

# A survey of Italian cat owners' attitudes towards cat vaccination through a web-based questionnaire

Joel Fernando Soares Filipe (✉ [joel.soares@unimi.it](mailto:joel.soares@unimi.it))

Università degli Studi di Milano Facoltà di Medicina Veterinaria <https://orcid.org/0000-0001-8849-2051>

Lucrezia Pina

UNIMI

Stefania Lauzi

UNIMI

Paola Dall'Ara

UNIMI

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## Research article

**Keywords:** Vaccination, Prevention, Infectious diseases, Questionnaire

**Posted Date:** January 26th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-153485/v1>

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**Version of Record:** A version of this preprint was published at BMC Veterinary Research on August 9th, 2021. See the published version at <https://doi.org/10.1186/s12917-021-02981-z>.

# Abstract

**Background:** Vaccination plays an important role in feline healthcare as it is the most effective measure for prevention against feline infectious diseases. Therefore, it is important to know owners' opinion towards cats' vaccination and current veterinary practices in order to advice owners on the use of the correct vaccination protocol.

This study aimed to identify factors motivating cat owners' decisions related to vaccination in Italy. A questionnaire was disseminated online (mainly via social networks) to collect data regarding Italian cat owners' demographics, information about cats, factors regarding vaccination of cats, and veterinary-owner relationship.

**Results:** The majority (90.7%; n=1,131) of cats were vaccinated and 80% (n=998) had been vaccinated within the last three years. Cats 2-4 years old and origin from a breeder or cat shops had a high significant positive impact on the vaccination within the last three years status of cats. Vaccination before the three year period was significantly associated with the importance of cat's indoor lifestyle, cats  $\geq 5$  years old and low annual household. The importance for cost vaccination, low annual household income and jobs of owner not related to healthcare had a significant impact on the unvaccination status of cats. In addition, 85.8% of owners present their cat regularly to veterinary clinics. Veterinarians play a significant role in owners' decision and they are considered the most useful source of information about vaccination by 97.3% of owners.

**Conclusions:** These results could help veterinarians to acquire a greater compliance from owners and better adapt vaccination protocols.

## Background

Vaccination is the most important measure for infectious diseases' prevention and has become an integral part of pet healthcare. According to the Vaccination Guidelines Group (VGG) of the World Small Animal Veterinary Association (WSAVA), all cats, regardless of circumstances or geographical location, should be vaccinated against feline parvovirus (FPV), feline calicivirus (FCV) and feline herpesvirus-1 (FHV-1) [1]. These vaccines have been defined "core vaccines". In areas of the world where rabies virus infection is endemic, vaccination against this pathogen should also be considered core. For those cats living in certain geographic locations, local environment or lifestyle at risk of specific infections, "non-core vaccines" should be also given. The "non-core vaccines" are vaccines against feline leukaemia virus (FeLV), *Chlamydomphila (Chlamydia) felis*, *Bordetella bronchiseptica* (not available in Italy) and feline immunodeficiency virus (FIV - not available in Italy). The vaccine against feline infectious peritonitis (FIP) is defined as "not recommended" [1]. Similar guidelines have been produced for Europe by the Advisory Board of Cat Diseases (ABCD), and for North America by the American Association of Feline Practitioners (AAFP), where vaccination against FeLV is recommended for all cats under 1 year of age with a booster

vaccination 1 year later. After this age, the need for subsequent vaccination is determined by the risk of exposure for each cat (e.g., cats with outdoor access) [2–4].

Pets numbers are increasing in Italy and the most recent reports estimate almost 7.3 million cats (1 cat every 3.5 families) in our country [5]. The routine vaccination programs in Italy have led to a decline in the frequency of some feline infectious diseases and reduced feline morbidity and mortality [6], and compliance of cat owners with vaccination is important [7].

However, pet owners' concerns regarding vaccination and prevention have increased in Italy in the past ten years [8, 9]. In human medicine, an anti-vaccination movement has been observed [10]. The fall-off in vaccinations has been linked to recent measles outbreaks [11], also in Italy [12], and the World Health Organization has named vaccine hesitancy as one of the top 10 global health threats. It has been suggested that pet owners may have similar concerns regarding vaccination of cats and dogs [13], and movements discouraging vaccination of pets have been recently reported [14, 15].

It is important to evaluate up-to-date owner's attitude towards vaccination of cats. Cat owners' vaccination compliance in Northern Europe has been previously evaluated in two studies, one from the UK [16], and the other from Germany [7]. To date, studies on vaccination compliance of respondents from Italy, a country where the non-vaccination movement has been reported in human medicine [12], have not been performed. Therefore, we evaluated Italian cat owners' attitudes towards cat vaccination through a web-based questionnaire. The aim of this study was to understand the factors influencing owners' decisions related to vaccination of cats in Italy, with special emphasis on the importance of the relationship between owner and veterinarian.

## Results

### *Description of cats' owners*

The majority of cat owners were females (92.1%; n=1145/1,247), 21-49 years old (75.5%; n=941/1,247) and from Northern Italy (72.6%; n=810/1,247). More than half of the owners (65.1%; n=805/1,236) belonged to a family with a high level of education (bachelor's or Master/post-university degree).

The cats of the majority of respondents (90.7%; n=1,131/1,247) had been vaccinated at least once; and 80% (n=998/1,247) of owners had their cats vaccinated within the last 3 years (2015-2018).

The demographic characteristics of the owners according to their decision regarding the vaccination status of their cats are summarized in Table 1.

### *Description of cats*

The majority of cat's owners possessed more than one cat (68.9%; n=854/1,240) and had acquired it as a kitten (91.4%; n=1,129/1,235). Most of the owned cats were previously stray cats or cats from shelters (56.8%; n=703/1,239), whereas few cats (18.2%; n=225/1,239) came from a breeder or a pet shop. Only

22.5% (n= 278/1,233) were purebred cats. The majority of cats lived indoor (63.5%; n=787/1,240) or had a mixed lifestyle with outdoor access (34.7%; n= 430/1,240). The minority of cats (34.2%; n=424/1,239) had traveled or had attended a cat show or a cattery.

A summary of the cats' characteristics according to their vaccination status is summarized in Table 2.

### *Respondents' attitudes towards vaccination*

Overall, respondents identified as "important" and "very important" factors such as the veterinary advice (86.6%; n=1,021/1,179), infectious disease susceptibility (88.3%; n=1,022/1,157), and vaccination efficacy (89%; n=1,032/1,159), while the time necessary to vaccinate cats was "unimportant" (90.8%; n=1,053/1,160).

The main factors related to owners' decision of recent vaccination, not recent vaccination or not vaccination of cats are reported in Table 3.

### *Relationship owner-veterinary and veterinary recommendations*

The majority (85.8%; n=1,041/1,213) of respondents took their cat to a veterinarian often (at least once a year) and veterinarians were considered the most important source of information about the cat's health by 97.3% (n=1,194/1,227) of owners (overcoming books, 86.2%; n=960/1,114 and internet, 70.8%; n=811/1,145).

The main reason why cats' owners decided not to take their cats to a veterinarian was the time involved with a visit to the veterinarian and the long distance from the veterinary clinics (7.5%; n=91/1,213).

Veterinarians usually suggested vaccination every year (58.8%; n=728/1,238), every two years (13.1%; n=162/1,238) or every three years (12.6%; n=156/1,238).

The majority of owners (62%; n=770/1,242) were not aware of the possibility to evaluate duration of immunity (DOI), however most of them (83.6%; n=1,031/1,233) were further in agreement with the possible use of DOI test in the future.

Results of the relationship between veterinarians and owners according to their decision regarding the vaccination status of their cats are presented in Table 4.

### *Factors with positive and negative impact on the vaccination status of cats*

Binomial linear regression was used to test the independent variables for association with cat's vaccination status. Variables that were correlated or that did not improve the fit of the model (e.g. age of cat at acquisition, postal code of the respondent, highest level of education in the household) were not included. The association of 17 factors with the vaccination status of cats was evaluated in a multinomial logistic regression. Results of the statistical analysis (p-values and OR) are reported in Tables 5 and 6. The adult age (2-4 years), origin from a breeder or a pet shop, the low importance for cost

vaccination and high annual household income had the highest and significant positive impact on the recently vaccinated status. Participation to a cat show and higher compliance with possible use of DOI tests tended to be factors associated to recent vaccination (Table 5). Importance of cat's lifestyle (indoor only versus outdoor lifestyle), 5-9 years of age and low annual household were important factors associated with not recent vaccination of cats (Tables 5 and 6). Importance of cost of vaccination, low annual household, high percentage of respondent working in jobs other than being a student or working in healthcare had the most significant impact on the unvaccinated status (Table 6). Owners aged 21-49 years tended to be more prone to not vaccinate their cats. The young age (8 weeks-1 year) of cats and age 5-9 years tended to be associated to the unvaccinated status when compared with recently vaccinated cats. The lower percentage of owners with a high income level tended to be associated to the unvaccinated status compared to the not recently vaccinated cats (Tables 5 and 6).

## Discussion

Vaccination is considered the most successful health measure both in human medicine and in veterinary practice. International guidelines of the vaccination of cats and vaccination experts (WSAVA, AAFP, ABCD) recommend that, whenever possible, all dogs and cats receive the benefit of vaccination. This not only protects the individual animal but provides optimum 'herd immunity' that minimizes the likelihood of infectious disease outbreaks [1, 2, 4, 17].

This study aimed to understand factors influencing the Italian cat owners' opinion about vaccination. The very high percentage (90.7%) of the owners that had taken their cats for vaccination to a veterinarian at least once showed Italian owners' trust in cats' vaccination. The high percentage (80%) of owners that had their cat recently vaccinated within a three-year interval was in line with the 77.9% of recently vaccinated cats in Germany [7]. Our results were not comparable with the 69% of vaccinated cats in the UK because the interval was set in the preceding 12 months in the English study [16]. The three-year interval was used in this study to differentiate the recently vaccinated and the not recently vaccinated groups of cats. It has to be reminded that the general three-year interval recommended for core vaccination by the current guidelines may not be always adequate and needs to be considered depending on the vaccine and cats' lifestyle, as previously observed [1, 7, 18, 19].

Due to the high percentage of recently vaccinated cats and the low percentage of not adequately vaccinated animals (not recently vaccinated and unvaccinated cats), our results suggest that the cat population of this study may be well protected (considering the aforementioned "herd immunity" concept). However, it has to be reminded that a recent vaccination may not necessarily imply that the cat has protective immunity [20]. Our results also suggest that the non-vaccination movement that has been reported in Italy in human medicine is apparently not a problem in veterinary medicine as it is likely not present at the moment among pet owners.

When analyzing all the variables of this study, some were not included in the final model because they were correlated (e.g. owners that go more often to the veterinary also vaccinate more often) or did not

improved the fit of the model.

Regarding the results from the multinomial logistic regression, the likelihood of recent vaccination being higher in cats between 2-4 years was surprising but was in accordance with a previous study [7]. The need to clarify with owners the necessity of vaccination in kittens starting at the age of 6-8 weeks and following thereafter the recommendations for a strong immunity is of paramount importance considering that our results also showed that young cats (8 weeks-1 year of age) tended to be associated with the unvaccinated status. However, the result may be biased by the low number of young cats analyzed in this study compared to older cats and by the three-year interval that may augment the number of cats > 1 year of age included in the recently vaccinated group, explaining the higher likelihood of 2-4 years old cats recently vaccinated.

The less common recent vaccination status in older cats agrees with previous findings [7], and may be explained by the importance of cats' age in the decision to vaccinate cats that was a variable associated with the not recently vaccinated group. However, the significant impact of cats aged 5-9 years on the vaccination status needs to be carefully evaluated because the significant older age of cat in the not recently vaccinated group may be biased by the three-year interval vaccination and therefore by the fact that cats within this group are surely more than 3 years and 8 weeks old. When excluding the not recently vaccinated group, older cats tended to be associated with the unvaccinated status, confirming the likely negative impact of older age on the vaccination status. Therefore, owners might think that older cats do not need vaccination, because of a long-lived immunity following vaccination and a higher protection against infectious disease. However, since old cats are known to have the same risk of infectious disease as younger cats and ageing is associated with a decline in functional competence of the immune system, regular boosters are recommended for cats, regardless of their age [1, 2, 4, 21].

Our analysis also showed that the annual household income had a significant impact on the vaccination status. Indeed, the likelihood of a recent vaccination status was significantly higher in cats with owners with a higher annual household income whereas not recently vaccinated cats and unvaccinated cats were significantly associated to a lower household income. The annual household income has not been reported previously as a factor affecting the vaccination status of cats in the UK and in Germany [7, 16]. This may be explained by the fact that Italian owners are accustomed to pay for all veterinary services whereas 40% of cats have health insurance in the UK and the insurance covers most of veterinary services [16]. Moreover, the median household income in Italy is lower compared to Germany and the UK [22], and payment of veterinary services, including vaccinations, may be troublesome, especially for owners with lower household income. The economic factor may have also accounted for the significantly higher likelihood of cats being unvaccinated among owners who perceived cost of vaccination an important factor. The importance of cost of vaccination has been previously reported to be associated with the unvaccinated status of cats in the UK [16]. Economic data should be carefully considered in the future due to the economic loss linked to the COVID-19 pandemic that may also reduce the likelihood of cats' vaccination.

Concerning the likelihood of recent vaccination status, the significantly higher recent vaccination status among cats from breeders or pet shops compared to other cats was not surprising. High purchase price could lead owners to be more prompt to vaccination. The majority of cats from breeders and pet shops are purebred cats and the higher percentage of purebred cats was correlated to Italian owners that had decided to recently vaccinate their cat. Our results are in accordance with the more common recent vaccination records in purebred cats compared to shorthair cats in Germany [7]. Our results did not confirm the likelihood of a vaccination status higher in cats that had traveled abroad, visited a cat show or a cattery. These factors have been associated with the requirement of up-to-date vaccinations and European Pet Passport with vaccination against rabies to travel within Europe and are usually more common in purebred cats [7, 16]. Our results may be explained by the lower presence of purebred cats in our data compared to previous studies [7].

The lower importance of cat's stress and the higher perception of vaccination efficacy reported in owners of recently vaccinated cats, even if not statistically significant, may also explain their willingness to vaccinate their cats.

The likelihood of not recent vaccination status was significantly higher in owners that perceived the lifestyle of cats as an important factor. This result is likely linked to the higher frequency of indoor lifestyle only in cats belonging to the not recently vaccinated group compared to unvaccinated cats, that tended to be an important factor associated to the decision on the vaccination status of cats. This result suggests that owners of these cats might have assumed that animals living for prolonged periods in closed environments with no contact with other cats were not at risk and did not need revaccination. However, European guidelines recommend vaccination booster every three years also for cats living indoor-only, except for FPV that may be administered every three years or more [18]. Veterinarians should consider this result and, to improve the vaccination status of cats, education of owners is required on the importance of adequate vaccination protocols and boosters also for cats living indoor-only.

The likelihood of unvaccinated status higher in owners with a lower frequency of health-related jobs, such as doctors, nurses or pharmacists, was not surprising. This result may also be linked to the lower level of education that was observed in the owners of the unvaccinated cats. Our results suggest that jobs not related to health-aspects and lower education levels may be associated with little knowledge on scientific aspects, including the importance of vaccination, and therefore the higher unvaccinated status of cats is more likely.

The likelihood of an unvaccinated status tended to be associated with owners being 21-49 years old. Despite this is not being a significant data, it is interesting to keep on monitoring this aspect because non-vaccination movements in Italy have been more frequently reported among people aged 25-44, even if not significantly, and significantly in people with a lower level of education [23].

The importance of factors preventing owners from having their cats vaccinated, such as cats' capture, travel to the veterinarian and inappropriate waiting times, may be related to the lower perception and knowledge of importance of vaccination. Therefore, it is likely that owners of unvaccinated cats consider

taking the cat to the veterinarian not necessary for their cat's health. Indeed, such factors have been considered not important by a high percentage of owners of recently vaccinated cats, followed by owners of not recently vaccinated cats. Moreover, the lower compliance of owners of unvaccinated cats with veterinary advice for vaccination and the lower importance for cats' susceptibility to infectious disease compared to the owners of vaccinated cats, even if not statistically significant, may also explain why owners of unvaccinated cats do not understand the need of vaccination in cats.

This study showed that Italian cats' owners have a good level of confidence in veterinarians. The majority of owners reported the importance of veterinary advice and considered veterinarians as the main source of information for their cats' health. More than half of respondents (58,8%) followed their veterinarian recommendation for annual vaccinations, which was surprising, as not in line with guidelines. Annual vaccination is recommended for some of the non-core vaccines, such as feline leukaemia virus (FeLV) in high risk cats, *Chlamydophila (Chlamydia) felis* and *Bordetella bronchiseptica* (vaccine not available in Italy) and might also apply for feline herpesvirus (FHV-1) and feline calicivirus (FCV) in high-risk situations [1, 2, 4]. However, the majority of cats of this study lived indoors (63,5%) and several lived in a single-cat household (31,1%), situations in which annual booster is not necessary. Recommendation of annual vaccination was recently reported also in German cats [7], and was suggested to be associated to lack of knowledge of feline vaccination guidelines or economic considerations.

Results on the knowledge of antibody test to evaluate vaccination status and avoid unnecessary boosters showed that respondents who had vaccinated their cats were more aware of it and owners of recently vaccinated cats were more inclined to use it in the future than other owners of cats. However, even if the minority of cats' owners were aware of this test before reading the questionnaire, most respondents were inclined to use it in the future suggesting that owners' decision also rely on their personal knowledge of other laboratory approaches.

Overall, the web-based questionnaire allowed us to include both vaccinated and unvaccinated cats because it was not spread among veterinarian practices. Moreover, online survey and social networks approach was a cheap and efficient way for obtaining data across a huge area in a short time: 83,8% of respondents found out about the questionnaire through the web.

Despite internet access was a requirement for participation, it likely did not introduce a bias in the study because according to the Italian office of statistics, the majority (65.3%) of the Italian population uses internet [24]. It is also likely that publicity conducted via social media network may have not introduced a bias towards owners that were more interested in cats and cats' health and more prone to vaccination. Indeed, our study confirmed that information on health status of cats is also obtained online by the majority (70.8%) of pet owners, regardless of compliance with vaccination of their cats [25]. However, considering the nature of internet-based surveys and publicity conducted via social media networks, there is the possibility that the sample acquired in this study was not truly representative of the general pet owner population. Indeed, females have been reported to be more incline to answer questionnaires and

use social networks than males in Italy and this may have accounted for the high prevalence of female respondents observed in this study.

Therefore, our results should be interpreted taking into consideration the possible limitations of this study. The sample of cat owners responding to the survey was based on self-selection and this may have also introduced the gender bias observed in our study and may have accounted for the high percentage of people aged 21-49 years of age in the population of respondents.

Even if greater than predicted, considering the high prevalence of female respondents in previous studies [7, 16], the strong bias towards female pet owners was in line with a recent study based on a questionnaire disseminated online to English-speaking pet owners regarding pet nutrition [26]. Considering that females are reportedly more likely to keep pets than males, the results of our study may be indicative of the general cat owner population [16, 26-28]. However, female have been reported to have higher empathy towards animals, be more interested in health-related topics and carry the primary responsibility for pets' healthcare compared to males and this may have increased the proportion of vaccinated cats compared to previous studies [16, 29].

Cat owners aged 21 to 49 years participated in the questionnaire more than owners in other age groups, probably reflecting the common use of the internet by younger owners compared to the elderly.

Finally, as previously reported, questions to confirm recipients understanding of the word "vaccination" were not asked in our study and whether the participants in the survey completely understood what vaccination was and if they could differentiate it from other procedures performed by veterinarians is not known. It is possible that this may represent another possible limitation of this study [16].

## Conclusions

The first positive and important result of this study is the high number of recently vaccinated cats, that likely excludes the risk at the moment of non-vaccination movements among cat owners. Further investigation should focus on a detailed analysis of each cat's vaccination history and a validation of the provided data that were not possible due to the high number of respondents and the anonymous nature of the questionnaire.

Our findings also suggest a growing attention towards feline vaccination and cats' health as well as the routinely visit to the veterinarian and the possibility of a preventive antibody test in order to control the protection status. These results could be very important for veterinarians. First of all, the importance of veterinarians in client education has been confirmed, as owners rely on the recommendation of the veterinarians. Moreover, knowing practical errors could help to improve owners' compliance (e.g. take appointment in order to reduce waiting time). Finally, keeping up to date with the vaccination guidelines will allow veterinarians to grow owners' confidence and avoid useless revaccinations reducing costs that have been identified as important factors for owners.

# Methods

## *Data collection*

The online questionnaire was developed exclusively for this study and has not been previously published or used, and it included 31 questions about the following items: sociodemographic information about the respondents, vaccination history of the cats, factors influencing owners' decision related to vaccination, experience of vaccination side effects in cats, relationship between cat owners and veterinarian and source of information about cat vaccination.

Owners were asked to rate factors that affected their decision in vaccination of their cat using a 5-points Likert scale from "not important" to "very important". Few (n=6) questions included an open-text option where owners could input their response. These included location of residency and cats' origin, vaccination side effects, factors influencing vaccination choice, reason not to go to veterinarian and owners' job if not present among the proposed answers. Owners had the option of omitting answers, which resulted in some incomplete data sets.

The questionnaire was initially piloted on 10 volunteers and questions were refined as required to improve the clarity and relevance of the questions. The questionnaire was prepared through the online program Google Forms and the link was mainly publicized using social networks (e.g. Facebook, Instagram, Twitter, cat forums), but also sent by email to acquaintances and promoted through leaflets. Concerning social networks, the questionnaire was publicized especially on cat-concerning pages.

Veterinarians were not included to minimize selection bias, as the aim of this study was to collect data from a sample representative of the general cat-owning population. The survey was available online from 28<sup>th</sup> June to 1<sup>st</sup> October 2018 and took about 10 minutes to be completed.

## *Vaccination status*

In this survey owners were asked if their cat had been vaccinated or not. Cats that had never been vaccinated were classified as "unvaccinated". Owners were also asked if cats had been vaccinated within or before the previous 3 years, according to the vaccination frequency suggested by the WSAVA guidelines for the core vaccines (Day et al., 2016). Cats that had been vaccinated in 2015-2018 were classified as "recently vaccinated" whereas cats that had been vaccinated before 2015 were classified as "not recently vaccinated".

## *Survey response*

Not all participants answered all questions and not all participants were included in the study. Data sets of owners less than 16 years of age (n = 3) and cats under 8 weeks of age (n=2) were excluded. Moreover, the data sets of respondents who had not answered to the question about the vaccination status of the cats (n=10) and the question about the last vaccination (n=2) were also excluded because these questions were essential for data analysis.

At the end of this first control, a total of 1,247 out of 1,264 questionnaires were statistically analyzed.

### *Data analysis*

Responses to open questions were categorized (e.g. “teacher” and “professor” were put together in the same category), and some categories were also combined to improve the fit of the model for statistical analysis (e.g. owner’s age 21-29/30-39/40-49, owner’s age 50-59/over 60 were combined as years of age, “cat from shelter”/“stray”, “important”/“very important” factors influencing cat vaccination).

Survey responses were analyzed, and quantitative and qualitative data were reported as frequency (n) and percentage (%). Binomial linear regression was used to test the independent variables for association with cat’s vaccination status and variables were included in the model if they could improve the fit of the model.

Multinomial logistic regression was used with cat’s vaccination status as dependent variable: “recently vaccinated”, “not recently vaccinated” and “unvaccinated”.

The statistical program SPSS version 25.0 was used. Variables with p-value  $\leq 0.05$  were considered to be statistically significant, whereas tendency was considered in the presence of p-values  $> 0.05$  but  $< 0.1$ .

## **Abbreviations**

**VGG:** Vaccination Guidelines Group

**WSAVA:** World Small Animal Veterinary Association

**FPV:** Feline Parvovirus

**FCV:** Feline Calicivirus

**FHV-1:** Feline Herpesvirus-1

**FeLV:** Feline Leukaemia Virus

**FIV:** Feline Immunodeficiency Virus

**FIP:** Feline Infectious Peritonitis

**ABCD:** Advisory Board of Cat Diseases

**AAFP:** American Association of Feline Practitioners

## **Declarations**

***Ethics approval and consent to participate***

An ethics approval is deemed unnecessary according to national regulations. In accordance to EU Regulation 2016/679, at the beginning of each questionnaire it was stated that “by answering the anonymous questionnaire, the participants authorize the processing of the data collected for educational, research and statistical purposes”.

### ***Consent for publication***

Not applicable.

### ***Availability of data and materials***

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### ***Competing interests***

The authors declare that they have no competing interests.

### ***Funding***

Not applicable.

### ***Authors' contributions***

PD and LP designed this study. PD, LP and JFSF performed the questionnaires. JFSF performed the statistical analysis. JFSF, LP, PD and SL drafted and revised the manuscript. All authors read and approved the final manuscript.

### ***Acknowledgements***

The authors thank the participating cat owners who provided data for the study.

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## Tables

### ***Table 1***

*Description of respondents.*

Question	Response option	No. (%) recently vaccinated	No. (%) not recently vaccinated	No. (%) unvaccinated
<b>Age of respondent</b>	17-20 years	12 (1)	4 (3)	6 (5)
	21-29 years	240 (24)	30 (23)	32 (28)
	30-39 years	257 (26)	45 (34)	26 (22)
	40-49 years	254 (26)	27 (20)	30 (26)
	50-59 years	165 (17)	19 (14)	20 (17)
	≥ 60 years	70 (7)	8 (6)	2 (2)
	<i>Total</i>	<i>998</i>	<i>133</i>	<i>116</i>
<b>Gender</b>	Female	915 (92)	122 (92)	108 (94)
	Male	80 (8)	11 (8)	7 (6)
	<i>Total</i>	<i>995</i>	<i>133</i>	<i>115</i>
<b>Living area of respondent</b>	City (≥ 15.000 people)	605 (61)	74 (56)	69 (60)
	Town (< 15.000 people)	393 (39)	59 (44)	46 (40)
	<i>Total</i>	<i>998</i>	<i>133</i>	<i>115</i>
<b>Postal code of respondent</b>	North Italy	639 (71)	98 (82)	73 (74)
	Middle Italy	97 (11)	5 (4)	6 (6)
	South Italy	90 (10)	7 (6)	9 (9)
	Abroad	70 (8)	10 (8)	11 (11)
	<i>Total</i>	<i>896</i>	<i>120</i>	<i>99</i>
<b>Level of education of respondent</b>	Primary/Middle/High school certificate	526 (53)	80 (60)	65 (56)
	Bachelor's degree	387 (39)	38 (27)	45 (39)
	Master/Post-university degree	82 (8)	15 (11)	6 (5)
	<i>Total</i>	<i>995</i>	<i>133</i>	<i>116</i>
<b>Job of respondent</b>	Healthcare job	190 (22)	30 (26)	12 (13)
	Student	145 (17)	27 (24)	19 (20)
	Other	529 (61)	57 (50)	64 (67)
	<i>Total</i>	<i>998</i>	<i>133</i>	<i>116</i>
<b>Highest level of education in the household of respondent</b>	Primary/Middle/High school certificate	332 (34)	45 (34)	54 (47)
	Bachelor's degree	479 (49)	60 (46)	49 (42)
	Master/Post-university degree	177 (18)	27 (21)	13 (11)
	<i>Total</i>	<i>988</i>	<i>132</i>	<i>116</i>
<b>Annual household income of respondent</b>	≤ 9.000 €	53 (6)	9 (7)	14 (14)
	10-29.000 €	420 (47)	67 (55)	59 (57)
	30-49.000 €	285 (32)	33 (27)	21 (20)
	≥ 50.000 €	133 (15)	13 (11)	10 (10)
	<i>Total</i>	<i>988</i>	<i>132</i>	<i>116</i>
<b>Number of children (≤ 13 years old) in the household of respondent</b>	None	806 (8)	112 (86)	91 (82)
	≥ 1	180 (18)	19 (15)	24 (18)
	<i>Total</i>	<i>986</i>	<i>131</i>	<i>115</i>
<b>How where you informed about the questionnaire?</b>	Internet (social networks included)	833 (85)	107 (82)	91 (80)

Relatives/friends	127 (13)	20 (15)	21 (18)
Others	1 (2)	4 (3)	2 (2)
<i>Total</i>	<i>983</i>	<i>131</i>	<i>114</i>

**Table 2**

*Cats' description.*

Question	Response option	No. (%) recently vaccinated	No. (%) not recently vaccinated	No. (%) unvaccinated
<b>Number of cats owned by respondent</b>	1	296 (30)	43 (32)	47 (41)
	2	314 (32)	38 (29)	25 (22)
	3	142 (14)	23 (15)	22 (19)
	≥ 4	239 (24)	29 (22)	22 (19)
	<i>Total</i>	<i>991</i>	<i>133</i>	<i>116</i>
<b>Age of cat</b>	8 weeks - 1 year	171 (17)	1 (1)	24 (21)
	2 - 4 years	445 (45)	7 (5)	33 (28)
	5 - 9 years	264 (27)	71 (53)	36 (31)
	≥ 10 years	107 (11)	54 (41)	23 (20)
	<i>Total</i>	<i>987</i>	<i>133</i>	<i>116</i>
<b>Age of cat at acquisition</b>	≤1 year	910 (92)	120 (90)	99 (85)
	2 - 4 years	51 (6)	9 (7)	9 (8)
	≥ 5 years	25 (3)	4 (3)	8 (7)
	<i>Total</i>	<i>986</i>	<i>133</i>	<i>116</i>
<b>Origin of cat</b>	Breeder/shop	215 (22)	6 (5)	4 (4)
	Animal	534 (54)	93 (71)	76 (66)
	shelter/charity/stray			
	Relatives/friends	200 (20)	29 (22)	31 (27)
	Internet	42 (4)	4 (3)	4 (4)
	<i>Total</i>	<i>991</i>	<i>132</i>	<i>115</i>
<b>Purebred cat</b>	No	727 (74)	120 (90)	108 (93)
	Yes	257 (26)	13 (10)	8 (7)
	<i>Total</i>	<i>984</i>	<i>133</i>	<i>116</i>
<b>Indoor/outdoor access</b>	Indoor only	648 (65)	77 (58)	62 (53)
	Indoor and outdoor	330 (33)	52 (39)	48 (41)
	Outdoor only	13 (1)	4 (3)	6 (5)
	<i>Total</i>	<i>991</i>	<i>133</i>	<i>116</i>
<b>Previous cat's experience</b>	Cattery/cat show	168 (17)	12 (9)	2 (2)
	Travel	199 (20)	28 (21)	15 (13)
	None	623 (63)	93 (70)	99 (85)
	<i>Total</i>	<i>990</i>	<i>133</i>	<i>116</i>
<b>Future cat's experience</b>	Cattery/cat show	156 (16)	1 (1)	7 (6)
	Travel	202 (21)	20 (15)	11 (10)
	None	622 (64)	111 (84)	98 (85)
	<i>Total</i>	<i>980</i>	<i>132</i>	<i>116</i>

**Table 3**

*Importance of factors influencing the decision on vaccination of cats among cat owners.*

<b>Factor</b>	<b>Response option*</b>	<b>No. (%) recently vaccinated</b>	<b>No. (%) not recently vaccinated</b>	<b>No. (%) unvaccinated</b>
Cost	Unimportant	862 (89.2)	99 (77.3)	75 (68.8)
	Important	104 (10.8)	29 (22.7)	34 (31.2)
	<i>Total</i>	<i>966</i>	<i>128</i>	<i>109</i>
Possible side reactions	Unimportant	312 (32.8)	34 (26.8)	35 (34.7)
	Important	639 (67.2)	93 (73.2)	66 (65.3)
	<i>Total</i>	<i>951</i>	<i>127</i>	<i>101</i>
Cat's stress	Unimportant	474 (50.5)	44 (34.9)	43 (48.1)
	Important	464 (49.5)	82 (65.1)	59 (51.9)
	<i>Total</i>	<i>938</i>	<i>126</i>	<i>102</i>
Veterinarian's advice	Unimportant	120 (12.6)	17 (13.6)	21 (20.2)
	Important	83 (87.4)	108 (86.4)	83 (79.8)
	<i>Total</i>	<i>950</i>	<i>125</i>	<i>104</i>
Cat's susceptibility to infectious diseases	Unimportant	103 (11)	14 (11.3)	18 (18)
	Important	830 (89)	110 (88.7)	82 (82)
	<i>Total</i>	<i>933</i>	<i>124</i>	<i>100</i>
Infectious diseases' level of danger	Unimportant	76 (8.1)	9 (7.3)	11 (10.9)
	Important	860 (91.9)	115 (92.7)	90 (89.1)
	<i>Total</i>	<i>936</i>	<i>124</i>	<i>101</i>
Effectiveness of vaccination	Unimportant	92 (9.8)	16 (12.7)	19 (19.6)
	Important	844 (90.2)	110 (87.3)	78 (80.4)
	<i>Total</i>	<i>936</i>	<i>126</i>	<i>97</i>
Time necessary to vaccinate the cat	Unimportant	873 (93.4)	104 (82.5)	76 (76.8)
	Important	62 (6.6)	22 (17.5)	23 (23.2)
	<i>Total</i>	<i>935</i>	<i>126</i>	<i>99</i>
Cat's lifestyle	Unimportant	418 (44.4)	25 (19.5)	39 (38.2)
	Important	524 (55.6)	103 (80.5)	63 (61.8)
	<i>Total</i>	<i>942</i>	<i>128</i>	<i>102</i>
Cat's age	Unimportant	431 (45.9)	32 (25.2)	52 (50)
	Important	508 (54.1)	95 (74.8)	52 (50)
	<i>Total</i>	<i>939</i>	<i>127</i>	<i>104</i>
Current cat's disease/therapy	Unimportant	158 (16.8)	21 (16.5)	33 (33)
	Important	781 (83.2)	106 (83.5)	67 (67)
	<i>Total</i>	<i>939</i>	<i>127</i>	<i>100</i>

\* important = responses "important" and "very important" combined

**Table 4**

*Relationship owner-veterinarian and veterinarian recommendations.*

Question	Response option*	No. (%) recently vaccinated	No. (%) not recently vaccinated	No. (%) unvaccinated	
<b>Revaccination recommendation by the veterinarian</b>	Every year	650 (65.3)	43 (32.8)	35 (31.3)	
	Every two/three years	280 (28.1)	34 (26.0)	7 (6.3)	
	More than three years	8 (0.8)	8 (6.1)	2 (1.8)	
	Unknown	57 (5.7)	46 (35.1)	68 (60.7)	
	<i>Total</i>	<i>995</i>	<i>131</i>	<i>112</i>	
<b>Main factors for not making an appointment with the veterinarian</b>	Cost	6 (0.6)	3 (2.3)	3 (2.8)	
	The cat has never had health problems	31 (3.2)	19 (14.4)	10 (9.3)	
	Unimportant	1 (0.1)	5 (3.8)	3 (2.8)	
	Distance to clinic and transport, waiting time, opening hours	58 (6)	16 (12.1)	17 (15.7)	
	Finding and catching the cat/cat's stress				
	None (I go to the veterinarian)	877 (90.1)	89 (67.4)	75 (69.4)	
	<i>Total</i>	<i>973</i>	<i>132</i>	<i>108</i>	
<b>Value of source of information about vaccination</b>	Internet	Useless	269 (29.5)	37 (29.4)	28 (26.4)
		Useful	545 (70.5)	89 (70.6)	78 (73.6)
		<i>Total</i>	<i>913</i>	<i>126</i>	<i>106</i>
	Books	Useless	119 (13.3)	17 (14)	18 (18.2)
		Useful	775 (86.7)	104 (86)	81 (81.8)
		<i>Total</i>	<i>894</i>	<i>121</i>	<i>99</i>
	Relatives/friends	Useless	525 (59.9)	75 (63.6)	54 (53.5)
		Useful	351 (40.1)	43 (36.4)	47 (46.5)
		<i>Total</i>	<i>876</i>	<i>118</i>	<i>101</i>
	Breeder	Useless	338 (38.8)	61 (51.3)	32 (32.3)
		Useful	533 (61.2)	58 (48.7)	67 (67.7)
		<i>Total</i>	<i>871</i>	<i>119</i>	<i>99</i>
	Veterinarian	Useless	24 (2.4)	5 (3.8)	4 (3.5)
		Useful	959 (97.6)	125 (96.2)	110 (96.5)
		<i>Total</i>	<i>983</i>	<i>130</i>	<i>114</i>
Pet shop	Useless	555 (64.5)	80 (67.8)	42 (41.2)	
	Useful	306 (35.5)	38 (32.2)	60 (58.8)	
	<i>Total</i>	<i>861</i>	<i>118</i>	<i>102</i>	
Animal shelter/charity	Useless	228 (25.8)	44 (39.3)	29 (27.9)	
	Useful	656 (74.2)	68 (60.7)	75 (72.1)	
	<i>Total</i>	<i>884</i>	<i>112</i>	<i>104</i>	
Family doctor	Useless	668 (77.9)	100 (86.2)	69 (68.3)	

		Useful	190 (22.1)	16 (13.8)	32 (31.7)
		<i>Total</i>	<i>858</i>	<i>116</i>	<i>101</i>
	Pharmacist	Useless	617 (71.8)	89 (76.1)	59 (58.4)
		Useful	242 (28.2)	28 (23.9)	42 (41.6)
		<i>Total</i>	<i>859</i>	<i>117</i>	<i>101</i>
<b>Duration of Immunity (DOI) test knowledge</b>	Yes		385 (38.8)	57 (42.9)	30 (25.9)
	No		608 (61.2)	76 (57.1)	86 (74.1)
	<i>Total</i>		<i>993</i>	<i>133</i>	<i>116</i>
<b>Possible use of DOI test</b>	Yes		840 (85.2)	108 (81.2)	83 (83.6)
	No		146 (14.8)	25 (18.8)	31 (16.4)
	<i>Total</i>		<i>986</i>	<i>133</i>	<i>114</i>

\* useful = responses "useful" and "very useful" combined

## Table 5

*Statistical analysis (multinomial logistic regression) of the results obtained from the online questionnaire using the cats recently vaccinated as the reference category.*

Question	Response option	Cat not recently vaccinated		Cat unvaccinated		
		<i>p-value</i>	OR	<i>p-value</i>	OR	
Origin of cat	Breeder/shop	<b>0.024</b>	0.239	0.764	0.788	
	Animal Shelter/charity/stray	0.572	1.207	0.628	1.221	
	Internet	0.836	0.819	0.602	1.536	
Number of cats owned by respondent	Relatives/friends		1		1	
	1	0.517	0.818	0.511	1.270	
Age of cat	≥ 2		1		1	
	8 weeks - 1 year	<b>0.000</b>	0.008	0.090	0.397	
	2 - 4 years	<b>0.000</b>	0.019	<b>0.000</b>	0.128	
	5 - 9 years	<b>0.032</b>	0.509	0.055	0.389	
Indoor/outdoor access	≥ 10 years		1		1	
	Indoor only	0.441	1.269	0.138	0.570	
Previous cat's experience	Indoor and outdoor		1		1	
	Cattery/cat shows	0.728	0.833	0.092	0.131	
	Travel	0.543	0.807	0.284	0.599	
Importance of factors influencing the vaccinated cats' owners (three-values scale from "unimportant" to "very important")	None		1		1	
	Cost	Important/Very important	0.234	1.591	<b>0.042</b>	2.266
		Unimportant		1		1
	Veterinarian's advice	Important/Very important	0.230	0.497	0.128	0.366
		Unimportant		1		1
	Time necessary to vaccinate the cat	Important/Very important	0.167	1.858	0.124	2.161
		Unimportant		1		1
	Cat's lifestyle	Important/Very important	<b>0.010</b>	2.801	0.242	1.703
		Unimportant		1		1
	Infectious diseases' level of danger	Important/Very important	0.185	0.429	0.816	0.846
Unimportant			1		1	
Duration of Immunity (DOI) test knowledge	Yes	0.984	1.007	0.295	0.643	
	No		1		1	
Possible use of DOI test	Yes	0.083	0.535	0.226	0.595	
	No		1		1	
Age of respondent	17-20 years	0.936	1.084	0.244	0.340	
	21-49 years	0.285	0.641	0.072	0.412	
	≥ 50 years		1		1	
Level of education of respondent	Primary/middle school certificate	0.392	0.278	0.739	0.604	
	High school certificate	0.713	1.112	0.193	1.610	
	Bachelor/Master/PhD		1		1	

<b>Job of respondent</b>	Other	0.054	0.497	0.257	1.696
	Students	0.993	1.006	0.876	1.205
	Healthcare		1		1
<b>Annual household income of respondent</b>	≤ 9.000 €	0.108	3.278	0.032	5.036
	10-29.000 €	<b>0.011</b>	3.605	0.121	2.448
	30-49.000 €	0.172	2.017	0.405	0.583
	≥ 50.000 €		1		1
<b>Children (≤ 13 years old) in the household of respondent</b>	Yes	0.711	0.857	0.693	1.186
	No		1		1

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**Table 6**

*Statistical analysis (multinomial logistic regression) of the results obtained from the online questionnaire using the unvaccinated cats as the reference category.*

Question	Response option		Cat not recently vaccinated		Cat recently vaccinated	
			<i>p-value</i>	OR	<i>p-value</i>	OR
<b>Origin of cat</b>	Breeder/shop		0.196	0.303	0.764	1.269
	Animal Shelter/charity/stray		0.982	0.989	0.628	0.819
	Internet		0.587	0.533	0.602	0.651
	Relatives/friends			1		1
<b>Number of cats owned by respondent</b>	1		0.302	0.644	0.511	0.788
	≥ 2			1		1
<b>Age of cat</b>	8 weeks - 1 year		<b>0.001</b>	0.020	0.090	2.521
	2 - 4 years		<b>0.006</b>	0.151	<b>0.000</b>	7.789
	5 - 9 years		0.584	1.307	0.055	2.567
	≥ 10 years			1		1
<b>Indoor/outdoor access</b>	Indoor only		0.063	2.229	0.138	1.756
	Indoor and outdoor			1		1
<b>Previous cat's experience</b>	Cattery/cat shows		0.133	6.376	0.092	7.656
	Travel		0.575	1.347	0.284	1.670
	None			1		1
<b>Importance of factors influencing the vaccinated cats' owners (three-values scale from "unimportant" to "very important")</b>	Cost	Important/Very important	0.447	0.702	<b>0.042</b>	0.441
		Unimportant		1		1
	Veterinarian's advice	Important/Very important	0.666	1.357	0.128	2.729
		Unimportant		1		1
	Time necessary to vaccinate the cat	Important/Very important	0.781	0.860	0.124	0.463
		Unimportant		1		1
	Cat's lifestyle	Important/Very important	0.362	1.645	0.242	0.587
		Unimportant		1		1
	Infectious diseases' level of danger	Important/Very important	0.396	0.507	0.816	1.182
		Unimportant		1		1
<b>Duration Of Immunity (DOI) test knowledge</b>	Yes		0.348	1.566	0.295	1.554
	No			1		1
<b>Possible use of DOI test</b>	Yes		0.822	0.899	0.226	1.679
	No			1		1
<b>Age of respondent</b>	17-20 years		0.304	3.184	0.244	2.938
	21-49 years		0.424	1.557	0.072	2.429
	≥ 50 years			1		1
<b>Level of education of respondent</b>	Primary/middle school certificate		0.632	0.460	0.739	1.657
	High school certificate		0.377	0.691	0.193	0.621
	Bachelor/Master/PhD			1		1
<b>Job of respondent</b>	Other		<b>0.018</b>	0.293	0.257	0.590

	Student	0.883	0.834	0.876	0.830
	Healthcare		1		1
<b>Annual household income of respondent</b>	≤ 9.000 €	0.628	0.651	<b>0.032</b>	0.199
	10-29.000 €	0.556	1.473	0.121	0.409
	30-49.000 €	0.094	3.459	0.405	1.715
	≥ 50.000 €		1		1
<b>Children (≤ 13 years old) in the household of respondent</b>	Yes	0.533	0.723	0.693	0.843
	No		1		1

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## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Questionnaire.pdf](#)