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FELINE HYPERTHYROIDISM

IN HONG KONG :

PREVALENCE AND RISK FACTORS

by

Cornelia S De Wet

Submitted in partial fulfilment of the requirements
for the degree of

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Dissertation

Feline hyperthyroidism in Hong Kong :
Prevalence and Risk Factors

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Declaration

I, Cornelia Susanna de Wet, do hereby declare that the research presented in this dissertation, was conceived and executed by myself, and apart from the normal guidance from my supervisor, I have received no assistance.

Neither the substance, nor any part of this dissertation has been submitted in the past, or is to be submitted for a degree at this University or any other University.

This dissertation is presented in partial fulfilment of the requirements for the degree MSc in Veterinary Science.

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C S de Wet

Date _____

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%	percent
>	greater than
<	less than
≥	greater than or equal to
ALP	alkaline phosphatase
ALT	alanine aminotransferase
CI	confidence interval
d f	degrees of freedom
DLH	domestic longhair
DSH	domestic shorthair
ELISA	enzyme-linked immunosorbent assay
FN	female (neutered)
fT_4	free T_4
MED	modified equilibrium dialysis
MN	male (neutered)
n	number of hyperthyroid cats
N	number of cats in study population
NTI	non thyroidal illness
nmol/L	nanomoles per litre
OR	odds ratio
P	probability
RIA	radioimmunoassay
T_3	L-triiodothyronine
T_4	L-thyroxine
TRH	Thyrotropin-releasing hormone
TT_4	total T_4
U/L	units per litre
µg	microgram
µg/dL	micrograms per decilitre

Summary

Feline hyperthyroidism is an important disorder in middle-aged and older cats. The cause and pathogenesis of the disease is still unknown and there are few published incidence rates or prevalence estimates.

A descriptive cross-sectional study was conducted to determine the prevalence of and potential risk factors for feline hyperthyroidism in Hong Kong. Serum thyroxine (T_4) was measured in 305 cats 10 years and older that presented at various veterinary clinics in Hong Kong between June 2006 and August 2007. The veterinarians taking the samples completed a questionnaire regarding the health of each cat. Each owner completed a questionnaire regarding vaccination history, internal and external parasite control, diet and the environment of their cat.

Serum total T_4 concentration was determined by use of a commercially available radioimmunoassay kit (Coat-a-count®, DPC®). For total T_4 the feline reference interval was 12.8-50.0 nmol/L (1.0-3.9 ug/dL). All cats with a serum total T_4 concentration of greater than 50.0 nmol/L were classified as hyperthyroid. Alanine aminotransferase (ALT) and alkaline phosphatase (ALP) activities were measured in all the samples.

The prevalence of feline hyperthyroidism in Hong Kong was estimated at 3.93% (95% CI : 2.05-6.77) and there was no significant difference in prevalence between healthy (3.16%) and sick (4.37%) cats. This demonstrates that although this disease is present in Hong Kong, the prevalence is lower than the reported prevalence in other parts of the world.

Risk factors that were examined included age, sex, breed, number of cats in household, vaccinations, parasite control, indoor environment, type of diet and type of water. Risk factors for hyperthyroidism identified by multivariate analysis were age and breed. Affected cats were more likely to be older (>15 years) and domestic shorthair cats were less likely to be diagnosed with hyperthyroidism than the other breeds combined. There was no statistically significant relationship between sex, vaccinations, parasite control or indoor environment and the development of hyperthyroidism. There was also no statistically significant relationship between the consumption of a canned food diet by the cats and hyperthyroidism.

There were no characteristic clinical features amongst the cats that were hyperthyroid and only one cat exhibited the typical clinical syndrome of ravenous appetite with severe weight loss. The lack of distinctive clinical signs could be due to the presence of a mild or early form of the disease, but can also be due to an atypical form of the disease. This study showed that the disease needs to be considered if any of the following factors are present in an older cat : polyphagia, diarrhoea, and a significant raise in ALT and ALP activities.

This study concluded that the prevalence of hyperthyroidism in cats in Hong Kong is less than in most other parts of the world, despite the presence of previously identified risk factors. Comparative epidemiological studies will be necessary to compare the presence of possible risk factors between feline populations in Hong Kong and elsewhere.

Chapter 1
Literature review

1.1 Introduction

Feline hyperthyroidism is a multi-systemic disorder resulting from excessive production and circulating concentrations of L-triiodothyronine (T_3) and, or, L-thyroxine (T_4) (Peterson 1984; Meric 1989; Thoday and Mooney 1992; Peterson and others 1994; Feldman and Nelson 2004). The illness occurs in middle to old age cats, with a reported range of four to 22 years (median age approximately 13 years). Only 5% of hyperthyroid cats are younger than 10 years of age at the time of diagnosis (Peterson and others 1994). The disease was first reported in cats in 1979 and has since been recognised with increasing frequency (Holzworth and others 1980; Hoenig and others 1982; Peterson and others 1983; Scarlett and others 1988; Scarlett 1994; Bruyette 2001). Between 1983 and 1993 there was a sevenfold increase in the diagnosis of hyperthyroidism in cats at The Animal Medical Center, New York (Peterson and others 1983; Broussard and others 1995). This increase in diagnosis occurred despite a similar feline caseload during the ten year period. Other authors also commented on the increase in affected cats and proved that this was due mainly to a general increase in disease incidence and only partly to a heightened awareness of the disease and the increase in the lifespan of cats (which provides a longer opportunity for development of the disease) (Scarlett and others 1988; Taylor and others 1989; Bruyette 2001; Edinboro and others 2004).

Hyperthyroidism is now accepted as the most common endocrine disorder in cats and the most important cause of morbidity in middle-aged cats in the United States (Gerber and others 1994; Scarlett 1994; Broussard and others 1995) and the United Kingdom (Thoday and Mooney 1992). The disease is also commonly seen in Australia, Canada, Europe, Japan and New Zealand (Taylor and others 1989; Tarttelin and others 1992; Gerber and others 1994; Bucknell 2000; Miyamoto and others 2002; Olczak and others 2004; Sassnau 2006).

1.2 Pathogenesis

The origin of feline hyperthyroidism as well as the pathogenesis of the disease is unknown. Ninety-nine percent of cases result from benign nodular hyperplasia, adenomatous hyperplasia, or adenoma (Hoenig and others 1982; Peterson and others 1983; Gerber and others 1994; Kass and others 1999). In affected thyroids, multifocal nodules are scattered throughout the gland. The lesions are histological similar to nodular hyperplasia or multiple adenomatous goitre of humans. Adenomas are usually solitary and large, involving much of the lobe and without distinct capsules (Feldman and Nelson 2004). Bilateral thyroid enlargement is observed in 70% of cases. Since there is no physical connection between the two thyroid lobes in the cat, it has been postulated that circulating factors (such as immunoglobulins), nutritional factors (such as iodine), environmental factors (such as toxins or goitrogens), or genetic factors may interact to cause pathologic changes (Ferguson 1994; Gerber and others 1994; Peterson and others 1994; Scarlett 1994; Nelson and Feldman 2004). Thyroid carcinoma, the primary cause of hyperthyroidism in dogs, causes hyperthyroidism in 1-3% of hyperthyroid cats (Nelson and Feldman 2004; Gunn-Moore 2005).

1.3 Clinical Signs

The raised concentrations of thyroid hormones affect nearly all organ systems and the clinical signs reflect a multi-systemic disorder (Peterson and others 1983; Peterson 1984; Meric 1989; Merchant and Taboada 1997; Gunn-Moore 2005). The occurrence of clinical signs is variable and the presence or absence of any one clinical sign cannot be used to ascertain the presence of the disease (Peterson 1984; Peterson and others 1994; Feldman and Nelson 2004). Signs of hyperthyroidism are insidious and progressive, which can mask the illness and delay the diagnosis until the clinical signs are more obvious (Thoday and Mooney 1992; Merchant and Taboada 1997; Feldman and Nelson 2004).

The excessive serum thyroxine concentrations increase the metabolic rate which results in weight loss, increased appetite, tachycardia, increased activity or restlessness and muscle wasting (Thoday and Mooney 1992; Peterson and others 1994; Broussard and others 1995; Feldman and Nelson 2004; Gunn-Moore 2005). The most common clinical signs reported by owners are weight loss despite a ravenous appetite (Holzworth and others 1980; Hoenig and

others 1982; Peterson and others 1983; Thoday and Mooney 1992). Cats commonly have an ill-kempt appearance with a matted or greasy coat and increased nail growth (Peterson and others 1983; Peterson 1984; Peterson and others 1994; Merchant and Taboada 1997). Polyuria, polydipsia, vomiting and diarrhoea often occur (Hoenig and others 1982; Peterson 1984; Meric 1989; Thoday and Mooney 1992; Feldman and Nelson 2004; Gunn-Moore 2005). Polyuria and polydipsia may result from the diuretic effects of T_4, increased renal blood flow, associated renal insufficiency, or a primary polydipsia (Peterson 1984; Peterson and others 1994; Feldman and Nelson 2004; Gunn-Moore 2005). Vomiting may be caused by eating too quickly and causing acute gastric distension or by the direct effect of T_4 on the chemoreceptor trigger zone in the brain. Diarrhoea may be due to intestinal hypermotility with shortened small and large bowel transit times and also by concurrent malabsorption (Peterson 1984; Peterson and others 1994; Feldman and Nelson 2004; Gunn-Moore 2005).

Physical examination findings usually include a palpable thyroid mass, thin body condition, tachypnoea, tachycardia, and heart murmur or gallop rhythm (Holzworth and others 1980; Hoenig and others 1982; Peterson 1984; Meric 1989; Thoday and Mooney 1992; Peterson and others 1994; Boussard and others 1995; Merchant and Taboada 1997). Cats often appear anxious and can be restless and difficult to control during a physical examination with some cats becoming aggressive when restrained (Holzwoth and others 1980; Peterson 1984; Thoday and Mooney 1992; Peterson and others 1994; Feldman and Nelson 2004). A small number of cats will present with congestive heart failure, ocular lesions or ventral neck flexion (Peterson and others 1983; Boussard and others 1995; Merchant and Taboada 1997; Bruyette 2001).

Clinical pathological examination usually reveals raised liver enzymes – more than 75% of hyperthyroid cats have increased activities of serum alanine aminotransferase (ALT) or serum alkaline phosphatase (ALP) (Peterson and others 1983; Thoday and Mooney 1992; Broussard and others 1995; Merchant and Taboada 1997; Feldman and Nelson 2004; Gunn-Moore 2005). This may be due in part to malnutrition, congestive heart failure, hepatic lipidosis, or direct toxic effects of thyroid hormones on the liver (Peterson and others 1983; Thoday and Mooney 1992). The ALP concentrations may also be raised because of abnormal bone metabolism (Archer and Taylor 1996; Foster and Thoday 2000).

About 5-10% of affected animals present with atypical clinical signs and this condition is referred to as “apathetic or masked hyperthyroidism”. Weight loss is still evident, but the cats suffer from a reduced appetite which can alternate with periods of polyphagia. These cats are often depressed and lethargic (Peterson and others 1983; Peterson 1984; Meric 1989;

Peterson and others 1994; Merchant and Taboada 1997; Bucknell 2000; Feldman and Nelson 2004). In most cats this can be explained by the presence of concurrent non-thyroidal illnesses and further investigation may reveal such disease (Thoday and Mooney 1992).

1.4 Diagnosis

Although feline hyperthyroidism is usually suspected based on clinical and historical findings, the definite diagnosis is by laboratory testing. Resting T_4 concentrations will be increased in most hyperthyroid cats. The serum total T_4 concentration is the sum of the protein-bound and free concentrations of T_4 circulating in the blood and in most cats; hyperthyroidism can be diagnosed on the basis of high-resting serum total T_4 concentration (Peterson and others 1983; Graves and Peterson 1994; Broussard and others 1995; Peterson and others 2001). Measurement of serum T_4 by radioimmunoassay (RIA) is more accurate than in-clinic ELISA methods and is therefore the method of choice (Nelson 2003). Occasionally normal resting serum total T_4 concentrations are recorded for cats with hyperthyroidism (Peterson and Gamble 1990; Ferguson 1994). This could be due to within or between day variations in mildly affected animals (Broome and others 1988; Ferguson 1994) or the effects of concurrent non-thyroidal illness (Peterson and Gamble 1990; McLoughlin and others 1993; Mooney and others 1996). Total serum T_4 concentration thus has high specificity but lower sensitivity as a diagnostic tool.

The calculated sensitivity of serum free T_4 (fT_4) concentrations as a diagnostic test for hyperthyroidism is significantly higher (0.985) than the test sensitivity for total T_4 concentration (0.913) (Peterson and others 2001). But the specificity is significantly lower (0.937 compared to 1.0), which suggests that measurement of serum free T_4 concentrations is not recommended as a sole diagnostic test for hyperthyroidism (Mooney and others 1996; Peterson and others 2001). Serum free T_4 is currently measured by one of two methods : RIA using kits designed for use in humans and a modified equilibrium dialysis (MED) technique that uses a short dialysis step to separate free T_4 from protein-bound T_4, followed by RIA for fT4. The MED technique is the most accurate method for determining serum fT_4 concentrations but is much more costly and is therefore often reserved for cats with suspected hyperthyroidism where T_4 values are borderline (Nelson 2003).

Another test that is useful to diagnose occult or early hyperthyroidism in cats is the T_3 suppression test which involves measurement of serum concentrations of thyroid hormones before and after exogenous T_3 administration (Peterson and others 1990; Graves and Peterson 1994; Peterson and others 1994; Merchant and Taboada 1997; Gunn-Moore 2005). Twenty-five µg of T_3 is given orally and repeated every eight hours for seven doses, with the final dose being given on the morning of the third day. Approximately four hours after the last dose, second T_4 and T_3 values are obtained. In normal cats, suppression of T_4 concentration by 50% or greater is seen. Hyperthyroid cats will have little or no suppression of T_4 concentration. An increased T_3 concentration confirms that the cat received and absorbed the administered T_3. The major disadvantage of this test is that it is a relatively long test which takes three days to complete. Another disadvantage is that the cat either has to be hospitalised or the owner has to be able to medicate the cat reliably.

The thyrotropin-releasing hormone (TRH) stimulation test has the advantages of being shorter and easier to perform and does not depend on the administration of an oral medication (Merchant and Taboada 1997; Gunn-Moore 2005). Blood for serum T_4 and T_3 values is taken before and four hours after intravenous administration of 0.1 mg/kg of TRH. Normal cats and cats with non thyroidal disease should show an increase in serum T_4 of greater than 50%, although hyperthyroid cats will not. A major disadvantage of the test is that transient and sometimes severe adverse effects (e.g. salivation, vomiting, tachypnoea and defecation) are often seen after administration of TRH (Graves and Peterson 1994; Peterson and others 2001; Shiel and Mooney 2007). Another disadvantage of this test is that it is unable to differentiate between hyperthyroid cats and those with severe non thyroidal illness (Tomsa and others 2001).

Radionuclide imaging reveals functional thyroid tissue and can be used to determine if one or both glands are involved, if the affected thyroid lobe had descended into the thoracic cavity and if the hyperthyroid state is due to ectopic thyroid tissue (Peterson 1984; Taylor and others 1989). Radioactive iodine isotopes or pertechnetate are given intravenously and are concentrated in the thyroid tissue in quantities related to the degree of function. Pertechnetate is preferred due to lower cost and superior image quality (Shiel and Mooney 2007). The cats are scanned with a gamma camera and the percentage uptake of pertechnetate is measured. Costs or technical requirements preclude the use of this procedure in many situations and it is generally only available at research institutions or large animal hospitals.

1.5 Risk factors

The first published case-control study of cats with hyperthyroidism found associations between hyperthyroidism and consumption of canned food in the five years prior to diagnosis, partial or complete indoor housing, non-Siamese breed, and regular exposure to lawn and flea control products (Scarlett and others 1988). A subsequent study found that consumption of canned commercial cat food presently or in the past and use of cat litter was significantly associated with greater risk of hyperthyroidism (Kass and others 1999). Use of topical ectoparasite preparations was less strongly associated with increased risk of developing hyperthyroidism. Both Siamese and Himalayan cats had significantly lower risk compared to other cat breeds. Both studies found that the greater risk of hyperthyroidism associated with consumption of canned food was statistically independent of other variables examined. A further study found that increasing age and preference for certain flavours of commercial canned cat food in the present diet were associated with greater risk of hyperthyroidism (Martin and others 2000). A more recent study concluded that the increase of feline hyperthyroidism was not solely the result of ageing of the cat population and a significant association was found between hyperthyroidism and consumption of canned food, particularly pop-top cans (Edinboro and others 2004). The risk for hyperthyroidism was found to be greater for female than for male cats. Olczak and co-workers (2004) also found a greater risk for female cats as well as for eating canned food and for sleeping on the floor. In addition, they found that purebred cats were at much lower risk of being diagnosed with hyperthyroidism than domestic short- and longhaired cats (Olczak and others 2004). In a small survey in 2006, Sassnau found that the prevalence of feline hyperthyroidism increased with age. More males (83%) than females (17%) were affected in this survey.

All these studies suggest that diet may play a role in the pathogenesis of feline hyperthyroidism and the iodine content of different cat foods has been investigated (Mumma and others 1986; Johnson and others 1992). The concentration of iodine varies widely in commercial cat foods in the United States and New Zealand, with some foods containing very small amounts and others dramatically exceeding current recommendations for cats. This variation has fuelled speculation that cats eating diets varying in iodine content over time may be more likely to develop hyperthyroidism.

1.6 Worldwide incidence and prevalence of feline hyperthyroidism

Not much is known about the distribution or determinants of feline hyperthyroidism and there are very few published incidence rates or prevalence estimates (Scarlett 1994). By definition the prevalence of a condition is the proportion or number of individuals in the population that is affected with a particular disease at a given time and the incidence is the rate of new cases of the disease over a certain period of time.

A report on the hospital prevalence at veterinary hospitals in North America suggested that there was a marked increase between 1979 and 1985 (Scarlett and others 1988). The average prevalence in 1979 was 0.3% and in 1985 that number had increased to 4.5%. Edinboro and others (2004) reported that age-adjusted hospital prevalence increased from 0.1% in 1978-1982 to 2% in the period of 1993-1997. An increase in hospital prevalence was also reported in Germany where the prevalence increased from 0.2% in 1987-1994 to 2.6% in 1998 (Kraft and Buchler 1999). Miyamoto and others (2002) reported a prevalence of 8.9% in cats nine years and older that were brought to hospitals in two areas in Japan whereas Sassnau (2006) reported a prevalence of 11.4% among cats eight years and older in an urban population in Germany. Wakeling and others (2005) reported a yearly incidence of 11.92% in a first opinion hospital in the United Kingdom. So far the cause of the worldwide occurrence as well as the increase in prevalence has eluded scientists and it has been postulated that immunologic, infectious, nutritional, environmental, or genetic factors may play a role in the development of the condition (Taylor and others 1989; Ferguson 1994; Gerber and others 1994; Scarlett 1994; Gunn-Moore 2005).

Further research into the worldwide prevalence as well as presence of possible causative factors would help to shed light on the cause and pathogenesis of this disease and lead to preventative measures (Scarlett 1994). As far as the author is aware, no prevalence studies have been done in Hong Kong, a geographic area in which hyperthyroidism in cats is thought to be rare.

Chapter 2
Objectives

2.1 Problem Statement

- The prevalence of hyperthyroidism in older cats in Hong Kong is unknown despite anecdotal reports that the disease is rare.
- Hong Kong is a cosmopolitan city with large numbers of pet owners as well as numerous pet shops. Although this implies that risk factors for the development of feline hyperthyroidism that have been identified in previous studies could be present in the feline environment, no studies have been done to describe the presence of any potential risk factors.

2.2 Research Questions

- What is the prevalence of hyperthyroidism in older cats in Hong Kong?
- Which risk factors that have been identified in previous studies are associated with feline hyperthyroidism in Hong Kong?

2.3 Benefits

- The prevalence of feline hyperthyroidism in Hong Kong will be determined.
- This study will add to our knowledge of the geographic distribution and worldwide prevalence of feline hyperthyroidism.
- The presence of possible causative factors of feline hyperthyroidism in Hong Kong will be investigated.
- The research conducted fulfils part of the requirements of the principal investigator's MSc degree.

Chapter 3
Materials and Methods

3.1 Experimental design

A descriptive cross-sectional study design aimed at describing the period prevalence of hyperthyroidism in cats in Hong Kong. Although the design was based on random sampling there was also a degree of stratification as this disease occurs mainly in older cats. Only cats that were presented by their owners for veterinary care were sampled and this might have caused bias towards cats that are being fed the type of diets that have previously been implicated in contributing towards hyperthyroidism.

Inclusion criteria :

- Cats older than 10 years.
- Any sex.
- Cats that have spent their whole life in Hong Kong.

Exclusion criteria :

- Patients presenting in shock.
- Cats that are treated with drugs that can affect T_4 concentrations such as carbimazole, long- or short-acting glucocorticoids and trimethoprim-potentiated sulphonamides.
- Cats undergoing chemotherapy.
- Patients whose physical state precludes the taking of blood samples.
- Cats that have been imported to Hong Kong from other countries.

3.2 Experimental procedures

Blood samples were taken from cats 10 years and older when they visited the veterinary clinics for either routine visits or health-related problems. Two to three millilitres of whole blood was collected from conscious animals by jugular venipuncture and this was done by qualified (and registered) veterinary surgeons.

The veterinarian taking the sample completed a questionnaire regarding the health of the cat (Addendum A). The veterinarian or the veterinary assistant assisted the owners in completing a second questionnaire (Addendum B) regarding vaccination history, food and diet, flea control and environment of their cats. The owners were given a cover letter (Addendum C) explaining the purpose of the sampling.

Blood was transferred to plain tubes and samples were centrifuged, the serum separated, aliquotted and frozen at -70^{0}C. After the relevant import permission had been obtained, the samples were shipped on dry ice to the Theriogenology laboratory, Faculty of Veterinary Science, Onderstepoort, where they were stored at -80^{o}C. All the samples were analysed at the same time to avoid inter-assay variation.

3.3 Observations

3.3.1 Laboratory tests

Serum total T_4 concentration was determined by use of a commercially available radioimmunoassay (RIA) kit (Coat-A-Count® canine total T_4, DPC®, Los Angeles). The Coat-A-Count® Canine T_4 procedure is a solid-phase radioimmunoassay, wherein ^{125}I–labelled T_4 competes for a fixed time with T_4 in the sample for antibody sites, in the presence of blocking agents for thyroid hormone-binding proteins. For total T_4 the feline reference interval was 12.8-50.0 nmol/L (1.0-3.9 ug/dL) (Kemppainen and Birchfield 2006). All cats with a serum total T_4 value greater than 50 nmol/L were classified as hyperthyroid.

Alanine aminotransferase (ALT) and alkaline phosphatase (ALP) activities were measured in all the samples by use of a modified colorimetric method (ALT) and a modified kinetic measurement (ALP), both from Alfa Wasserman clinical Chemistry systems (ACE® & NExCT^{TM}). The feline reference intervals used were 3.6-42 U/L for ALT and 35-123 U/L for ALP. For the univariable statistical analysis the cut-off value of ALT was increased to 126 U/L (three times the top value for the reference interval). The reason for this was that older cats presenting to veterinary clinics with a variety of illnesses can reasonably be expected to have mild to moderate elevation in ALT activities. A more significant raised cut-point would thus guard against the false positive association of elevated ALT activities and hyperthyroidism in this study.

3.3.2 Variables – risk factors

The following possible risk factors were examined :

- Age.
- Sex.
- Breed.
- Number of cats in household.
- Vaccination status.
- Frequency of de-worming and the preparation used.
- External parasite control and the preparation used.
- Environment of the cat (indoors or outdoors).
- Presence of commercial food in diet as well as presence of dry and canned food.
- Type of water given to cat.

3.3.3 Variables – clinical signs

The presence of the following clinical signs was recorded :

- Weight loss.
- Polyphagia.
- Heart rate.
- Cardiac murmur.
- Respiratory rate.
- Vomiting.
- Diarrhoea.
- Palpable thyroid lobe.

3.4 Statistical considerations

Prevalence of hyperthyroidism (defined as total T_4 > 50 nmol/L), with exact binomial 95% confidence intervals, was calculated for all cats combined, for cats classified as healthy (no clinically significant disease identified) and for those classified as sick. Prevalence was compared between healthy and sick cats using a two-tailed Fisher's exact test.

Univariable associations between potential risk factors and hyperthyroidism were assessed using a two-tailed Fisher exact test. Thereafter, all predictors were entered into a multiple logistic regression model to estimate their effect on the risk of hyperthyroidism. To determine whether age should be included as a continuous or categorical variable, it was categorised into quintiles and the log odds of hyperthyroidism for each quintile was estimated using logistic regression (Dohoo and others 2003). Because a monotonic change in estimated log odds was not seen with each successive quintile, age was modelled as a categorical variable with three categories (10-14 years, 15-19 years and ≥20 years). The model was developed by backward elimination by successively dropping the least significant predictor until all remaining independent variables were significant in the model with $P_{Wald} \leq 0.1$. No interaction terms were assessed.

Associations between clinical signs and hyperthyroidism were assessed on a univariable level using a two-tailed Fisher's exact test.

Associations between raised ALT activities and hyperthyroidism, and between raised ALP activities and hyperthyroidism, were assessed using a two-tailed Fisher's exact test.

The fit of the final logistic regression model was assessed using the Hosmer-Lemeshow goodness-of-fit test. All analyses were done using STATA version 10.0 (Stata Corporation, College Station, TX, USA).

Chapter 4
Results

4.1 Study population

The study population consisted of 305 cats that presented at participating veterinary practices between June 2006 and August 2007. Most of the cats were sampled at the Society for the Prevention of Cruelty to Animals (SPCA), Hong Kong clinics in Wan Chai (250 cats), Kowloon (26 cats) and Hang Hau (7 cats). The remaining cats were sampled at private practices in Mid-Levels (17), Wan Chai (3) and Happy Valley (2).

Breeds included domestic shorthair (181), domestic longhair (61), Persian and Persian crosses (38), Angora (10), Himalayan (7), Chinchilla (4), Siamese and Siamese crosses (3) and one British Shorthair. There were 166 females (153 ovariohysterectomised) and 139 males (120 castrated).

The ages of the cats ranged from 10-26 years of age with a median of 13 years. The age distribution is depicted in Table 1.

Table 1 : Age distribution of 305 cats 10 years and older presented to veterinary clinics in Hong Kong

Age (years)	Number of cats
10	48
11	43
12	51
13	27
14	39
15	30
16	25
17	22
18	10
19	4
20	3
21	1
22	1
26	1

Of the 305 cats, 62 were presented for annual vaccinations, 57 were presented for routine visits and 184 were presented for various illnesses. Two cats were presented for unknown reasons. On the basis of the veterinary assessment the cats that were presented for routine visits were classified as “healthy” or “sick” and this brought the total of healthy cats to 95 and the total of the sick cats to 206. In four cats there was insufficient information to classify them into either group and their disease status remained “unknown”.

4.2 Laboratory results for study population

The results for the total T_4 measurements ranged from 2.7-172.33 nmol/L with a mean concentration of 24.89 nmol/L and a median of 23.03 nmol/L. There were 12 cats that had total T_4 values above 50 nmol/L and these cats were considered to be hyperthyroid.

4.3 Laboratory results for hyperthyroid cats

The signalment and the laboratory values for the twelve hyperthyroid cats are shown in Table 2. There were nine female (ovariohysterectomised) and three male (castrated) cats. Five of the cats were domestic longhair, four were domestic shorthair, two were Persian, and one was a Chinchilla (which is also a Persian type cat). Their ages ranged from 10-22 with a median age of 16.5 years.

Table 2 : Signalment and laboratory values of 12 hyperthyroid cats (total T4 > 50 nmol/L)

Cat No	Sex	Breed	Age	TT_4 (nmol/L)[1]	ALT (U/L)[2]	ALP (U/L)[3]
3	FN	DLH	14	172.33	421	75
21	FN	DLH	17	53.36	195	45
452	MN	Chinchilla	16	66.62	72	55
620	FN	DLH	14	57.43	70	63
628	MN	Persian	17	83.39	83	45
745	FN	DSH	17	166.31	204	241
752	MN	Persian	19	104.21	69	56
763	FN	DSH	18	62.05	88	80
774	FN	DSH	10	72.09	42	47
784	FN	DLH	10	52.29	37	55
812	FN	DLH	14	111.41	154	66
835	FN	DSH	22	109.21	470	163

F = female, M = male, N = neutered
DLH = domestic longhair, DSH = domestic shorthair
TT_4 = total T_4, nmol/L = nanomoles per litre
ALT = alanine aminotransferase, ALP = alkaline phosphatase, U/L = units per litre
Reference ranges : [1]total T_4 12.8-50.0 nmol/l; [2]ALT 3.6-42 U/l; [3]ALP 35-123 U/l

4.4 Prevalence of hyperthyroidism

The prevalence of hyperthyroidism in the entire study population was 3.93% (95% confidence interval : 2.05-6.77) and there was no significant difference in prevalence of hyperthyroidism between healthy (3.16%) and sick (4.37%) cats (*P* = 0.76) (Table 3).

Table 3 : Prevalence of hyperthyroidism in 305 cats 10 years and older presented to veterinary clinics in Hong Kong

	n	Prevalence (%)	95% CI
Sick cats	9/206	4.37	2.02-8.13
Healthy cats	3/95	3.16	0.66-8.95
Unknown	0/4	0.00	0.00-52.71
Total	12/305	3.93	2.05-6.77

n = number of cats

4.5 Risk factors

4.5.1 Univariable analysis

Univariable associations between potential risk factors and the development of hyperthyroidism are summarised in Table 4.

Table 4 : Univariable analysis of risk factors for hyperthyroidism (total T4 > 50 nmol/L) in cats 10 years and older presented to veterinary clinics in Hong Kong

Variable	Category	N	Hyperthyroid cats		*P**
			n	%	
Age	10-14 yrs	208	5	2.4	0.06
	15-19 yrs	91	6	6.59	
	20-26 yrs	6	1	16.67	
Sex	Female	166	9	5.42	0.2
	Male	139	3	2.16	
Breed	DSH	181	4	2.21	0.2
	DLH	61	5	8.2	
	Persian type	49	3	6.12	
	Angora	10	0	0	
	Other	4	0	0	
Number cats in house**	1	161	5	3.11	0.9
	2	60	2	3.33	
	>2	62	3	4.84	
Vaccination**	Yes	199	7	3.52	>0.999
	No	76	3	3.95	
De-wormed**	Yes	137	6	4.38	0.8
	No	129	4	3.1	
Flea control**	Yes	138	7	5.07	0.3
	No	124	3	2.42	
Exclusively indoors**	Yes	258	9	3.49	>0.999
	No	20	0	0	
Canned food diet**	Yes	159	7	4.4	>0.999
	No	101	4	3.96	
Water**	Tap unboiled	119	5	4.2	0.6
	Tap boiled	120	4	3.33	
	Other	17	1	5.88	

**P*-value for two-tailed Fisher's exact test
**Data were not available for all of the cats in the study population
N = number of cats from study population, n = number of hyperthyroid cats
DSH = domestic shorthair, DLH = domestic longhair

Although there were more female cats (5.42%) with hyperthyroidism than male cats (2.16%), the difference was not statistically significant.

There was no statistically significant relationship between vaccinations, parasite control or indoor environment with the development of hyperthyroidism.

There was also no statistically significant relationship between feeding either canned or dry food diet to the cats and the development of hyperthyroidism.

4.5.2 Multivariate analysis

Only breed and age were retained in the final logistic regression model of risk factors (Table 5). Domestic shorthair cats were less likely to be diagnosed with hyperthyroidism (OR = 0.30, 95% CI = 0.08-1.06) than the other breeds combined, while the cats in the two older age categories (15-19 years and ≥ 20 years of age) were more likely to be diagnosed with hyperthyroidism than the 10-14 year old cats.

Table 5 : Final logistic regression model of risk factors for hyperthyroidism (total T_4 > 50 nmol/L) in cats 10 years and older presented to veterinary clinics in Hong Kong

Variable	Category	OR	95% CI	*P*
Breed	DSH	0.30	0.08-1.06	0.06
	Other[1]	1.00	-	
Age	10-14 yrs[1]	1.00		
	15-19 yrs	2.77	0.82-9.40	0.10
	20-26 yrs	11.88	1.06-133.7	0.05

Hosmer-Lemeshow goodness-of-fit test χ^2 = 0.38 (3 d.f.), *P* = 0.95
DSH = domestic shorthair
[1] = reference category

4.6 Historical and clinical findings

Of the three hyperthyroid cats that were considered healthy, one presented for routine vaccination and two presented for routine health checks with no systemic signs. Of the nine hyperthyroid cats that were sick, three had gastro-intestinal signs (vomiting and/or diarrhoea), two were seen because of weight loss, one was seen for an urocystolith and one was producing dilute urine and came in for a routine blood test. In two of the cats the illnesses were not specified.

Table 6 lists the frequency of the main clinical features in the hyperthyroid cats. Weight loss and raised ALT activity were the most common findings, followed by vomiting, diarrhoea and polyphagia. Only one of the affected cats had a palpable thyroid lobe.

Table 6 : Main clinical features in 12 hyperthyroid cats (total T4 > 50 nmol/L)

Finding	No of cats	Percentage
Weight loss	7	63.6
ALT > 126 U/L	5	41.7
Vomiting	4	36.4
Diarrhoea	3	27.3
Polyphagia	3	27.3
Tachycardia	3	27.3
ALP > 123 U/L	2	16.7
Tachypnoea	2	16.7
Cardiac murmur	1	8.3
Palpable thyroid lobe	1	8.3

ALT = alanine transferase
ALP = alkaline phosphatase
U/L = units per litre

4.6.1 Univariable analysis

The univariable analysis (Table 7) for these clinical signs as predictors of hyperthyroidism demonstrated that the presence of the following factors was significant : polyphagia, diarrhoea, and raised ALT and ALP activities.

Table 7 : Univariable analysis of predictors for hyperthyroidism (total T_4 > 50 nmol/L) in cats 10 years and older presented to veterinary clinics in Hong Kong*

Variable	Category	N	Hyperthyroid cats		*P***
			n	%	
Weight loss	Yes	140	7	5.00	0.4
	No	155	4	2.58	
Polyphagia	Yes	19	3	15.79	0.03
	No	278	8	2.88	
Heart Rate	<200	183	7	3.83	0.6
	200-240	93	4	4.30	
	>240	12	1	8.33	
Cardiac Murmur	Yes	39	1	2.56	>0.999
	No	260	11	4.23	
Respiration	Normal	269	10	3.72	0.5
	Increased	24	2	8.33	
	Dyspnoeic	8	0	0.00	
Vomiting	Yes	80	4	5.00	0.5
	No	217	7	3.23	
Diarrhoea	Yes	11	3	27.27	0.005
	No	283	8	2.83	
Palpable Thyroid	Yes	2	1	50	0.08
	No	296	11	3.72	
ALT > 126	Yes	41	5	12.20	0.01
	No	264	7	2.65	
ALP > 123	Yes	6	2	33.33	0.02
	No	298	10	3.36	

*Data were not available for all of the cats in the study population
***P*-value for two-tailed Fisher's exact test

Chapter 5
Discussion

It has been more than 25 years since feline hyperthyroidism was first reported, yet the cause and pathogenesis is still unknown. The disease occurs mainly in middle-aged to old cats and it was thought at first that the increase in incidence was due to an increase in the lifespan of cats and the heightened awareness of the disease. Researchers have proven however, that the increase in incidence is independent of age (Scarlett and others 1988; Taylor and others 1989; Bruyette 2001; Edinboro and others 2004) and subsequent studies have concentrated on uncovering an inciting or trigger factor in the environment of these cats. This factor had to be something that had been present in the environment of the cats at the time that the disease was initially reported. Although the disease was first reported in the United States there had been numerous reports from other countries and it is clear that we are looking for a trigger factor that has managed to cross continents in a very short time.

Various descriptive and case-control studies have been undertaken to determine the presence of such a trigger factor in the environment of affected cats. Factors that have been implicated include diet, indoor housing, pesticides, and cat litter (Scarlett and others 1988; Kass and others 1999; Martin and others 2000; Edinboro and others 2004; Olczak and others 2004). All of the studies found that diet may play a role and the presence of canned food in the diet had been linked to the development of hyperthyroidism. Unfortunately there is no clear explanation why cats that have eaten exclusively dry food also get hyperthyroidism and it is possible that there are other goitrogens present in either the environment or in commercial cat foods. These goitrogens may be more important in cats if they are metabolised by glucuronidation, a metabolic pathway that is exceptionally slow in cats (Peterson and Ward 2007).

Some studies have also reported a possible genetic effect with Siamese and Himalayans at lower risk of developing hyperthyroidism and this had fuelled speculation that there could be an interaction between environmental factors and a genetic predilection (Scarlett and others 1988; Kass and others 1999).

The prevalence of feline hyperthyroidism differs between different geographical regions and it is not clear if this is due to an absence of the potential trigger factor or if it reflects

differences in diagnosing and reporting of the disease. If it is due to a true difference in disease prevalence then this may suggest a difference in the presence of a possible trigger factor. As feline hyperthyroidism is rarely reported in Hong Kong and no prevalence studies have been completed previously, this study was undertaken to determine the prevalence of hyperthyroidism in older cats in this area. Both healthy and sick cats were sampled to ensure that the results represent the true prevalence and are not affected by under-reporting or misdiagnosis. Feline hyperthyroidism causes various manifestations of disease by its effect on multiple organ systems and it was essential to include sick cats in this survey. But the disease can be insidious and sub clinical in onset and therefore apparently healthy cats could not be excluded. This was emphasised by the fact that three of the twelve hyperthyroid cats in this study were presented without any systemic signs and that there was no difference in prevalence between cats that were considered healthy and those that were considered sick. Exclusion of (apparently) healthy cats would have led to an underestimation of the prevalence of the disease.

Sampling sick cats for measurement of T_4 concentrations are however, not without its own set of problems. A range of studies have demonstrated that the presence of non thyroidal illness (NTI) can significantly decrease the serum T_4 concentration of hyperthyroid cats (McLoughlin and others 1993; Peterson and others 2001). This can apparently normalise T_4 concentrations in a hyperthyroid cat with concurrent NTI, especially in cats with early or mild hyperthyroidism (Peterson and Gamble 1990) and means that there is a small chance that this study could have underestimated the presence of hyperthyroidism in cats with NTI. The sensitivity of total T_4 concentration as a diagnostic test for hyperthyroidism is 0.913 (Peterson and others 2001) and if this is taken into consideration, the true prevalence of feline hyperthyroidism in Hong Kong could be slightly higher than the 3.93% determined.

The prevalence of hyperthyroidism in the study population of geriatric cats in Hong Kong was 3.93%. This demonstrates that although this disease is present in Hong Kong the prevalence is much lower than the prevalence in geriatric populations in Japan, Germany and the United Kingdom (Miyamoto and others 2002; Sassnau 2006; Wakeling and others 2005). The reason for the lower prevalence in Hong Kong could be due to differences in genetic factors, diet or environment and comparative epidemiological studies will be necessary to compare these factors between feline populations in Hong Kong and elsewhere. It is possible that the prevalence will increase in future if the same trigger factor that is present in other countries is also present in the environment of the cats in Hong Kong. If this is the case then another epidemiological survey may have to be conducted to

determine differences in putative risk factors between the current and future populations of geriatric cats in Hong Kong.

Scarlett and others (1988) and Kass and others (1999) showed that Siamese cats have a significantly lower risk of developing hyperthyroidism compared with other breeds. In this study there were only three Siamese type cats and none of them had hyperthyroidism. However, when we compared the domestic shorthair cats with the rest of the cats the shorthair group had a significant lower likelihood of developing hyperthyroidism. The typical domestic shorthair cat in Hong Kong is smaller with a more delicate bone structure than domestic shorthair cats in the United Kingdom and North America (personal observation) and it is possible that a large percentage of the domestic shorthair cats in Hong Kong are of oriental (or Siamese) descent. This could explain the contribution of a possible protective genetic factor in the domestic shorthair cats in Hong Kong. None of the Angora cats in our study had hyperthyroidism, but the low numbers (10 cats) prevent any important conclusions.

The average age of hyperthyroid cats in previous studies varied from 11.8-13.4 years (Hoenig and others 1982; Peterson and others 1983; Broussard and others 1995; Thoday and Mooney 1992). Peterson and others (1994) reported that only 5% of cats were less than 10 years of age and Thoday and Mooney (1992) reported that five out of 126 cats (4%) in their study were less than nine years of age. A low prevalence of feline hyperthyroidism was suspected in Hong Kong and stratifying the population by excluding cats less than 10 years of age increased the chances of diagnosing affected cats. In this study there was a significantly increased risk of hyperthyroidism with increasing age. This confirms the findings of previous studies (Martin and others 2000) and also concurs that feline hyperthyroidism is a disease of middle-aged to old cats.

There were more female than male cats that had hyperthyroidism but the difference was not statistically significant. Most of the previously published studies reported no sex predilection for feline hyperthyroidism (Peterson and others 1983; Scarlett and others 1988; Thoday and Mooney 1992; Scarlett 1994; Broussard and others 1995; Kass and others 1999). There were however, two studies that showed a significant association between female cats and hyperthyroidism (Edinboro and others 2004; Olczak and others 2004) and in one study (Sassnau 2006) there were significantly more male than female cats affected. The lack of significance in the current study is likely because of the low numbers of hyperthyroid cats and the presence of other unmeasured confounding factors.

In the present study an association between feeding canned food and the development of hyperthyroidism was not found. This finding is in sharp contrast to previous studies where a strong correlation was found between feeding canned food and development of the disease (Scarlett and others 1988; Kass and others 1999; Martin and others 2000; Edinboro and others 2004; Olczak and others 2004). Seven of the hyperthyroid cats in our study ate a mixed canned/dry food diet and four cats ate an exclusive dry food diet. (Diet information was not provided for the remaining cat). The lack of evidence for canned food being associated with feline hyperthyroidism can be due to the low numbers of hyperthyroid cats in our study, different packaging materials or even different iodine content of the canned food in Hong Kong. The presence of hyperthyroidism in cats that are fed exclusively dry food can be due to the presence of a different causative factor in either the food or the environment of these cats. However, hyperthyroidism may have a multi-factorial aetiology and there could potentially be an interaction with a genetic predilection.

There were no characteristic clinical features amongst the cats that were hyperthyroid and only one cat exhibited the typical clinical syndrome of voracious appetite with severe weight loss that has been described elsewhere (Holzworth and others 1980; Peterson and others 1983; Peterson 1984; Thoday and Mooney 1992; Broussard and others 1995; Merchant and Taboada 1997). The most common clinical presentation (7/12 cats) was weight loss (as is expected with this debilitating disease) and this concurs with previous studies (Holzworth and others 1980; Hoenig and others 1982; Peterson and others 1983; Thoday and Mooney 1992). Only 25% of owners reported that their pets had an increase in appetite which is less than expected. In most of the previous reports this was the second most common disorder. Five of the cats (42%) presented with gastro-intestinal signs – vomiting, diarrhoea or both. The lack of a palpable thyroid nodule in eleven of the twelve hyperthyroid cats was unexpected as 80-90% of hyperthyroid cats usually have a palpable thyroid nodule (Holzworth and others 1980; Hoenig and others 1982; Thoday and Mooney 1992; Broussard and others 1995). The reason for this could be due to inexperience of the veterinary surgeons or lack of thyroid enlargement due to an early or sub clinical form of the disease. One cat had a palpable thyroid nodule but normal serum T_4 concentrations. It is very likely that the nodule palpated was not the thyroid gland but another cervical mass. This cat came in for a routine acupuncture visit and is therefore unlikely to have suffered from concurrent severe NTI which would have suppressed the thyroid concentrations into the normal range. Further testing (measuring free T_4 concentrations, T_3 suppression test, TRH stimulation test and/or nuclear imaging) might have been able to shed light on this dilemma. The general lack of typical clinical signs in the hyperthyroid cats could indeed be due to the presence of a mild or early form of the disease, but can also be due to an atypical form of the disease. It is

furthermore possible that the lack of typical clinical signs reflects the status that existed in the USA prior to 1979, when veterinarians first became aware of feline hyperthyroidism as a syndrome. Several reports demonstrated that although the presence of thyroid adenomas were relatively high prior to 1979, the majority of cats lacked recognisable clinical signs and most of the thyroids were not grossly enlarged (Scarlett and others 1988; Gerber and others 1994; Scarlett 1994). Despite the absence of recognisable clinical signs, this study showed that the disease needs to be considered if any of the following factors are present in an older cat : polyphagia, diarrhoea, and a significant raise in ALT and ALP activities.

The present study had several limitations that need to be considered. The low prevalence of hyperthyroidism made it difficult to compare the group of hyperthyroid cases with the other cats as far as risk factors are concerned. Another major limitation was the size of the study population – a bigger study population would have yielded more positive cats and therefore more statistically significant results. It is also possible that there could have been some bias because the study only included cats that were brought in to veterinary practices by their owners. The vast majority of the cats in the study population were fed commercial food and only four out of 305 cats were fed a non-commercial diet. This suggests that the cats that took part in this survey belonged to owners who not only brought their pets in for veterinary care but who also bought commercial cat food. This study would therefore have been biased towards cats that were exposed to possible risk factors such as canned food, indoor environment and topical ectoparasite applications that have been described in previous studies.

Another shortfall of this study was that hyperthyroid cats with early or sub clinical disease or hyperthyroid cats with severe concurrent NTI would have been missed due to normal serum T_4 concentrations. The effect of NTI on T_4 concentrations had been discussed earlier but a more common cause of misdiagnosis is the fact that cats with early or mild hyperthyroidism have serum T_4 concentrations that can fluctuate within the normal range (Thoday and Mooney 1992). There are a range of additional tests that can confirm hyperthyroidism in cats with normal T_4 concentrations such as measuring free T_4 concentrations, T_3 suppression test, TRH stimulation test and/or nuclear imaging. If all of these tests could have been undertaken in the study population a more accurate determination of the percentage of affected cats might have been possible. These tests however, are costly and are usually reserved for cats where the condition is suspected based on clinical signs and history but not confirmed. It is of interest to note that there was only one cat with a palpable thyroid nodule but normal T_4 concentrations in this study and that there were no cats where the disease was strongly suspected (based on clinical signs) and not confirmed by raised T_4 concentrations.

This study concluded that the prevalence of hyperthyroidism in cats in Hong Kong is less than in most other parts of the world, despite the presence of previously identified risk factors. Risk factors for hyperthyroidism identified by multivariate analysis were older age and breed other than domestic shorthair. It is possible that the prevalence of the disease in Hong Kong will increase in future unless we can identify and eliminate known risk factors. The disease should be considered in any aged cat that presents with polyphagia, diarrhoea, or raised ALT and ALP activities.

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Addendum A
Questionnaire – Part I

(TO BE COMPLETED BY VETERINARIAN)

Date : _____

Name of clinic : _____

Name of vet : _____

Owner name : _____

Client reference : _____

Name of cat : _____

Reason for visit

- Routine health check ☐
- Vaccination ☐
- Illness (specify) ☐

Clinical examination findings

- Has the cat lost weight in the last 3 months? Yes ☐ No ☐
- Is the cat polyphagic? Yes ☐ No ☐
- Heart rate : <200 ☐
  200-240 ☐
  >240 ☐
- Is a cardiac murmur audible? Yes ☐ No ☐
- Respiratory rate : Normal ☐ Increased ☐ Dyspnoeic ☐
- Does the cat vomit? Yes ☐ No ☐
- Does the cat have diarrhoea? Yes ☐ No ☐
- Are the thyroid glands palpable No ☐
  Right only ☐
  Left only ☐
  Both ☐

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Addendum B
Questionnaire – Part II

(TO BE COMPLETED BY OWNER)

Owner name : _____ Name of cat : _____

Sex : Male ☐ Female ☐ Neutered ☐

Breed : _____ Age of cat/year of birth : _____

How long have you owned your cat? <5yrs ☐ 5-10yrs ☐ >10yrs ☐

Number of cats in household : 1 ☐ 2 ☐ >2 ☐

Vaccination/worming history

Is your cat vaccinated? Yes ☐ No ☐ Not sure ☐

Frequency : Yearly ☐ Infrequently ☐

Is your cat wormed? Yes ☐ No ☐ Not sure ☐

Frequency : Yearly ☐ Infrequently ☐

Brand of wormer (if known) _____

Do you use parasiticides on your cat? Yes ☐ No ☐ Not sure ☐

Type of preparation : Spot-on ☐ Powder ☐ Collar ☐ Spray ☐

Brand (if known) _____

How long have you been using parasiticides on your cat? _____

Environment

Does your cat live : strictly indoors ☐ strictly outdoors ☐ in and outdoors ☐

Diet/food

Is your cat fed : Commercial canned food ☐ Commercial dry food ☐

Commercial semi-moist food ☐ Non-commercial food ☐

Mixture of commercial rations ☐ Mix of non- and commercial rations ☐

Does your cat have a favourite brand/flavour that you use most frequently _____

Does your cat catch insects, rats or mice? _____

What type of water does you cat drink : Distilled ☐ Mineral ☐ Tap water boiled ☐

Tap water unboiled ☐ Other _____

Addendum C
Cover letter

BLOOD SAMPLING TO TEST FOR HYPER THYROIDISM IN CATS IN HONG KONG

Feline hyperthyroidism is the most common cause of disease in middle-aged and older cats in the United States and the United Kingdom. It is also very common in Europe, Australia and New Zealand.

The origin and cause of this disease is unknown. It has been suggested that immunologic, infectious, nutritional, environmental or genetic factors may interact to cause pathological changes in the thyroid gland. So far nobody could explain how these factors could cause disease to develop in cats on different continents within a relatively short period of time. The variation in geographic incidence may reflect differences in dietary or environmental factors and a recent study found a significant association between feline hyperthyroidism and consumption of canned food.

Hyperthyroidism in cats is rarely observed and reported in Hong Kong but it is possible that the incidence will increase in future if there is a true correlation between commercial food and this disease.

The aim of this study is to determine the presence of hyperthyroidism amongst cats in Hong Kong and to determine the environmental, nutritional or infectious agents that they are exposed to. These results may assist in preventing an increase in the incidence of this disease in Hong Kong. The benefit to participating cat owners will be that their cats will be tested for hyperthyroidism free of charge.

Addendum D
Raw-data

Raw data from 305 cats 10 years and older presented to veterinary clinics in Hong Kong.

cat nr	sex	breed	age	yrs owned	Cats In hh	vacc	vac	worming	freq	parasiticide	parasiticide type	environmt	diet	brand	water	reason visit	loss wt	polyph	HR	murmur	resp rate	vom	diarr	thyroid	TT4	ALT	ALP
3	fn	dlh	14	>10yrs	1	yes		no		yes	frontline, program	indoors	comm dry	pH control	tap, unboiled	illness	yes	no	220	no	increased	no	yes	left	172.33	421	75
6	mn	persian	12													illness (const)	no	no	<200	no	normal	no	no	no	12.717	31	10
7	m	persian	12	>10yrs	2	yes	yearly	yes	infreq	yes	frontline	indoors	canned, dry	hills snr, fish	tap, unboiled	illness, diabetic	yes	no	<200	no	normal	no	no	no	13.124	63	64
8	mn	dsh	17	>10yrs	1	not sure		not sure		not sure	spot-on	indoors	dry	hills k/d	mineral, boiled tap	illness, kidneys	yes	no	>240	yes	normal	no	no	no	28.095	78	23
9	fn	Persian	18	>10yrs	1	yes	yearly	yes	yearly																20.423	54	23
11	fn	dlh	10	>10yrs	1	yes	yearly	yes	yearly	yes	spot-on	indoors	dry, home		boiled tap	vacc	no	no	<200	no	normal	no	no	no	28	36	12
12	mn	dsh	15	>10yrs	1	yes		yes		Yes	frontline spot	in and out	canned, dry	Hills, RC	distilled	routine, acupuncture	no	no	200-240	no	increased	no	no	both?	20.884	48	23
13	fn	dlh	10	>10yrs	2	yes	infreq	yes	infreq	no		indoors	canned, dry	Whiskas, Friskies	tap, unboiled	vacc	no	no	200-240	no	normal	no	no	no	13.443	206	45
14	fn	dsh	10	>10yrs	2	yes	infreq	yes	infreq	no		indoors	canned, dry	Whiskas, Friskies	tap, unboiled	vacc	no	no	200-240	no	normal	no	no	no	13.28	57	38
15	fn	dsh	14	>10yrs	>2	yes	infreq	yes	infreq	no	frontline, spot	indoors	mix comm/non	Friskies, prawns	tap, unboiled	routine	yes	no	200-240	no	normal	yes	no	no	20.005	39	18
16	fn	dsh	12	>10yrs	>2	yes	infreq	yes	infreq	no	frontline, spot	indoors	mix commercial	Friskies	tap, unboiled	routine	no	no	200-240	no	normal	no	no	no	22.822	59	30
17	fn	dsh	13	>10yrs	>2	yes	infreq	yes	infreq	no	frontline, spot	indoors	mix commercial	Friskies, Whiskas	tap, unboiled	routine	no	no	200-240	no	normal	no	no	no	13.312	43	20
18	mn	dsh	9.5	5-10yrs	2	yes	yearly	yes		no		indoors	mix commercial	Friskies, Whiskas	tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	38.21	93	30
19	fn	dsh	12	>10yrs	>2	yes	yearly	yes	yearly	not sure		indoors	dry	Whiskas	tap, boiled	vacc	no	no	200-240	no	normal	no	no	no	27.638	64	60
20	fn	dsh	11	>10yrs	>2	yes	yearly	yes	yearly	not sure		indoors	dry	whiskas	tap, boiled	vacc	no	no	<200	no	normal	yes	no	no	25.191	126	64
21	fn	dlh	17	>10yrs	1	not sure		no		yes	powder	indoors	canned, mixec comm		tap, boiled	routine	yes	yes	<200	no	normal	no	no	no	53.358	195	45
22	fn	persian	10	>10yrs	2	yes	infreq	yes	infreq	yes	collar	indoors	mix commercial	friskies	tap, unboiled	routine (spay)	no	no	<200	no	normal	yes	no	no	19.511	106	37
23	mn	dsh	15	>10yrs	>2	yes	infreq	yes	infreq	yes	spot-on	indoors	canned, dry	Whiskas	tap, unboiled	routine (diabetic)	no	no	200-240	no	normal	no	no	no	19.896	33	38
24	m	dsh	12	>10yrs	1	no		yes	infreq	no		outdoors	dry	Iams	tap, boiled	illness	yes	no	<200	no	normal	no	no	no	8.424	32	13
25	mn	dsh	16	>10yrs	2	yes		no		yes	frontline spot	indoors	mix commercial	Whiskas	tap, unboiled	illness	yes	no	<200	no	increased	no	no	no	46.52	22	23
26	mn	persianx	16	>10yrs	1	yes	yearly	yes	yearly	not sure	frontline	indoors	dry	Hills Hairball Snr	tap, boiled	vacc	yes	no	<200	yes	normal	no	no	no	23.626	43	18
27	mn	dsh	14	>10yrs	1	no		no		no		in and out	mix commercial	a/d	tap, boiled	illness (DM)	yes	no	<200	yes	normal	no	no	no	5.875	1395	25
28	fn	dsh	13	>10yrs	1	not sure		not sure		yes	collar	indoors	canned	Whiskas	tap, unboiled	illness	yes	no	200-240	no	normal	no	no	no	27.118	55	20
29	fn	persianx	11	>10yrs	1	no		no		yes	collar	indoors	canned	Whiskas	tap, unboiled	illness	yes	no	<200	no	normal	yes	no	no	2.7	48	57
30	fn	dsh	12	>10yrs	2	yes	yearly	no		yes	collar	outdoors	canned, mix non and comm		tap, unboiled	illness (const)	no	no	200-240	no	increased	yes	no	no	18.977	86	18
31	fn	dsh	14	>10yrs	1	yes		yes		yes	powder	indoors	mix commercial	no	all water	routine (dental)	no	no	<200	no	normal	no	no	no	27.424	46	24
32	mn	dlh	19	>10yrs	>2	yes	yearly	no		no	collar	in and out	dry		tap, unboiled	mass removal	no	no	<200	no	normal	no	no	no	26.019	39	34
33	mn	dsh	15	>10yrs	1	yes	yearly	yes	yearly	yes	collar	indoors	mix commercial	no	tap, boiled	illness (mastcell)	no	no	<200	yes	normal	no	no	no	19.491	202	28
34	fn	dsh	12	>10yrs	2	yes	yearly	yes	infreq	yes	spray	indoors	dry	Hills	distilled	routine (dental)	no	no	200-240	no	normal	no	no	no	22.21	52	29
35	f	dsh	11	>10yrs	>2	no		yes	infreq	no		indoors	dry		tap, unboiled	illness (MGT)	no	no		no	normal	yes	no	no	19.932	57	45
36	mn	himalayan	16	>10yrs	1	yes	yearly	yes	infreq			indoors	mix commercial	RC	tap, unboiled	illness (renal)	no	no	>240	yes	normal	no	no	no	14.195	28	21
37	fn	chinchilla	15													illness	yes	no	<200	no	normal	yes	no	no	20.71	87	28
38	mn	dsh	17	>10yrs	1	no		no		no		indoors	mix commercial	Whiskas	tap, unboiled	illness (renal)	no	no	<200	no	normal	no	no	no	21.712	43	38
39	mn	dsh	15													illness (renal)	yes	no	<200	yes	normal	yes	no	no	10.782	32	15
40	mn	persian	17	>10yrs	>2	yes	infreq	yes	infreq	yes	frontline, spot	indoors	mix commercial	Whiskas	tap, boiled	illness	yes	no	<200	yes	normal	no	no	no	27.921	93	20
41	fn	dsh	11	>10yrs	1	yes	yearly	no		no		indoors	dry, semi-moist	no	tap, unboiled	vacc	yes	no	<200	no	normal	no	no	no	33.963	44	35
42	fn	persian	11	5-10yrs	1	yes	yearly	no		yes	collar	indoors	dry		tap water	vacc	yes	no	200-240	no	normal	no	no	no	24.308	89	0
43	m	dsh	10	>10yrs	1	yes	infreq	no	infreq	no		indoors		hills senior	tap, unboiled	illness (const)	yes	no	200-240	no	normal	no	no	no	16.207	1	52
44	fn	dsh	12	>10yrs	1	yes	yearly	yes	yearly	no		indoors	mix commercial	no	tap, unboiled	illness	no	no	200-240	no	normal	no	no	no	30.829	149	55
45	mn	dlh	13	>10yrs	>2											illness (injury)	no	yes	<200	no	normal	no	no	no	28.758	185	53
46	mn	angora	13	>10yrs	1	no		no				indoors				illness	yes	no	<200	yes	normal	yes	no	no	10.06	109	9
47	mn	dsh	12	>10yrs	2	yes	yearly	no		no		indoors	dry		tap, unboiled	vacc	no	no	200-240	no	increased	no	no	no	27.203	29	17
48	fn	dsh	12	>10yrs	2	yes	yearly	no		no		indoors	dry		tap, unboiled	vacc	no	no	200-240	no	increased	no	no	no	32.916	65	4
49	fn	dsh	11	>10yrs	>2	yes	yearly	yes	yearly	other	frontline	indoors	mix commercial	Hills, Proplan	tap, filtered	illness (dental)	no	no	<200	no	normal	no	no	no	33.436	40	51
50	fn	persian	10	5-10yrs	1	yes	infreq	not sure		yes	spot-on	indoors	dry		tap, unboiled	illness	no	no	200-240	no	normal	no	no	no	10.123	7	3
51	fn	dsh	14	>10yrs	1	yes	yearly	not sure		no		indoors	dry	Whiskas - tuna	tap, unboiled	vacc	no	yes	200-240	no	normal	no	no	no	39.972	138	36
52	fn	persian	14	>10yrs	2	yes	yearly	no		no			dry	pH control, c/d		illness	no	no	<200	no	normal	yes	no	no	2.7	62	17
54	fn	dlh	10	>10yrs	>2	yes	yearly	yes	yearly	yes	spot-on	in and out	dry	Iams	tap, boiled	vacc	no	no	>240	yes	normal	no	no	no	24.163	26	21
56	fn	dlh	15	>10yrs	1	yes	yearly	yes	yearly	yes	frontline spot	indoors	dry	hills	tap, unboiled	illness (renal)	yes	no	<200	no	normal	no	no	no	7.98	26	23
57	fn	dlh	16	>10yrs	2	yes	yearly	yes	infreq	no		indoors	dry	Whiskas	tap, boiled	illness (renal)	no	no	<200	no	normal	occas	no	no	29.184	104	45
58	m	dsh	12	>10yrs	1	yes	yearly	yes	yearly	no		indoors	dry, home		tap, unboiled	vacc	no	no	200-240	no	normal	no	no	no	25.107	32	22
59	fn	persian	13	>10yrs	1	yes	yearly	yes	infreq	not sure		indoors	dry	Hills, Felix		illness	yes	no	<200	no	normal	yes	no	no	15.804	46	19

61	mn	dsh	15	>10yrs	2	yes	yearly	yes		no		indoors	mix, commercial	Whiskas	tap, boiled	illness (mass)	yes	no	<200	no	normal	yes	no	no	24.781	341	114
62	fn	dsh	13	>10yrs	2	yes	infreq	no		yes	other	indoors	mix, commercial	no	tap, filtered	illness	yes	no	<200	no	normal	yes	no	no	12.937	307	72
63	f	persian	11	>10yrs	1	no		no		yes	shampoo	indoors	dry	lams	tap, unboiled	illness (dental)	no	no	<200	no	normal	no	no	no	31.529	46	28
64	fn	dsh	11	>10yrs	1	yes	yearly	no		no		indoors	dry	Hills	tap, boiled	vacc	no	no	200-240	no	normal	no	no	no	34.503	43	12
65	mn	siamx	14	>10yrs	1	yes		no		no		indoors	mix commercial	Hills, lams	tap, boiled	illness (vom)	yes	no	200-240	no	increased	yes	no	both	45.376	34	21
66	mn	dsh	15	>10yrs	1	yes	yearly	yes	yearly	no		indoors	mix commercial	Hills k/d	tap, boiled	illness (renal)	yes	yes	200-240	no	normal	yes	no	no	23.301	59	23
67	fn	Angora	11	5-10yrs	2	not sure		no		yes	collar	indoors	canned	Whiskas tuna	tap, boiled	illness	yes	no	<200	no	normal	yes	no	no	5.181	12	12
68	mn	dsh	10	>10yrs	1	yes		no		yes	frontline spot	indoors	mixed commercial	Whiskas	tap, boiled	illness (AG)	no	no	<200	no	normal	no	no	no	35.864	47	12
71	fn	Chinchilla	10	>10yrs	1	yes	yearly	yes	yearly	yes	frontline spot	indoors	mix commercial	Hills	tap, boiled	vacc	no	no	<200	no	normal	no	no	no	23.673	20	33
72	mn	dsh	12	>10yrs	1	no		no		yes	spot-on	indoors	mix commercial	Whiskas	tap, boiled	illness	yes	yes	<200	no	normal	no	no	no	23.47	31	43
73	mn	dsh	10	5-10yrs	2	no		no		yes	collar	indoors	dry	yes?	tap, boiled	routine	yes	no	<200	no	normal	no	no	no	22.09	24	29
74	mn	dsh	12	>10yrs	>2	yes	infreq	yes	infreq	yes	spot-on	indoors	canned	First Choice tuna	tap, unboiled	illness	no	no	<200	no	normal	no	no	no	23.866	22	23
75	mn	dsh	10	>10yrs	1	yes	infreq	not sure		no		indoors	canned		distilled	illness (dental)	no	yes	<200	no	normal	yes	no	no	27.083	42	25
76	mn	dlh	10	>10yrs	1	yes		yes		yes	program	outdoors	dry		tap, boiled	vacc	no	no	<200	no	normal	no	no	no	26.535	70	24
77	m	angora	17	>10yrs	2	yes	infreq	no		no		indoors	mix commercial	Whiskas	tap, boiled	illness (vom)		no	<200	yes	normal	yes	no	no	16.554	21	22
78	fn	dsh	16	>10yrs	1	yes	infreq	no		yes	frontline spot	indoors	mix commercial		distilled, unboiled	illness	no	no	<200	no	normal	no	no	no	26.355	104	37
79	fn	dsh	15	>10yrs	>2	yes	yearly	no		no		indoors	mix commercial	fish	tap, unboiled	vacc	no	no	<200	no	increased	no	no	no	25.474	135	30
80	fn	persian	10	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline spot	indoors	mix commercial	Hills	tap, boiled	vacc	no	no	<200	no	normal	no	no	no	25.775	34	20
82	mn	dlh	15	>10yrs	1	yes	yearly	yes	yearly	no		indoors	mix commercial	Hills	tap, unboiled	vacc	yes	no	<200	no	normal	no	no	no	32.257	41	32
83	mn	dsh	10	>10yrs	2	yes	infreq	yes	infreq	yes	frontline spot	indoors	dry	Whiskas	tap, boiled	routine (dental)	no	no		no	normal	no	no	no	14.351	49	70
84	mn	dsh	14	>10yrs	1	yes	yearly	yes	infreq	yes	frontline spot	indoors	dry, non-comm	Whiskas	tap, unboiled	illness	yes	yes	<200	no	normal	yes	yes	no	19.423	32	23
85	mn	dsh	10	>10yrs	2	no		no		yes	spot-on	indoors	mix commercial		tap, unboiled	routine (dental)	no	no	<200	no	normal	no	no	no	16.496	47	17
86	m	dsh	10	>10yrs	2	no		no		yes	spot-on	indoors	mix commercial		tap, unboiled	routine (dental)	no	no	<200	no	normal	no	no	no	11.119	26	15
87	mn	dsh	10	>10yrs	1	yes	yearly	yes	infreq	no		indoors	dry	lams	tap, boiled	routine (dental)	yes	no	200-240	yes	normal	no	no	no	17.337	22	27
88	m	dsh	12	>10yrs	>2	no		yes		yes	spray	indoors	dry		tap, unboiled	illness (dental)			200-240	no	normal	no	no	no	25.558	67	25
89	mn	dsh	17	>10yrs	2	no		no		no		indoors	mix commercial		tap, boiled	illness (const)	yes	no	<200	no	normal	yes	no	no	8.589	25	10
90	fn	dsh	10	>10yrs	1	yes		yes		no		indoors	dry	lams	tap, boiled	illness	yes	no	200-240	no	normal	yes	no	no	12.602	453	228
91	mn	dlh	14	<5yrs	1	yes	yearly	yes	yearly	yes	frontline	in and out	mix commercial	no	tap, unboiled	routine (diabetic)	no	yes	<200	no	normal	no	no	no	19.898	34	21
92	fn	persian	15	>10yrs	2	no		no		no		indoors	mix commercial	Whiskas		illness		no	>240	yes	normal	no	no	no	22.497	52	29
94	mn	dsh	17	>10yrs	1	yes	yearly	no		yes	spot-on	indoors	dry		tap, boiled	vacc	no	no	200-240	no	normal	no	no	no	7.083	84	49
96	fn	dsh	15	>10yrs	2	yes		no		no?	spot-on	indoors	dry		tap, boiled	vacc	no	no	<200	no	normal	no	no	no	31.676	50	48
97	fn	dsh	11	>10yrs	2	yes		no		no?	spot-on	indoors	dry		tap, boiled	vacc	no	no	<200	no	normal	no	no	no	34.445	104	51
98	fn	dsh	15	>10yrs	2	no		no		once	shampoo	indoors	dry	RC, pH control	tap, boiled	illness	no	no	<200	no	normal	yes	no	no	21.069	35	31
99	mn	dsh	13	>10yrs	2	yes	infreq	yes	infreq	no			mix comm/non		tap, unboiled	illness	yes	no	<200	no	normal	no	no	no	5.414	204	192
100	fn	dsh	17	>10yrs	1	no		no		no					tap, unboiled	illness (resp)	yes	no	<200	no	incr, dyspn	no	no	no	12.008	20	11
211	fn	dlh	10	5-10yrs	>2	no		no		yes	spot-on	indoors	comm dry		tap, boiled	illness	yes	no	<200	no	normal	yes		no	6.199	31	20
214	fn	dsh	12	5-10yrs	>2	no		yes	infreq	yes	frontline spray	in and out	comm semi-moist		tap water	illness	yes	no	<200	no	normal	no	no	no	10.514	164	20
321	fn	dsh	11	5-10yrs	2	yes		yes		no		indoors	mix commercial	Hills	tap, boiled	routine (dental)	no	no	>240	no	normal	no	no	no	20.584	42	13
323	fn	dsh	11	>10yrs	1	yes	yearly	yes	infreq	yes	program	indoors	comm canned	Hills	tap, unboiled	routine (diabetic)	yes	yes	<200	no	normal	no	no	no	19.864	38	14
324	m	domestic	16	>10yrs	1	yes	infreq	no		yes	spray	indoors	comm dry	Hills g/d	tap, unboiled	illness	yes	no	200-240	yes	normal	yes	no	no	22.447	34	19
325	m	dsh	12	>10yrs	1	yes		not sure		not sure		indoors	comm dry				no	no	<200	no	normal	yes	no	no	31.21	29	22
326	fn	dsh	10	>10yrs	>2	no		no		no		outdoors	mix comm/non	all types	tap, unboiled	illness (renal)	yes	no	<200	no	normal	yes	no	no	15.204	19	12
327	mn	persian	14													vacc	no	no	<200	no	normal	no	no	no	25.97	42	27
328	fn	dlh	11	>10yrs	1	no		not sure		not sure		indoors		RC intestinal		illness	yes	no	<200	yes	normal	no	yes	no	18.259	62	27
341	f	dsh	12													routine (dental)	no	no		no	normal	no	no	no	31.052	27	36
342	fn	dsh	13													illness	no	no	<200	no	normal	yes	no	no	26.746	31	16
343	m	dsh	13	>10yrs	1	no		no		no		indoors		fish only	tap, unboiled	illness (pu/pd)	yes	no	<200	no	normal	yes	no	no	13.594	53	29
344	fn	dsh	11	>10yrs	>2	not sure		not sure				indoors	mix commercial		tap, boiled	illness	no	no	<200	no	normal	no	no	no	41.703	78	31
345	m	dsh	14	>10yrs	1	no		not sure		no		indoors	mix commercial	Whiskas fishy	tap, unboiled	illness	?	no	<200	yes	normal	no	no	no	6.16	31	20
346	f	dlh	16	>10yrs	1	yes		yes		not sure		indoors	mix commercial	Hills dry/canned		illness		no	<200	no	normal	yes	no	no	16.16	213	2
347	fn	persian	10	>10yrs	>2	yes		yes		yes	revolution spot-on	indoors	mix commercial			routine	no	no	<200	no	normal	no	no	no	30.582	40	48
348	fn	dsh	10	>10yrs	2	no		no		no		indoors	mix commercial	Whiskas		routine	yes	no	<200	no	normal	yes	no	no	26.473	41	31
349	mn	dlh	11	>10yrs	2											routine (dental)	no	no	<200	no	normal	no	no	no	26.621	60	56
350	mn	dsh	12	>10yrs	>2	not sure		not sure		no		indoors		hills k/d		illness (renal)	yes	no		yes	normal	no	no	no	8.268	31	6
451	fn	dsh	17	>10yrs	1	yes	yearly					indoors	mix non/comm			illness	no	no	200-240	no	normal	no	no	no	15.174	25	12
452	mn	Chinchilla	16	>10yrs	2	yes		yes		not sure		indoors	mix commercial		tap, unboiled	illness	yes	no	<200	yes	incr	no	no	no	66.624	72	55
453	fn	dsh	11	>10yrs	>2	not sure		not sure		no		indoors	mix commercial		tap, boiled	illness	no	no	<200	no	incr	no	no	no	22.677	24	23
603	fn	dsh	14	>10yrs	1	yes	yearly	yes	infreq	yes	spray	indoors	dry	no	tap, unboiled	illness	no	no	<200	no	normal	yes	no	no	14.54	32	26
604	fn	dsh	13	>10yrs	>2	yes	yearly	yes	infreq	yes	collar	in and out	mix commercial	Hills	tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	27.691	176	35
609	m	persian	19	>10yrs	1	yes	infreq	yes	infreq	no		indoors	comm dry, semi	Hills	tap water	routine	no	no	<200	no	normal	no	yes	no	29.698	81	26
610	mn	dsh	10	5-10yrs	>2	yes	yearly	yes	infreq	yes	collar	in and out	mix commercial	Hills	tap, unboiled	vacc	yes	no	<200	no	normal	no	no	no	37.718	71	40

611	mn	dsh	12	>10yrs	>2	yes	infreq	yes	yearly	yes	frontline spot	indoors	dry	Hills	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	31.635	84	27
612	fn	siamx	13	>10yrs	>2	yes	infreq	yes	yearly	yes	frontline spot	indoors	dry	Hills	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	17.467	17	24
613	fn	dsh	12	>10yrs	>2	yes	infreq	yes	yearly	yes	frontline spot	indoors	dry	Hills	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	27.782	83	49
614	fn	dlh	10	>10yrs	1	no		no		no		indoors	mix commercial	Hills	tap, boiled	routine (AP)	yes	no	200-240	no	incr	yes	no	no	33.75	88	35
615	fn	dlh	15	>10yrs	1	yes	yearly	no		yes	spot-on	indoors	mix commercial	no	tap, boiled	vacc	no	no	<200	no	normal	no	no	no	30.777	2	20
616	mn	dlh	15	>10yrs	1	yes	yearly	yes	infreq	not sure		outdoors	mix commercial	Whiskas, Friskies	tap, boiled	vacc	no	no	200-240	no	normal	yes	no	no	23.303	122	19
617	fn	dlh	11	>10yrs	2	yes	infreq	yes	infreq	no		indoors	dry	Whiskas	tap, unboiled	illness (vom)	yes	no	<200	no	normal	yes	no	no	23.011	38	49
618	fn	dsh	18	>10yrs	1	no		no		no		indoors	dry	hills k/d	tap, boiled	routine	no	no	200-240	yes	normal	no	no	no	21.028	103	49
619	f	siamese	11	>10yrs	2	no		no		yes	collar	indoors	mix commercial	Whiskas	tap, boiled	illness (tumor)		no	<200	no	normal	no	no	no	17.609	22	43
620	fn	dlh	14	>10yrs	>2	yes	infreq	yes	yearly	yes	frontline spot	indoors	comm dry	hills snr, oral care	tap, unboiled	illness (vom)	no	no	>240	no	normal	yes	yes	no	57.426	70	63
621	mn	dsh	12													illness	yes	no	<200	no	normal	yes	no	no	22.317	19	34
623	mn	dsh	10	>10yrs	1	yes	yearly	yes	infreq	yes	frontline spot	indoors	comm dry	Whiskas	tap, boiled	vacc	no	no	200-240	yes	normal	no	no	no	26.214	66	56
624	mn	dsh	18	>10yrs	1	yes	infreq	no		no		indoors	mix commercial	Whiskas	distilled	illness (AG)	no	no	<200	yes	normal	no	no	no	26.19	31	18
625	fn	dsh	17	>10yrs	>2	yes	infreq	yes	infreq	yes	frontline spot	indoors	mix commercial	Whiskas	tap, boiled	illness	no	no	>240	no	normal	yes	no	no	33.863	75	32
626	fn	dsh	14	>10yrs	1	no		no		yes	frontline spot	indoors	mix commercial	Whiskas	tap, boiled	illness (surgery)	yes	no	200-240	no	normal	no	no	no	28.389	124	30
627	mn	dlh	10	5-10yrs	1	yes	infreq	yes	infreq	yes	spot-on	indoors	mix commercial		tap, unboiled	routine (dental)	yes	no	<200	no	normal	yes	no	no	29.184	26	39
628	mn	persian	17	>10yrs	1	yes	yearly	yes	infreq	yes	other (oral)	indoors	dry	Hills	distilled	routine	yes	no	<200	no	normal	no	no	no	83.39	83	45
629	fn	dsh	12	>10yrs	2	yes	yearly	yes	infreq	yes	program	indoors	mix commercial		tap, boiled	routine	no	no	<200	no	normal	no	no	no	27.743	36	20
630	fn	dlh	17	>10yrs	2	yes	infreq	no		no		indoors	mix commercial	Shrimp flavour	tap, boiled	illness (pu/pd)	yes	no	<200	yes	normal	yes	no	no	18.012	17	19
631	fn	dsh	11													illness (mass)	no	no	<200	no	normal	no	no	no	19.623	50	31
632	mn	dsh	12	>10yrs	1	yes	yearly	yes	infreq	no		indoors	mix commercial		tap, boiled	illness (limping)	yes	no	200-240	no	normal	yes	no	no	25.378	37	18
633	mn	dsh	13	>10yrs	2	yes	yearly	yes	infreq	yes	collar	indoors	mix commercial		tap, boiled	illness	yes	no	200-240	yes	normal	yes	yes	no	28.7	264	121
634	mn	dsh	12	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline spot	indoors	mix commercial	Hills	tap, unboiled	routine (clean ears)	no	no	<200	no	normal	no	no	no	7.191	10	7
635	mn	dsh	18	>10yrs	1	no		no		yes	collar	indoors	mix commercial	Whiskas	tap, unboiled	illness	yes	no	<200	no	normal	yes	no	no	19.335	69	11
636	fn	dsh	12	>10yrs	2	yes	infreq	yes	yearly	yes	collar	indoors	mix commercial	Iams	tap, boiled	illness	no	no	<200	no	normal	yes	no	no	26.547	36	22
637	fn	himalayan	12	>10yrs	>2	yes	yearly	no				indoors	comm dry	Royal Canin	tap, boiled	routine (renal)	no	no		no	normal	no	no		14.307	26	20
638	fn	dsh	17	>10yrs	>2	yes	yearly	yes	infreq	yes	frontline, program	indoors	mix non/comm		tap, unboiled	vacc	yes	no	>240	yes	normal	no	no	no	21.384	29	33
639	fn	dlh	12	>10yrs	1	yes	yearly	yes	infreq	yes	frontline spot	indoors	comm dry		tap, boiled	vacc	no								27.847	55	42
640	fn	persian	14	>10yrs	2	yes	yearly	no		no		indoors	mix commercial	Hills	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	46.934	30	17
701	fn	angora	14	>10yrs	2	no		no		no		indoors	mix commercial		tap, unboiled	illness	yes	no	200-240	no	normal	yes	no	no	46.061	134	27
702	mn	dsh	14	>10yrs	1	no		no		no		indoors	dry		tap, unboiled	illness	yes	no	<200	no	normal	no	no	no	7.586	30	24
703	mn	dsh	13	>10yrs	1	no		no		no		indoors	mix commercial	no	tap, unboiled	illness	yes	no	growling	no	incr	yes	no	no	10.259	185	38
704	mn	dsh	12	>10yrs	1	yes	yearly	yes	yearly	not sure		indoors	mix commercial	Hills	tap, unboiled	vacc	no	no	<200	no	normal	yes	no	no	32.961	94	42
705	fn	persian	14	>10yrs	1	no		no				indoors	mix commercial	Whiskas		illness	no	no	<200	yes	incr	no	no	no	28.627	41	54
706	mn	dsh	12	>10yrs	1	yes	yearly	no		yes	frontline spot	indoors	dry	Iams		routine (dental)	no	no	<200	no	normal	no	no	no	38.545	32	17
707	fn	dsh	10	>10yrs	1	not sure		not sure				indoors				illness	yes	no	200-240	no	normal	no	no	no	21.961	10	13
708	m	dsh	11	>10yrs	1	not sure		not sure		yes	spot-on	indoors	mix commercial		tap, unboiled	illness	yes	no	200-240	no	normal	yes	no	no	13.697	69	5
709	mn	dlh	13	>10yrs	1	yes	yearly	not sure		yes	frontline spot	indoors	canned	Whiskas	tap, unboiled	routine (dental)	yes	no	200-240	yes	normal	no	no	no	11.694	47	12
710	fn	dsh	10	>10yrs	>2	yes	yearly	no		no		indoors	dry	no	tap, boiled	illness (AG)	no	no	200-240	no	normal	no	no	no	23.683	27	48
711	f	dsh	14	>10yrs	1	no		no		not sure		indoors	mix commercial	Whiskas		illness	yes	no	>240	yes	incr	no	no	no	21.337	24	48
712	fn	angora	10	>10yrs	1	no		not sure		no		indoors	dry		tap, boiled	illness	yes	no	<200	no	normal	no	no	no	12.855	68	74
713	fn	dlh	11	>10yrs	>2	yes	yearly	yes	yearly	no		indoors	mix non/comm	dry, fresh fish/liver	tap, unboiled	vacc	no	no	<200	no	normal	yes	no	no	31.948	35	19
714	fn	dsh	12	5-10yrs	>2	yes	yearly	yes	yearly	not sure		indoors	mix commercial	Whiskas, Hills w/d	tap, unboiled	illness (const)	yes	no	<200	no	normal	no	no	no	28.823	159	17
715	fn	dsh	16	>10yrs	1	no		no		not sure		indoors	mix commercial	Whiskas		illness (tumor)	yes	no	<200	no	normal	no	no	no	27.071	22	19
716	mn	dsh	14	>10yrs	1	yes	yearly	yes	infreq	no		indoors	dry	Hills r/d	tap, unboiled	vacc	no	no	200-240	no	normal	no	no	no	27.715	133	38
717	fn	dlh	13	>10yrs	>2	yes	yearly	yes	infreq	no		indoors	mix commercial	Iams	tap, boiled	vacc	no	no	200-240	no	normal	no	no	no	30.169	57	46
718	mn	dsh	10	5-10yrs	1	yes	yearly	yes	infreq	no		indoors	mix commercial	First Choice	tap, unboiled	vacc	no	no	200-240	no	normal	no	no	no	26.895	55	23
719	fn	dsh	14	>10yrs	>2	yes	infreq	yes	infreq	yes	spot-on	indoors	mix commercial	Whiskas dry	tap, boiled	illness	yes	no	200-240	no	incr	no	no	no	9.283	116	86
720	fn	dlh	14	>10yrs	1	yes	yearly	yes	infreq			indoors	dry	Iams, Hills t/d		illness (lump)	yes	no	<200	no	normal	no	no	no	32.289	115	21
721	fn	dsh	11	>10yrs	1	yes	infreq	yes	infreq	no		indoors	dry		tap, unboiled	illness (skin)	no	no		no	normal	no	no	no	33.262	74	18
722	fn	dlh	12	>10yrs	1	yes	yearly	yes	infreq	yes	collar	indoors	mix commercial	Whiskas	distilled	vacc	no	no	200-240	no	normal	no	no	no	26.128	43	25
723	m	persian	15	>10yrs	1	yes		no		yes	other	indoors	mix commercial	no	tap, unboiled	illness (nail)	no	no	<200	no	normal	no	no	no	21.501	51	15
724	mn	dsh	15	>10yrs	1	yes		no		yes	spot-on	indoors	mix commercial		tap, boiled	illness (ear)	no	no	200-240	no	normal	no	no	no	28.45	34	30
725	mn	angora	16	5-10yrs	1	yes	infreq	no		no		indoors	mix commercial		tap, boiled	illness (const)	no	no		no	normal	no	no	no	17.704	28	18
726	fn	dsh	15	5-10yrs	1	no		no		no		indoors	dry		tap, unboiled	illness	yes	yes	<200	no	normal	no	no	no	24.996	23	63
727	fn	persian	16	<5yrs	1	yes		yes		no		indoors	dry		distilled	illness	no	no	<200	no	normal	no	no	no	46.417	63	41
728	fn	dsh	10	5-10yrs	2	yes	yearly	no		yes	frontline	indoors	comm dry	Whiskas	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	27.465	61	61
729	fn	persianx	16	>10yrs	1	no		no		yes	flea collar	indoors	mix non/comm		tap, unboiled	illness	yes	no	<200	no	normal	yes	no	no	14.002	43	26
730	fn	dsh	13	>10yrs	>2	no		no		no		indoors	Comm dry	RC (renal)	tap, unboiled	illness (renal)	yes	no	<200	no	normal	no	no	no	6.013	24	10
731	mn	himalayan	18	>10yrs	1	yes	infreq	yes	infreq	yes	program	indoors	comm dry	Whiskas	tap, boiled	illness	yes	no	<200	no	dyspnoea	no	no	no	25.162	41	42

																(pneumothorax)											
732	mn	dlh	12	>10yrs		yes	infreq	no		no		indoors	mix comm/non		tap, boiled	illness (renal)	yes	no	<200	no	normal	no	no	no	15.004	23	5
733	mn	persian	13	>10yrs	2	yes	yearly	yes	yearly	no		indoors	comm dry	RC (urinary)	tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	30.998	79	24
734	fn	persianx	14	>10yrs	2	not sure		not sure		no		indoors	mix commercial	Caesar	tap, unboiled	illness (vom)	yes	no	<200	no	normal	yes	no	no	15.303	49	47
735	mn	dlh	14	5-10yrs	1	yes		no		no		indoors	mix commercial		tap, unboiled	illness	yes	no	200-240	no	normal	yes	yes	no	16.997	63	22
736	mn	dlh	16	>10yrs	2	yes		yes		no		indoors	mix commercial		tap, boiled	vacc	yes	yes	200-240	no	normal	no	no	no	24.689	104	34
737	fn	dsh	13	>10yrs	2	no		no		no		indoors	comm dry	RC (urinary)	tap, boiled	illness (tumor)	no	no	<200	no	normal	no	no	no	15.462	50	28
738	fn	dsh	11	>10yrs	1	yes	infreq	yes	infreq	yes	frontline	indoors	comm dry		tap, boiled	vacc	no	no	<200	no	normal	no	no	no	34.249	73	26
739	mn	dlh	10	5-10yrs	>2	yes	yearly	yes	yearly	no		indoors	mix commercial	Whiskas, w/d	tap, unboiled	illness (inapp)	yes	no	<200	no	normal	no	no	no	2.7	197	10
740	fn	Angora	11	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline	indoors	mix commercial	Hills r/d	distilled	routine (mc)	no	no	<200	no	normal	no	no	no	39.256	32	52
741	mn	dsh	17	>10yrs	1	yes	infreq	no		yes	collar, spot-on	indoors	mix non/comm		tap, boiled	illness	no	no	<200	yes	normal	no	no	no	23.882	23	48
742	mn	dsh	17	>10yrs	1	no		no		yes	frontline spot	in and out	mix comm/non	steam fish	tap, boiled	illness	yes	no		yes	normal	yes	no	no	15.873	72	43
743	fn	dsh	18	<5yrs	1	yes	yearly	no		no		indoors	comm dry		tap, boiled	vacc	yes	no	<200	no	normal	yes	no	no	20.492	35	10
744	fn	dsh	13	>10yrs	1	no		no		no		indoors	comm canned	Whiskas fish		illness (anaemia)	yes	no	>240	yes	increased	yes	no	no	24.296	49	26
745	fn	dsh	17	>10yrs		no		yes	infreq	yes	frontline spot			Whiskas		illness (vom)	yes	yes	200-240	no	normal	yes	yes	no	166.31	204	241
746	mn	dsh	11	5-10yrs	>2	yes	infreq	no		yes	spot-on	indoors	mix commercial		tap, boiled	illness	yes	no	<200	no	normal	no	no	no	18.012	17	10
747	mn	dlh	14	5-10yrs	>2	no		no		no		indoors	mix commercial		tap, boiled	illness	yes	no	<200	no	normal	no	no	no	16.961	51	25
748	mn	dlh	15	>10yrs	1	yes	yearly	yes	yearly	yes		indoors	comm dry		tap, unboiled	illness		no	<200	no	normal	yes	no	no	9.866	19	101
749	fn	dlh	16	>10yrs	1	no		no		no		indoors	mix commercial		tap, boiled	illness	yes	yes	>240	no	increased	yes	no	no	35.238	54	35
750	mn	dsh	10	5-10yrs	1	no		no		yes	program	indoors	comm dry		tap, boiled	illness (renal)	no	no	200-240	no	normal	yes	no	no	8.719	66	20
751	fn	dlh	15	>10yrs	1	no		no		not sure		indoors	mix commercial	Whiskas		illness (hi BP)	yes	no	<200	no	normal	no	no	no	30.517	290	23
752	mn	persian	19	>10yrs	2	no		no		no		indoors	mix comm/non	Whiskas, seafood	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	104.21	69	56
753	fn	dsh	11	>10yrs	1	no		no		no		indoors	non comm		tap, boiled	illness (anaemia)	yes	no	<200	no	normal	no	no	no	29.383	47	49
754	fn	dsh	16	>10yrs	2	no		no		yes	shampoo	indoors	comm dry		tap, boiled	PD (old age)	yes	no	200-240	no	normal			no	26.746	41	30
755	fn	dlh	21	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline spot	indoors	mix commercial	Whiskas, k/d	tap, unboiled	illness (cystitis)	yes	yes	200-240	no	normal	no	no	no	34.535	47	37
756	fn	dsh	12	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline spot	indoors	comm semi-moist	hills adult	tap, boiled	vacc	no	no	<200	no	normal	no	no	no	25.438	46	34
757	fn	dsh	15	>10yrs	1	no		no		no		indoors	non comm		tap, boiled	illness (pollakiuria)	no	no	<200	no	normal	no	no	no	32.161	51	37
758	f	himalayan	10	5-10yrs	1	no		no		no		indoors	mix commercial	hills	tap, unboiled	illness (dyspnoea)	yes	no	<200	no	dyspnoea	yes	no	no	12.053	36	30
759	mn	angora	17	>10yrs	1	no		no		no		in and out	non comm		tap, unboiled	illness (const)	no	no	<200	no	normal	yes	no	no	22.569	28	42
760	fn	dsh	13	>10yrs	1	no		no		no		indoors	non comm	fish	tap, boiled	illness (haematuria)	yes	no	<200	yes	normal	no	no	no	20.641	330	90
761	fn	dsh	12	>10yrs	1	yes	infreq	yes	infreq	yes	fronline spot	indoors	mix non/comm	w/d	tap, boiled	illness (DKA)	no	no	<200	no	normal	no	no	no	6.564	54	28
762	fn	dsh	10	5-10yrs	1	yes	yearly	yes	infreq	yes	collar	in and out	mix commercial		tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	34.589	89	22
763	fn	dsh	18	>10yrs	1	yes	yearly	yes	yearly	yes	collar	indoors	comm dry		tap, boiled	vacc	no	no	<200	no	normal	no	no	no	62.051	88	80
764	fn	dsh	12	>10yrs	1	yes	infreq	yes	infreq	yes	frontline spot	indoors	mix commercial	Whiskas	tap, boiled	illness (weak)	no	no	200-240	no	normal	no	no	no	28.8	36	35
765	fn	dsh	11	>10yrs	1	yes		no		yes	collar, spray, spot	indoors	comm dry		tap, unboiled	illness	no	yes	200-240	no	normal	no	no	no	33.46	107	27
766	mn	bsh	10		>2	yes		yes	yearly	no		indoors	comm dry		tap, boiled	vacc	no	no	<200	no	normal	no	no	no	39.026	45	11
767	m	himalayan	14	>10yrs	2	no		no		yes	spot-on	indoors	mix non/comm	friskies	tap, boiled	illness (stroke)	no	no	<200	yes	increased	no	no	no	20.584	58	24
768	mn	dsh	13	>10yrs	1	yes		no		no		indoors	mix commercial	japanese brand	tap, boiled	vacc	no	no	<200	no	normal	no	no	no	30.195	126	32
770	fn	dlh	17	>10yrs	1	yes	yearly	yes	yearly	no		indoors	mix commercial		tap, boiled	illness (seizure)	yes	no	200-240	no	normal	no	no	no	29.779	160	60
771	mn	dsh	20	>10yrs	1	no		no		not sure		indoors	mix commercial	Whiskas		routine	no	no	<200	no	normal	no	no	no	23.468	97	33
772	mn	dsh	16			yes	infreq				frontline spot					illness (weight loss)	yes	no	200-240	no	normal	yes	yes	no	22.437	40	43
773	m	dlh	16	>10yrs	2	yes	yearly	yes	infreq	yes	frontline	indoors	comm dry	Choice	tap, unboiled	vacc	no	no	200-240	no	normal	yes	no	no	32.122	25	17
774	fn	dsh	10	>10yrs	1	no		no		no		indoors	mix commercial	Whiskas	tap, unboiled	illness (haematuria)	no	no	<200	no	normal	yes	no	no	72.095	42	47
775	fn	persian	14	5-10yrs	1	no		no		yes	spot-on	indoors	comm dry		tap, boiled	illness	yes	no	<200	no	increased	no	no	no	22.98	128	14
776	mn	angora	11	5-10yrs	1	no		no		no		indoors	mix commercial	Various		illness	no	no	<200	no	normal	yes	no		12.717	123	19
777	fn	dsh	13	>10yrs	1	no		no		no		indoors	mix commercial	Whiskas		illness	yes	no	200-240	no	normal	no	no	no	7.314	125	19
778	fn	dsh	10			yes	yearly									routine (dental)	no	no	200-240	no	normal	no	no	no	23.235	30	19
779	mn	dsh	15	>10yrs	1	yes	infreq	yes	yearly	not sure	spot-on	indoors	mix commercial		tap	illness (renal)	no	no	200-240	no	normal	no	no	no	26.659	64	51
780	mn	dsh	10	>10yrs	>2	yes		yes		yes	frontline spot	indoors	mix commercial	Natural Balance		vacc	no	no	<200	no	normal	no	no	no	26.3	53	34
781	mn	dsh	16	>10yrs	2	yes	infreq	yes		yes	collar	indoors	mix commercial	KFC, steak, Whiskas	tap, unboiled	illness (DM)	yes	no	200-240	no	normal	no	no	no	17.727	103	46
782	fn	dsh	13	>10yrs	1	yes		no		no		indoors	comm dry	renal support	tap, boiled	vacc	no	no	200-240	no	normal	no	no	no	27.43	33	52
783	fn	dsh	26	>10yrs	2	no		no		no		indoors	mix non/comm	fish, rice, dry, canned	tap, boiled	illness (dental)	yes	no	200-240	no	normal	no	no	no	17.439	72	23
784	fn	dlh	10	>10yrs		not sure		not sure		not sure						PD (old age)			<200	no	normal			no	52.293	37	55
785	fn	dsh	15	>10yrs	1	no		no		no		indoors	comm dry		tap, unboiled	illness	yes	no	200-240	no	normal	no	no	no	20.263	9	19
787	mn	dsh	14	>10yrs	1	yes	yearly	no		yes	spot-on	indoors	mix commercial		tap, boiled	illness (const)	yes	no				no	no	no	17.278	86	8

788	mn	dsh	11	>10yrs	>2	Yes	infreq	yes	yearly	not sure		indoors	mix commercial	friskies		illness (anorexia)		no	200-240	no	increased	yes	no	no	9.274	156	30
789	fn	dsh	12		1	no		no		no		indoors				illness (hepatitis)	yes	no	<200	no	normal	yes		no	8.547	111	377
790	fn	dlh	11	>10yrs	1	yes	yearly	yes	infreq	no		indoors	mix commercial	first choice	tap, boiled	vacc	no	no	200-240	no	normal	no	no	no	28.354	86	61
792	fn	dlh	17	>10yrs	1	no		no		yes	collar	indoors	comm canned	hills	tap, boiled	routine (renal)	yes		<200	no	normal	no	no	no	26.465	50	17
793	f	persian	11	>10yrs	1	yes	infreq	no		yes	frontline spot	indoors	mix commercial	royal	tap, unboiled	illness (vom)	no	no	<200	no	normal	yes	no	no	15.73	42	4
794	mn	dsh	15	>10yrs	>2	yes	infreq	no		yes	collar	in and out	mix commercial		tap, boiled	illness (ataxic)	no	no	200-240	no	normal	no	no	no	25.785	363	53
795	fn	dsh	12	>10yrs	>2	yes	infreq	yes	infreq	no		in and out	mix commercial		tap, boiled	illness (stomatitis)	yes	no	<200	no	normal	no	no	no	19.889	340	31
796	mn	angora	16	<5yrs	1	not sure		no		no		indoors	mix non/comm	whiskas	tap, boiled	Elected euth	yes		>240	no	normal			no	13.038	54	11
797	mn	dsh	15	>10yrs	1	yes	infreq	yes	yearly	yes	frontline spot	indoors	comm dry	lams	tap, boiled	illness (const)	no	no	200-240	no	normal	yes	no	no	30.187	88	45
799	fn	dsh	17	>10yrs	1	yes	yearly	yes	yearly	yes	spot-on	indoors	comm dry		tap, unboiled	vacc	no	no	<200		normal	no	no	no	38.304	121	39
800	mn	himalayan	11	>10yrs	1	yes	infreq	yes	infreq	yes	program	indoors	mix commercial	japanese brand	tap, unboiled	illness (inapp)	yes	no	<200	no	dyspnoea	no	no	no	12.804	31	109
801	mn	dlh	13	5-10yrs	1	yes	not sure	no		yes	collar	indoors	mix commercial		tap, unboiled	vacc	no	no	<200	yes	normal	no	no	no	18.478	85	16
802	mn	dlh	12	>10yrs	1	yes	infreq	no		no			comm semi-moist		tap, unboiled	illness (vom)	yes	no		no	normal	yes		no	34.08	71	47
803	fn	persian	14	>10yrs	1	yes	yearly	yes	yearly	yes	collar, spray	indoors	comm dry	old age diet	tap, unboiled	illness (anorexia)	yes	no	<200	no	normal	no	no	no	7.427	75	27
804	m	dlh	16													illness (renal)	yes	no	<200	no	normal	no	no	no	6.639	35	15
805	fn	dsh	11	<5yrs	1	yes	infreq	yes	infreq	no		indoors	mix non/comm	friskies, fish	tap, boiled	routine (dental)	no	no	<200	no	normal	no	no	no	17.059	55	39
806	f	persian	16			yes	yearly			yes	collar		mix commercial	RC pH control		illness (vom)	yes	no	<200	yes	normal	yes	no	no	2.7	79	12
807	mn	persian	12	>10yrs	2	yes	infreq	not sure		no		indoors	comm dry	RC Urinary	tap, unboiled	routine (injury)	no	yes	200-240	no	normal	no	no	no	11.553	38	14
808	fn	Chinchilla	11	>10yrs	1			no		no		indoors	mix non/comm	hills snr hairb, jap canned		routine (rabies blds)	no	no	<200	no	normal	no	no	no	26.438	34	30
809	mn	dsh	11	>10yrs	2	no		no		no		indoors	mix commercial	Whiskas	tap, unboiled	illness	no	yes	200-240	no	dyspnoea	no	no	no	23.034	66	19
810	mn	dsh	16													illness	yes	no	<200	no	normal	yes	no	no	8.871	390	
811	fn	dlh	11	5-10yrs	1	yes	infreq	no		no		in and out	comm dry	Friskies	distilled	illness	yes	no	200-240	no	dyspnoea	no	no	no	14.904	14	9
812	fn	dlh	14	>10yrs	>2	yes		yes		no			mix non/comm	Whiskas, First Choice	tap, boiled	illness (weight loss)	yes	no	200-240	no	normal	yes	no	no	111.41	154	66
813	mn	dlh	12	>10yrs	1	yes		yes	yearly	no		indoors	mix commercial	Whiskas	tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	10.124	44	28
814	mn	dsh	15													illness	yes	no	200-240	no	normal	yes	no	no	17.026	14	15
815	f	dsh	18	>10yrs	1	no		no		no		indoors	mix commercial		tap, unboiled	illness	yes	no	<200	no	normal	no	no	no	11.993	75	80
816	fn	dsh	11		1	yes	yearly	yes	infreq	yes	program	indoors	mix commercial		distilled	illness	no	no	<200	no	normal	no	no	no	26.107	97	22
817	mn	dsh	15	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline, collar	indoors	mix commercial	friskies, 1st choice, mio	tap, boiled	illness (liver)	yes	no	<200	no	normal	no	no	no	15.605	192	388
818	mn	dlh	14	5-10yrs	>2	yes	yearly	yes	yearly	yes	frontline spot	indoors	mix commercial	RC, whiskas	tap, unboiled	illness (dyspnoea)	yes	no	200-240	no	increased	no	no	no	31.758	23	62
819	mn	dlh	10	>10yrs	1	yes	yearly	yes	yearly	yes	spot-on	indoors	comm dry	Hills c/d	tap, unboiled	vacc	no	no	200-240	no	normal	no	no	no	37.538	69	71
820	mn	persian	11	>10yrs	1		not sure	yes	infreq	no		indoors	mix commercial	Whiskas	tap, unboiled	illness	yes	no	<200	no	normal	no	no	no	23.434	81	50
821	fn	dlh	10	5-10yrs	1	yes	yearly	no		no		indoors	comm dry	Hills	tap, boiled	routine (dental)	no	no	<200	no	normal	no	no	no	25.03	23	11
822	fn	dsh	12	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline spot	in and out	mix non/comm	fish flavor, steamed fish	tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	19.495	59	24
823	mn	dsh	20	>10yrs	2	yes		yes		yes	collar	indoors	mix non/comm		tap, unboiled	routine (dental)	yes	no	<200	no	normal			no	11.888	28	15
824	fn	dlh	13	>10yrs	2	yes	yearly	yes	yearly	no		indoors	mix commercial	Hills	tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	34.977	101	31
825	fn	dlh	12	>10yrs	2	yes	yearly	yes	yearly	no		indoors	mix commercial	Hills	tap, unboiled	vacc	no	no	<200	no	normal	no	no	no	25.318	86	26
826	mn	persian	18	>10yrs	1	yes	infreq	yes	infreq	no		indoors	comm dry	lams lamb flavour	tap, unboiled	illness (dyspnoea)	yes	no			dyspnoea	no	no		12.725	52	76
827	fn	dsh	15	>10yrs	1	yes	yearly	no		yes		indoors	mix commercial	RC, Hills		illness (vom)	yes	no	200-240	no	normal	yes	no	no	31.013	182	42
829	mn	dlh	10	>10yrs	1	yes	yearly	yes	infreq	yes	spot-on, spray	indoors	mix commercial		tap, boiled	illness	yes	no		no	normal	no	no	no	12.485	205	28
830	fn	dsh	12	5-10yrs	>2	yes	infreq	no		no		indoors	comm dry		tap, boiled	illness (dental)	yes	no	<200	no	normal	no	no	no	12.177	27	28
831	fn	dlh	16	>10yrs	1	yes	yearly	yes	yearly	yes	spot-on	indoors	mix commercial	hills k/d	tap, boiled	vacc	no	no	<200	yes	normal	no	no	no	40.791	141	35
832	m	dsh	15	>10yrs	1	no		no		no		indoors	mix non/comm	cooked fish	tap, boiled	illness (growth)	yes	no	<200	no	normal	no	no	no	14.085	36	13
833	mn	dsh	16	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline	indoors	mix commercial		tap, boiled	vacc	yes	no	<200	yes	normal	no	no	no	22.25	79	31
834	mn	dsh	13	>10yrs	>2	yes	yearly	yes	yearly	yes	frontline	indoors	mix commercial		tap, boiled	routine	yes	no	<200	no	normal	no	no	no	23.859	39	31
835	fn	dsh	22	>10yrs	>2	yes		not sure		yes	spot-on	indoors	mix commercial		tap, boiled	illness	yes	yes	200-240	no	normal	no	no	no	109.21	470	163
836	fn	persian	14	>10yrs	1	yes		yes	infreq	no		indoors	comm dry	RC Urinary	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	19.011	26	24
837	f	dsh	12													illness (mass)	yes	no	<200	no	normal	no	no	no	22.416	14	15
838	mn	dsh	12	>10yrs	1	yes	yearly	yes	yearly	no		indoors	mix non/comm	fresh fish occas	tap, unboiled	routine	yes	no	200-240	yes	normal			no	21.984	29	22
839	mn	dsh	11	>10yrs	1	no		no		no		indoors	comm canned		tap, boiled	illness	yes	no	<200	no	dyspnoea	no	no	no	2.7	152	14
840	fn	persian	15	>10yrs	1	no		no		no		indoors	mix commercial	whiskas	tap, unboiled	illness (diarrhoea)	yes	no	200-240	no	normal	no	yes	no	8.747	10	15
841	mn	dsh	20	>10yrs	2	yes	yearly	yes	infreq	no		indoors	mix commercial	whiskas, RC urinary	tap, boiled	routine	yes	no	<200	no	normal	no	no	no	18.654	39	21
842	mn	dsh	14	>10yrs	2	no		no		no		indoors	comm dry	Hills	tap, boiled	illness (glaucoma)	no	no		no	normal	yes	no	no	28.092	46	25
843	mn	dsh	10	>10yrs	>2	yes	infreq	no		no		indoors	comm dry	Whiskas	tap, boiled	routine	no	no	200-240	no	normal	no	no	no	28.429	60	30
844	fn	dsh	14	>10yrs	>2	yes	yearly	no		no		indoors	mix commercial	RC dry	tap, boiled	illness (const)	no	no	<200	no	normal	yes	no	no	31.599	22	25
845	fn	dsh	11	>10yrs	1	yes	yearly	yes	yearly	yes	frontline spot	indoors	mix commercial	Whiskas, Friskies	tap, boiled	vacc	no	no	<200	no	normal	no	no	no	21.709	48	31

846	f	dlh	11	>10yrs	2	no		no		yes	frontline spot	indoors	mix commercial		distilled	routine	no	no	200-240	no	normal	yes	no	no	23.395	71	26
847	fn	dsh	12	>10yrs	1	yes		no		no		indoors	comm canned	w/d	tap, boiled	illness (const)	no	no	<200	no	normal	no	no	no	18.256	28	13
848	mn	dsh	10	>10yrs	>2	no		no		yes	collar, shampoo	indoors	mix non/comm	whiskas, fresh fish	tap, unboiled	illness (urti)	no	no	200-240	no	normal	no	no	no	14.301	56	13
849	mn	dsh	10	>10yrs												illness	yes								15.611	92	46
850	mn	dlh	14	>10yrs	1	yes		yes		yes	spot-on	indoors	mix commercial		tap, boiled	routine (renal)	no	no	200-240	no	normal	no	no	no	41.305	123	56
851	mn	persian	14			yes		no		no		indoors	comm dry		tap, boiled	illness	yes	no	<200	no	normal	no	no	no	14.738	53	38
852	mn	dlh	11	>10yrs	1	yes	infreq	yes	infreq	yes	collar	indoors	comm canned		tap, boiled	illness (diarrhoea)	yes	no	<200	no	normal	no	yes	no	29.23	39	14
853	mn	dsh	13	<5yrs	1	yes	infreq	no		no		indoors	mix non/comm	Hills Snr Hairball	tap, boiled	illness (weight loss)	yes	no	200-240	no	normal	no	no	no	18.14	22	16
854	fn	dsh	15	>10yrs	1	yes	infreq	no		yes	frontline spot	indoors	comm semi-moist	Hills, RC	tap, boiled		no	no	200-240	no	normal	no	no	no	27.396	46	31
855	mn	dlh	14	<5yrs	1	yes	yearly	no		yes	spot-on	indoors	comm dry	RC Urinary	tap, unboiled	vacc	no	no	<200	yes	normal	no	no	no	31.115	50	30
856	fn	dsh	12	>10yrs	2	no		no		yes	spray	indoors	comm dry	supermarket brand	tap, unboiled	illness (renal)	yes	no	<200	no	normal	no	no	no	2.7	44	84
857	fn	dsh	19	>10yrs	1	yes	yearly	no		no		indoors	mix commercial	RC renal	tap, filter	routine	yes	no	<200	no	normal	no	no	no	21.012	36	27
858	m	dsh	18	>10yrs	1	no		no		no		indoors	mix commercial		tap, boiled	illness	yes	no	200-240	no	dyspnoea	no	no	no	16.916	62	18
859	fn	persian	14	<5yrs	1	yes	yearly	no		no		indoors	comm dry	Hills	filtered	vacc	no	no	<200	no	normal	no	no	no	29.216	43	28
860	fn	dsh	12	>10yrs	1	no		no		no		indoors	comm dry	Friskies, others	tap, unboiled	routine	no	no	<200	no	normal	no	no	no	21.959	71	36
861	mn	dsh	17													illness (weight loss)	yes	no	<200	no	increased	no	no	no	2.7	220	88
862	mn	dsh	12	>10yrs	>2	yes	infreq	yes	infreq	yes	collar	indoors	mix commercial		tap, boiled	illness (vom)	yes	yes	200-240	yes	normal	yes	no	no	14.385	156	53
863	mn	dsh	10			no		no		no		indoors	comm dry	RC Urinary	tap, boiled	illness (dull)	yes	no	200-240	no	normal	yes	no	no	32.68	72	81
864	f	dsh	12	>10yrs	1	yes		yes	infreq	not sure		indoors		canned food	tap, unboiled	illness (mass)	no	no	200-240	no	increased	no	no	no	16.188	137	16
865	mn	persian	11	>10yrs	2	yes	yearly	yes	yearly	yes	frontline spot	indoors	comm dry	Hills	tap, boiled	routine	no	no	<200	no	normal	no	no	no	24.931	46	42
866	fn	himalayan	14	>10yrs	1	yes	yearly	yes	yearly	yes	frontline	indoors	mix commercial	Whiskas	tap, boiled	routine	no	no	200-240	no	normal	no	no	no	23.064	30	25
869	fn	dlh	17	>10yrs	2	yes	yearly	yes	infreq	no		indoors	mix commercial	Whiskas canned	tap, unboiled	illness	no	no	200-240	no	normal	no	no	no	19.41	102	48
870	fn	dsh	12	>10yrs	1	no		no		no		indoors	comm dry	Whiskas	tap, boiled	illness (cystitis)	yes		200-240	yes	normal	no	no	no	22.06	33	61

Addendum E
Journal publication emanating from this research