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Life table analysis of feline polycystic kidney disease in Japan

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ABSTRACT. Feline polycystic kidney disease (PKD) is an inherited renal disorder observed in various breeds. Analyses of life expectancy and distribution of age at death among cats are not well documented. The current study preliminarily assessed life expectancy, cumulative survival rates, and distribution of age at death in cats with PKD by performing a follow-up investigation. This retrospective cohort study was conducted on 300 cats that tested positive for the feline *PKD1* variant (c.10063C >A) in Japan. A life table analysis was performed, and a distribution graph of age at death was generated. The life expectancy at birth was approximately 12.7 years, with a 5- and 10-year cumulative survival rates of 95.1% and 61.3%, respectively. Of the 300 cats, 48 (16.0%) progressed to uremia, and 62 (20.7%) died of renal failure and other causes. The median age at death in 62 cats was 8 years, with the first decile being 5 years. The highest number of deaths was at the age of 7 years. The cumulative survival rate began to decline significantly at the age of 6–7 years. This study first performed a survival analysis of feline PKD and provided an important basis for understanding the patterns of overall mortality associated with this genetic disorder. Our findings emphasized the importance of frequent examination at a young age, with consideration of the remarkable decrease in the cumulative survival rate between the ages of 6 and 7 years.

KEYWORDS: cumulative survival rate, feline polycystic kidney disease, follow-up investigation, life expectancy, life table analysis

INTRODUCTION

Feline polycystic kidney disease (PKD) is one of the most commonly inherited kidney diseases in cats and is caused by a single nonsense mutation of the *PKD1* gene (c.10063C >A) [14]. Feline PKD is characterized by the development of fluid-filled cysts in the two kidneys and a decline in renal function as the number and size of the renal cysts increase over time [18]. In general, clinical signs reflecting the decline in renal function begin to appear at approximately 7–8 years of age. However, the age at which cats with PKD die varies significantly. Some cats with PKD survive into their senior years. However, others develop uremia at a young age [17]. Given the significant variations in the progression of PKD, even among cats carrying the same genetic mutation, there is suspicion that other factors influence the progression. These factors can be identified by studying cats with PKD that die at a very young age. However, studies on the distribution of age at death in cats with PKD are lacking. Subsequently, the specific range for young age at death is not clearly defined.

Life table analysis is a statistical method that summarizes the actual age at death of a given population. It includes cohort and clinical life tables, which can provide important information for understanding factors associated with diseases, such as life expectancy and cumulative survival. Life table analysis has been established in the fields of social welfare, insurance, and medical science and is also considered useful in veterinary medicine [9]. Nevertheless, no research has used life table analysis, with a paucity of reports in veterinary medicine. In fact, there are only seven studies, none of which focused on feline PKD [1, 7, 8, 11, 12, 15, 19]. Cohort life tables are a fundamental type of life table analysis, tracking groups born simultaneously until death and providing insights into age-specific mortality rates and life expectancy [9, 10]. Clinical life tables, which are derived from cohort life tables in the medical field, are adapted for populations with variable participation and censoring. Thus, it can be a valuable tool for comparing treatment efficacy and determining prognosis [2, 4]. In the field of human medicine, clinical life tables have been employed for the life table analysis of specific diseases with limited sample sizes [16]. Further, a combination of clinical and cohort life tables has been utilized for life table analysis with death as a target event [3]. This study utilized a combination of cohort and clinical life tables to calculate

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life expectancy and cumulative survival rates for feline PKD.

The current study aimed to conduct the first large-scale, live-and-death follow-up investigation of cats with PKD in Japan. Furthermore, it quantitatively assessed life expectancy, cumulative survival rates, and distribution of age at death.

MATERIALS AND METHODS

Animals

Breeds that were closely related were combined. In particular, Persians and Chinchilla were combined as Persians; Exotic Shorthairs and the mixes as Exotic Shorthairs; Scottish Shorthairs and the mixes as Scottish Shorthairs; and American Shorthairs and the mixes as American Shorthairs. Domestic cats included domestic shorthair and longhair cats. This retrospective cohort study included 313 cats that tested positive for the feline *PKD1* variant (c.10063C >A) at the Veterinary Teaching Hospital in Iwate University between January 1, 2008, and May 31, 2024. *PKD1* genetic testing was requested by the owners due to the presence of renal cysts on ultrasonography, a family history of PKD, or the breeds prone to PKD. Cats without records on dates of birth and *PKD1* genetic testing were excluded from the study. The distribution of age at death among cats that were confirmed to be dead after the *PKD1* genetic test was examined. The dataset comprised the following variables: status (alive or dead), age at the final follow-up, breed, sex, neuter status, and the presence or absence of liver cysts on ultrasonography. The *PKD1* gene test using peripheral blood leukocytes was performed according to the method of Sato *et al*. [17]. All procedures were conducted in accordance with local and national animal ethics guidelines. The animal research committee of Iwate University approved this study (approval numbers: A201905, A202203, and A202412). Either a verbal or written informed consent for the procedure(s) undertaken was obtained from the owner of all animals described in this work. No animals or humans are identifiable in this publication. Therefore, additional informed consent for publication was not required.

Construction of the life tables

The generation of life expectancy tables for cats with PKD involved a comprehensive approach, which included the combination of cohort and clinical life tables. These tables were based on the deceased and survivor populations. The life table was calculated using specific variables. These variables included the number of dead cats at 1-year interval (x, $x + 1$), referred to as $d(x)$, and the quantity of valid observations, referred to as $N(x)$. The quantity of valid observations, denoted as $N(x)$, was determined by assuming censoring at the midpoint of the age interval (x, $x + 1$). This quantity was then calculated by subtracting half the number of censored cats, denoted as $w(x)$, from the number of living cats at age x. The mortality events were assumed to occur at the midpoint of the age interval (x, $x + 1$), with a weighting factor of $a(x)$=0.5. Then, age-specific mortality rates were calculated as $q(x)=d(x)/N(x)$. Age-specific survival rates were calculated as $p(x)=1-q(x)$. The cumulative survival rate, defined as the sum of age-specific survival rates, was calculated as $P(x)=p\ (0) \times p\ (1) \times \ldots \times p(x)$. Assuming a birth population of 100,000 animals and constant mortality rates, the hypothetical number of survivors, denoted as $l(x)$, was predicted to decrease according to the age-specific mortality rate $q(x)$. Therefore, if x=0, $l\ (0)$=100,000 and for x >0, $l(x)$ was calculated as $l(x)=\{1-q\ (x-1)\} \times l\ (x-1)$. The number of cat years lived at age x, denoted as $L(x)$, is equivalent to the sum of years lived by cats that survived from age x to age $x + 1$ and those that passed away between the same interval (x, $x + 1$), denoted as $a(x)$. Thus, $L(x)$ was calculated as follows: $L(x)=l\ (x + 1) + a(x) \times [l(x)-l\ (x + 1)]$. Assuming $a(x)$=0.5, this equation could be simplified to $L(x)=\{l(x) + l\ (x + 1)\}/2$. For 0-year-old cats, it was assumed that 80% of deaths occurred in the first few months of life, and this was calculated as $L\ (0)=0.2 \times l\ (0) + 0.8 \times l\ (1)$.

The total number of years lived beyond age x, denoted as $T(x)$, is equivalent to the sum of the number of years lived in each age interval beginning with age x. Therefore,

$T(x)$ is equivalent to $\sum_{i=x}^{\omega} L(x)$. Life expectancy at age x was calculated as $e(x)=\frac{T(x)}{l(x)}$. Life expectancy at birth corresponded to life expectancy at an age interval of 0–1 year.

Bayesian statistical approach

After the generation of life expectancy tables for all the survey cats, a stratified analysis was performed, with the cats further categorized according to breed or sex. The stratified life tables were generated using the Bayesian statistical method to estimate age-specific mortality rates for each breed and sex [21]. Initially, the beta distribution was designated as the prior distribution of the mortality rate, with the prior mean E (X) and prior variance V (X) expressed as follows: $E(X)=\frac{\alpha}{\alpha+\beta}$, $V(X)=\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$. Subsequently, if the mortality rate of the population was θ, the posterior distribution was derived from the number of effective observations N for each stratum and the number of deaths by age d. Since the posterior distribution also follows the beta distribution, the posterior mean $E\ (\theta|N,d)$ and the posterior variance $V\ (\theta|N,d)$ were expressed using the following formula: $E(\theta|N,d)=\frac{\alpha+d}{\alpha+\beta+N}$, $V(\theta|N,d)=\frac{(\alpha+d)(\beta+N-d)}{(\alpha+\beta+N)^2(\alpha+\beta+N+1)}$. In this study, each stratum of sex and breed was denoted by i, the number of valid observations for each was denoted by N_i, and the crude age-specific mortality rate was denoted by q_i. The mean Q and variance V of the age-specific

mortality rates were calculated using the following weight coefficient w: $Q=\sum_{i=0}^{17} w_i q_i$, $V=\sum_{i=0}^{17} w_i (q_i - Q)$, $w_i = \frac{N_i}{\sum_{i=0}^{17} N_i} (0 \le i \le 17)$. As the mean Q and the variance V were defined as the prior mean and prior variance, respectively, constants α and β were expressed as follows: $\alpha = Q\left\{\frac{Q(1-Q)}{V} - 1\right\}$, $\beta = (1-Q)\left\{\frac{Q(1-Q)}{V} - 1\right\}$. Finally, the age-specific mortality rate for each stratum was expressed as $q(x) = \frac{\alpha + d(x)}{\alpha + \beta + N(x)}$ using α and β. The following values were used in this study: Q=0.105 for the prior mean, V=0.027 for the prior variance, α=0.266, and β=2.258.

Statistical analysis

The normality of the data was assessed using the Shapiro–Wilk test. For data with a non-normal distribution, the median (minimum to maximum) and 1st and 9th deciles were presented. Life tables were created using Microsoft® Excel® 2016, and the Shapiro–Wilk test was performed using Excel statistics ver. 3.21. A P value of <0.05 indicated statistically significant differences.

RESULTS

Study population

As shown in Fig. 1, 313 cats were positive for the feline *PKD1* variant (c.10063C >A). Among them, 300 were finally included in the life table analysis after excluding 3 cats with unknown birth data and 10 cats with unknown genetic test dates. The following reasons were given for *PKD1* genetic testing: 255 cats with renal cysts detected by ultrasonography, 9 with a family history of PKD, 2 from breeds prone to PKD, and 34 for breeding suitability testing. The cases in which cyst formation was not tested by ultrasonography included 41 cats. Of the 4 cats without renal cysts detected by ultrasonography, 2 had a family history of PKD and 3 were being

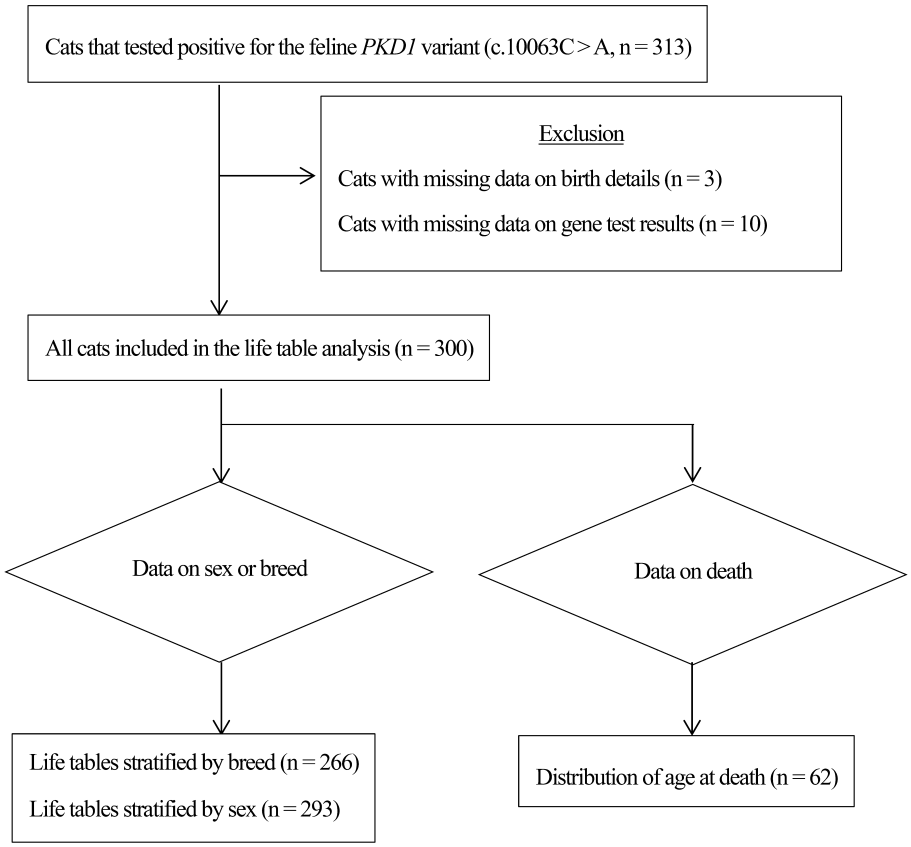

Fig. 1. Methodology and the number of cats included in this study population. In total, 313 cats tested positive for the feline *PKD1* variant (c.10063C >A), of which 300 were finally included in the life table analysis. The breed- and sex-stratified life table analyses included 266 and 293 cats, respectively. Data on death were obtained from 62 cats.

evaluated for breeding suitability.

Of these, 68 were Persian cats; 37, Exotic Shorthairs; 7, Minuets; 70, Scottish Folds; 26, American Shorthairs; 16, Munchkin; 4, British Shorthairs; 3, Ragamuffins; 2, Maine Coons; 1, Siberian Cat; and 66, domestic cats. Therefore, 112 (37.3%) cats were classified as Persian and 188 (62.7%) as non-Persian. The cats were aged 0–19 years. In terms of sexes, 150 cats were male and 143 were female. The time from the *PKD1* genetic testing date to the survey date ranged from 0 to 10 years. In the event of deaths occurring during the study period, the number of years from the date of genetic testing to the age of death was calculated.

For the breed-stratified life table analysis, 266 of the 300 cats with PKD were utilized, of which sufficient numbers were obtained for this analysis. The cats included 63 Persians, 32 Exotic Shorthairs, 25 American Shorthairs, 65 Scottish Folds, 44 Japanese mixed cats, and 37 domestic cats.

For the sex-stratified life table analysis, 293 of the 300 cats were utilized, with seven cats excluded due to the lack of data on sex. The cats comprised 109 castrated males, 41 intact males, 91 spayed females, and 52 intact females.

Life table analysis

Table 1 shows the life table for the whole sample of cats, and Fig. 2 depicts the cumulative survival rate. The number of cats was calculated in 1-year increments up to 16 years of age. Cats living for >17 years were grouped into an age interval of 17+ years. The life table analysis results indicated that the 5-, 10-, and 15-year cumulative survival rates of cats with PKD in Japan were 95.1%, 61.3%, and 34.0%, respectively. The life expectancy of cats with PKD in Japan was 12.7 years.

Life expectancy according to the breed and sex of cats with PKD

The life expectancy for each cat breed was as follows: Persian, 13.5 years; Exotic Shorthair, 10.8 years; American Shorthair, 12.8 years; Scottish Fold, 12.5 years; Japanese mixed cat, 11.1 years; and other domestic cats, 12.4 years (Fig. 3). The life expectancy based on sex was as follows: castrated male, 13.7 years; intact male, 12.6 years; spayed female, 12.6 years; and intact female, 11.8 years (Fig. 4).

Distribution of age at death

Of the 300 cats included in the study, 62 died during the study period. Renal cysts were present in the 62 cats that died. The breeds of the deceased cats were as follows: Persians, n=12; Scottish Folds, n=10; Exotic Shorthairs, n=5; American Shorthairs, n=4; Munchkins, n=3; British shorthairs, n=3; Exotic Longhair, n=1; Ragdoll British Shorthair mix, n=1; Japanese mixed cats, n=18; and other domestic cats, n=5. The distribution of sex among the cats was as follows: neutered males, n=25; intact males, n=3; spayed females, n=25; and intact females, n=9. Therefore, 18 (29%) cats were classified as Persian and 44 (71%) as non-Persian. The overall mortality rate

Table 1. Life expectancy table for 300 cats with polycystic kidney disease (PKD)

Age interval in years (x, x+1)	$N(x)$ Valid population	$d(x)$ Deceased population	$w(x)$ Censored population	$q(x)$	$p(x)$	$P(x)$	$l(x)$	$L(x)$	$T(x)$	$e(x)$ Life expectancy (years)
0–1	300	0	43	0.00	1.00	100.00	100,000	100,000	1,268,075	12.7
1–2	257	0	20	0.00	1.00	100.00	100,000	100,000	1,168,075	11.7
2–3	237	0	12	0.00	1.00	100.00	100,000	100,000	1,068,075	10.7
3–4	225	0	19	0.00	1.00	100.00	100,000	100,000	968,075	9.7
4–5	206	3	15	0.02	0.98	98.49	100,000	99,244	868,075	8.7
5–6	188	6	23	0.03	0.97	95.14	98,489	96,815	768,831	7.8
6–7	159	8	12	0.05	0.95	90.17	95,141	92,653	672,016	7.1
7–8	139	13	18	0.10	0.90	81.15	90,166	85,658	579,363	6.4
8–9	108	11	18	0.11	0.89	72.13	81,149	76,641	493,705	6.1
9–10	79	4	19	0.06	0.94	67.98	72,133	70,057	417,064	5.8
10–11	56	5	10	0.10	0.90	61.32	67,981	64,649	347,007	5.1
11–12	41	1	10	0.03	0.97	59.61	61,316	60,465	282,358	4.6
12–13	30	6	6	0.22	0.78	46.37	59,613	52,989	221,893	3.7
13–14	18	1	1	0.06	0.94	43.72	46,366	45,041	168,904	3.6
14–15	16	0	4	0.00	1.00	43.72	43,716	43,716	123,863	2.8
15–16	12	2	6	0.22	0.78	34.00	43,716	38,859	80,147	1.8
16–17	4	1	1	0.29	0.71	24.29	34,002	29,144	41,288	1.2
17+	2	1	1	0.67	0.33	8.10	24,287	12,143	12,143	0.5

N(x), valid population calculated by subtracting half the number of censored cats from the number of living cats at age x; *d(x)*, deceased population at 1-year interval (x, x + 1); *w(x)*, censored population at 1-year interval (x, x + 1); *q(x)*, age-specific mortality rates; *p(x)*, age-specific survival rates; *P(x)*, cumulative survival rates, equal to the factorial of age-specific survival rates up to age x; *l(x)*, number of a hypothetical population of cats surviving to the age x, calculated from a starting population of 100,000 cats at birth and decreases according to age-specific mortality rates; *L(x)*, number of cat years lived at age x, equal to the sum of cats surviving at 1-year interval (x, x + 1) and the fraction *a(x)* of cats being censored at 1-year interval (x, x + 1); *T(x)*, number of cat years lived beyond year x; *e(x)*, life expectancy for cats at 1-year interval (x, x + 1).

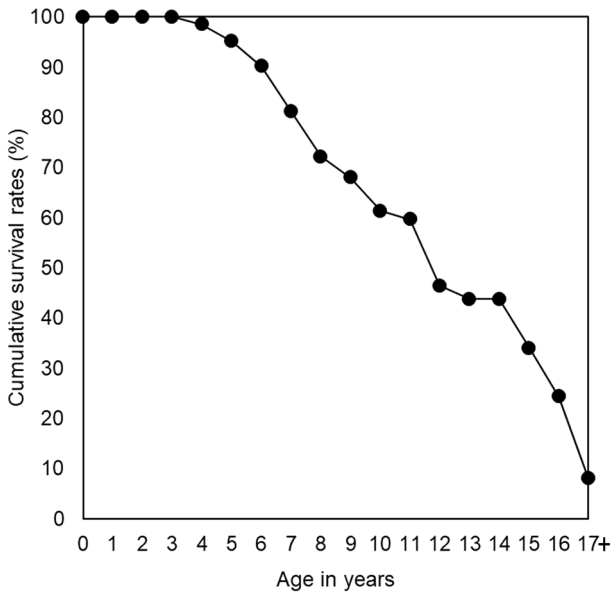

Fig. 2. Changes in the cumulative survival rates of cats with polycystic kidney disease (PKD, n=300). The number of cats was calculated in 1-year increments up to 16 years of age. Cats living for >17 years were grouped into an age interval of 17+ years.

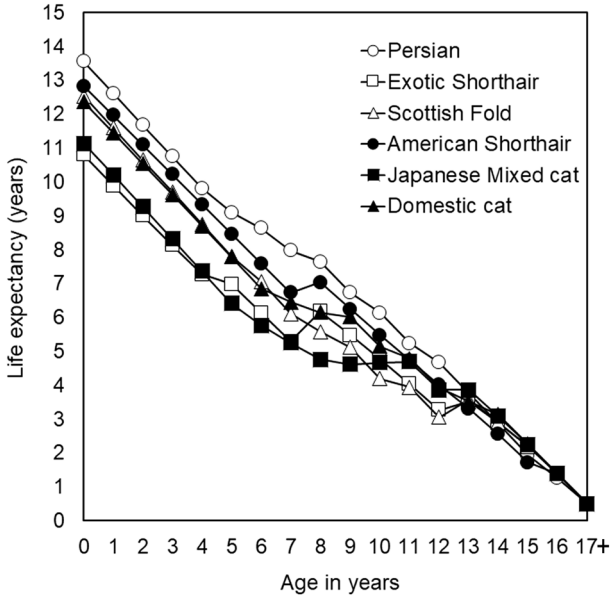

Fig. 3. Life expectancies of cats with polycystic kidney disease (PKD) according to age interval and breed. Life expectancies are shown for the following breeds: Persian (○), Exotic Shorthair (□), Scottish Fold (Δ), American Shorthair (●), Japanese mixed cats (■), and other domestic cats (▲).

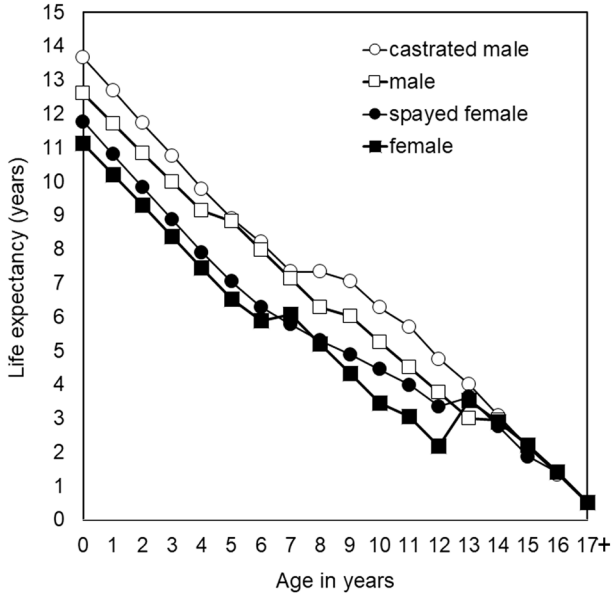

Fig. 4. Life expectancies of cats with polycystic kidney disease (PKD) according to age interval and sex. Life expectancies are shown for the following sex: castrated male (○), intact male (□), spayed female (●), and intact female (■).

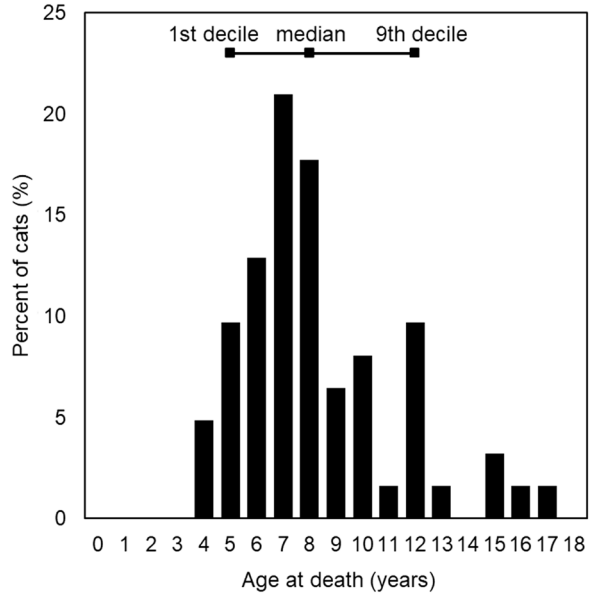

Fig. 5. Distribution of ages at death in cats with polycystic kidney disease (PKD). The bars in the graph represent the median age at death in 62 cats with PKD and the 1st and 9th deciles.

of the cats with PKD in this study was 20.7%. Uremia due to the progression of PKD (n=48, 77.4%) was the leading cause of death, followed by viral infections (n=2, 3.2%), non-kidney cancers (n=2, 3.2%), others (n=2, 3.2%), and unknown because of incomplete questionnaire (n=8, 12.9%). Viral infections were caused by enteric coronavirus or systemic herpesvirus. Non-kidney cancers included breast cancer and nasal lymphoma. The other causes of death included hypertrophic cardiomyopathy and nonregenerative anemia.

A distribution graph was generated based on the age at death of the 62 cats (Fig. 5). Among these, five (8.1%) cats died at or above the life expectancy of 12.7 years, as shown on the aforementioned life table analysis. Conversely, 57 (92.0%) cats died before reaching the age of 13 years. The distribution of cats that died at the age of <13 years old was as follows: 4 years, n=3 (4.8%); 5 years, n=6

(9.7%); 6 years, n=8 (12.9%); 7 years, n=13 (21.0%); 8 years, n=11 (17. 7%); 9 years, n=4 (6.5%); 10 years, n=5 (8.1%); 11 years, n=1 (1.6%); and 12 years, n=6 (9.7%). The median age at death was 8 (range: 4–17) years, with the 1st decile at 5 years and the 9th decile at 12 years.

DISCUSSION

In clinical practice, cats with PKD die at various ages, even among those carrying the same genetic mutation, and there is a significant individual variation in the rate of disease progression [17]. Given the suspicion that other factors also influence PKD progression, examining cats with PKD that die at a very young age is likely to identify these factors. However, the specific range of young age at death and the age distribution of death have not been clarified by previous studies. The current study aimed to establish fundamental information for characterizing cats with PKD that die at a young age. Furthermore, it quantitatively evaluated life expectancy, cumulative survival rate, and distribution of age at death in cats with PKD via a live/death follow-up. In total, 300 cats that tested positive for the feline *PKD1* variant (c.10063C >A) between January 1, 2008, and May 31, 2024, were included in this analysis. The life table analysis combining cohort and clinical life tables first revealed the life expectancy at birth and cumulative survival rate of cats with PKD. The ages at death, as determined in 62 deceased felines in the current study, exhibited a broad distribution. These findings support the reality that deaths are observed from young to old in a manner consistent with conventional clinical experience and are the first step toward establishing a quantitative index for the specific age range in which deaths are considered as young mortality. Further research should be performed to facilitate the collection of international data, which can provide more accurate indicators of feline PKD.

To the best of our knowledge, this study first performed a life table analysis in the context of PKD, and it can break new grounds in understanding the complexity of the lifespan in cats with PKD. Only three previous reports have performed a life table analysis in cats, all involving broad study populations that included all-cause death. This study, which utilized a combination of cohort and clinical life tables, showed that this combination is effective in a limited number of populations. Two previous studies have provided support for the choice to use a combination of cohort and clinical life tables [3, 16]. In particular, Roy *et al*. [16] have shown a sample size comparable to that in this study. Further, they revealed the efficacy of clinical life tables in a small study population. Baird *et al*. [3] have found that the combination of cohort and clinical life tables is effective.

The survey on age at death in cats with PKD yielded compelling results, shaping a comprehensive understanding of their lifespans. Life table analysis of the 300 cats revealed a life expectancy at birth of 12.7 years, which is an index for the overall prognosis of feline PKD. Of the 300 cats with PKD in this study, 62 (20.7%) died of uremia (77.4%) or other causes (22.6%). The median age at death in 62 cats was 8 years, with the first decile being 5 years. The age of observation with the highest number of deaths was 7 years. The life expectancy table showed that the cumulative survival rate started to decrease at the age of 4 years and exhibited a 10% annual decline, strating at the age of 6 years. Based on these findings, feline PKD may develop as early as 3 years of age. Consequently, to detect feline PKD, screening via abdominal ultrasonography should be performed at a young age. Moreover, genetic testing for *PKD1* should be considered to confirm the diagnosis of hereditary PKD if renal cysts are identified.

Anicom, a Japanese pet insurance company, has reported statistical data on companion animals in Japan annually. A book, entitled "White Paper on Household Animals 2024," by Anicom [1] has shown that the life expectancy at birth of cats including all-cause death was 14.4 years, and the life expectancy at birth in our study (12.7 years old) was shorter. The report also found breed-stratified life expectancy at birth. The life expectancy at birth of all breeds in our study was shorter than that reported by Anicom. The life expectancies at birth in our study and Anicom were as follows: Persian, 13.5 vs. 14.9; Exotic, 10.8 vs. 13.4; American Shorthair, 12.8 vs. 13.7; Scottish Fold, 12.5 vs. 13.6; Japanese mixed cat, 11.1 vs. 15.1; other domestic cats, 12.4 vs. 15.0.

The differences in lifespan between studies might partly reflect various survey years. The survey was conducted between January 1, 2008, and May 31, 2024. Meanwhile, in the book by Anicom, the survey was conducted in 2022. Both a study conducted in the US and Anicom have shown that the life expectancy at birth has increased with the years surveyed. Therefore, the life expectancy in this study might have been influenced by including cats that were surveyed in the past more than those in the Anicom book. Thus, the longevity of cats with PKD can be similar to those of cats in Japan, including all-cause death. By contrast, the overall cumulative survival rate and the observed age distribution of deaths began to decline sharply between the ages of 6 and 7 years. This finding indicated the importance of frequent medical checkups during the adult feline period.

Our analysis of the sex-stratified life table for PKD revealed that male cats survived longer than female cats, regardless of neuter status. In contrast to findings in human autosomal polycystic kidney disease, where male individuals have a worse prognosis than female ones [5, 6, 20], the males in this study had a longer life expectancy than the females. The potential role of female sex hormones in influencing renal outcomes raises interesting questions and serves as a fertile ground for future exploration. Outdoor cats are exposed to numerous risk factors, including trauma, infection, and accidents. Hence, the influence of environmental factors other than sex should also be considered [13]. However, we could not discuss this issue due to the lack of data on the breeding environment and concomitant diseases. Therefore, further investigation should be conducted.

A potential limitation of this study was that the age of cats that survived was censored at the end of the study. If all cats that survived could be followed-up until the end of life, the difference between the true age at death and the predicted age for death life expectancy might differ from our prediction. The lack of detailed information on the breeding environment and possible concomitant diseases of the cats might be considered a limitation. Advancements in veterinary medicine could have affected the lifespan of the cats during the follow-up period. Therefore, our results should be interpreted with caution.

The life expectancy analysis of cats with PKD in this study can have several promising applications within the field of veterinary

medicine. First, the evaluation of life expectancy and the distribution of age at death may facilitate the prediction of disease onset, thereby indicating that early diagnosis and intervention—prior to the phase of a marked increase in mortality—are significantly important. Concurrently, the availability of such quantitative data can facilitate the informed consent process by providing owners with clearer and more detailed information, allowing them to make more informed decisions. Furthermore, because cumulative survival rates can be an indicator for assessing the efficacy of existing treatments, they can be used to evaluate the efficacy of novel therapeutic approaches. Moreover, by leveraging data on the breed distribution and cumulative survival rates of cats with PKD in Japan, it may be possible to advance the prevention of this genetic disorder via breeding restrictions and the standardization of genetic screening protocols. The continued accumulation of survival analysis data on feline PKD can further enhance our understanding of this disease. The insights gained from the current study can be considered as foundational data for our future research endeavors, which will focus on elucidating detailed risk factors and pathological characteristics that are unique to cats that die at a young age.

In conclusion, the current study performed an initial follow-up investigation on survival outcomes of cats with PKD in Japan. Further, the study provided initial estimates of life expectancy and cumulative survival rates and revealed a broad distribution of ages at death. The analysis results were in accordance with conventional clinical observations—that mortality occurs from young to old age—and could be a preliminary step toward establishing a quantitative indicator for defining the specific age range associated with young-age mortality. Finally, this study can contribute to the development of early diagnostic and interventional strategies and, ultimately, the improvement of prevention and management programs for PKD.

CONFLICT OF INTEREST. The authors declare no conflict of interest.

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