Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

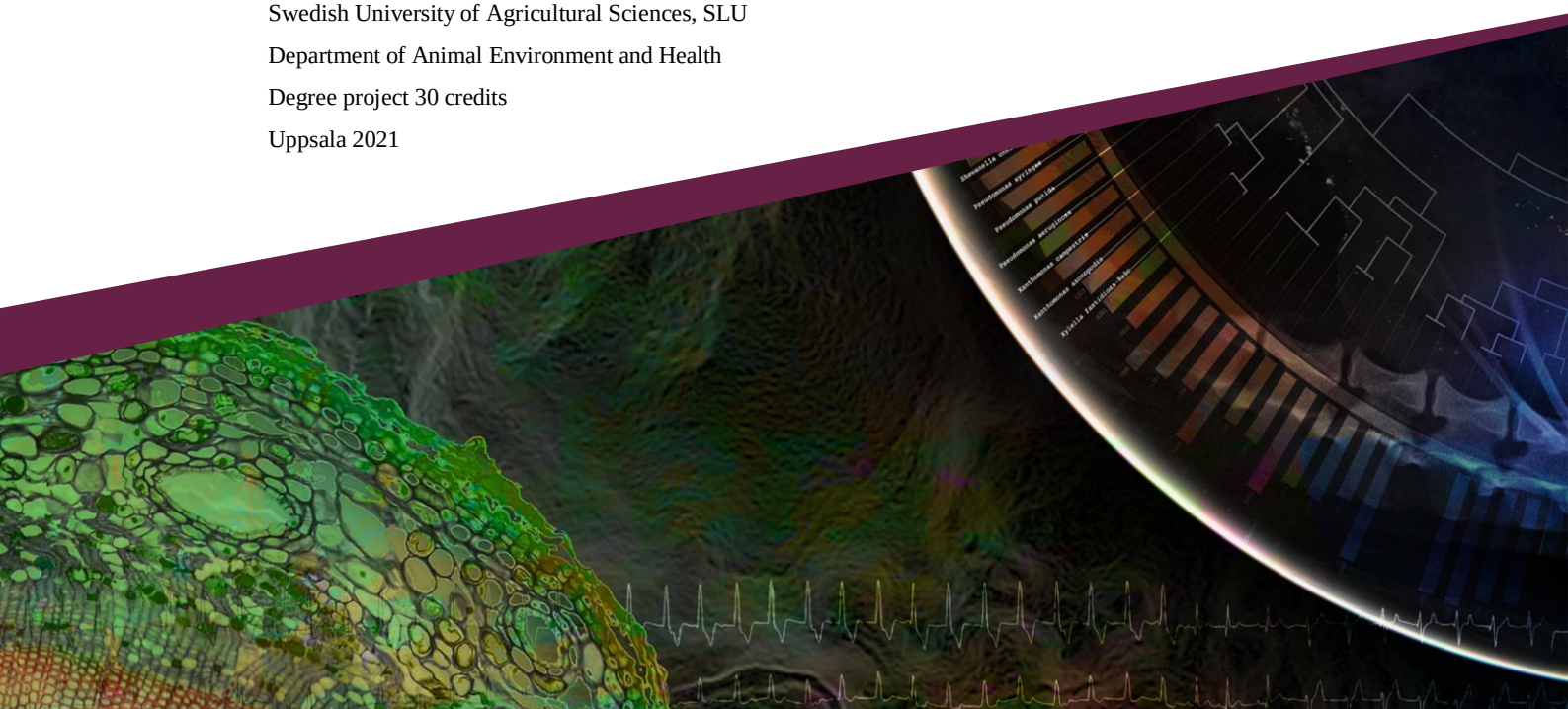
Department of Animal Environment and Health

Water consumption of cats (*Felis catus*)

A literature-based project with some preliminary data from a pilot study

Author's name: Faria Alipourmazandarani

Swedish University of Agricultural Sciences, SLU
Department of Animal Environment and Health
Degree project 30 credits
Uppsala 2021



Water consumption of cats

Author's name: Faria Alipourmazandarani

University, Department: Swedish University of Agricultural Sciences, SLU
Department of Animal Environment and Health

Supervisors: Anna.Lundberg & Hanna.Lindqvist
Department: Animal Environment and Health

Examiner: Therese Rehn
Department: Animal Environment and Health

Credits: 30 credits
Level and specialised study: Advanced A2E
Course title: Degree project in Animal Science
Course code: EX0870
Programme: Independent project

Keywords: Ethology, owner, food, housing, indoor, outdoor, questionnaire

Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Faculty of Veterinary Medicine and Animal Sciences
Department of Animal Environment and Health

Abstract

The main objective of this project was to investigate water intake habits of Swedish cats. A survey undertaken in this research include information of age, breed, health and food type of cats and correlate that to the 5-day trial of measuring water intake of cats from the water bowl (by weighing the water bowl twice a day). Also, other parameters such as housing, water serving type and their effect on the water intake of cats is discussed. Instructions for measuring water consumption of cats were distributed to four cat owners and the answers from the survey were compared to earlier research results. Responses and data analysis showed that the water intake from the water bowl was lower than the estimated water requirement of these four cats. Other water resources like water from outside or from other indoor sources like sink or glass of water or through their food was not measured, but probably contributed to fulfil water requirement of the cats in this study. The survey showed that the water intake differed between day and night, some cats drank more water during the day and some at night. How often the water bowl was cleaned and where water was served are factors that might influence water intake, factors to be aware of to encourage the cat to drink more water if necessary. Furthermore, this report also thoroughly explained the available literature related to cat's water intake and its relationship to food, hygiene, and most common diseases i.e., urinary tract disease and chronic kidney disease

Keywords: Ethology, owner, food, housing, indoor, outdoor, questionnaire

Table of contents

1. Introduction

The history of cat's date back to 10.8 million years ago in Southeast of Asia (O'Brien & Johnson, 2007). Under the skin, all cat's species are similar to each other, big cats (lion), midsize cats (tiger's) and small cats (domestic cats) (O'Brien & Johnson, 2007). Cats are carnivores and nocturnal animals, also scientists believe that felines have evolved as a desert creature (Wilting *et al*., 2016; MacDonald *et al*., 1984). This characteristic of the cats enables them to survive with less drinking water. If we compare cats' feeding patterns with dogs, cats rely on their food for attaining adequate amount of water, whereas dogs drink more water (MacDonald *et al*., 1984). Cats have lower sensitive reaction to thirst and dehydration than omnivores (Zoran, 2002). Cats also regulate their water intake based on type of their food (Zoran, 2002). Cats eating dry food usually drink more water than cats eating wet food as the wet food supply more water by the food (Zoran, 2002). Eating canned food increase water intake and urine volume of cats, decline the concentration of uroliths-forming minerals in urine (Zoran, 2002). Thus, water intake through various sources is essential for cats to maintain a good metabolic and physiological function. However, the question of "do domestic cats need to drink water beside their food" remains to be answered. There is plenty of information describing the water intake and drinking habit of domestic cats as well as correlating the water intake of cats to their health in the previous studies. The literature review about these topics is summarized herein.

Moreover, the effect of food type (dry, semi-moist, wet) on drinking water habits of cats have been discussed in various studies (Little, 2011). Different components of cats' diet such as protein, carbohydrate, fat and sodium influence water intake and health and could have an impact on total water intake (Little, 2011). This is also described in the literature review.

The main aim of this project was to study the water intake of Swedish domestic cats with preliminary results from a pilot survey study. Another aim was to learn more about the drinking habits, water need of cats and the relationship to food type, water serving and hygiene.

2. Literature review

2.1. Water intake

Water requirement and intake in cats is affected by weather, food and activity (Buffington, 2002). Water is considered as the most essential foodstuff for mammals as it is a medium for metabolic waste removal and is responsible for multitude of physiological functions (Zanghi, 2017). The body water compartment of a cat is a constant flux (Zanghi, 2017). Thus, the regulation of water balance and thirst-driven water intake are essential to compensate the continuous evaporation of water through the cat's skin surface, inhalation and water loss via their saliva, feces and urine (Zanghi, 2017). Assessments of daily water requirement of the cats have been stated in study by Zanghi (2017). Three different methods are generally used to estimate the daily water requirement of cats: 1) mL/ME kcal ingested (water/calorie intake ratio); 2) mL/kg body weight (BW); and 3) mL/kg dry matter ingested (National Research Council, 2006). A cat needs approximately 50-60 ml of water for one kilogram of body weight (National Research Council, 2006). For example, if a cat is 4 kg in weight, approximately 200-240 mL of water or one cup of water is required per day for the body to function properly. However, it is emphasized that the total water requirement can be obtained from the combination of metabolic water, ingestion of water as food moisture and free water from drinking (Zanghi, 2017). Metabolic water is achieved by the oxidation of macronutrients like carbohydrates, fats and protein (Zanghi *et al*., 2018).

It is reported that the total body water (TBW) among adult cats is within a wide range of 52-67% of their BW (Zanghi *et al*., 2013). In general, there are reasons to believe that the water intake of domestic cats is not covering the need of the cat since several health problems in cats are correlated to insufficient water intake (Little, 2011). Increasing the voluntary water intake has been a management strategy to limit the appearance of various diseases among cats (Buckley *et al*., 2011). This includes diseases like urinary tract disease or chronic kidney disease (Buckley *et al*., 2011). Different strategies have been done to improve the water intake of cats such as enhancing the moisture content of the food in their diet,

increasing the dietary salt or using the fresh water by aid of dynamic water sources (Buckley *et al*., 2011). Dynamic water sources are different shapes of water bowls i.e., free-falling bowls or circulating bowls (Robbins *et al*., 2019). Also, it has been suggested that using fountains or adding flavours to the water can increase the total water intake of cats (Grant, 2010). A study presented by Grant (2010) investigated the effect of different water sources (bowl or fountain) on the water intake and urine concentration in cats. Urinalysis including urine specific gravity and urine osmolality value were measured using an advanced Microosomometer instrument. Results showed an increase in water intake when drinking from a fountain compared to water bowl and this was experimentally proven by the dilution of urine and lower urine specific gravity and urine osmolality values (Grant, 2010). One study suggests that increasing the water intake of cats can be done by changing their diet components, by the addition of sodium to the diet (Forrester & Roudebush, 2007). A study by Nestlé Purina on healthy cats also demonstrated that drinking nutrient-enriched water would increase the amount of water intake that led to a urine dilution (Zanghi, 2017).

In addition, feed intake has a significant effect on the free drinking water intake of cats (Mendonça *et al*., 2018). If cats consume dry food, they drink more water and if they consume wet food, they drink less water (Zanghi, 2017). However, cats have different preferences towards dry or wet food intake (Westropp & Buffington, 2004).

2.1.1. Water serving

There are different types of water serving used to provide water for cats such as water bowls (still) and water fountains (running water). According to a study published in 2010, cats are more interested to drink from a flowing water source instead of still water (Pachel & Neilson, 2010). Use of water fountains instead of water bowls could increase water intake (Burger & Smith, 1987). This is possibly explained by the form and shape of water fountain (running water) that encourage cats to play and drink (Grant, 2010). However, changing water bowl to water fountain might not always lead to higher water intake (Grant, 2010). Cats have different preferences in drinking water as well as drinking fresh or old water. Water fountain might not be a pleasant source of water for some cats and these cats may even decrease their water intake if their bowl is exchanged for a fountain. In addition, an increase in water intake of cats that are drinking out of fountain might be due to their feed intake and diet, and not the water source type (Grant, 2010). Robbins *et al*. (2019) also stated that it is not feasible to conclude that certain types of water sources would increase the water intake of cats.

Furthermore, there are various water source types for cats other than bowl and fountain. A study investigated by Wooding & Mills (2007) showed that cats prefer running water as they can find it easier with their keen sense of hearing. Felines have poor ability to see the standing water in their bowl, thus, they prefer to use their sense of hearing than vision to find water (similar to their attraction to river and running waters in the wild). Another study reported that cats are capable of distinguishing between different water types, and in a study among shelter cats in the UK it was found that cats prefer to drink from tap water instead of purified water (Wooding & Mills, 2007). However, the reason for this distinction has not been systematically tested yet (Wooding & Mills, 2007). Some reports also mentioned the possibility of drinking from glasses in case of cats, possibly due to cats' dehydration or different preferences (Fritz & Handl, 2018).

2.1.2. Hygiene of water

It is recommended that both food and water served to cats to be clean (daily) and fresh to minimize the bacterial growth such as *Escherichia coli* (Odonkor & Ampofo, 2013). Quality of running water (fountain) is higher compared to still water (bowl) because of better circulation and oxygenation that minimize the bacteria growth (O'Malley, 2018). It is preferred that cats have their own water bowl and food bowl to limit the contamination and transmission of bacteria, also, separate bowls provide privacy for cats while eating and drinking if fed simultaneously (cats are inherently being solitary animals in nature) (Westropp & Buffington, 2004). Having clean water is important for cats to achieve a healthy organ structure (internal organs and skin), body moisture and a high body fluid level (Odonkor & Ampofo, 2013). Also, animals can adjust their body temperatures and reduce waste from their bodies via respiration, urine and sweat which requires that the animal is drinking adequate amount of clean water (Odonkor & Ampofo, 2013). Gastrointestinal disease in cat may occur from inadequate hygiene of water, unsafe water source or contamination of water with feces. Unclean water could contain parasites that cause diarrhea and intestinal bleeding (Srikullabutr *et al.*, 2021). According to a recent study in Indonesia, drinking water for cats needs to be changed every 12 hours, especially if the owner use tap water or have a longhaired cat (Srikullabutr *et al*., 2021). In this study, longhaired cats were shown to have a significantly higher risk of contaminating their water sources (coliform water contamination), due to the greater exposure of long hair to feces and dirt. In addition, this study showed that tap water is more likely to be contaminated by

bacteria such as *E. coli* and *Enterobacter spp*, compared to the processed (distilled) water (Srikullabutr *et al*., 2021).

2.1.3. Common diseases related to the water intake

In the field of animal science, many researchers have striven to improve the health of felines. Lower urinary tract disease (FLUTD) and urinary stone are common diseases in cats and preventions of these diseases by improving drinking habits of cats have become important strategies for a longer lifespan (Little, 2011). FLUTD is one of the most common health problems among domestic cats related to their water intake. FLUTD was discovered in 1925, and constitutes for approximately 25 % of total feline diseases treated in the veterinary hospitals in which 54-69% were caused by feline idiopathic cystitis (lower urinary tract disease without any obvious cause and hydration of cats has a significant effect on idiopathic cystitis), (Lund *et al*, 2016; Nururrozi *et al*., 2020). FLUTD is caused by different disorders like urolithiasis, infections, neoplasia, anatomical defects or iatrogenic and urethral plugs. Furthermore, different factors can influence FLUTD such as high amount of dry feed intake or exercise (i.e., lower water intake and low physical activity, respectively). There are also some other FLUTD cases without any clinical signs that are still unknown and require more research (Little, 2011). Cats with FLUTD often form bladder tumours, as a result of long exposure of carcinogenic chemicals in the urine (Little, 2011). FLUTD has a negative influence (bacterial infections) on urethra and bladder of the cats which cause pain while urinating, blood in urine or increase incidence of urination.

In urinary tract disease cats do not always show clinical symptoms such as pain while urinating, blood in urine, more frequent urination, urination outside the litter box, etc. Thus, diagnosis of FLUTD is suggested to be based both on physical examination of urine and clinical signs. Laboratory examination such as renal size or urinalysis (colour analysis of urine at different pHs) are the common procedures to determine the FLUTD in cats (Little, 2011). An increase in water intake amount might decrease the risk of FLUTD by increasing the urine volume (Kerr, 2013).

Chronic kidney disease (CKD) is another common disease among cats which is caused by blockage of urine or blood to or from the kidney (Bartlett *et al*, 2010). Maintaining a good fluid intake and an increase in water intake (by encouraging the cat to drink more water than the normal intake) would increase the urination and minimize the risk of CKD. According to a study in 2010, older cats are more sensitive to CKD than younger ones (Bartlett *et al*, 2010). The risk of CKD in cats over 12 years old is 28% and 30% among cats older than 15 years old (5.8% among

dogs) (Bartlett *et al*, 2010). CKD is irreversible and progressive and leads to azotaemia, uremia and kidney malfunction in cats. In this case, animals demonstrate clinical signs of body weight loss, low appetite, vomiting and consumption of an excessive amount of water. Also, the cat will have an increase in urine production (Bartlett *et al*, 2010). Based on the severity of the disease, it is possible for cats with CKD to remain stable for many years or die a few months after the diagnosis (Kuwahara *et al*., 2006).

Urinary stone is another common problem among cats consuming dry food or cats drinking low amount of water. In case of dry food with 10% moisture content (and if the cat would not drink enough water), the urine becomes more concentrated and is due to this more likely to form crystals and stones. To prevent cats from urinary stone disease, balancing of body fluid and exercise to increase body activity are considered as useful practices (Westropp & Buffington, 2004).

2.1.4. Food and water

Different types of food and their water contents have a significant effect on the total water intake of cats (Mendonça *et al*., 2018). The most common types of cat food are dry, semi-moist, and canned (wet). The moisture content of different types of food is ranging from 6-10% in dry food, 15-30% in semi-moist food, and 75% in canned food. Generally, canned food has the highest amount of fat and protein content and lower carbohydrate content, compared to the dry and semi-moist food (Pierson, 2013). By evolution, cats are adapted to fulfil most of their water needs from their diet (Pierson, 2013), as their normal prey in the wild contain 70–75% water e.g., a bird body have a water content of 65-70% of the total body mass (Ellis & Jehl Jr, 1991) and mice and rats have a water content of 67-72% of the total body weight (Annegers, 1954). Canned foods with 75% moisture content are more similar to the natural diet of cats and can meet their water needs. This might be the reason why most cats are more interested to consume wet food than dry food. It is also reported that the total water intake of cats consuming dry food is half of those consuming canned foods (Pierson, 2013). Inadequate water intake in cats could lead to kidney and bladder problems.

Domestic cats are fed different foods with various carbohydrate content (Mendonça *et al.*, 2018). Starch is a carbohydrate that causes a urine discharge and a reduction in the water intake of cats (Grant, 2010, Dijcker *et al*, 2011). Dry feed often has a high carbohydrate content and reduce the total water intake of cats (Mendonça *et*

al., 2018). It is reported that starchy and dry food are two factors affecting the formation of calcium oxalate stone in cats (Dijcker *et al.*, 2011). Canned and wet food (non-acidic food) are recommended to eliminate this the calcium oxalate stone issue due to high moisture content in wet or canned food (Dijcker *et al*., 2011).

Protein in cats' diet seem to increase water intake of cats (Mendonça *et al*., 2018, Paßlack *et al*., 2014, Mendonça *et al*., 2018). It is recommended to maintain high level of protein (over 35-40% of total calories) and fat level under 50% and carbohydrate level under 10% in the cat's diet to achieve a healthy animal with normal drinking habits (Pierson, 2013).

Cats are fed by wide different brands of prepared food (Anderson, 1982; Wei *et al*., 2011) and different food types provide different water contents for the animal, depending on their intake. For some cats, adding water to dry or wet food might stimulate the appetite and increase their total water intake (Buckley *et al*., 2011; Carciofi *et al*., 2005). According to a study in 2011, scientists discussed that feeding wet food with high water content to a cat may decrease body weight of the cats, as the cat needs more food to reach the energy requirement. Because water content lowers the energy density of food, due to the dilution upon addition of water (energy density is defined as the energy per gram of food). For example, one study mentioned that high water content in diet lowers the energy density of food and decrease the body weight of cats, especially in obese cats when fed *ad libitum* (Wei *et al*., 2011). Similarly, another study concluded that increasing the water content of cats' diet from dry food (1.5-2.0 ml water content in each gram) to canned food (75-80% water content) would decrease the energy intake (EI), and cause weight loss of the animal (cats consume lower dry matter (DM) and calories with canned food, compared to dry food) (Morris *et al*., 2006; Burger *et al*., 1978; Kane *et al*., 1981). However, it is mentioned that the weight loss by consumption of wet food is not always the case for cats, as most are able to regulate their food intake well (Wei *et al*., 2011). Thus, cats would eat more of the wet food than a dry food to cover the energy intake (Wei *et al*., 2011).

Cats usually eat 10-20 small meals per day and this amount is divided between day and night period, depending on their indoor/outdoor lifestyle (Rochlitz, 2009). Drinking habits of cats show that cats drink water both during day and night and there is no specific connection between the number of times they eat and drink (Kane *et al*., 1981).

2.1.5. Protein

It is necessary that the diet of the cat meet all nutritional needs of the animal including the minerals, vitamins and protein. Also, the amount of calorie intake per day should be calculated for cats. Minimum protein requirement for the cats is 4.96 g/kg BW to maintain an adequate muscle mass (National Research Council, 2006). Plus, moderate-high amount of protein intake in cats suffering from uroliths (calcium oxalate) is recommended to be a good treatment due to the increasing water intake and urinary volume when fed higher dietary protein concentration (Paßlack *et al*., 2014). Studies have also shown that high protein intake along with low fat concentration in the diet is beneficial for cats and decrease the concentration of urinary oxalate (oxalic acid which is ester or salt) (Zentek & Schulz, 2004).

2.1.6. Carbohydrate

Cats consume small prey in nature including birds and rodents (Zoran, 2002). These prey animals consist of high amounts of water and protein, minimal amount of carbohydrates and moderate amounts of fat (Plantinga *et al*., 2011). According to a study by Plantinga *et al*., (2011) composition of prey animal includes 46% crude fat, 52% crude protein and 2% carbohydrates of the total metabolisable energy (ME). Cats have low capacity for complex starch and carbohydrate digestion due to the limited activity of amylase enzyme, responsible for initiating the carbohydrate digestion and breakdown in cats (Kienzle, 1993). However, cats are able to digest simple sugars (Verbrugghe & Hesta, 2017).

Carbohydrate is not required in healthy adult cats' diet, but glucose is essential as their main energy source and is derived from protein in gluconeogenesis (Plantinga *et al*., 2011). Conventional dry and canned food for cats usually contain up to 55% (ME) carbohydrates, including a minimum of 25% (ME) protein and 20% (ME) fat, as suggested by The European Pet Food Industry Federation and American Association of Feed Control Officials (AAFCO, 2015; FEDIAF, 2017). In general, cats have greater needs of protein and fat than carbohydrate to fulfil their nutritional needs (Verbrugghe & Hesta, 2017).

2.1.7. Fat

Fat is a more efficient form of energy in comparison to carbohydrate and protein (Laflamme *et al*., 2011). For the complete digestion of fat in a cat's body, presence of different lipases and acids (co-lipase, lipase, phospholipase A2 in pancreas and bile acid in liver) are essential to break down the fat in the stomach (Zoran, 2002). It is possible that rather common intestinal mucosal damage disease causes an incomplete process of fat digestion in cats. In case of incomplete fat digestion, bacteria in the colon would ferment the undigested fat (Guilford, 1994). As a result, gastric inflammation will occur, and the cat will suffer from diarrhea (diarrhea cause fecal water loss and dehydration in cats) (Willard, 1999). It is mentioned that gastric inflammation commonly occurs in middle-aged to older cats (Willard, 1999).

Essential omega-6 fatty acids such as arachidonic acid and omega-3 has an important physiological effect in cat's body. Omega-3 is predominant in the cell membrane of tissues that are responsible for function and excretion of kidney (remove extra water from blood as urine) (Zoran, 2002). In conclusion, moderate amounts of fat (for example 15–25% fat, dry basis) is recommended for cats (Laflamme *et al*., 2011).

2.1.8. Sodium

High amounts of sodium intake can increase the amount of drinking in cats, but consuming high amounts of sodium in the diet in long term may cause different diseases that needs to be taken into account (Nguyen *et al*., 2017). The main electrolytes in the body fluids are sodium, potassium and chloride. The sodium level among adult mammals is approximately 0.13% of the body weight (National Research Council, 2006). According to a study by Kienzle *et al*. (1993) the total amount of sodium concentration in kittens are 1.9 g/kg BW and among adult cats are 1.4 g/kg BW. Nearly one-third of the total sodium content in the body is embedded in the integral structure of skeleton, which is not available for the fluid compartments (Goldman & Choure, 2010). The remaining amount of sodium in the body is distributed in the blood plasma (12%), fluid (29%), and a negligible amount in the collagenous tissues (Weaver, 2013). Any alteration in the concentration of plasma sodium in the body change the osmolality of plasma. Thus, body changes its regulations in physiological mechanism (by adjusting the water loss in the urine and water intake by drinking), in order to maintain a normal osmolality of plasma

(Nguyen *et al*, 2017). Thus, it is important for cats that are consuming sodium in the diet to have free access to water to regulate sodium concentration in the body (Nguyen *et al*, 2017).

Addition of sodium in the food of cats has been a controversial topic in the field of veterinary science (Nguyen *et al*., 2017). Veterinarians may change the amount of sodium level in cats' food if the animal is suffering from diseases such as cardiac problems (treated by lowering the sodium level), kidney failure (treated by lowering the sodium level) and urolithiasis (treated by increasing the sodium level) (Nguyen *et al.*, 2017). The minimum amount of sodium for cats is recommended to be 0.5 g/kg DM/day (310 mg/MJ ME) which is approximately 70–80 mg/kg body weight (Avolio *et al*., 1986). Also, FEDIAF (European Pet Food Industry Federation) did not establish the maximum amount of any nutritional for cats, but it is noted that sodium level more than 3.75 g/1000 kcal ME which means 895 mg/MJ ME will be safe for healthy cats (Nguyen *et al*., 2017).

Sodium appetite in animals means that they seek salted food or sodium solution rather than unsalted food or water (Nguyen *et al.*, 2017). However, Yu *et al*. (1997) conducted a study on 24 kittens with various sodium level in the body. Results showed that different sodium levels in kitten's body did not change kitten's choice of diet (Yu & Morris, 1997).

Although a high level of sodium content in the diet might increase the risk of some diseases in cats, it is not considered as a concern for healthy cats in the short term (as extra sodium is excreted in urine). High amounts of sodium intake in older cats might cause problems like high blood pressure or heart disease (Nguyen *et al*, 2017). For example, it is recommended that cats with CKD would be on a sodium restricted diet (Campese, 2014). CKD cause the loss of renal function reserve (due to reduced ultrafiltration capacity of kidney) and leads to a salt-induced hypertension, thus, decreasing the salt content in animal's food is considered a beneficial treatment for cats having this disease (Campese, 2014).

3. Method

A literature review was done to compare food, water serving and hygiene with our results in this study. The papers were found from google scholar through Swedish university of agriculture website by using the keywords cat, evolution, water intake, water serving, disease, and food. In this study, we prepared a questionnaire of 17 questions distributed to Swedish cat owners. The general questions were related to the age, sex, breed, neutering, indoor and outdoor access, appetite, medicine intake and health condition i.e., kidney and urinary disease of cats. The questionnaire also included questions about food. Besides, the questionnaire was designed for cat owners with one cat in the household since otherwise an individual measurement of the water intake would be difficult (see below). Both indoor and outdoor cats were included, but water intake was only measured by an indoor water bowl.

To study the water drinking habits of cats, owners were asked about the type of water bowl, the location of the water bowl in the house, drinking preference of the cat, cleaning and frequency of refilling the water, and drinking behaviour of cats (splashing and/or playing with water from the bowl). Cat owners were also asked to weigh the water bowl in the morning and evening for five consecutive days, to record the day and night water intake of cats. Water evaporation was also measured every day and night by weighing a separate bowl (control bowl) similar to the cat's water bowl (Figure 1) which was placed next to the cat's water bowl. A strainer or colander was utilized to cover the control bowl to hinder the cat to drink out of this bowl. All the results have been corrected for evaporation in this study. The results were compared to the previous literature and required water intake of cats as recommended by National Research Council (National Research Council, 2006).

Figure 1. The cat's water bowl to the left and the control bowl to the right.

3.1. Results

Four participants completed the questionnaire and these results were included in this report. Three cats were reported to be healthy and were not taking any medicine, one cat had a chronic teeth problem. One cat was male, three were females and all four cats were neutered. The breeds of the cats were reported to be mixed or unknown and the ages varied between 3-15 years old. Cats' body weights ranged between 3.5-5 kg. Two cats were both indoor and outdoor and the other cats were mostly indoors. None of the cat owners observed any abnormal behaviour in their cats or splashing water out of their water bowl. The cats also did not suffer from urinary tract or kidney disease.

All cats were fed a mixture of dry and wet food. Regarding the appetite of the cats, all cat owners mentioned that their cat has a normal appetite. Furthermore, one cat drank mostly outdoors, two cats preferred to drink from their water bowl and one cat was often seen to drink water from water glasses, plates, jugs, bathroom, wastes left behind and less from the water bowl (water bowl was cleaned and refilled every three days in this case). Three of the cats had their water bowl being cleaned every third day and one cat, every day. Two of the cats had their water bowl next to the food bowl and the other two cats had the water bowl apart (>2 meter) from the feeding bowl. The total average water intake was on average 37.5 g/day. The average amount of water intake from the water bowl during the daytime was 10.5 g and was 27.5 g during the night (detail of drinking water amount in day or night in 5 days of this study is reported in the appendix Figure A1 and A2). Three cats were drinking more at nights and one was drinking the same amount in day and night.

The total amount of water consumed from cat's water bowls per one day is shown in Figure 2. The cat with access to outdoor showed lower water intake from the indoor water bowl during the 5 days of this study.
Required total water intake based on the average body weight of cats in this study (50-60 mL/kg BW) was estimated, as recommended by National Research Council (2006). This value was compared to the total water intake of cats from their water bowl or food, in Table 1. The average estimated water requirement for cats in this study was calculated to 271.5 gram per day. Average daily measured water intake in this study ranged from 22 to 70 gram per day with an average of 37.5 gram per day. A brief estimate of food water intake was made from a random cat food manufacturer, to predict the approximate intake of water from food. The range of water intake from wet food were estimated to 48-209 gram per day and were 0.5-3 gram per day from dry food (average of 149.3 gram per day).

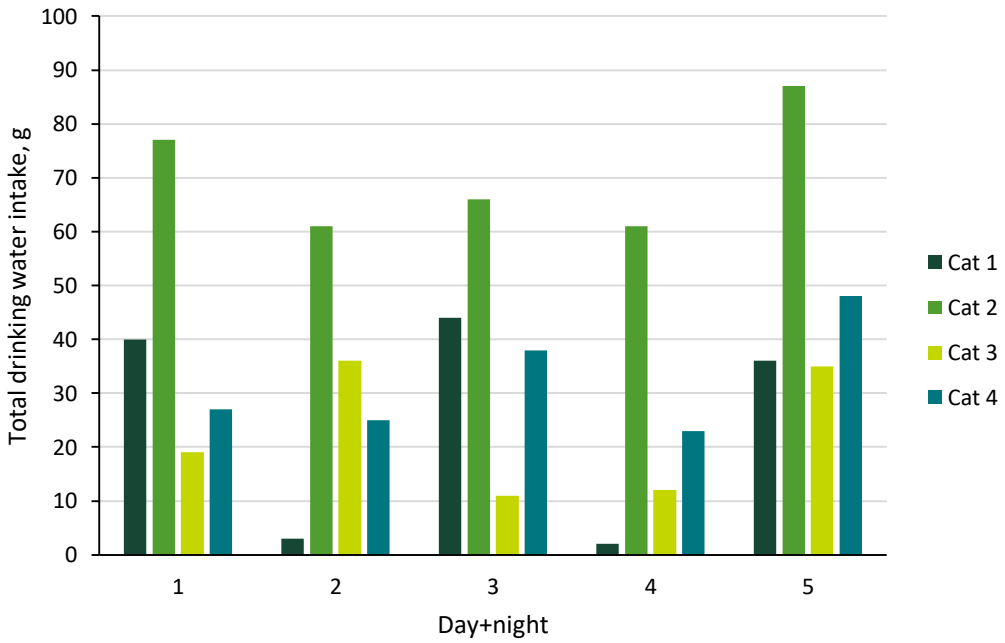


Figure 2. Total drinking water consumption (day +night).

Table 1. Body weight, required water, average total drinking water and estimated water intake from food.

Cats	Average body weight	Average required water (60g/ kg BW), g	Average total drinking water per day, g	Average assumed water intake from food, g
1-4	4.5	271.5	37.5	149.3

3.1.1. Discussion

The evolutionary background of cat as a desert animal plays an important role in the drinking behavior of cats. Cats satisfy their need of water mainly from ingested feed (Pierson, 2013). This could probably be a reason that cats in this study drank less water from the water bowl than their estimated need. Food type and water content is important and by eating dry food cats get less water compared to when eating wet food. If a cat has a common health disease like urinary tract disease or chronic kidney disease, it is important that cat owners serve more wet food instead of dry food to help the cat to ingest more water (Buckley *et al*., 2011). Besides, for encouraging the cats to increase their water intake, cat owners can clean the water bowl once/twice a day (Odonkor & Ampofo, 2013), adding more sodium to the food (Forrester & Roudebush, 2007) or using a water fountain (Grant, 2010).

Considering the freshness and hygiene of the water, it is recommended to change the water once a day or every 12 hours (Tabitha Kucera & CCBC, 2020). In this study, three cat owners reported that they changed the water in the bowl every third day and one cat owner changed the water every day. The average water intake for the cats with the water changed every third day was 33.8 g/day and the water intake for the cat that got fresh water every day was on average 22.6 g/day. In the literature, it is suggested that some cats prefer old water for drinking and do not like fresh water and perhaps this was the case for the cats in this study since the water intake was higher for the three cats where the water in the bowl were changed less often. On the other hand, this might be due to individual differences, possibly due to food or outdoor water resources and these three cats might have been drinking even more if their water bowl was cleaned and the water was changed more often. Furthermore, none of the cat owners provided more than one watering point, and the water bowl was placed next to the food bowl for two of the cats. According to Fritz & Handl (2018), cats generally prefer drinking water from bowls that are placed further away from their feed bowl. This can be a natural adaptation, a natural instinct in feline, as feeding and preying locations and water sources in the wild are not close to each other (Fritz & Handl, 2018). And if they are, old food might contaminate the water with bacteria and therefore not chosen to drink (National Research Council, 2006).

Previous reports indicated that the total water intake of cats consuming dry food is half of those consuming canned foods (Pierson, 2013). This was partly in agreement with the cat that consumed the highest amount of dry food and drank the lowest

amount of water from bowl herein (eating 80% dry food and drinking an average of 22 g/day). However, the mentioned cat had greater outdoor access and possibly consumed some water from other resources or preys. The age, the activity level, the breed, the sex and different health issues are some other factors that can influence the water intake but due to the low number of participants (and the fact that the questionnaire did not measure the activity or health precisely and asked based on the observation of owner), drawing any conclusions about the importance of these factors are not feasible.

In this study, we used this particular method to measure the exact amount of water intake in cats. Our result showed that drinking habits during daytime and night time differed between cats. Three cats seemed to drink more water at night and one cat drank more during day. An explanation to these observations might be that cats are nocturnal animals that are more active during nights (Robertson, 1998) and therefore drink more during night. However, there are several alternative hypotheses which could explain the difference in water intake between day and night. Perhaps cats in this study spent more time outside during daytime and therefore, showed a low water intake from their water bowl during day. Another explanation is that the cats preferred a quiet place without distraction when drinking water and the human activity was lower during night time. Besides, in the wild animal usually hunt and eat prey during night and this might influence the drinking patterns among domestic cats so they eat and drink more during night if they have free access. If cats are not given free access of wet food or if the wet food is only preferred when fresh, wet food might be consumed during daytime and then dry food is consumed during night time and this could be a reason why these cats drank more during the night. Plus, health, diet and food, physical activity, and environmental factors play a role to increase or decrease water intake of cats during day or night (Kane *et al*., 1981).

Intake of water from the water bowl and estimated food water intake of the cats in this survey do not seem to fulfil the cat's water requirement according to recommendations by the National Research Council (2006). Prey or water from outdoors or other indoor water sources or from food might have been consumed to fulfil the requirement. Activity, or temperature might also have influenced the cat's requirement (National Research Council 2006). Addition of water to the food can also help to increase the water intake for some cats (Buckley *et al*., 2011).

More in-depth discussion about the nutritional intake of cats and its correlation to water intake is not feasible in this study because the questionnaire did not ask about the nutritional composition of cat's diet. Generally, as presented in the literature review, an appropriate amount of fat, sodium and carbohydrate is needed to have healthy cats. For example, high sodium intake causes increase water intake of cats

but should not be used for a long time because it leads to different diseases connected to blood pressure or heart disease for the cats (Nguyen *et al*, 2017). Also, a feed with high starch (carbohydrate) can decrease water intake and high protein intake cause an increased water intake (Grant, 2010, Dijcker *et al*, 2011; Mendonça *et al*., 2018). So, if a cat has a problem due to low water intake, the cat owner can choose a food type with high a content of protein and low content of carbohydrate. Furthermore, cat owners should have enough knowledge about appropriate feed composition of cat's diet because an unbalanced diet can cause health problems and common diseases for their cat. In this study, we do not know how much food the four cats were given by the owner and if the cats ate any prey animals so it is not possible to investigate if the protein requirements of each cat was fulfilled.

The questionnaire in this research was designed to collect background information of each cat such as age, weight of cats, water serving, if the cat had access to indoor and/or outdoor areas. In addition, the cat owner got instructions how to measure the amount of consumed water during day and night through weighting the water bowl on a regular basis (every 12 hour). Even though the questionnaire was published in different groups on Facebook no participants were found this way. Instead, the four cat owners participating in this study were all friend and colleagues. A reason to the low number of cat owners found might be that it was limited to people with only one cat and no other animals in the household to be able to measure individual water intake. Another factor might be the need of a scale for sufficient accuracy. To get a reliable measure of water intake cat owners were asked to weigh the bowls during five days which could be seen as a great work effort and a discouraging task.

Another disadvantage with this study is that we relied on the cat owners for weighing the water bowls, registration and reporting data. Also, that the answers about the cat is dependent on the honesty and the knowledge of the cat owner. The literature review section of this study includes the most investigated topics relevant to water intake of cats from studies conducted in 1954 to 2021 and there was a lot of literature in this field for improving the knowledge of people. FLUTD and CKD were the most frequently observed diseases related to water intake. High levels of protein 35-40% and fat level under 50% and carbohydrate level under 10% of total calories shown to be the optimum diet condition to maintain a normal water habit among cats. However, more detailed studies are needed about distances between food bowl and water bowl.

Cats have a special place in Swedish society because of their role of companionship and easy maintenance. Ethical consideration and standards in the care of cats, especially cats kept in the laboratory for research, is evaluated in the publication of "*Guide for Laboratory Animal Facilities and Care"* (Animal care panel US, 1963). From social and ethical point of view, pet is a group of animals with no

economical profit which morally separate them from other animals that are raised for food/profit purposes (Pierce, 2016). In addition, pets are not eaten but they feed our souls. The relationship of people with pets are similar to the members of a family and affiliative with a strong bond (between owner and animal) (Pierce, 2016). The pet industry provides a social circumstance to value pet keeping (Pierce, 2016). The key reason for people who seek pets is the psychological aspects and companionship, meaning that pet animal makes people satisfied and happy. Also, another ethical aspect of keeping cats as pet might include increasing the owner's knowledge about cats so that owners can take care of their cats in a proper way. Ethical way of taking care of cats include knowing the specific needs of cat, consider life from cat's perspective, owner's willingness to change and learn, and lower the environmental impact (Neville, 2004). In addition, in this particular project, the ethical aspect of research on water consumption of cats would be to provide different water sources around the house because different cats might prefer different water resources depending on time, day, month, temperature, water quality etc. Ethical aspects of the experiments conducted in this project might not have a significant influence on the cat but it might have made it harder for the cat to find alternative water resources such as glasses or shower around the house since the owner might have taken these away during the study. The concluding ethical aspect of this research is to ensure that cats are served with the sufficient amount of water that they need. An advantage with this study is that the cat owners that participated in this study became aware of the drinking habits of their cats, they learned more about their cats needs and hopefully got more interested in learning the behaviour of their cats.

A more detailed study needs to be conducted in the future to determine the relationship between the time spent outdoor/indoor to the drinking habits of cats in detail. The author also recommended that indoor cat owners to weight the daily food intake in the future survey to make it possible to correlate the food and drinking habits of cats. Other contributing factors such as hair type of cat (longhair, shorthair), brand of food, exact composition of dry and wet food i.e., protein, carbohydrate and fat content of food and their effects on the drinking habit of cats need to be reported precisely to make a thorough conclusion in future studies. Other future improvements on this topic can include a longer experimental trial period for higher reliability of measurements. Author also suggest a wider distribution of questionnaire to various areas with different climates, to provide thorough information of cats living in different parts of Sweden could. Also, this study could be done instead of this study because of more data collection. A suggestion to find more participants is to collaborate with veterinarians as well as provide these cat owners with a scale. Besides, providing the questionnaire in social media such as Instagram, LinkedIn, university website, or hard copy paper prints on the walls and

a reward for participant is expected to increase the number of participants of results in future studies

3.1.2. Conclusion

In this report, we have not sufficient information to make any conclusion about the drinking habit of Swedish cats. In general, results from the questionnaire indicated that all cats drank less from water bowl compared to the water requirement of cats which suggest that these cats fulfilled their need of water by drinking outdoor, from food or prey animals or other water resources indoor such as sink, glass of water etc. Also, cats prefer to drink more water during night but it depends on food and having access to indoor and outdoor. The literature show that cats rely on their feed for achieving adequate amount of water and this is important facts for cat owners, especially if their cat has health issues that are improved by a higher water intake. Nevertheless, further research is needed in this field on a larger scale to correlate more factors to the water intake of Swedish cats.

4. References

AAFCO, 2015. AAFCO official publication.

Anderson, R.S., 1982. Water balance in the dog and cat. Journal of Small Animal Practice, 23(9), pp.588-598.

Animal Care Panel (US). Animal Facilities Standards Committee, 1963. Guide for laboratory animal facilities and care (No. 1024). US Department of Health, Education, and Welfare, Public Health Service.

Annegers, J., 1954. Total body water in rats and in mice. Proceedings of the Society for Experimental Biology and Medicine, 87(2), pp.454-456.

Avolio, A.P., Clyde, K.M., Beard, T.C., Cooke, H.M., Ho, K.K. and O'Rourke, M.F., 1986. Improved arterial distensibility in normotensive subjects on a low salt diet. Arteriosclerosis: An Official Journal of the American Heart Association, Inc., 6(2), pp.166-169.

Bartlett, P.C., Van Buren, J.W., Bartlett, A.D. and Zhou, C., 2010. Case-control study of risk factors associated with feline and canine chronic kidney disease. Veterinary medicine international, 2010.

Buckley, C.M., Hawthorne, A., Colyer, A. and Stevenson, A.E., 2011. Effect of dietary water intake on urinary output, specific gravity and relative supersaturation for calcium oxalate and struvite in the cat. British journal of nutrition, 106(S1), pp. S128-S130.

Buffington, C.T., 2002. External and internal influences on disease risk in cats. Journal of the American Veterinary Medical Association, 220(7), pp.994-1002.

Burger, I.H. and Smith, P.M., 1987. Effects of diet on the urine characteristics of the cat. In Proceedings. International Symposium on Nutrition, Malnutrition, and Dietetics in the Dog and Cat (pp. 71-73).

Burger, I.H., Anderson, R.S. and Holme, D.W., 1978. Nutritional factors affecting water balance in the dog and cat. In Nutrition of the dog and cat: proceedings of the International Symposium on the Nutrition of the Dog and Cat, arranged by the Institute of Animal Nutrition in conjunction with the 200-year anniversary of the Veterinary School, Hannover, 26 June 1978/editor, RS Anderson.--. Oxford; New York: Pergamon Press, 1980.

Campese, V.M., 2014, September. Pathophysiology of resistant hypertension in chronic kidney disease. In Seminars in nephrology (Vol. 34, No. 5, pp. 571-576). WB Saunders.

Carciofi, A.C., Bazzoli, R.S. and Zanni, A., 2005. Influence of water content and the digestibility of pet foods on the water balance of cats. Braz J Vet Res Anim Sci, 42, pp.429-434.

Dijcker, J.C., Plantinga, E.A., Van Baal, J. and Hendriks, W.H., 2011. Influence of nutrition on feline calcium oxalate urolithiasis with emphasis on endogenous oxalate synthesis. Nutrition research reviews, 24(1), pp.96-110.

Ellis, H.I. and Jehl Jr, J.R., 1991. Total body water and body composition in phalaropes and other birds. Physiological zoology, 64(4), pp.973-984.
Forrester, S.D. and Roudebush, P., 2007. Evidence-based management of feline lower urinary tract disease. Veterinary Clinics of North America: Small Animal Practice, 37(3), pp.533-558.
Fritz, J. and Handl, S., 2018. The water requirements and drinking habits of cats. Veterinary Focus, 28(3), pp.32-40.
Goldman, J. and Choure, G.S., 2010. Metabolic Disturbances of Acid–Base and Electrolytes. In Critical Care Study Guide (pp. 691-713). Springer, New York, NY.
Grant, D.C., 2010. Effect of water source on intake and urine concentration in healthy cats. Journal of feline medicine and surgery, 12(6), pp.431-434.
Guilford, T., 1994. " Go-slow" Signalling and the Problem of Automimicry. Journal of Theoretical Biology, 170(3), pp.311-316.
Kane, E., Rogers, Q.R. and Morris, J.G., 1981. Feeding behavior of the cat fed laboratory and commercial diets. Nutrition Research, 1(5), pp.499-507.
Kerr, K.R., 2013. Companion Animals Symposium: dietary management of feline lower urinary tract symptoms. Journal of animal science, 91(6), pp.2965-2975.
Kienzle, E., 1993. Carbohydrate metabolism of the cat 1. Activity of amylase in the gastrointestinal tract of the cat 1. Journal of Animal Physiology and Animal Nutrition, 69(1-5), pp.92-101.
Kienzle, E., 1993. Carbohydrate metabolism of the cat 2. Digestion of starch 1. Journal of Animal Physiology and Animal Nutrition, 69(1-5), pp.102-114.
Kienzle, E., Stratmann, B. and Meyer, H., 1991. Body composition of cats as a basis for factorial calculation of energy and nutrient requirements for growth. The Journal of nutrition, 121(suppl_11), pp. S122-S123.
Kuwahara, Y., Ohba, Y., Kitoh, K., Kuwahara, N. and Kitagawa, H., 2006. Association of laboratory data and death within one month in cats with chronic renal failure. Journal of small animal practice, 47(8), pp.446-450.
Laflamme, D.P., Xu, H. and Long, G.M., 2011. Effect of diets differing in fat content on chronic diarrhea in cats. Journal of veterinary internal medicine, 25(2), pp.230-235.
Little, S., 2011. The Cat-E-Book: Clinical Medicine and Management. Elsevier Health Sciences.
Lund, H.S., Sævik, B.K., Finstad, Ø.W., Grøntvedt, E.T., Vatne, T. and Eggertsdóttir, A.V., 2016. Risk factors for idiopathic cystitis in Norwegian cats: a matched case-control study. Journal of feline medicine and surgery, 18(6), pp.483-491.
MacDonald, M.L., Rogers, Q.R. and Morris, J.G., 1984. Nutrition of the domestic cat, a mammalian carnivore. Annual review of nutrition, 4(1), pp.521-562.
Mendonça, F.S., Pedreira, R.S., Loureiro, B.A., Putarov, T.C., Monti, M. and Carciofi, A.C., 2018. Hydroxyproline and starch consumption and urinary supersaturation with calcium oxalate in cats. Animal Feed Science and Technology, 246, pp.72-81.
Morris, J.G., 2002. Idiosyncratic nutrient requirements of cats appear to be diet-induced evolutionary adaptations. Nutrition research reviews, 15(1), pp.153-168.

Morris, P.J., Calvert, E.L., Holmes, K.L., Hackett, R.M. and Rawlings, J.M., 2006. Energy intake in cats as affected by alterations in diet energy density. The Journal of nutrition, 136(7), pp.2072S-2074S.
National Research Council, 2006. Mineral tolerance of animals: 2005. National Academies Press.
National Research Council, 2006. Nutrient requirements of dogs and cats. National Academies Press.
Neville, P.F., 2004. An ethical viewpoint: the role of veterinarians and behaviourists in ensuring good husbandry for cats. Journal of feline medicine and surgery, 6(1), pp.43-48.
Nguyen, P., Reynolds, B., Zentek, J., Paßlack, N. and Leray, V., 2017. Sodium in feline nutrition. Journal of animal physiology and animal nutrition, 101(3), pp.403-420.
Nururrozi, A., Yanuartono, Y., Sivananthan, P. and Indarjulianto, S., 2020. Evaluation of lower urinary tract disease in the Yogyakarta cat population, Indonesia. Veterinary World, 13(6), p.1182.
O'Brien, S.J. and Johnson, W.E., 2007. The evolution of cats. Scientific American, 297(1), pp.68-75.
Odonkor, S.T. and Ampofo, J.K., 2013. Escherichia coli as an indicator of bacteriological quality of water: an overview. Microbiology research, 4(1), pp.5-11.
O'Malley, C.I., Staying Hydrated: Your Cat's Water Requirement.
Pachel, C. and Neilson, J., 2010. Comparison of feline water consumption between still and flowing water sources: A pilot study. Journal of Veterinary Behavior, 5(3), pp.130-133.
Paßlack, N., Burmeier, H., Brenten, T., Neumann, K. and Zentek, J., 2014. Relevance of dietary protein concentration and quality as risk factors for the formation of calcium oxalate stones in cats. Journal of nutritional science, 3.
Pierce, J., 2016. Run, Spot, run: The ethics of keeping pets. University of Chicago Press.
Pierson, L.A., 2013. Feeding Your Cat: Know the Basics of Feline Nutrition. Retrieved February, 2, p.2019.
Plantinga, E.A., Bosch, G. and Hendriks, W.H., 2011. Estimation of the dietary nutrient profile of free-roaming feral cats: possible implications for nutrition of domestic cats. British Journal of Nutrition, 106(S1), pp. S35-S48.
Robbins, M.T., Cline, M.G., Bartges, J.W., Felty, E., Saker, K.E., Bastian, R. and Witzel, A.L., 2019. Quantified water intake in laboratory cats from still, free-falling and circulating water bowls, and its effects on selected urinary parameters. Journal of feline medicine and surgery, 21(8), pp.682-690.
Robertson, I.D., 1998. Survey of predation by domestic cats. Australian Veterinary Journal, 76(8), pp.551-554.
Rochlitz, I., 2009. Basic requirements for good behavioural health and welfare in cats. In BSAVA Manual of canine and feline behavioural medicine (pp. 35-48). BSAVA Library.
Srikullabutr, S., Sattasathuchana, P., Kerdsin, A. and Thengchaisri, N., 2021. Prevalence of coliform bacterial contamination in cat drinking water in households in Thailand. Veterinary World, 14(3).
Tabitha Kucera, R.V.T. and CCBC, K., 2020 Keeping Your Cats Busy, Not Bored: Enrichment for Your Cat.

The European Pet Food Industry Federation (FEDIAF). 2017. Available online: http://www.fediaf.org/selfregulation/nutrition.html (accessed on 25 September 2017).
Verbrugghe, A. and Hesta, M., 2017. Cats and carbohydrates: the carnivore fantasy? Veterinary sciences, 4(4), p.55.
Weaver, C.M., 2013. Potassium and health. Advances in Nutrition, 4(3), pp.368S-377S.
Wei, A., Fascetti, A.J., Villaverde, C., Wong, R.K. and Ramsey, J.J., 2011. Effect of water content in a canned food on voluntary food intake and body weight in cats. American journal of veterinary research, 72(7), pp.918-923.
Westropp, J.L. and Buffington, C.T., 2004. Feline idiopathic cystitis: current understanding of pathophysiology and management. Veterinary Clinics: Small Animal Practice, 34(4), pp.1043-1055.
Willard, M.D., 1999. Feline inflammatory bowel disease: a review. Journal of feline medicine and surgery, 1(3), pp.155-164.
Wilting, A., Duckworth, J.W., Breitenmoser-Würsten, C., Belant, J.L. and Mathai, J., 2016. Distribution of and conservation priorities for Bornean small carnivores and cats. Raffles Bulletin of Zoology Supplement, 33, pp.1-217.
Wooding, B. and Mills, D.S., 2007. 10: Drinking water preferences in the cat. Journal of Veterinary Behavior, 2(3), p.87.
Yu, S., Rogers, Q.R. and Morris, J.G., 1997. Absence of a salt (NaCl) preference or appetite in sodium-replete or depleted kittens. Appetite, 29(1), pp.1-10.
Zanghi, B., 2017. Water needs and hydration for cats and dogs. Proceedings, Nestlé Purina Companion Animal Nutrition Summit. Vancouver, BC, pp.15-23.
Zanghi, B.M., Cupp, C.J., Pan, Y., Tissot-Favre, D.G., Milgram, N.W., Nagy, T.R. and Dobson, H., 2013. Noninvasive measurements of body composition and body water via quantitative magnetic resonance, deuterium water, and dual-energy x-ray absorptiometry in cats. American journal of veterinary research, 74(5), pp.721-732.
Zanghi, B.M., Gerheart, L. and Gardner, C.L., 2018. Effects of a nutrient-enriched water on water intake and indices of hydration in healthy domestic cats fed a dry kibble diet. American journal of veterinary research, 79(7), pp.733-744.
Zentek, J. and Schulz, A., 2004. Urinary composition of cats is affected by the source of dietary protein. The Journal of nutrition, 134(8), pp.2162S-2165S.
Zoran, D.L., 2002. The carnivore connection to nutrition in cats. Journal of the American Veterinary Medical Association, 221(11), pp.1559-1567.

5. Appendix

The complete description of 17 questions in questionnaire distributed among Swedish cat owners listed below:

Q1) Age of cat now?
Q2) Breed?
Q3) Please weight your cat by scale and describe:
Q4) sex?
Q5) How is your cat kept, indoor, outdoor or a mix?
Q6) Type of feed given to your cat?
Q7) How often do you feed your cat?
Q8) Please mention if your cat uses any medications?
Q9) Please describe if your cat has any previous history of urinary tract infections and any other health problem(s) if it has? In what age started?
Q10) How is the appetite of your cat?
Q11) How is your cat served water?
Q12) Please describe the location of water bowl?
Q13) Where is your cat served water?
Q14) How much water do you think your cat drink?
Q15) How often do you change water and clean the water bowl?
Q16) Does your cat lick or chew on itself more than you would expect?
Q17) Please mention any more information about water intake, feeding, indoor or outdoor behavior of your cat that you like to share.

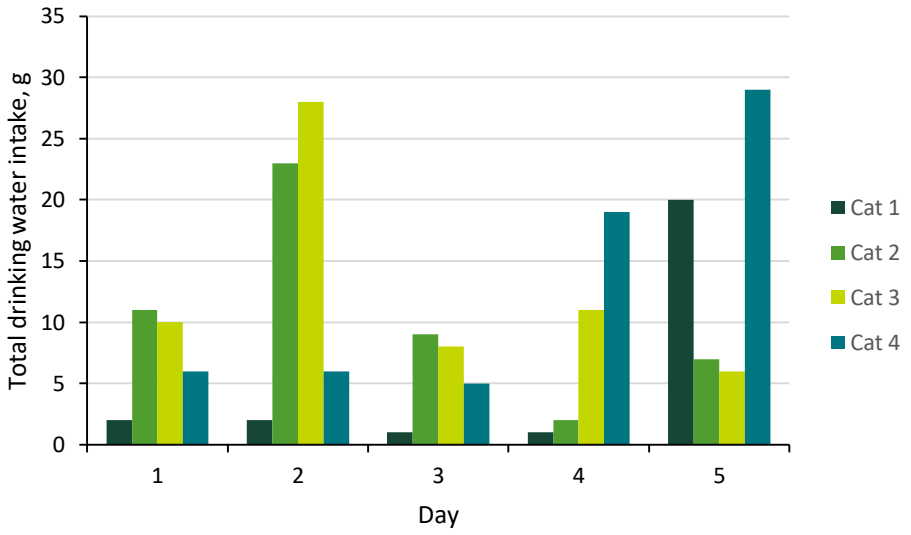


Figure A1. Total drinking water consumption of cats during the day.

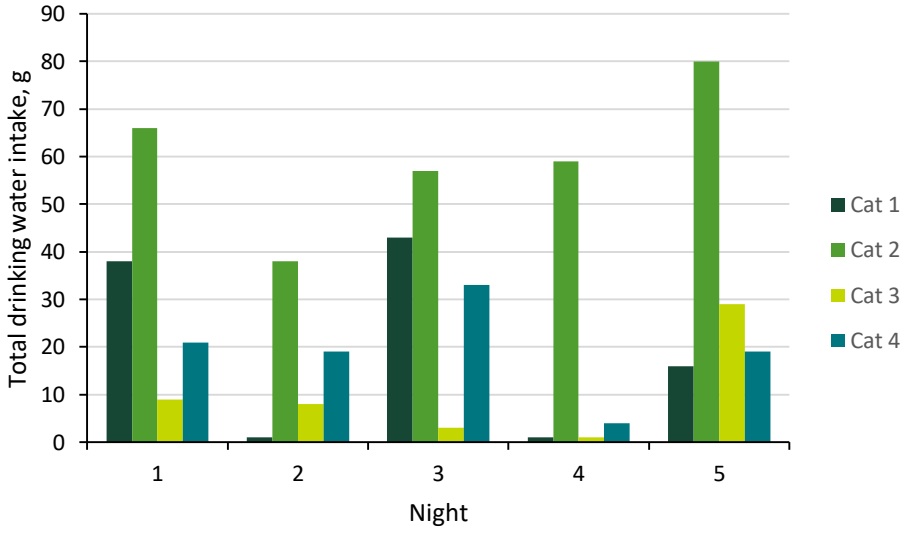


Figure A2. Total drinking water consumption of cats during the night.

6. Acknowledgements

I truly appreciate my supervisors, Anna Lundberg and Hanna Lindqvist for their support and help during the nine months of my previous course and master thesis.
I would like to thank my family for their support, love and positive energy throughout my study in the past two year. Although last year was a hard year for me and my family due to Covid-19 restrictions, they always sent their love and positive energy from a far distance. Without them I was not able to finish this route.

7. Popular scientific summary

Cats are desert animal that are less sensitive to thirstiness and hydration than dogs. Cats are more affected by the water content in their food. Dry food will provide low amount of water for cat's body if cats drink low amount of water. In the literature section, drinking water habits of cats, water serving type, food composition and various diseases relevant to water intake is discussed extensively. For domestic cats, drinking low amount of water can cause diseases like lower urinary tract disease (FLUTD) and chronic kidney disease (CKD). The clinical signs of cats that suffer from FLUTD is blood in urine/more frequent urination and cats suffering from chronic kidney disease is weight loss, vomiting and increased water intake.

In this study, we were interested to evaluate drinking habit of Swedish cats. Also, the effect of other factors like housing, age and food type on amount of water intake of cats. We made an online survey with weighing water bowl and water evaporation (control bowl) test and questionnaire. Also, we used social media, Facebook and email for advertising and distributing the survey. Cat owners used a digital household scale that shows the weight in grams for weighing bowls. Weighing each bowls was for 5 days each 12 hours (7 am and 7 pm). After weighing the bowls for 5 days, in day 6 cat owners enter the numbers in the survey web page and answered to the questions about their cat. We have received 4 answers from cat owners that completed the survey. The number of responses was not too high enough for statistical analyses or having clear conclusion from this survey. We calculated average water intake of cats during day and night and the amount of assume water intake from food as well as required amount of water. This calculation showed that all 4 cats drank less water from water bowl that is probably because of drinking water from outside or drinking water from other indoor sources like glass of water

or sink. Also, there was difference in drinking water of cats during day and night which possibly because of spending more time outside. It is recommended to the cat owners to encourage cats for drinking more amount of water. For example, everyday cleaning the water bowl or placing water bowl far from food bowl could be useful. Plus, using more wet food than dry food can provide sufficient amount of water for cats.

Publishing and archiving

Approved students' theses at SLU are published electronically. As a student, you have the copyright to your own work and need to approve the electronic publishing. If you check the box for **YES**, the full text (pdf file) and metadata will be visible and searchable online. If you check the box for **NO**, only the metadata and the abstract will be visible and searchable online. Nevertheless, when the document is uploaded it will still be archived as a digital file.

If you are more than one author, you all need to agree on a decision. Read about SLU's publishing agreement here: https://www.slu.se/en/subweb/library/publish-and-analyse/register-and-publish/agreement-for-publishing/.

☒ YES, I/we hereby give permission to publish the present thesis in accordance with the SLU agreement regarding the transfer of the right to publish a work.

☐ NO, I/we do not give permission to publish the present work. The work will still be archived and its metadata and abstract will be visible and searchable.