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The environmental impact of overfed cats in the Netherlands

Bachelor Thesis Human Geography and Planning

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Summary

This research examines the connection between the environmental impact and overweight of cats in the Netherlands. The environmental impact of people is something that has been discussed extensively for a long time. Nevertheless, the impact of pets such as cats remains hardly discussed. Food is the most critical contributor to a cat's environmental impact. It is estimated that 25 to 50% of cats in the Netherlands are already overweight, which has an even more significant impact on the environment. Therefore this study aims to assess if cat owners are willing to manage their cats' food intake and thereby limit its damage to the environment. The main question addressed in this study is: What factors influence a cat owner's willingness to prevent overfeeding to effectively reduce the environmental paw print? An answer to this question is provided by a literature study and primary collected data, obtained by a distributed questionnaire that recruited sixty-three cat owners. The data were then analysed, and a multiple linear regression was performed. The study found that the ecological paw print (EPP) of a cat's diet is between 4.46 and 7.80 ha for the entire lifetime, which results in 1690 to 2960 kg of carbon dioxide emissions. Furthermore, a cat's water paw print (WPP) is 85 m³ per year. Emerging from the questionnaire, the main reason given for feeding cats extra food or snacks, is that owners want to make the cat happy. Another reason outside the answers was that training cats could also be a reason to feed it a snack. A surprising result from this study is that most of the partaking respondents were unwilling to monitor the cat's food intake if this had to be done to lessen their cat's environmental impact, however most respondents were willing to do so out of health considerations. Contrary to previous studies, this research cannot conclude a linear relationship between the various factors discussed in this study and the willingness to manage cat food intake. A possible explanation for this difference is that previous studies mainly focus on preventing overweight in relation to the cat's health, while this study mainly focuses on preventing overweight to save the environment. However, this research has shown that cat owners may be more willing to manage food intake to the benefit of their pet's health rather than environmental considerations.

Table of contents

Summary	2
Introduction.....	4
Theoretical framework.....	5
The environmental impact	5
Causes of overfed cats.....	6
Preventing overweight	7
Adaptation to climate change	7
Conceptual model	8
Methodology	8
Data collection.....	8
Ethics	9
Analysis.....	9
Dependent variable	9
Possible explanatory variables	10
Reference category	10
Results	11
Descriptive statistics.....	11
Reasons for overfeeding cats	11
Multiple linear regression	12
Conclusions.....	13
References.....	14
Appendix.....	17
Questionnaire outline	17
SPSS output	24
Descriptive table.....	25

Introduction

Ecosystems are the engines of the planet and enable humanity to exist. However, ecosystems hugely depend on how humanity uses and cares for them (Revenga et al., 2000). Therefore, it is no longer a surprise that humanity itself is up for discussion in the rich debate about the increasing global environmental problems. Yet, the environmental impact of our pets have been much less discussed (Martens et al., 2019).

Research has shown that pet ownership brings physical, psychological, and social benefits to us, which is likely to be why more than half of all households worldwide own a cat or dog (Alexander et al., 2020; Satriajaya, 2017). Although, more and more attention is being paid to the fact that pets compete for food and its impact on land usage. In addition, greenhouse gas emissions from these animals are considered a serious cause of global warming (Leenstra et al., 2011). Multiple studies have shown that the most prominent part of our pets carbon footprint can be traced back to the food they need (Herrera-Camacho et al., 2017; Martens et al., 2019; Satriajaya, 2017).

Even though a large part of pets' environmental impact comes from food, there is also an emerging trend in food consumption known as obesity and overweight. Obesity is not only a human problem, but also one affecting our pets (Graas, 2016). The environmental impact of pets is highly dependent on the weight and size of the animal. As can be concluded from the increasing number of overweight pets, these animals receive too much food, making their environmental impact even more noticeable (Graas, 2016; Herrera-Camacho et al., 2017; Satriajaya, 2017). In the Netherlands, there are approximately 2,3 million cats, and an estimated 25 to 50% of Dutch cats already appear overweight (Courcier et al., 2010a; Graas, 2016; Zalk, 2020; Dibevo, 2020). Overweight cats are 10 to 19% above the ideal weight, while obese cats are at least 20% above the ideal weight (Courcier et al., 2010a; Timmer, 2019). In contrast to the negative effects of having pets, Marents et al. (2019) explain that people with pets are generally healthier than people without pets. Moreover, people with pets are said to be more involved in animal welfare and human problems. This suggests that people with pets are more likely to care for the environment had they known it to be better for animal welfare or human problems such as climate change. Rather than the radical solution of encouraging the reduction of the actual pets, an option might be to encourage cat owners to give cats the proper nutrition they need rather than too much nutrition.

By maintaining an ideal body weight and avoiding overfeeding, the environmental impact can be reduced. The environmental impact of cats is now even more relevant than ever as the demand for pets has skyrocketed due to the COVID-19 pandemic, as pets can provide the social support many people currently need (Lieshout & Zwaan, 2020). Therefore, it is important to investigate whether people are willing to avoid overfeeding to limit the environmental impact of their cat and which factors influence this willingness. Consequently, this study investigates which factors influence the willingness to monitor cats' food intake to limit their impact on the environment in the Netherlands. The research objective is achieved by answering the following research question:

What factors influence a cat owner's willingness to prevent overfeeding to reduce the environmental paw print?

This will be answered by the following three sub-questions:

1. What is the effect of food on the ecological and water paw print of cats?
2. What are the reasons for pet owners to feed their cat more than necessary?
3. Are cat owners willing to manage their cat's food intake to spare the environment, and what factors influence this?

This paper is structured in the following way. First, a literature review will emphasise the environmental impact of cats and cat food as well as various studies that explain factors that create overfed cats. This paper will also discuss factors playing a role in changing feeding patterns. The literature review aims to give some preliminary answers to the sub-questions. This will be followed by the paper's methodology, leading to the results of the primary data analysis. In addition, it is examined whether the primarily collected data can be an addition to the theoretical explanation of why pet owners give their cats more food than necessary. Finally, concluding remarks will be made regarding the research questions, limitations of the research and future research possibilities.

Theoretical framework

The environmental impact

The environmental impact of cats can be understood using the concepts: ecological- and water footprint. Hoekstra and Hung (2002) introduced the water footprint concept, subsequently elaborated by Chapagain and Hoekstra (2004). It refers to an analogue of the ecological footprint concept, introduced in the 1990s, which indicates the area in hectares needed to sustain a population. The water footprint represents the required volume of water in cubic meters per year required to sustain a population (Chapagain et al., 2006). The ecological paw print (EPP) and the water paw print (WPP) are the indicators for assessing the impact of companion animals on the environment (Alexander et al., 2020; Martens et al., 2019).

Several studies conclude that most of our cats ecological and water paw prints are made up mainly from catfood (Herrera-Camacho, 2017; Satriajaya, 2017; Su & Martens, et al., 2018; Leenstra, et al., 2011; Alexander et al., 2020). The water paw print consists of the water drunk directly by the cat and the water needed for food production. In effect, the water paw print is most dependent on the water needed for food. The average water paw print of a cat is 85 m³ per year (Satriajaya, 2017). This, in turn, is most dependent on the amount of food the cat eats and the percentage and type (fresh or dry meals) animal content in the food. A cat's average annual food intake is estimated at 98 kg per cat, and the average percentage of animal content in the food at 50% (Alexander, et al., 2020). The ecological footprint is calculated in the number of hectares of land needed, but the calculated required annual ha differs per study (Chapagain et al., 2006). For example, Su and Martens' study (2018) indicates that the number of ha required to produce food for the average cat during its entire lifetime is between 4.46 and 7.80 ha. This calculation is based on an average lifespan of 14 years. As a result, the average EPP per year is approximately between 0.3 and 0.6 ha. However, Leenstra et al. (2011) calculated the required land use for a cat per year, which came out at 0.1 ha.

Apart from the ecological and water paw print, another indicator of the environmental impact of cats is the emission of greenhouse gases. Carbon dioxide equivalent (CO₂e) describes different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO₂e signifies the amount of CO₂, which would have the equivalent global warming impact (Brander & Davis, 2012). For humans, the annual emission of greenhouse gasses, according to Leenstra et al. (2011), increases by 10 percent when this individual became responsible for feeding a cat because the annual CO₂e for cats has been calculated to be respectively 411 kg per year. Yet, this differs enormously from Su and Martens (2018), who also calculated the EPP of cat food. Their research shows that an average-sized cat is responsible for between 1690 and 2960 kg of Co₂e throughout its life (assuming a cat lives 14 years) and between 120 and 210 kg per year. The different results of the studies may be due to different average amounts of food or different percentages or types of animal content in the food used in the calculation. In addition, the difference between the studies may also be because Leenstra et al. (2011) has

researched cats in Europe and the US and Su & Martens (2018) into cats in Japan. Since many cats are overfed, data on feed consumption may be underestimated.

Causes of overfed cats

People are mainly responsible for the footprint they leave behind with their diets by choosing what and how much to eat. Unlike humans, pets cannot adjust their consumption rate or choose what food to consume. Thus, the decision to reduce the environmental impact through nutrition is in the hands of pet owners to provide the right amount of pet food and choose the best ingredients for both pets and the environment (Satriaajaya, 2017). Due to the growing knowledge that pets' meat-based diet contributes negatively to the environment, some pet owners, usually already vegetarian or vegan themselves, are considering allowing their pet to eat only vegetarian food (Knight & Leitsberger, 2016). However, cats cannot synthesize some essential nutrients found mainly in animal products. Therefore the risk of nutritional deficiencies is higher with vegetarian food, with the result that cats cannot be on a completely vegetarian or vegan diet without compromising their health status (Wakefield et al., 2006).

Cat owners are responsible for providing a healthier amount of pet food to reduce the negative consequences for the environment. Nevertheless, some cats get too much food (Graas, 2016; Pretlow & Corbee, 2016; Zalk, 2020). Just like humans, animals are also overweight due to overeating and too little exercise. An animal that does not move enough and consumes more than is required is left with surplus energy (LICG, 2010). According to the Dutch Food Industry Companion Animals (NVG) (n.d.), giving snacks causes overweight pets. Also, the frequent feeding of meal leftovers, such as a piece of cheese or cake, can lead to weight gain (NVG, n.d.)

A reason for overfeeding cats is that pet owners may tend to "humanize" their pets and feed them on a similar diet to their own (Sloth, 1992). Unlike humans, for whom eating is a social function, cats have no inherent need for social interaction during feeding time. When a cat makes contact, owners often assume they are hungry and ask for food. However, when fed after contact, the cat soon learns that initiating contact results in a food reward (German, 2016). Pretlow & Corbee (2016) argues that pet obesity is primarily caused by pet owners feeding their animals extra with the reason to receive affection in response (Pretlow & Corbee, 2016). Next to these reasons mentioned above for overfeeding, Russel et al. (2000) add a human lifestyle trend. An increasing number of owners live alone or work longer. With an increasing number of animal owners who live alone or work longer, the feeding regimen has likely been adjusted accordingly. The owner may opt to feed several meals simultaneously when present or may try to compensate for absences by overfeeding several large meals. Besides, guilt can be increased if the responsibility is only borne there by one person (Russell et al., 2000).

Because more people are away from home for longer and do not go out that much, cats have less and less function to catch smaller animals such as mice. Therefore cats can become bored, which can cause them to gain weight, resolving their boredom by continually eating (Dierenarts van Kessel, n.d.: Sloth, 1992). The number of minutes of movement per day and thus the energy requirements can be related to the availability of a garden. Some studies have shown that keeping a cat indoors is a risk factor for obesity, while others have not shown such a link (Rowe, et al., 2015: Scarlett, et al., 1994: Robertson, 1999: Courcier, et al., 2010a: Russell, et al., 2010). Cats that live in an apartment and therefore have less access to the outdoors are more likely to be obese, according to Scarlett et al. (1994). This is also confirmed in the study by Robertson (1999), in which cats that spent most of their time indoors were more likely to be overweight. In his research, Robertson (1999) also found a relationship between the number of cats in a household and the risk of obesity. Cats in households with one or two cats would be more likely to be obese than households with more than two cats.

Possible explanations for this are that households with one or two cats give more attention and perhaps provide extra food, while in households with more than two cats, the animals use up more energy by interacting more with each other. Furthermore, Robertson's (1999) and Cao's (2014) studies found that older cats are more at risk of being overweight. However, when the diet is adjusted to the energy drop in aging cats, there is no increased risk of overweight.

Corbee (2014) states that norms about the appearance of cats could play a role in overfeeding. Significant differences in weight were found between cat breeds, which may be related to breed standards. The standards of the more obese breeds refer to terms such as plump, stocky, firm, square, round, powerful, muscular, broad-chested, and short bull's neck, which could promote overfed conditions (Corbee, 2014).

In addition to the characteristics of the cats themselves, the characteristics of the owners also appear to influence overweight. For example, Heuberger & Wakshlag (2011), state that overweight in cats is significantly associated with owners aged sixty or older. Additionally, Courcier et al. (2010b) states that the importance given to lower prices and offers was related to the lower-income of overweight pet owners. The conclusion drawn from this is that people with a lower income are much more likely to have obese pets.

Preventing overweight

Zalk (2020), expresses the role of vet visits in preventing overweight. Zalk (2020) indicates that the prevention of overweight starts with the first visit to the vet since the information from the vet can significantly influence pet owners' behaviour and provide preventive care for overweight cats. But, Zalk (2020) did not declare whether information about environmental consequences can also contribute to preventing overweight. Robertson (1999) also affirmed that veterinarians play an important role in encouraging owners to monitor their pet's body weight and food intake (including snacks). On the other hand, Michel et al. (2008), states that effectively communicating nutrition and dietary pet-management to their owners can be difficult, especially when the goal is to persuade a pet owner to alter feeding practices.

Apart from vets, a pet club can also inform owners how to prevent pet-obesity. This may indicate that owners of a pet club or social media group have more information and are therefore more likely to prevent overweight (Suarez, et al., 2012).

Adaptation to climate change

To most people our climate system may seem abstract; they may not experience how their actions directly affect the environment, because their result may occur elsewhere. On a more local scale, people are likely to feel more impact than on the global climate system. It will differ per person whether someone only feels involved in their immediate environment or whether this involvement also applies to the more extensive world system (Bouma & de Vries, 2020). Various studies have shown that especially the higher educated, women and young people are concerned about the environment and on how to live more environmentally conscious (Dietz, et al., 1998; Liere & Dunlap, 1980); Leroy & Nelissen, 1999). In Kamphuis & Thijssen (2019) study, Dutch people who indicate that they (almost) never show a sustainable activity do not consider themselves ignorant in taking no or less account of certain aspects of their impact on the environment. Explanations for this are provided in the WRR report "Knowing does not yet" (2017). The emphasis here is on the importance of self-control or the ability to regulate one's behaviour and resist the temptations that come our way every day. Moreover, conviction also plays a role in deciding whether or not to take the environment into account. If someone believes that something makes no sense or contributes little to the environment, they will be less likely to adapt than someone who thinks it can significantly contribute.

Conceptual model

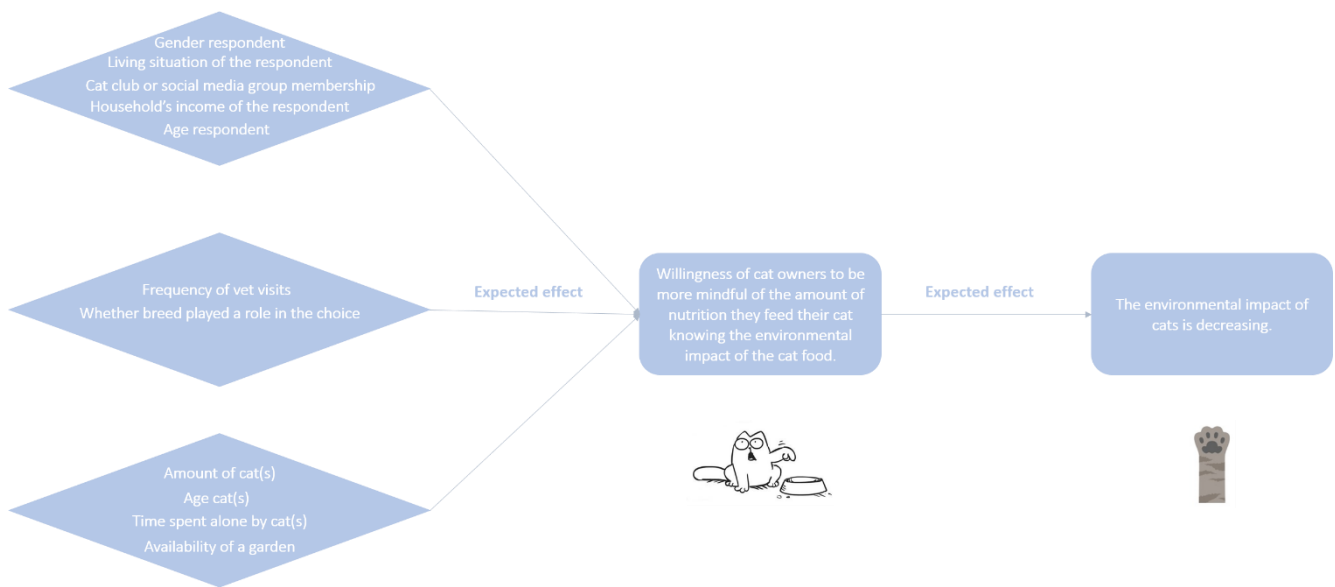


Figure 1: Conceptual model created by the researcher.

The conceptual model in Figure 1, is a visual representation of the various factors hypothesized to influence the willingness of cat owners tracking their pet's diet to reduce the environmental impact. Factors covered are characteristics of the cat owners that may explain why they are more environmentally aware, which may play a role in managing food intake. Additionally, it has been indicated above that breed can provide specific nutritional patterns to guarantee the cat's appearance, which may mean that owners with a particular breed are less willing to change the cat's nutritional pattern. It has also been indicated that veterinarians can play a role in people's willingness to adjust dietary patterns. Therefore, breed and amount of vet visits are also factors that will be studied. Cat characteristics are also being investigated. This is because some cats are more likely to get fat. For example, cats that live without other cats or with one other cat, older cats or cats without outside access are more likely to become overweight because their owners do not adjust the feeding pattern to these circumstances. It is, therefore, expected that cat owners who have cats in these categories are less willing to manage the food intake. The model shows the hypothesis that a relationship is expected between the factors in the model and the willingness to manage the food intake in favour of the environment and that most cat owners want to do this.

Methodology

Data collection

Due to the COVID-19 pandemic, it was not possible to physically distribute the questionnaire. Therefore, a snowball methodology was used to select the cat owners to be included in an online Dutch questionnaire. The questionnaire was completed eighty-three times, of which twelve did not complete the questionnaire, and seven respondents were unusable because they did not have a cat. Sixty-three cat owners were recruited in April 2021 via Facebook and social contacts. Most questions were "closed questions", multiple-choice or multiple answers, and the questionnaire took approximately ten minutes to complete. Preceding the questionnaire was an introduction with personal information, the purpose of the questionnaire and the expected duration of the questionnaire. An advanced thank-you concluded the introduction. Information on possible explanatory factors was recorded in the first part of the questionnaire. In the first part, it was also

checked whether the participant falls within the population and therefore fulfils the requirement to be an owner of a cat. In the second part, information was collected about why extra food is fed to compare this with the theory found. In the third part, information was asked about the nutritional regimen and the readiness to manage this nutrition regimen. This included the given amount, reasons and motivation behind providing a given amount, and willingness to keep track of the given amount. Sometimes it was possible to choose "other" for the multiple-choice or multiple answer questions. If this was the case, there was also the option to elaborate in words. The entire questionnaire outline can be found in the appendix.

Ethics

Privacy and data protection have been taken into account when conducting the questionnaire. This includes measures related to data collection, data handling and safe storage. Each respondent participated in the survey voluntarily. There was the option of not answering by adding the answer for potentially sensitive questions, prefer not to say. Before the questionnaire started, it was announced that the questionnaire is entirely anonymous and will not be shared with third parties. The answers to the questionnaires are stored in the researcher's university account with a secure login password to help ensure this.

Analysis

This research aims to identify a relationship between different factors and the willingness to avoid overfeeding to reduce the environmental impact of cats using multivariable analysis. Therefore, as a statistical test, a regression was chosen. This statistical test seeks to find a relationship between variables and was, therefore, most suitable. Binary logistic regression was not chosen due to issues with multicollinearity of the dependent dummy variable. The statistical method used instead is multiple regression. This was chosen because another dependent variable was available to use: ratio instead of a dummy. The ratio-dependent variable for the multiple linear regression has observations from 0 to 7 days. Possible explanatory variables were derived using an enter-selection approach based on the theory that these factors could influence the willingness to avoid overfeeding. The null hypothesis for this multiple linear regression is that the explained variance equals 0 in the population. The null hypothesis stands for finding no linear relationship between the various factors and the willingness to manage cat food intake. Analyses were conducted using the statistical software packages SPSS.

Dependent variable

The dependent variable is derived from two questions in the questionnaire. The first question explains the environmental impact of cats and then asks whether the respondent is willing to manage the food intake in favour of the environment. It was decided to use the data from Su and Martens (2018) when informing the respondents about the environmental impact of cats because this information provides a clear picture of the environmental impact of a cat's entire lifespan and because this study indicates that the environmental impact of cats fluctuates per cat and is therefore not abstract. In addition, the environmental impact of cats is calculated using Japanese cats. Since Japan has more or less a western culture and has no records of very high obesity, it was considered a representation of the Netherlands. Another reason for choosing the data from Su & Martens (2018) is that the environmental impact is based on the cats' diet and not their whole cats' impact. This study is about reducing the environmental impact by decreasing overfeeding, and, therefore, the information about the impact of the food is most relevant. Also, Su & Martens' study states that by giving the right amount of food, companion animals' environmental impacts can be reduced.

The second questionnaire question from which the dependent variable is about How many days per week the respondent intends to stick to the maximum amount of food to limit the environmental impact. The option was to choose between zero and seven days. The dependent variable used is a ratio variable with a range from 0 to 7.

However, a large majority of the sample did not want to pay attention to the cats' food intake, although it would benefit the environment. As a result, there were missing cases in the ratio variable of the number of days willing to manage food intake. This was due to their unwillingness to consider careful feeding for the benefit of the environment. The missing cases have been replaced with a 0. Since those respondents had indicated that they did not want to control the amount of feeding their cat in relation to their environmental impact, they did not want to take a day into account during feeding.

Possible explanatory variables

Data related to the owner's age, gender, annual net household income, living situation of the owner, amount of cats, age of the cat, time spent alone, outdoor access, cat club or social media group membership, frequency of vet visits, and whether breed played a role in the choosing their cat were extracted from the questionnaires to be analysed as possible factors for influencing the willingness to manage the amount of food given to the cat to reduce their environmental impact and thus used as independent variables in the multiple linear regression.

To avoid multicollinearity in this multiple linear regression, it was decided to merge categories of variables. Regression models function worse when more x variables are added. Due to the many dummies that have to be made from nominal data to use these data in multiple linear regression, it is logical to narrow the categories. This ensures fewer x variables in the model and the prevention of multicollinearity. Different respondents gave multiple answers during the multiple answer questions about the cats' age. In this case, these respondents have several cats of different ages. In the regression, these data are inserted as a dummy variable.

Reference category

For each variable, a reference category had to be chosen to make a dummy, which is necessary for nominal variables in a regression. A reference category is identified as a category of comparison for the other categories. For variables with two categories, it was chosen to use 'no' as the reference category. It was never chosen to use the categories, 'other', 'prefer not to say' or 'I don't know', as a reference category because it does not provide a logical analysis.

The variables for which a conscious choice has been made as a reference category are discussed below. For the variable 'gender', it was decided to use 'woman' as the reference category. For the variable 'age of the respondent', it was decided to use the youngest category because examined literature states that young people are more willing to take the environment into account (Dietz, et al., 1998; Liere & Dunlap, 1980); Leroy & Nelissen, 1999). It was decided to compare the respondents who earn the least with the other incomes for household income. Zero hours have been chosen as the reference category for the variable "time the cat is home alone". This has been chosen because Russel et al. (2000) indicate that overfeeding can be a consequence if the owner feels guilty about the cat being alone. Zero visits have also been chosen as the reference category for the number of vet visits per year. Zalk (2020) and Robertson (1999) state that veterinarians could play an essential role in changing the feeding patterns of pet owners. Therefore, comparing pet owners going to the vet multiple times compared to zero times a year. More than two was chosen as the reference category in the variable about the number of cats in the household based on Robertson (1999). Robertson

indicated a difference in risks for obesity between those with one or two cats and households with more than two cats.

Results

Descriptive statistics

Eighty-three cat owners were questioned, of which sixty-three (75.9%) owned a cat. Only twenty-two (34.9%) of the sixty-three respondents indicated that they were willing to track their cat's food intake to limit the cat's environmental impact, which can be seen in figure 2. A possible reason for this is described in the WRR report (2017). People may find that tracking the cat's food intake is not contributing enough to the environment to start doing this themselves. The average number of days these twenty-two cat owners will measure their cat's food intake is 4.86 days. It is striking that two of the twenty-two who indicated that they wanted to take the environment into account when feeding the cat indicated that they would eventually measure the nutrition for zero days. It is also remarkable that fifty-four (85,71%) respondents want to track their cat's food intake or already do this for health reasons. Of the twenty-eight (44,44%) respondents who already tracked the amount of their cat's food, seven respondents confirmed to do so on their veterinarian's advice. This confirms the picture outlined by Zalk (2020) & Robertson (1999), that the veterinarian plays a vital role in encouraging owners to monitor their pet's body weight and food intake. However, the most commonly chosen reason for the quantity given is the instruction on the food packaging. An extensive table of the demographic results can be found in the appendix.

Willingness to manage food intake to reduce the environmental impact of cats

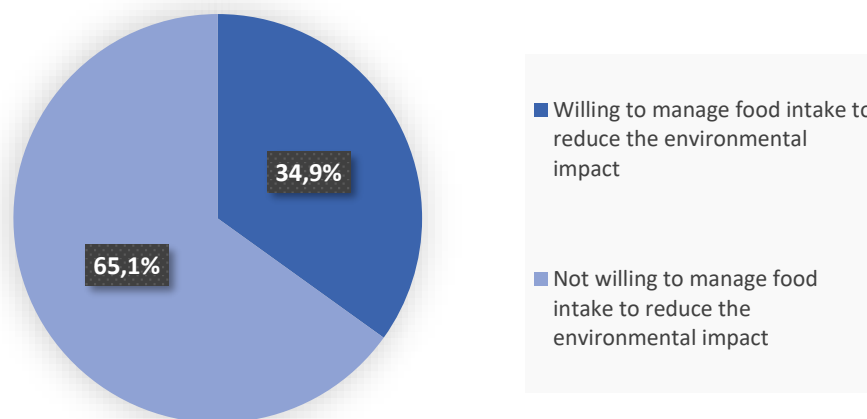


Figure 2: Illustrates the results of the respondents willingness to keep track of cat's food intake to reduce the ecological paw print of cats

Reasons for overfeeding cats

Previously, several reasons were given as to why owners would give their cats snacks or extra food. According to German (2016), owners often feed cats because they make contact, and the owners interpret this as a sign that their cat is hungry. Nevertheless, this is not the intention of the cat's nature, only when the cat learns that making contact ensures food, it makes contact deliberately to obtain it. Sloth (1992) adds that owners tend to match the cat's diet to their own. Pretlow & Corbee (2016) indicate that owners mainly give extra food to get affection in return. As a modern trend, Russel et al. (2000) add that many people spend much time away from home and that this makes

them want to give their cat extra pampering when they are there, leading to extra nutrition. In the questionnaire, the owners were asked what the reasons are for feeding the cat extra. The respondents had the option to select multiple answers and the option to add an extra reason. The most frequently chosen reason (34 times) was that they wanted to make the cat happy. This was followed by that the respondents fed their cat extra because they believe their cat is hungry (chosen 17 times). Whether this is consistent with German's (2016) claim that owners feed cats after the cat makes contact cannot be concluded as it is unclear whether they assumed their cat was hungry after the cat made contact or not. The reasons for giving extra food, such as the cat is begging, the owner feels sorry if the cat has nothing to eat when the owner eats, or if the owner wants to make up for the time the cat was alone is chosen five times. This concurs with the explanations mentioned above by German (2016), Russel et al. (2000) and Sloth (1992). In contrast to Pretlow & Corbee (2016), who states that getting love is the main reason for owners to feed extra, this reason was only chosen four times. However, 16 times in the sample, it was chosen that the reason was different from one of the previously mentioned reasons. A Different reason added was to give extra food to train the cat. Another reason was that if another pet receives a reward, all pets in the house receive a reward. In addition, respondents stated to give their cat something extra if they thought they needed it, such as old or thin cats.

Multiple linear regression

Table 1. ANOVA table SPSS with amount of days willing to manage food intake as dependent variable.

<i>Model</i>	<i>Sum of squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Regression</i>	198,660	24	8,277	1,364	0,192
<i>Residual</i>	230,610	38	6,069		
<i>Total</i>	429,270	62			

The non-significant result in the ANOVA table means that the null hypothesis cannot be rejected. Therefore, it cannot be concluded that there is a linear relationship between the various factors and the willingness to manage cat food intake. This non-significant result of the model also means that the given coefficients have no power to say something about a relationship between the variables. This model did not suffer from multicollinearity, as can be seen in the SPSS tables displayed in the appendix.

Although literature gave ground to believe that there is a relationship between certain factors and the willingness to manage cats food intake to spare the environment, this cannot be concluded in this study. A possible explanation for why the results from this study do not match the literature can be because the literature is often focused on reducing overweight for the animal's health. While this study mainly focuses on reducing overweight to favour the environment. From this reasoning and the result from the questionnaire that 85,71% of the respondents want to track their cat's food intake or already do this for health reasons, it can be assumed that cat owners deal with the cat's diet differently regarding animal health or environmental health.

Table 2. Model summary table SPSS

<i>Model</i>	<i>R</i>	<i>R Square</i>	<i>Adjusted R-square</i>
1	.680	.463	.123

The non-significant result may be caused by the snowball sampling strategy. As a result of this snowball sampling, the sample may not correspond to the society of the Netherlands. Also, a sample size of sixty-three may not be enough to reveal a statistically significant correlation. It appears from R-squared, seen in table 2, that there is a relatively large (46,3%) variation in willingness to manage food intake favouring the environment explained by this model and thus by the entered independent variables. Nevertheless, when looking at Adjusted R-squared, a modified version of R-squared, adjusted for the number of predictors in the model, little (12,3%) remains of the variation explained by this model. Therefore, the explained variance of the model is mainly derived from the number of independent variables that have been added to the model instead of the value of these variables, which may indicate that other factors play a more critical role in explaining the willingness to manage food intake to reduce the environmental impact than the factors used in this study.

Conclusions

Since the impact of pets is a little-discussed topic and the influence of pet overweight on the environment is even less discussed, the goal in this study was to find out what the impact of overfeeding cats is on the environment, what causes there are for overfed cats, and to examine the willingness of owners to change dietary patterns to limit the environmental impact and what factors play a role in this choice. The research has revealed that the average water paw print of a cat is 85 m³ per year, and the cat's food ecological paw print is between 4.46 and 7.80 ha for the entire lifetime of a cat. Furthermore, a cat's diet is responsible for 1690 and 2960 kg of CO₂ emissions in their lifetime. In this study, various reasons were presented for giving the cat(s) extra food, which can cause overweight. However, the most given reason for giving something extra in the questionnaire is that the owner wants to make their cat happy. The most common new reason obtained through the questionnaire for giving something extra is that owners try to train the cat. It is striking that the most frequently mentioned reason in other research, the return of love, has hardly been confirmed by the respondents in the questionnaire. Another very striking result from this study is that most of partaking respondents were unwilling to monitor the amount of food their cat is fed, if this had to be done to reduce their cat's environmental impact. Yet, 85.71% of the same respondents wanted to monitor the food intake with health considerations as motivation. Based on the literature study, there could be relationships between certain factors and the overfeeding of cats. Nevertheless, the multiple linear regression performed in this study has shown that based on the primary data, it cannot be concluded that there is a linear relationship between the various factors and the willingness to manage cat food intake, which answers the research question. A possible reason for this variation may be that in the literature, the focus is mainly on limiting overweight for the health of cats, while in this study, the focus is on limiting overweight for the environment. Since the primary data also revealed a significant difference in the motivation to manage the food intake between health or environmental impact, there can be a difference in the approach of cat owners when it comes to the health of the animal or environment.

The questionnaire uses the definition of Su & Martens (2018). This may be either an overestimation or underestimation of the actual cat's environmental impact in the Netherlands. This may be because these data are not about the Netherlands and because there are significant variations between studies. If this is the case, respondents could have reacted differently to more fitting information. In addition, the snowball sampling strategy may have resulted in a sample that is not representative of the Dutch cat owner population. This could explain the non-significant result. Since the variance explained by the model in this study is low, concluded from the adjusted R-square, it is likely that other factors are more of influence than the factors used in this study. Also, the small sample size may be not enough to reveal a statistically significant correlation.

The amount of pets is increasing. However, due to the knowledge that pets' meat-based diet contributes negatively to the environment and is a competitor for the human supply of food, it is crucial to explore the reason that, according to this study, few cat owners want to manage the amount of food they give their cat(s) to save the environment and whether this corresponds with the report of WRR (2017), which states that people do not adapt to the environment if they think it will not achieve enough for the environment. In addition, it is also important to investigate which factors are of more explanatory power than the factors used in this study to approach cat owners in a more targeted way to manage their cat's food intake.

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Appendix

Questionnaire outline

Introduction

I am a student at the University of Groningen and study Social Geography and Spatial Planning. The environment is an essential subject in my study. Last year I became the proud owner of two lovely cats Yuka and Wolf. That is why I have chosen to research the environmental impact of cats for my graduation project.

Completing the questionnaire only takes a few minutes. The questionnaire is completely anonymous and is not shared with third parties. Only complete this questionnaire if you have a cat as a pet.

I am very pleased that you are willing to participate in my research and thus help me a little further in obtaining my diploma.

Thanks again and best regards,

Romée Woning

Part 1:

Do you have a cat as a pet at home?

- Yes
- No

No

Yes

Thank you for taking the time to participate in this survey. Your answer has been registered.

What is your gender?

- Female
- Male
- Other
- Prefer not to say

How old are you?

- 17 or younger
- 18 to 30
- 31 to 50
- 51 to 70
- 71 or older
- Prefer not to say

Do you live together with people or alone?

- Together
- Alone
- Prefer not to say



What was your (collective) net income in the past year? (This includes labour income, business income, rental income, pensions, dividends, interest, Social Security, and any other income of tax-paying adults in your household)

- € 0 – € 19.999
- € 20.000 – € 39.999
- € 40.000 – € 59.9999
- € 60.000 or more
- I do not know
- Prefer not to say



How many cats do you have?

- 1
- 2
- 3
- 4 or more



How many hours per day is / are your cat (s) home alone on average (under normal circumstances, not during the Covid-19 pandemic)?

- 0 hours
- Between 1 and 4 hours
- Between 5 and 8 hours
- Between 9 and 12 hours
- 13 hours or more



Does your cat(s) have access to a garden?

- Yes
- No

Have you chosen your cat (s) based on the breed?

- Yes
- No



What was the purchase price of your cat (s)? (if several cats, please indicate the average) **MA**

- € 0
- € 1 – € 99
- € 100 – € 199
- € 200 – € 299
- € 300 or more
- I do not know
- Prefer not to say



What is the age of your cat (s)? (For several cats, please select both ages) **MA**

- Zero to six months
- Seven months to two years
- Three to six years
- Seven to ten years
- Eleven to fourteen years
- 15 years or older



How many years of your life have you owned a cat?

- Between 0 and 5 years
- Between 6 and 10 years
- Between 11 and 15 years
- Between 16 and 20 years
- 21 years or more



Are you a member of a cat club or cat social media group?

- Yes
- No
- Prefer not to say

How often do you visit the vet with your cat(s) on average per year?

- 0 times a year
- 1 times a year
- 2 times a year
- 3 times a year
- 4 times a year or more
- I do not know



Part 2:

What are the reasons why you sometimes give your cat some extra food or a snack? **MA**

- When I am eating myself, I feel sorry if my cat has nothing to eat
- Because my cat is begging for food
- Because my cat has been alone for a long time and I want to make up for this
- Because I want to get love from my cat in return
- Because I want to make my cat feel happy
- Because I notice that my cat is hungry
- I do not know
- Other



Part 3:

Do you know how much (grams or tablespoons) you feed your cat (s) per day?

- Yes
- No

No

Yes

Why are you giving this amount of food to your cat?

MA

- I follow the advice of the vet
- I follow the information about the amount of food I found through the internet
- I follow the description on the food packaging
- I'm doing this out of habit
- I follow the advice I have received from family or friends
- I don't know why I'm doing this
- Other

What can motivate you to keep track of how much food you give your cat (s)? **MA**

- Health considerations
- Environmental impact of pets
- Other

How many days a week do you give your cat (s) this amount on average?

- 1
- 2
- 3
- 4
- 5
- 6
- 7



What are the reasons for tracking how much your cat(s) eats? **MA**

- Health considerations
- Environmental impact of pets
- Other

The lifelong diet of an average sized cat requires between 0.04 and 0.08 square kilometers of farmland. This equates to between 6 and 11 football fields. In addition, a cat needs 85 m³ water per year. As a result a cat's diet is responsible for 1690 and 2960 kg of CO₂ emissions in their lifetime. A Dutch person emits an average of 9,000 kg of CO₂ per year. Having a cat, therefore, provides an individual with between 1,3% and 2,3% more CO₂ emissions per year. The above is when a cat is fed the right amount of food he/she needs. It is estimated that 25 to 50% of cats in the Netherlands are overweight and are given too much food, resulting in a heavier impact on the environment. By feeding the correct amount of food, appropriate to the ideal body weight of cats, the above ecological effects can be reduced.

Is the environmental impact of your cat (s) diet a reason for you to keep track of how much you feed your cat (s)?

- Yes
- No

No

Yes

Thank you for taking the time to participate in this survey. Your answer has been registered.

If you are late for an appointment, do you still take the effort / time to measure how much food you are feeding your cat (s)?

- Yes
- No

Thank you for taking the time to participate in this survey. Your answer has been registered.

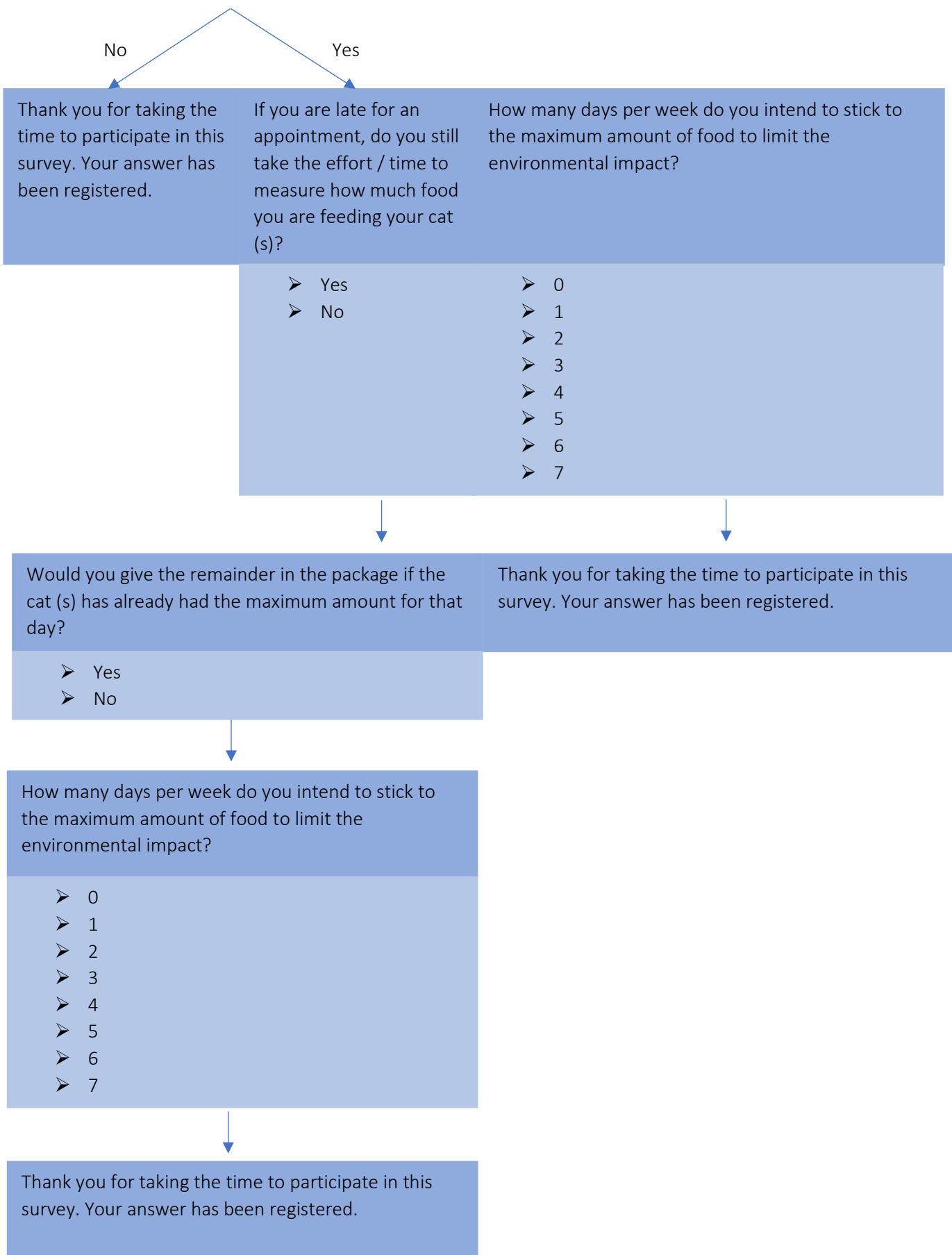
The lifelong diet of an average sized cat requires between 0.04 and 0.08 square kilometers of farmland. This equates to between 6 and 11 football fields. In addition, a cat needs 85 m³ water per year. As a result a cat's diet is responsible for 1690 and 2960 kg of CO₂ emissions in their lifetime. A Dutch person emits an average of 9,000 kg of CO₂ per year. Having a cat, therefore, provides an individual with between 1,3% and 2,3% more CO₂ emissions per year. The above is when a cat is fed the right amount of food he/she needs. It is estimated that 25 to 50% of cats in the Netherlands are overweight and are given too much food, resulting in a heavier impact on the environment. By feeding the correct amount of food, appropriate to the ideal body weight of cats, the above ecological effects can be reduced.

Is the environmental impact of your cat (s) diet a reason for you to keep track of how much you feed your cat (s)?

Would you give the remainder in the package if the cat (s) has already had the maximum amount for that day?

- Yes
- No

- Yes
- No



SPSS output

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	198,660	24	8,277	1,364	,192 ^b
	Residual	230,610	38	6,069		
	Total	429,270	62			

a. Dependent Variable: Dagen

b. Predictors: (Constant), Dummy_homealone14and58, Age_3150, Vet_2, Income_cat2, Dummy_Anders, Vet_Weetniet, Dummy_Man, Amountcats_2, Income_Zegniet, Age_Zegniet, Member_yes, Garden_yes, Breed_Ja, Dummy_02jaar_Ja, Vet_3, Living_Samen, Age_5170, Income_Weetniet, Dummy_11plusJa, Vet_1, Dummy_310Jaarja, Time_912, Income_40000, Amountcats_1

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,680 ^a	,463	,123	2,463

a. Predictors: (Constant), Dummy_homealone14and58, Age_3150, Vet_2, Income_cat2, Dummy_Anders, Vet_Weetniet, Dummy_Man, Amountcats_2, Income_Zegniet, Age_Zegniet, Member_yes, Garden_yes, Breed_Ja, Dummy_02jaar_Ja, Vet_3, Living_Samen, Age_5170, Income_Weetniet, Dummy_11plusJa, Vet_1, Dummy_310Jaarja, Time_912, Income_40000, Amountcats_1

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	Dummy_homealone14and58, Age_3150, Vet_2, Income_cat2, Dummy_Anders, Vet_Weetniet, Dummy_Man, Amountcats_2, Income_Zegniet, Age_Zegniet, Member_yes, Garden_yes, Breed_Ja, Dummy_02jaar_Ja, Vet_3, Living_Samen, Age_5170, Income_Weetniet, Dummy_11plusJa, Vet_1, Dummy_310Jaarja, Time_912, Income_40000, Amountcats_1 ^b		Enter

a. Dependent Variable: Dagen

b. All requested variables entered.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	5,492	2,606		2,107	,042		
	Dummy_Man	-2,274	,948	-,331	-2,399	,021	,744	1,344
	Dummy_Anders	-4,311	2,961	-,206	-1,456	,154	,703	1,422
	Age_Zegniet	5,407	2,850	,259	1,897	,065	,759	1,317
	Age_3150	-,426	1,032	-,068	-,413	,682	,523	1,912
	Age_5170	-,700	,966	-,121	-,725	,473	,506	1,977
	Living_Samen	-,887	1,175	-,133	-,755	,455	,452	2,212
	Income_cat2	-1,686	1,481	-,254	-1,139	,262	,285	3,509
	Income_40000	-,308	1,452	-,059	-,212	,833	,183	5,470
	Income_Zegniet	-3,424	1,672	-,385	-2,047	,048	,400	2,502
	Income_Weetniet	-,387	1,928	-,044	-,201	,842	,301	3,324
	Amountcats_2	-1,148	1,581	-,219	-,726	,472	,155	6,447
	Amountcats_1	-2,306	1,503	-,439	-1,534	,133	,173	5,792
	Time_912	-3,755	2,443	-,422	-1,537	,132	,187	5,337
	Garden_yes	,701	1,009	,109	,694	,492	,577	1,732
	Breed_Ja	-,934	,973	-,152	-,959	,343	,560	1,784
	Member_yes	-,507	1,145	-,065	-,443	,661	,663	1,508
	Dummy_11plusJa	-,536	1,130	-,087	-,474	,638	,416	2,404
	Dummy_02jaar_Ja	,257	1,344	,047	,191	,850	,230	4,349
	Dummy_310Jaarja	,822	1,344	,155	,612	,544	,220	4,548
	Vet_Weetniet	2,416	3,148	,116	,767	,448	,622	1,607
	Vet_3	1,735	1,702	,195	1,019	,314	,386	2,592
	Vet_2	,187	1,212	,032	,155	,878	,333	3,007
	Vet_1	,624	1,105	,119	,564	,576	,319	3,131
Dummy_homealone14and58	-1,695	1,974	-,227	-,859	,396	,202	4,955	

a. Dependent Variable: Dagen

Descriptive table

Characteristic	No.	%
<u>Gender cat owner</u>		
Female	51	80,95%
Male	11	17,46%
Other	1	1,59%
<u>Age cat owner</u>		
0 to 30 years old	30	47,62%
31 to 50 years old	14	22,22%
51 to 70 years old	18	28,57%
Prefer not to say	1	1,59%
<u>Living situation cat owner</u>		
Alone	12	19,05%
Together	51	80,95%
<u>Household income</u>		
€ 0 – € 19.999	8	12,70%
€ 20.000 – € 39.999	12	19,05%
€ 40.000 or more	31	49,21%
I don't know	6	9,52%
Prefer not to say	6	9,52%
<u>Amount of cats in the household</u>		
1	28	44,44%
2	29	46,03%
More than 2	6	9,52%
<u>Hours home alone</u>		
0	3	4,76%
1 to 8 hours	54	85,71%
9 to 12 hours	6	9,52%
<u>Availability of a garden</u>		
Yes	50	79,37%
No	13	20,63%
<u>Chosen based on breed</u>		
Yes	15	23,81%
No	48	76,19%
<u>Member of cat club of social media group</u>		
Yes	8	12,70%
No	55	87,30%
<u>Vet visits per year</u>		
0	11	17,46%
1	28	44,44%

2	17	26,98%
3	6	9,52%
<i>I don't know</i>	1	1,59%
<u><i>Age cat between 0 and 2 years</i></u>		
Yes	23	36,51%
No	40	63,49%
<u><i>Age cat between 3 and 10 years</i></u>		
Yes	37	58,73%
No	26	41,27%
<u><i>Age cat 11 or older</i></u>		
Yes	15	23,81%
No	48	76,19%
<u><i>Amount of food is tracked</i></u>		
Yes	28	44,44%
No	35	55,55%
<u><i>Willing to manage food intake</i></u>		
Yes	41	65,08%
No	22	34,92%
<u><i>Reason for or what could be a reason for managing food intake</i></u>		
<i>Health consideration</i>	54	85,71%
<i>Environmental impact of pets</i>	3	4,76%
<i>Other</i>	9	14,29%
<u><i>Reason for giving a certain amount by 28 respondents</i></u>		
<i>Other</i>	1	3,57%
<i>I'm doing this out of habit</i>	5	17,86%
<i>I don't know why I'm doing this</i>	4	14,29%
<i>I follow the advice of the vet</i>	7	25,00%
<i>I follow the information about the amount of food I found through the internet</i>	1	3,57%
<i>I follow the description on the food packaging</i>	12	42,86%