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Feline Demographics and Disease Distribution in the Republic of Korea

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Abstract The population of pet cats has increased significantly, from 0.3% in 2002 to 5.6% in 2017. Large-scale feline demographic and disease data from Korea are lacking. The aim of this study was to investigate the demographic data (breed, sex, and age) and disease distribution of cats who visited private veterinary practices in Korea. Data including breed, sex, age, and disease, were compiled from 32,728 electronic medical records from 30 selected private veterinary practices, between January 1, 2016, and December 31, 2017. Diseases were classified based on the International Classification of Diseases 11 by the World Health Organization, and then compared and cross-analyzed according to breed, sex, and age. Korean shorthair was the most common breed. There was a high distribution of young cats, with 77.6% of the cats under 4 years of age, and an average age of 2.5 years. Diagnoses related to preventative medicine were the most frequent and diagnoses common to young cats had higher incidence. This demographic data and information about disease distribution can be used as a basis for future research and may be helpful for determining priorities in the diagnosis of diseases and establishing strategies for health management in cats.

Key words cat, demographics, disease distribution, ICD, Republic of Korea.

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Introduction

In the Republic of Korea, there has been a significant increase in the population of pet cats, from 0.3% in 2002 to 5.6% in 2017 (7,13). Given that there is an increasing number of single-person households with the inhabitants spending most of their days outside their residence, it is thought that the number of people choosing to have cats for pets is increasing since cats have more independent tendencies than dogs. Considering that approximately 25.4% of households have pet cats in the United States (US) (1) and 25.5% of households have pet cats in the United Kingdom (UK) (17), the population of cats could increase further in Korea in the future.

In developed countries such as the US, UK, and Japan, nationwide survey studies on cat diseases have been conducted (9,15,20). These studies analyzed the medical records of private veterinary practices that commonly provide care to cats; the studies aimed to facilitate the diagnosis of disease by veterinary clinicians and to contribute to the establishment of a health strategy in each country. In Korea, some previous studies have reported the regional incidence of specific diseases of cats, such as feline panleukopenia virus and coronavirus (2,12), and a small-scale epidemiological study has investigated the cause of death in cats (10). However, a large-scale study of demographic characteristics and disease distribution of cats in Korea has not been reported.

This study aimed to investigate the demographic data (breed, sex, and age) and disease distribution of cats who visited private veterinary practices in Korea.

Materials and Methods

Thirty private veterinary practices were selected with at least one veterinary practice in each administrative district (Seoul, Incheon, Gyeonggi, Gangwon, Chungbuk, Daejeon, Chungnam, Jeonbuk, Gwangju, Jeonnam, Daegu, Gyeongbuk, Busan, Ulsan, Gyeongnam, and Jeju). Veterinary practices that focused on specific departments such as dentistry, ophthalmology, and imaging, and clinics mainly providing referral services, including large and university veterinary hospitals, were excluded.

Data from cats who were presented to the selected private veterinary practices between January 1, 2016, and December 31, 2017, were extracted from electronic medical records. The data included breed, sex, age, date of the visit, reason for the visit, and a diagnosis or a medical description that could facilitate a diagnosis. Consent for using the information was obtained from each veterinary practice. Owner information was excluded from the data.

The extracted data were processed according to breed, sex, age, and disease. Given that breed notations differed across veterinary practices, the terms were unified. For example, the Korean shorthair cat, Korean domestic shorthair cat, and the abbreviation KSH referred to the same breed and were unified as Korean shorthair. Sex was classified into intact male, neutered male, intact female, and spayed female. If the sex was not specified, it was classified as "unknown". The age of the cats was calculated using the date of birth and the date of the visit. Age groups were divided into six groups as follows: <1 year, 1 to <4 years, 4 to <7 years, 7 to <10 years, 10 to <15 years, and ≥15 years. Diseases were recorded once by six experienced veterinarians reviewing the diagnoses, reasons for visit, and the medical descriptions. If the same cat revisited to the clinic for an unrelated issue, it was considered a different sample. Recorded diseases were classified based on the International Classification of Diseases (ICD)-11 by the World Health Organization (WHO) (26). Classified diseases were compared and cross-analyzed according to breed, sex, and age.

Frequency/percentage and mean/standard deviation were used to present the characteristics of breed, sex, age, and disease distribution. The $\chi 2$-test (Fisher's exact test) was used to assess differences in breed, sex, and age according to the ICD diagnosis, and the prevalence was presented with the calculation of a 95% confidence interval. Statistical analyses were performed using SPSS software version 25. Statistical significance was set at $p < 0.05$.

Table 1. Distribution of selected data according to the administrative district

District	Veterinary practice (n)	Data (n)	Data (%)
Seoul	7	8868	27.1
Incheon	1	2445	7.5
Gyeonggi	4	6613	20.2
Gangwon	1	1169	3.6
Chungbuk	2	455	1.4
Daejeon	2	709	2.2
Chungnam	1	2823	8.6
Jeonbuk	1	664	2.0
Gwangju	2	436	1.3
Jeonnam	1	970	3.0
Daegu	1	418	1.3
Gyeongbuk	1	919	2.8
Busan	2	724	2.2
Ulsan	1	1825	5.6
Gyeongnam	2	2019	6.2
Jeju	1	1671	5.1
Total	30	32728	100.0

Results

A total of 32,728 samples were obtained from 30 private veterinary practices (Table 1). Table 2 presents the breed, sex, and age distribution of the cats. The most common breed was the Korean shorthair, accounting for 40.5%, followed by the Persian (10.3%), Scottish fold (7.7%), Russian blue (7.6%), mixed breed (5.5%), Siamese (5.2%), and Turkish Angora (5.1%). As for sex distribution, 20.6%, 21.9%, 19.1%, 36.3%, and 2.1% were classified as female intact, female spayed, male intact, male neutered, and unknown, respectively. The mean age was 2.5 years (mean ± SD: 2.51 ± 2.89). The group under 1 year of age accounted for 39.8%, and the group between 1 to <4 years of age accounted for 37.8%.

Table 2. Demographic summary of data

Variables	Number (%)
Popular breeds	
Korean Shorthair	13,248 (40.5)
Persian	3,365 (10.3)
Scottish Fold	2,545 (7.7)
Russian Blue	2,503 (7.6)
Mixed	1,811 (5.5)
Siamese	1,696 (5.2)
Turkish Angora	1,664 (5.1)
Others*	5,896 (18.0)
Sex	
Female intact	6,738 (20.6)
Female spayed	7,183 (21.9)
Male intact	6,242 (19.1)
Male neutered	11,867 (36.3)
Unknown	698 (2.1)
Age (years)	
<1	13,067 (39.8)
1 to <4	12,358 (37.8)
4 to <7	4,468 (13.7)
7 to <10	1,708 (5.2)
10 to 15	949 (2.9)
≥15	178 (0.5)

*Bengal (893, 2.73%), Munchkin (794, 2.73%), American Shorthair (788, 2.41%), Abyssinian (688, 2.10%), Norwegian Forest (648, 1.93%), British Shorthair (456, 1.39%), Ragdoll (331, 1.01%), Scottish Straight (238, 0.73%).

For disease distribution based on the ICD category (Fig. 1), the category with the most frequency was "Factors influencing health status or contact with health services" (26.0%), followed by "Diseases of the digestive system" (18.7%), "Diseases of the skin" (8.4%), "Diseases of the genitourinary system" (6.8%), "Diseases of the visual system" (6.7%), and "Diseases of the respiratory system" (6.1%).

Among the ICD disease categories, which showed significant differences ($p < 0.001$) by the top seven breeds were: "Neoplasm", "Diseases of the visual system", "Diseases of the ear or mastoid process", "Diseases of the circulatory system", "Diseases of the respiratory system", "Diseases of the digestive system", "Diseases of the skin", "Diseases of the musculoskeletal system or connective tissue", "Diseases of the genitourinary system", "Pregnancy, childbirth or the puerperium", "Symptoms, signs, or clinical findings, not elsewhere classified", "External causes of morbidity or mortality", "Factors influencing health status or contact with health services" (Table 3). In the mixed and Korean shorthair breeds, the distribution of "External causes of morbidity or mortality" was relatively higher than in other breeds. In the Persian and Scottish fold breeds, "Diseases of the ear or mastoid process" and "Diseases of the circulatory system" categories showed a

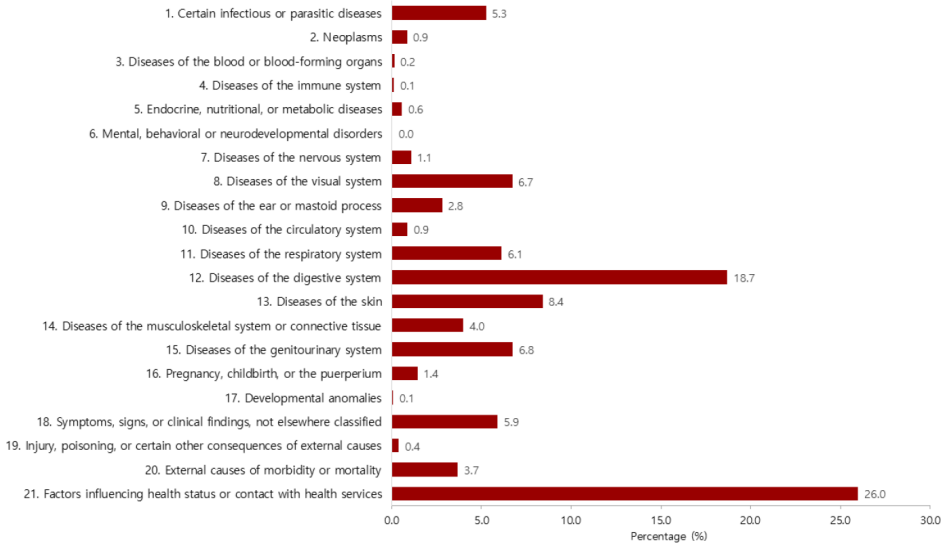

Fig. 1. Feline disease distribution according to ICD-11 category.

Table 3. Distribution of diseases according to the most common top 7 breeds (%, 95% confidence interval)

ICD*-breed	Korean Shorthair	Persian	Scottish Fold	Russian Blue	Mixed	Siamese	Turkish Angora	Others	p-value
1	5.3 (4.9-5.7)	4.6 (4.0-5.4)	6.2 (5.4-7.3)	5.3 (4.5-6.3)	6.5 (5.5-7.7)	5.2 (4.3-6.4)	3.7 (2.9-4.7)	5.2 (4.6-5.8)	0.003
2	1.0 (0.9-1.2)	1.1 (0.8-1.5)	0.8 (0.5-1.3)	0.5 (0.3-0.9)	0.8 (0.5-1.3)	0.5 (0.3-1.0)	1.4 (0.9-2.1)	0.4 (0.3-0.6)	<0.001
3	0.1 (0.1-0.2)	0.2 (0.1-0.4)	0.1 (0.0-0.3)	0.1 (0.1-0.4)	0.2 (0.1-0.5)	0.1 (0.0-0.4)	0.5 (0.2-1.0)	0.2 (0.1-0.3)	0.079
4	0.1 (0.1-0.2)	0.2 (0.1-0.4)	0.1 (0.0-0.3)	0.2 (0.1-0.4)	0.1 (0.0-0.4)	0.1 (0.0-0.4)	0.3 (0.1-0.7)	0.2 (0.1-0.3)	0.312
5	0.6 (0.5-0.8)	0.6 (0.4-0.9)	0.3 (0.2-0.6)	0.7 (0.5-1.1)	0.3 (0.1-0.7)	0.3 (0.1-1.7)	0.8 (0.5-1.4)	0.5 (0.3-0.7)	0.064
6	0.1 (0.0-0.1)	0.0 (0.0-0.2)	0.0 (0.0-0.3)	0.0 (-)	0.1 (0.0-0.4)	0.0 (-)	0.1 (0.0-0.4)	0.0 (0.0-0.1)	0.927
7	1.2 (1.1-1.4)	0.7 (0.5-1.0)	0.7 (0.5-1.2)	1.3 (0.9-2.0)	1.3 (0.9-2.0)	0.8 (0.5-1.4)	1.5 (1.0-2.2)	0.8 (0.6-1.1)	0.006
8	6.2 (5.8-6.6)	7.2 (6.4-8.1)	8.2 (7.2-9.3)	5.8 (5.0-6.8)	6.4 (5.4-7.6)	8.5 (7.3-9.9)	6.9 (5.8-8.2)	7.1 (6.4-7.7)	<0.001
9	2.2 (1.9-2.4)	3.3 (2.8-4.0)	3.8 (3.1-4.6)	3.0 (2.4-3.7)	2.7 (2.1-3.6)	2.7 (2.0-3.6)	2.9 (2.2-3.9)	3.5 (3.1-4.0)	<0.001
10	0.5 (0.4-0.7)	1.8 (1.4-2.3)	1.3 (1.0-1.9)	0.7 (0.4-1.1)	1.0 (0.7-1.6)	0.4 (0.2-0.9)	1.4 (1.0-2.1)	0.9 (0.7-1.2)	<0.001
11	5.9 (5.5-6.3)	4.8 (4.2-5.6)	8.4 (7.4-9.6)	6.1 (5.2-7.1)	5.1 (4.2-6.3)	5.5 (4.5-6.7)	4.3 (3.4-5.4)	7.3 (6.7-8.0)	<0.001
12	19.6 (19.0-20.3)	20.1 (18.8-21.5)	14.2 (12.9-15.6)	16.8 (15.4-18.3)	18.7 (17.0-20.6)	18.8 (17.0-20.7)	19.6 (17.8-21.6)	18.2 (17.3-19.2)	<0.001
13	7.1 (6.7-7.5)	10.5 (9.5-11.6)	9.5 (8.5-10.8)	9.1 (8.0-10.3)	7.0 (5.9-8.3)	8.4 (7.1-9.8)	11.5 (10.1-13.2)	9.0 (8.3-9.7)	<0.001
14	4.6 (4.3-5.0)	2.9 (2.3-3.5)	4.0 (3.3-4.8)	4.0 (3.3-4.8)	5.1 (4.2-6.3)	3.8 (3.0-4.9)	3.2 (2.4-4.1)	3.2 (2.8-3.7)	<0.001
15	6.6 (6.2-7.2)	8.1 (7.2-9.0)	6.3 (5.4-7.3)	8.2 (7.1-9.3)	6.5 (5.5-7.7)	7.1 (60.-8.5)	8.6 (7.3-10.0)	5.5 (4.9-6.1)	<0.001
16	0.8 (0.7-1.0)	2.3 (1.9-2.9)	1.7 (1.3-2.3)	1.4 (1.0-1.9)	0.8 (0.5-1.4)	1.5 (1.0-2.2)	1.3 (0.9-2.0)	2.5 (2.2-3.0)	<0.001
17	0.1 (0.0-0.1)	0.0 (0.0-0.2)	0.2 (0.1-0.4)	0.2 (0.1-0.5)	0.1 (0.0-0.4)	0.2 (0.1-0.6)	0.0 (-)	0.1 (0.0-0.2)	0.023
18	6.9 (6.5-7.4)	5.4 (4.7-6.2)	4.1 (3.4-5.0)	5.3 (4.5-6.2)	7.5 (6.4-8.8)	5.9 (4.9-7.1)	5.2 (4.2-6.3)	4.6 (4.1-5.2)	<0.001
19	0.4 (0.3-0.5)	0.4 (0.2-0.6)	0.2 (0.1-0.5)	0.3 (0.2-0.6)	0.5 (0.3-1.0)	0.5 (0.3-1.0)	0.7 (0.4-1.2)	0.4 (0.3-0.6)	0.359
20	4.4 (3.0-4.7)	2.9 (2.4-3.6)	2.5 (2.0-3.2)	3.5 (2.8-4.3)	4.9 (4.0-6.0)	3.3 (2.5-4.3)	4.2 (3.3-5.3)	2.8 (2.4-3.3)	<0.001
21	26.3 (25.6-27.1)	22.7 (21.3-24.2)	27.2 (25.5-29.0)	27.6 (25.9-29.4)	24.3 (22.4-26.3)	26.2 (24.1-28.3)	21.9 (20.0-23.9)	27.6 (26.4-28.7)	<0.001

*International Classification of Diseases (ICD): 1. Certain infectious or parasitic diseases; 2. Neoplasm; 3. Diseases of the blood or blood-forming organs; 4. Diseases of the immune system; 5. Endocrine, nutritional or metabolic diseases; 6. Mental, behavioural or neurodevelopmental disorders; 7. Diseases of the nervous system; 8. Diseases of the visual system; 9. Diseases of the ear or mastoid process; 10. Diseases of the circulatory system; 11. Diseases of the respiratory system; 12. Diseases of the digestive system; 13. Diseases of the skin; 14. Diseases of the musculoskeletal system or connective tissue; 15. Diseases of the genitourinary system; 16. Pregnancy, childbirth or the puerperium; 17. Developmental anomalies; 18. Symptoms, signs, or clinical findings, not elsewhere classified; 19. Injury, poisoning, or certain other consequences of external causes; 20. External causes of morbidity or mortality; 21. Factors influencing health status or contact with health services.

relatively higher distribution than in other breeds. In the Turkish Angora, the "Diseases of the circulatory system" category showed a relatively higher distribution than in other breeds.

Sex-based significant differences ($p < 0.001$) in the disease distribution among the ICD classifications were as follows: "Certain infectious or parasitic diseases", "Neoplasm", " "Dis-

eases of the visual system", "Diseases of the circulatory system", "Diseases of the respiratory system", "Diseases of the digestive system", "Diseases of the musculoskeletal system or connective tissue", "Diseases of the genitourinary system", "Pregnancy, childbirth or the puerperium", "Symptoms, signs, or clinical findings, not elsewhere classified", "External

Table 4. Distribution of diseases according to the sex (%, 95% confidence interval)

ICD*-sex	Male intact	Male castrated	Female intact	Female spayed	Unknown	p-value
1	8.4 (7.7-9.1)	3.4 (3.1-3.8)	7.0 (6.4-7.6)	3.6 (3.2-4.1)	8.7 (6.9-11.1)	<0.001
2	0.5 (0.4-0.8)	0.7 (0.9-1.2)	0.6 (0.4-0.8)	1.2 (1.0-1.5)	0.4 (0.1-1.3)	<0.001
3	0.1 (0.1-0.3)	0.2 (0.1-0.3)	0.2 (0.1-0.3)	0.1 (0.1-0.2)	0.0 (-)	0.687
4	0.1 (0.1-0.3)	0.1 (0.1-0.2)	0.1 (0.0-0.2)	0.2 (0.1-0.3)	0.0 (-)	0.266
5	0.4 (0.3-0.6)	0.6 (0.5-0.8)	0.4 (0.3-0.6)	0.8 (0.6-1.0)	0.4 (0.1-1.3)	0.025
6	0.1 (0.0-0.2)	0.0 (0.0-0.1)	0.0 (0.0-0.1)	0.0 (0.0-0.1)	0.4 (0.1-1.3)	0.007
7	1.2 (1.0-1.5)	1.0 (0.8-1.2)	0.8 (0.6-1.1)	1.3 (1.0-1.5)	2.1 (1.3-3.5)	0.003
8	7.2 (6.6-7.9)	6.0 (5.6-6.5)	7.7 (7.1-8.3)	6.6 (6.1-7.2)	6.4 (4.8-8.5)	<0.001
9	3.1 (2.7-3.6)	2.5 (2.2-2.8)	3.4 (3.0-3.8)	2.6 (2.2-3.0)	2.1 (1.3-3.5)	0.003
10	0.5 (0.4-0.7)	1.3 (1.1-1.5)	0.7 (0.5-0.9)	0.7 (0.5-0.9)	0.4 (0.1-1.3)	<0.001
11	7.0 (6.4-7.6)	5.6 (5.2-6.0)	7.0 (6.4-7.6)	5.3 (4.8-5.8)	8.7 (6.9-11.1)	<0.001
12	17.5 (16.5-18.4)	20.4 (19.7-21.1)	16.0 (15.2-16.9)	19.6 (18.7-20.6)	17.3 (14.7-20.3)	<0.001
13	8.6 (7.9-9.3)	8.1 (7.6-8.6)	8.4 (7.7-9.0)	8.8 (8.2-9.5)	8.0 (6.2-10.3)	0.499
14	5.2 (4.7-5.8)	3.6 (3.3-3.9)	4.1 (3.7-4.6)	3.4 (3.0-3.9)	5.0 (3.6-6.9)	<0.001
15	3.9 (3.4-4.4)	11.0 (10.5-11.6)	3.1 (2.7-3.6)	6.0 (5.5-6.6)	2.7 (1.7-4.2)	<0.001
16	0.2 (0.1-0.3)	0.0 (0.0-0.1)	5.4 (4.9-6.0)	1.2 (1.0-1.5)	1.0 (0.5-2.1)	<0.001
17	0.1 (0.0-0.2)	0.1 (0.1-0.2)	0.1 (0.0-0.2)	0.1 (0.0-0.2)	0.0 (-)	0.799
18	5.9 (5.3-6.5)	5.5 (5.1-6.0)	5.9 (5.4-6.5)	6.0 (5.5-6.6)	10.6 (8.5-13.1)	<0.001
19	0.3 (0.2-0.5)	0.3 (0.2-0.4)	0.6 (0.4-0.8)	0.4 (0.3-0.5)	0.4 (0.1-1.3)	0.025
20	4.0 (3.5-4.5)	3.5 (3.2-3.8)	4.1 (3.7-4.6)	3.1 (2.7-3.5)	6.9 (5.2-9.0)	<0.001
21	25.8 (24.7-26.9)	25.6 (24.8-26.4)	24.5 (23.5-25.5)	29.0 (27.9-30.0)	18.1 (15.4-21.1)	<0.001

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causes of morbidity or mortality", "Factors influencing health status or contact with health services" (Table 4). The distribution of "Diseases of the circulatory system" and "Diseases of the genitourinary system" was higher in neutered males than in other sexes. Females showed a higher frequency of "Pregnancy and childbirth or the puerperium" compared with oth-

Table 5. Distribution of diseases according to age (%, 95% confidence interval)

ICD*-age	<1 year	1-4 years	4-7 years	7-10 years	10-15 years	≥15 years	Pattern	p-value
1	7.2 (6.8-7.7)	4.7 (4.3-5.1)	3.2 (2.7-3.8)	2.5 (1.8-3.3)	1.3 (0.7-2.2)	2.8 (1.2-6.6)		<0.001
2	0.5 (0.4-0.6)	0.7 (0.6-0.9)	1.4 (1.1-1.8)	1.6 (1.1-2.3)	3.6 (2.6-5.0)	3.4 (1.5-7.3)		<0.001
3	0.1 (0.0-0.1)	0.2 (0.1-0.3)	0.2 (0.1-0.4)	0.2 (0.1-0.5)	0.5 (0.2-1.3)	1.1 (0.3-4.4)		0.001
4	0.1 (0.1-0.2)	0.2 (0.1-0.3)	0.1 (0.1-0.3)	0.2 (0.1-0.6)	0.0 (-)	0.0 (-)		0.282
5	0.2 (0.2-0.3)	0.4 (0.3-0.6)	0.7 (0.5-1.0)	1.8 (1.3-2.6)	3.6 (2.6-5.0)	1.7 (0.5-5.1)		<0.001
6	0.0 (0.0-0.1)	0.1 (0.0-0.1)	0.0 (0.0-0.2)	0.0 (-)	0.0 (-)	0.6 (0.1-3.9)		0.205
7	1.1 (0.9-1.3)	0.9 (0.8-1.1)	1.1 (0.8-1.4)	1.3 (0.8-1.9)	1.8 (1.1-2.9)	3.4 (1.5-7.3)		0.005
8	6.5 (6.0-6.9)	7.0 (6.5-7.4)	7.5 (6.7-8.3)	5.9 (4.9-7.1)	5.9 (4.6-7.6)	3.4 (1.5-7.3)		0.024
9	3.2 (2.9-3.5)	2.6 (2.4-2.9)	2.4 (2.0-2.9)	2.8 (2.1-3.6)	2.0 (1.3-3.1)	2.8 (1.2-6.6)		0.028
10	0.4 (0.3-0.5)	0.9 (0.8-1.1)	1.3 (1.0-1.7)	2.0 (1.4-2.8)	2.3 (1.5-3.5)	4.5 (2.3-8.7)		<0.001
11	6.6 (6.2-7.1)	5.6 (5.2-6.1)	6.0 (5.3-6.7)	6.1 (5.1-7.4)	6.4 (5.0-8.2)	7.3 (4.3-12.2)		0.047
12	14.7 (14.1-15.3)	19.6 (18.9-20.3)	23.5 (22.3-24.8)	23.4 (21.4-25.4)	29.5 (26.7-32.5)	25.8 (19.9-32.8)		<0.001
13	7.4 (7.0-7.9)	9.2 (8.7-9.7)	9.4 (8.6-10.3)	8.8 (7.6-10.3)	6.7 (5.3-8.5)	3.9 (1.9-8.0)		<0.001
14	4.1 (3.8-4.5)	4.1 (3.7-4.4)	3.8 (3.3-4.4)	3.2 (2.5-4.2)	3.8 (2.7-5.2)	2.8 (1.2-6.6)		0.457
15	1.5 (1.3-1.8)	7.5 (7.1-8.0)	13.4 (12.5-14.5)	17.5 (15.8-19.4)	15.1 (12.9-17.5)	20.8 (15.4-27.4)		<0.001
16	0.8 (0.7-1.0)	2.6 (2.3-2.9)	1.0 (0.7-1.3)	0.2 (0.1-0.6)	0.0 (-)	0.0 (-)		<0.001
17	0.1 (0.0-0.1)	0.1 (0.1-0.2)	0.1 (0.0-0.2)	0.0 (-)	0.1 (0.0-0.7)	0.0 (-)		0.537
18	5.0 (4.6-5.3)	5.9 (5.5-6.3)	6.7 (6.0-7.5)	9.1 (7.8-10.5)	8.6 (7.0-10.6)	11.8 (7.8-17.4)		<0.001
19	0.3 (0.3-0.5)	0.5 (0.4-0.6)	0.4 (0.3-0.6)	0.1 (0.0-0.5)	0.6 (0.3-1.4)	0.0 (-)		0.138
20	2.8 (2.6-3.1)	4.5 (4.2-4.9)	4.2 (3.6-4.8)	3.7 (2.9-4.7)	2.8 (2.0-4.1)	1.7 (0.5-5.1)		<0.001
21	37.3 (36.5-38.2)	22.7 (22.0-23.5)	13.5 (12.5-14.5)	9.6 (8.3-11.1)	5.3 (4.0-6.9)	2.2 (0.8-5.8)		<0.001

*International Classification of Diseases (ICD): 1. Certain infectious or parasitic diseases; 2. Neoplasm; 3. Diseases of the blood or blood-forming organs; 4. Diseases of the immune system; 5. Endocrine, nutritional or metabolic diseases; 6. Mental, behavioural or neurodevelopmental disorders; 7. Diseases of the nervous system; 8. Diseases of the visual system; 9. Diseases of the ear or mastoid process; 10. Diseases of the circulatory system; 11. Diseases of the respiratory system; 12. Diseases of the digestive system; 13. Diseases of the skin; 14. Diseases of the musculoskeletal system or connective tissue; 15. Diseases of the genitourinary system; 16. Pregnancy, childbirth or the puerperium; 17. Developmental anomalies; 18. Symptoms, signs or clinical findings, not elsewhere classified; 19. Injury, poisoning or certain other consequences of external causes; 20. External causes of morbidity or mortality; 21. Factors influencing health status or contact with health services.

er classified sexes, as expected.

Table 5 shows the results of the cross-analysis of age-based differences in disease distribution according to the ICD categories. The categories in which the incidence increased with age were: "Neoplasm," "Diseases of the blood or blood-forming organs," "Endocrine, nutritional, or metabolic diseases," "Diseases of the nervous system," "Diseases of the circulatory system," "Diseases of the digestive system," "Diseases of the genitourinary system," and "Symptoms, signs or clinical findings, not elsewhere classified." In contrast, "Certain infectious or parasitic diseases," "External causes of morbidity or mortality," and "Factors influencing health status or contact with health services" were more commonly observed in younger cats and their incidence decreased with age.

Discussion

As in other countries, the domestic shorthair and mixed breed were the most common breeds (9,15,20). The most common breed by country was the domestic shorthair (65.3%) in the US, crossbreed (89.5%) in the UK, and crossbreed (36.2%) in Japan. Compared to the US and UK where the proportion of pure breeds is relatively low, this study showed a similar distribution to the Japanese study with its higher proportion of pure breeds such as the Scottish fold, Russian blue, and Persian (9).

The characteristics of disease occurrence according to breeds generally support previous studies as follows: The "External causes of morbidity or mortality" was highest in mixed and KSH breeds. These two breeds are the most common breeds of stray cats in Korea (12), and it is thought that this is the reason they are most exposed to external risks compared to other breeds. "Diseases of the ear or mastoid process" was the most frequently observed distribution in the Scottish fold, followed by in the Persian. It is known that Scottish folds have narrow ear canals compared to other breeds due to congenitally curved ear cartilage, which causes wax build-up and frequent ear disease (16). Persians are known to have frequent ear disease due to excessive ceruminous gland production (21). "Diseases of the circulatory system" showed the highest incidence in the Persian, followed by in the Turkish Angora and Scottish fold. These three breeds are known to be predisposed to hypertrophic cardiomyopathy (HCM), which accounts for most of the circulatory system diseases of cats (6,14).

The neutering rate of male cats (70.5%) was higher than the neutering rate of females (51.5%), which is thought to be because neutering for males is generally simpler and cheaper than spaying females. The total combined neuter rate was 59.4%, which was lower than the 78.5% and 96.8% reported in previous studies in the US and UK, respectively (15,20). According to a survey conducted in Korea over the phone and online in 2017, the neuter rate was 49.8% (13), and the rate of neuter surgeries for pet cats in Korea is expected to increase gradually in the future, similar to the rate in other developed countries (15,20).

"Diseases of the circulatory system" showed the highest distribution in neutered males. In most previous studies, HCM was found to be more frequent in males than in females, which was consistent with this study (4,22,24). In a human study, it was also found that men are more likely to have HCM than women (19). The difference in the incidence of heart disease according to sex may be affected by modulating agents, including hormones and epigenetic factors (8). Although there are no reports on the relationship between neutering and heart disease, the higher incidence of heart disease in neutered males than in non-neutered males is thought to be because the reported diagnosis age of heart disease (4.8 years) is later than the age when neutering is typically performed (1.6 years) (13,22). The incidence of "Diseases of the genitourinary system" was highest in neutered males than in other sexes; moreover, it was higher in neutered cats than in intact cats. Previous studies reported that neutered males had the highest incidence of feline lower urinary tract disease (FLUTD) (23), and neutering increases the risk of FLUTD in both the sexes (25).

In a telephone survey conducted in the US, the average age of cats was 6.4 years, which was higher than the average of 4.0 years obtained in a Korean survey (3,7). In addition, the average age of cats visiting veterinary practices in the US and UK was 4.3 and 4.5 years, respectively, which was higher than the average of 2.5 years from this study (15,20). This suggests that cats raised in Korea are younger than those raised in the US and UK; the cats visiting the veterinary practices in Korea also showed a younger age distribution.

The incidence of neoplasia, nervous system diseases, circulatory diseases, and urinary diseases increased with age. This showed a similar pattern to the disease distribution of cats according to age studied in Japan (9). However, due to the difference in age distribution, there was a difference in the proportion of these geriatric diseases. In the UK, where the average age was higher than in this study, the incidence of neoplasia and circulatory diseases, which are representative geriatric diseases, was 3.4% and 5.6%, respectively; both categories had only a 0.9% incidence in this study (20). Since cats have just recently started to be raised in Korea, young cats are more prevalent, and the distribution of diseases that occur mainly in young age is also high. As cats in Korea get

older, they may gradually show similar age distributions to other developed countries, and the distribution of diseases is also expected to become similar.

Disease distribution was classified according to the ICD method, suggested by the WHO as the standard classification criteria for diseases and causes of human deaths. Although this method is mainly used as a classification method for human diseases, there are studies using this method in the classification of animal diseases (9,11). Using the ICD method, most diseases in this study could be classified into corresponding categories. In some studies, diseases were classified according to the organ system (OS) and pathophysiologic process (PP) methods (5,18). Compared to the ICD method, these methods classified diseases according to more direct and specific classification criteria. Because of this, there were many diseases that could not be classified into the appropriate categories. OS and PP methods may be useful for certain purposes, but the ICD method may be more suitable for large-scale studies involving multiple samples such as this study. Therefore, the ICD classification method could be used more appropriately than other methods to establish a database for diseases or for insurance systems that require comprehensive classification of various diseases.

This study may have some limitations. This study was made based on data from 5 years ago, and the current feline demographics and disease distribution may have changed. Some diseases may have been recorded based on symptoms or causes recorded on the medical records at the time of the visit, which may differ from the true diagnosis. In addition, there may be confusion between the recorded symptoms and the underlying disease that caused the symptoms (e.g., digestive symptoms due to kidney disease or difficulty breathing due to heart disease). There may also be confusion in breeds; in particular, the classification between mixed breeds and other purebred breeds may be subjective to the clinicians and clients who have registered the breeds. In terms of age, the age of a rescued or stray cat may be estimated because the actual age is unknown, so there may be a difference from the actual age.

In conclusion, this study investigated the demographic distribution of cats and cat diseases in Korea. Most cats raised in Korea belonged to the young age groups, which increased the frequency of visits to private veterinary practices due to characteristic diseases in this age group. It is expected that the number of geriatric diseases will increase as these young cats age. This study systematically classified diseases observed in veterinary practices in Korea, based on the ICD-11 classification method suggested by the WHO. This demographic data and information about disease distribution can be used as a basis for future research and may be helpful for determining priorities in the diagnosis of diseases and establishing strategies for health management in cats.

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Conflicts of Interest

The authors have no conflicting interests.

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