動物霊園のデータを用いた猫の平均余命の推定とその疫学的考察

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Epidemiological Studies on the Expectation of Life for Cats Computed from Animal Cemetery Records

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ABSTRACT. Based on the Chiang's method, the life table for cats was constructed from the death data of 3936 cats. They died in the Kanto area and were buried in an animal cemetery in Tokyo from June 1981 through May 1982. This life table seems to be the first one for domestic pet cats. The expectation of life for cats was 4.2 years at age 0, 5.0 years at age 1, 5.4 years at age 4, 5.3 years at age 5, 3.5 years at age 10, and 2.2 years at age 15. The maximum age at death was 22 years. From age 0 to age 5, the probability of dying for cats was higher than that for dogs, but over 6 years of age it seemed that Gompertz's equation was applicable to this life table for cats. From these results, if the probability of dying for cats at early ages decreases, the fundamental pattern of dying curve for cats seems to be a similar figure of dogs. The life table was constructed for different breeds and localities. Comparing the expectation of life at age 1 (e_1) of the two populations divided by breeds or localities, there was significant difference in the e_1 among different localities but not among different breeds. These facts suggest the existence of some factors which may influence the life span of cats among different localities.—KEY WORDS: cat, life expectation, life table.

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We previously reported the life table for dogs constructed from animal cemetery records and described its characteristics [3]. Cats, which are the companion animals as the same as dogs, intimately share man's physical environment. Therefore, it is very important not only for veterinary medicine, but also for animal care, comparative medicine, and public health to clarify the actual living state of cats. But it is difficult to clarify the actual living state of cats in Japan because there is no system of registration on cat. In this study, using the same method as dogs described before, we constructed the life table for cats and presented its characteristics. The results were viewed from an epidemiological point, comparing with that of dogs.

MATERIALS AND METHODS

Materials: The data, including the age at death, the death date, breed and the cat owner's residence, were obtained from 3936 cats which died in the Kanto area and were buried in an animal cemetery in Tokyo from June 1981 through May 1982.

Construction of life table: The life table for cats was constructed by the method described before [3]. The life tables were prepared not only from the data, but also from different breeds and localities. Breeds were classified into two groups: mongrel cats and pure-bred cats. Based on 1980 census data, the localities were classified into two, localities A and B, of which human population densities were above 10,000 and less than 10,000 per square kilometer, respectively. We used the age interval of one year, and the value 0.5 for

Table 1. The life table for cats constructed using the animal cemetery records, 1981–1982

Age interval (in years)	Number living at age x	Number dying in $(x, x+n)$	Probability of dying in $(x, x+n)$	Years lived in $(x, x+n)$	Years lived beyond x	Expectation of life at age x
$(x, x+n)$	l_x	d_x	q_x	L_x	T_x	e_x
0— 1	3936	1323	0.34	3274.5	16353.0	4.2
1— 2	2613	590	0.23	2318.0	13078.5	5.0
2— 3	2023	346	0.17	1850.0	10760.5	5.3
3— 4	1677	319	0.19	1517.5	8910.5	5.3
4— 5	1358	195	0.14	1260.5	7393.0	5.4
5— 6	1163	185	0.16	1070.5	6132.5	5.3
6— 7	978	101	0.10	927.5	5062.0	5.2
7— 8	877	112	0.13	821.0	4134.5	4.7
8— 9	765	115	0.15	707.5	3313.5	4.3
9—10	650	80	0.12	610.0	2606.0	4.0
10—11	570	155	0.27	492.5	1996.0	3.5
11—12	415	55	0.13	387.5	1503.5	3.6
12—13	360	82	0.23	319.0	1116.0	3.1
13—14	278	77	0.28	239.5	797.0	2.9
14—15	201	32	0.16	185.0	557.5	2.8
15—16	169	65	0.38	136.5	372.5	2.2
16—17	104	33	0.32	87.5	236.0	2.3
17—18	71	23	0.32	59.5	148.5	2.1
18—19	48	17	0.35	39.5	89.0	1.9
19—20	31	9	0.29	26.5	49.5	1.6
20—21	22	13	0.59	15.5	23.0	1.1
21—22	9	6	0.67	6.0	7.5	0.8
22—23	3	3	1.00	1.5	1.5	0.5

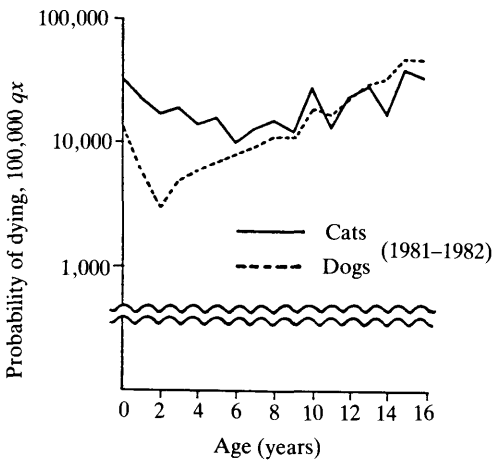

Fig. 1. Probability of dying in cats and dogs.

the fraction of the last age interval of life (a_x) for all intervals.

Comparing the expectation of life: To compare expectations of life in the two populations divided by breeds or localities, the significance of difference of the expectation of life was tested using the method described by Chiang [1].

RESULTS

Table 1 shows the life table for cats constructed from the animal cemetery records. The expectation of life was 4.2 years at age 0, 5.0 years at age 1, 5.4 years at age 4, 5.3 years at age 5, 3.5 at age 10 and 2.2 at age 15. The expectation of life was the longest at age 4. Maximum age at death was 22 years, and the highest mortality was shown at age 0.

Figure 1 presents the curve of probability of dying for cats, compared with that of dogs [3]. From age 0 to age 5, the probability of dying for cats was higher than that for dogs. But over 6 years of age, the probability of dying for cats was similar to that for dogs

Table 2. The expectation of life at age 0 and age 1 for cats by breeds, 1981–1982

Breed	Number	Expecation of[a] life at age 0	Expectation of life at age 1
All cats	3936	4.2	5.0
pure-bred cats	445	4.9	5.0
Mongrel cats	2812	4.6	5.0
Breed unknown cats	679	1.9	4.8

a) Statistical test for the significance of difference was not done.

which seemed to elevate straightly on a semilogarithm graph according to Gompertz's equation.

Table 2 shows the expectation of life at age 0 (e_0) and at age 1 (e_1) compared for different breeds. The e_0 of the unknown breed cats was 1.9 years, shorter than that of other breeds. But the e_1s for all breed cats were about 5.0 years, and there was no significant difference in the e_1 among them.

The e_0 and the e_1 in the two localities are shown in Table 3. The e_1s in localities A and B were 5.2 and 4.6, respectively, and the former was significantly longer than the latter ($p<0.01$). The e_1 for mongrel in locality A was significantly longer than that in locality B ($p<0.01$).

Table 3. The expectation of life at age 0 and age 1 for cats by breeds and localities, 1981–1982

Breed[a]	Number	Expecation of[b] life at age 0	Expectation of life at age 1
		Locality A	
All cats	2995	4.1	5.2[c]
pure-bred cats	326	4.9	5.1
Mongrel cats	2155	4.7	5.2[c]
		Locality B	
All cats	941	4.3	4.6
pure-bred cats	119	4.7	4.7
Mongrel cats	657	4.4	4.5

a) Breed unknown cats were excluded from this table.
b) Statistical test for significance of difference was not done.
c) Locality A>Locality B($p<0.01$).

DISCUSSION

We previously reported that the curve of probability of dying for dogs from the animal cemetery records was similar to that for man in basic form [3]. From age 0 to age 5, the probability of dying for cats was higher than that for dogs, but over 6 years of age, it seemed that Gompertz's equation was applicable to the life table for cats (Fig. 1). From these results, if the probability of dying for cats from age 0 to age 5 decreases, the fundamental pattern of cat's dying curve seems to be a similar with that of dogs. Cats have some fatal viral infectious diseases, such as feline panleukopenia (FPL) and feline infectious peritonitis (FIP), which seem to be more sensitive to the young than the old. And because of their life-style allowed to go around freely in and outside the room, they can frequently have contact with others. Therefore, we suggest that many cats at early ages are readily infected with such infectious diseases and may die as a result. Furthermore, because of their life-style, cats at such ages seem to be at a much greater risk of dying from animal interaction and traffic accidents than dogs.

The e_1s for dogs and cats, based on the animal cemetery record at the same period and area, were 8.6 and 5.0, respectively. A signifficant difference was found between them. Comfort [2] reported that there were a few cats living over 20 years and the potential maximum age of cats was greater than in any breed of dogs. And the max-

imum age at death of dogs and cats in the animal cemetery records were 26 and 22, respectively, and little difference was found between them. Therefore, we suggest that the difference of the e_1 between dogs and cats is caused by the differences within environmental factors around them but not in the potential maximum age.

As the same as dogs, we used the e_1 to compare the expectation of life for cats among breeds and localities because the e_1 seems to be more suitable to compare than the e_0. As a result, the e_1s for mongrel and pure-bred cats were both 5.0 and the significant difference was not found between them (Table 2). However a significant difference between mongrels and pure-breds was found in dogs but not in cats. This fact seems to be caused by the variation of life-styles between mongrels and pure-breds which is smaller in cats than in dogs. Since the pure-bred cats involve much breeds having different genetic factors, we need to collect more data to compare the longevity among breeds in the future.

The e_1 in locality A, which had a high human population density, was significantly longer than that in locality B, which had a low human population density. Also the e_1 for mongrel cats in locality A was significantly longer than that in locality B, but no signifficant difference of e_1 for pure-bred cats between the two localities was seen. This fact suggests that there are some differences of the environmental factors influenced the longevity of cats among the two localities. To be more concrete, as environmental conditions in locality A were improved more than that in locality B, the risk of infectious diseases seems to have decreased in locality A but not in locality B. Furthermore, socioeconomical factors and veterinary medical services seem to be different in the two localities and effects the difference of the e_1. In the future, it is necessary to collect more data and to clarify the factors which may effect the longevity of cats in the two localities.

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要　約

動物霊園のデータを用いた猫の平均余命の推定とその疫学的考察：林谷秀樹・近江佳郎・小川益男・福富和夫[1)]（東京農工大学農学部獣医学科家畜衛生学教室，[1)]国立公衆衛生院衛生統計学部）——1981年6月から1982年5月までの1年間に関東地方で死亡し，動物霊園に埋葬された猫3936頭の死亡データを用いて，Chiangの生命表作成法に従って，猫の生命表を作成した．これは家庭飼育猫について作成された最初の生命表と思われる．生命表から算出された猫の平均余命は，0歳で4.2歳，1歳で5.0歳，4歳で5.4歳，5歳で5.3歳，10歳で3.5歳，15歳で2.2歳で，最高死亡年齢は22歳であった．猫の死亡確率は犬に比べ，0歳から5歳にわたる幅広い年齢で著しく高かったが，6歳以上においてはほぼ等しく，犬と同様にGomperzの法則に従うように思われた．このように調査時点では猫の死亡確率の基本パターンは犬のものと著しく異なっていたが，今後0～5歳の低年齢における死亡確率が減少した場合には，両者のパターンは近似すると思われた．1歳の平均余命（e_1）は，品種間（雑種，純血種に大別）では差が見られなかったが，地域間ではA地域（人口密度1万人以上）はB地域（1万人未満）に比べ有意に長かった．このことから，犬の場合と同様，B地域ではA地域に比べ猫の平均余命を短くするような要因がより強く作用していることがうかがわれた．