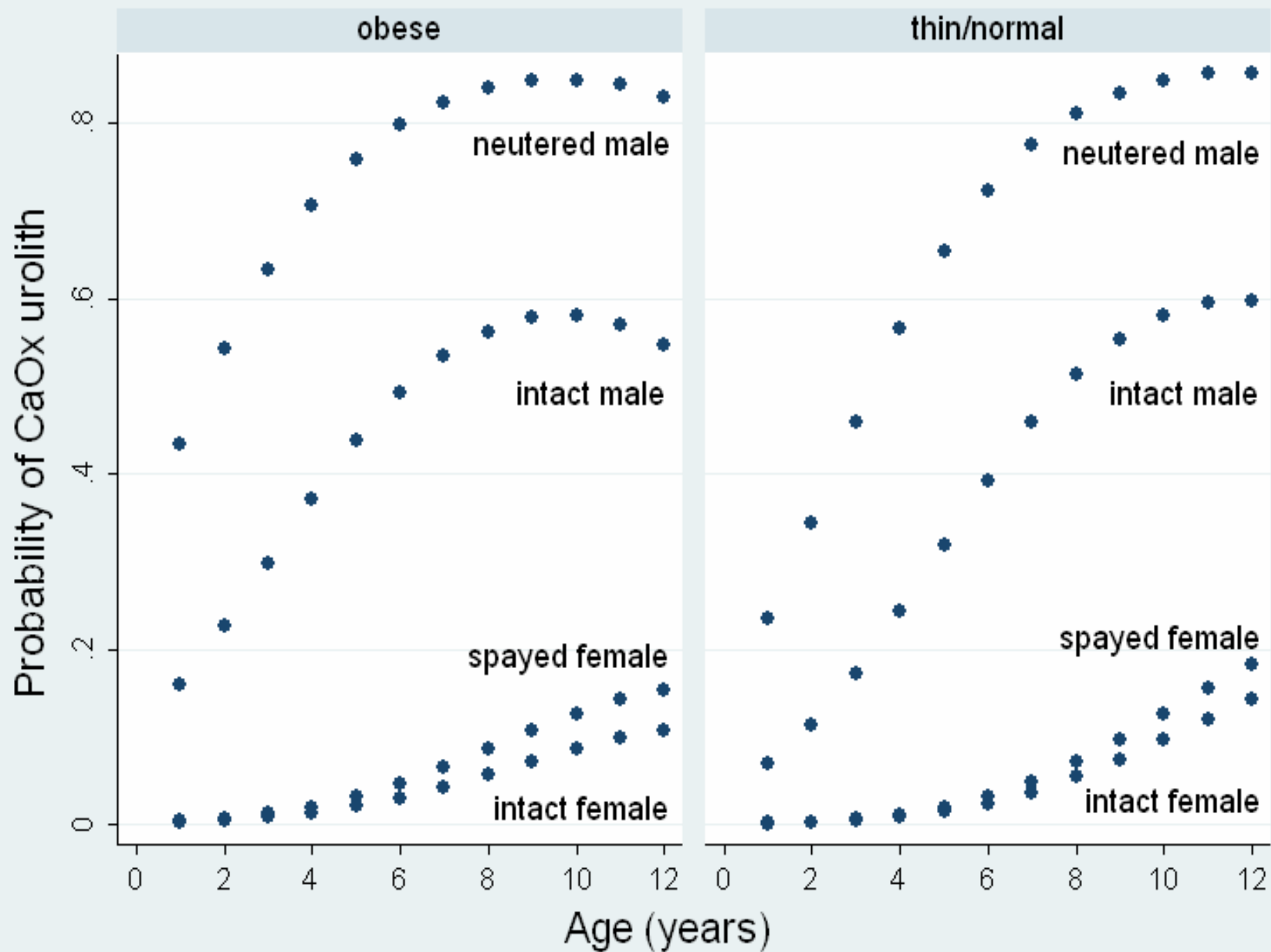
Dog-level variables

Study # 2

- **Age and quadratic**
- **Sex**
- **Breed type:**
 1. large and medium pure breeds
 2. small pure breeds
 3. mixed breeds

- **Body condition (thin/normal vs. obese)**
- **Neuter status**

- **Two-way interactions among these variables:**
 1. sex*age
 2. body condition*age
 3. sex*neuter status



Dietary variables	OR	P-value
Vet diet =>6months vs. other diet	1.54	<0.0001
Canned vs. dry		
1. Small breed	0.70	0.03
2. Mixed breed	0.76	0.44
3. Large breed*	7.71	<0.0001
Canned vs. both		
1. Small breed	0.80	0.21
2. Mixed breed	0.88	0.74
3. Large breed*	7.03	0.001

Community and time level variables	OR	P-value
Year 2006 (ref: 1998)	1.59	0.011
Cluster:		
CaOx vs. struvite	2.38	0.004
CaOx vs. outside	1.38	0.004
Struvite vs. outside	0.60	0.052
Statistics Canada 2006 - ArcGIS CSD Median family income \$ 70,000 (ref <\$54,000 category)	1.41	0.020
* SAC, distance		N/S

Discussion

- **Complex interactions among the individual dog level risk factors**

Discussion

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- **Dietary variables:**
 - 1. Dietary moisture and breed-type**
 - 2. Vet diets require further evaluation**

Discussion

- **Complex interactions among the individual dog level risk factors**
- **Dietary variables:**
 1. **Dietary moisture and breed-type**
 2. **Vet diets require further evaluation**
- **Impact of income and cluster**
 1. **lifestyle**
 2. **treatment choice**

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