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ORIGINAL ARTICLE

Prevalence of Schirmer Tear Test I-Defined Keratoconjunctivitis Sicca in Shelter Dogs in Yozgat, Central Anatolia

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ABSTRACT

Keratoconjunctivitis sicca (KCS) is a common ocular surface disease often unrecognized in shelter dogs. This study aimed to determine tear production, the prevalence of STT-I-defined KCS, and its associations with ophthalmological and demographic variables. A total of 236 shelter dogs aged ≥1 year were included. Ophthalmic assessment of the right eye included macroscopic examination, Schirmer tear test I (STT-I), fluorescein staining, and corneal opacity scoring. KCS was defined based solely on STT-I values (≤5 mm/min) without comprehensive clinical confirmation and is therefore referred to as STT-I-defined KCS. STT-I-defined KCS was identified in 56 dogs, corresponding to a prevalence of 23.7% based solely on STT-I classification. According to STT-I classification, 13.6% of dogs had normal tear production, while 21.2%, 41.5%, and 23.7% showed mild, moderate, and severe reduction, respectively. The mean age was 4.04 ± 1.67 years, and the mean STT-I value was 8.97 ± 4.18 mm/min. STT-I-defined KCS was not significantly associated with age or sex ($p>0.05$) but was significantly associated with fluorescein uptake ($p<0.001$). STT-I values showed significant negative correlations with both corneal opacity score and fluorescein uptake ($\rho=-0.413$, $\rho=-0.425$; $p<0.001$). Age was also negatively associated with STT-I values ($B=-0.415$, $p=0.011$). Corneal opacity score emerged as an independent predictor of STT-I-defined KCS (OR=11.28, $p=0.001$). In conclusion, STT-I-defined KCS is highly prevalent in shelter dogs and is closely associated with reduced tear production and ocular surface abnormalities.

Keywords: Corneal opacity, dry eye, keratoconjunctivitis sicca, schirmer tear test, shelter dogs

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Introduction

The eye is a highly specialized and complex organ in terms of both its structural and functional properties. It should never be considered an isolated structure; rather, it must be regarded as an integral part of the whole organism, as many systemic diseases can manifest with ocular findings. Due to the high sensitivity of ocular tissues, even the smallest disturbances in homeostasis-whether caused by direct trauma or by local or systemic factors-can markedly affect visual function (Bonea et al., 2025). Keratoconjunctivitis sicca (KCS), commonly known as "dry eye syndrome," is a prevalent ophthalmic disorder observed in dogs (Bittencourt et al., 2016; O'Neill et al., 2021). This clinical condition is characterized by a quantitative deficiency in the aqueous component of the tear film, leading to dryness of the ocular surface.

The precorneal tear film plays a critical role in maintaining ocular surface health. It supplies essential nutrients such as oxygen, glucose, and electrolytes to the avascular cornea, lubricates the eyelids and ocular surface, provides protective antimicrobial proteins, immunoglobulins, and growth factors, and facilitates the removal of cellular debris (Dodi et al., 2009). Disruption of tear film stability may occur either due to reduced tear secretion from the lacrimal glands or as a result of excessive evaporation of tears from the corneal surface (De Almeida et al., 2009). The resulting ocular dryness may lead to a range of pathological changes, including conjunctival hyperemia, corneal ulceration, keratitis, pigmentation, and neovascularization (Gelatt, 2014). The etiology of KCS in dogs is considered multifactorial. The condition has been associated with numerous factors, including congenital abnormalities, immune-mediated mechanisms, neurogenic and iatrogenic causes, drug-related effects, infectious and metabolic diseases, and exposure to radiation. (Iwashita et al., 2023; O'Neill et al., 2021).

Shelter environments expose dogs to various stressors, such as confinement, unfamiliar surroundings, and human contact. These conditions can affect physiological functions-including tear production-leading to reduced tear secretion and disruption of the ocular surface balance (Chen et al., 2025).

Consequently, evaluation of eye health and determination of the prevalence of STT-I-defined KCS in shelter dogs are of significant importance, both in terms of animal health and in terms of facilitating early diagnosis and treatment, particularly in environments with high dog populations such as shelters. Therefore, the aim of this study was to analyze the quantitative and qualitative findings obtained from the Schirmer Tear Test (STT-I) and the fluorescein staining test in shelter dogs to assess ocular surface health, and to examine the relationship of these findings with variables such as age and sex.

Materials and Methods

The study was approved by the Local Ethics Committee of Yozgat Bozok University (decision no: 3, 2/2026, date: 11.03.2026). A total of 236 dogs aged ≥1 year, of various ages and both sexes, housed at the Yozgat Municipality Temporary Animal Shelter were included in the study. Nearly all dogs in the shelter were mixed-breed, and no purebred dogs were present. Only a limited number of animals phenotypically resembling breeds Golden Retriever, Rottweiler, Terrier, Pointer, Pug, Cocker Spaniel, Jack Russell Terrier, Kangal, and Maltese Terrier were observed. Therefore, breed was not used as a reference variable during data collection. All ophthalmic examinations were performed by a veterinary ophthalmologist. The examination was limited to a macroscopic assessment relevant to the aims of the study rather than a complete ophthalmologic work-up. The evaluation included identification of ocular adnexa, detection of corneal lesions, testing of pupillary and palpebral reflexes, and quantitative measurement of tear production using the STT-I. All dogs tolerated the STT-I procedure, and no sedation was required.

Dogs were planned to be excluded from

the study if they had received systemic or topical medications within the previous seven days that were known or suspected to affect tear production (e.g., anticholinergics, sedatives, anesthetic agents, or anti-inflammatory drugs), if they were pregnant or lactating, or if they exhibited behavior that prevented adequate examination.

Assessment of Tear Production and STT-I-Based KCS Classification

To standardize the testing procedure and to avoid potential reflex tearing in the contralateral eye associated with bilateral STT-I application, only the right eye of each dog was evaluated. In addition, STT-I measurements were taken once for each dog. This approach was considered acceptable based on previous studies indicating that tear production does not differ significantly between the right and left eyes in clinically healthy dogs (Purbantoro et al., 2021). To reduce potential diurnal variation in tear production, all STT-I measurements were performed at the same time of day, since tear secretion may exhibit mild fluctuations throughout the day (Hartley et al., 2006). All measurements were performed in a controlled environment with an average temperature of 18 °C and a relative humidity of 60% to minimize variability in tear production. Standard STT-I test strips from the same manufacturer and lot number (Schirmer test strip, No. 41 filter paper, 5 × 35 mm, ERC, Türkiye) were used throughout the study. Each strip was folded at the notched end and placed at the junction of the middle and medial third of the lower eyelid. After one minute, the length of the moistened area was recorded in millimeters (mm/min). All measurements were carried out in a quiet clinical room under consistent environmental conditions to minimize stress-related variations in tear production. No topical anesthetics or sedatives were used. All examinations were conducted by the same researcher throughout the study period. Quantitative tear production was assessed using STT-I. The severity of KCS was classified solely according to STT-I values as follows: dogs with STT-I values ≥15 mm/min were considered normal (score 0); values of 11-14 mm/min indicated mild KCS (score 1); values of 6-10 mm/min represented moderate KCS (score 2); and values ≤5 mm/min were classified as severe KCS (score 3). In this study, STT-I ≤5 mm/min was considered to indicate STT-I-defined KCS in order to identify clinically significant disease.

Assessment of Corneal Surface Health

Corneal surface health was evaluated using fluorescein staining to detect corneal epithelial defects. A single drop of 1% fluorescein dye (Fluorescein, Kimyalab, Türkiye) was instilled into the right eye. After one minute, excess dye was gently rinsed with sterile saline solution. The corneal surface was then examined without magnification using an ophthalmic penlight, and fluorescein uptake was recorded qualitatively as positive or negative. No quantitative grading or tear film break-up time assessment was performed.

Corneal opacity was evaluated in all dogs and graded using a five-point scale. A score of 0 indicated a clear cornea without opacity. Mild opacity, in which iris details were clearly visible, was assigned a score of 1. Moderate opacity, characterized by difficulty distinguishing iris details, was scored as 2. Marked opacity, where iris structures were no longer visible, received a score of 3. Severe opacity, defined by a completely opaque cornea with pronounced fibrosis or leukoma, was assigned a score of 4 (Kocaman & Yanmaz, 2026) . All corneal opacity assessments were performed by the same investigator.

Sample Size Determination and Statistical Analysis

The sample size was calculated to determine tear production using STT-I and the prevalence of KCS in dogs housed in the shelter. Calculations were based on a 95% confidence level (Z=1.96) and a margin of error of ±5% (d=0.05). The expected prevalence used in the calculation was derived from pilot STT-I data obtained from 100 dogs previously evaluated in the same shelter. In this pilot assessment, the proportion

of dogs with STT values ≤5 mm/min was 27%. Because the total number of animals in the shelter population was limited (N=700), a finite population correction was applied to the initially estimated sample size, resulting in a required minimum sample of 212 animals. Considering the possibility of incomplete measurements or missing data in field studies conducted under shelter conditions, the target sample size was increased by approximately 10%, and the final planned sample size was set at 236 dogs.

In this study, KCS was defined based solely on STT-I values (STT-I ≤5 mm/min) and is therefore referred to as STT-I-defined KCS throughout the manuscript. The prevalence of severe STT-I-defined KCS was calculated as the proportion of dogs meeting this criterion relative to the total sample size and was reported with a 95% confidence interval (CI). STT-I values were also categorized according to tear production levels (≥15 mm/min normal, score 0; 11-14 mm/min mild, score 1; 6-10 mm/min moderate, score 2; ≤5 mm/min severe, score 3), and frequency and percentage distributions were calculated for these categories. The normality of continuous variables was verified via the Shapiro-Wilk test. Non-normally distributed data were presented as the median accompanied by the interquartile range (IQR). To evaluate age differences between dogs with and without STT-I-defined KCS, the Mann-Whitney U test was employed. Categorical associations, specifically regarding sex and fluorescein staining results in relation to KCS status, were analyzed using the chi-square test, with Fisher's exact test utilized for instances of low expected cell frequencies. Furthermore, the correlation between STT-I values and corneal opacity scores was determined through Spearman rank correlation. The potential relationship between age and STT-I values was further assessed using linear regression. All statistical procedures were executed in IBM SPSS Statistics (v. 26.0), maintaining a significance threshold of $p<0.05$.

Results

STT-I-defined KCS, reflecting severe aqueous tear deficiency, was identified in 56 of the 236 dogs (23.7%). According to the STT-I classification, normal tear production was detected in 13.6% of the dogs (32/236), while reduced tear production was observed as mild in 21.2% (50/236), moderate in 41.5% (98/236), and severe in 23.7% (56/236) of the animals (Table 1, Figure 1-2).

Table 1. Prevalence of STT-I-defined KCS and distribution of STT-I categories in shelter dogs (n=236)

Variable	Category	n	%
STT-I-defined KCS	Absent	180	76.3
	Present	56	23.7
STT-I category	Normal (≥15 mm/min)	32	13.6
	Mild (11-14 mm/min)	50	21.2
	Moderate (6-10 mm/min)	98	41.5
	Severe (≤5 mm/min)	56	23.7
Corneal Opacity Score	0	205	86.9
	1	24	10.2
	2	6	2.5
	3	1	0.4

STT-I-defined KCS was defined as STT-I ≤5 mm/min. STT-I categories were classified as normal (≥15 mm/min), mild (11-14 mm/min), moderate (6-10 mm/min), and severe (≤5 mm/min). KCS: Keratoconjunctivitis sicca

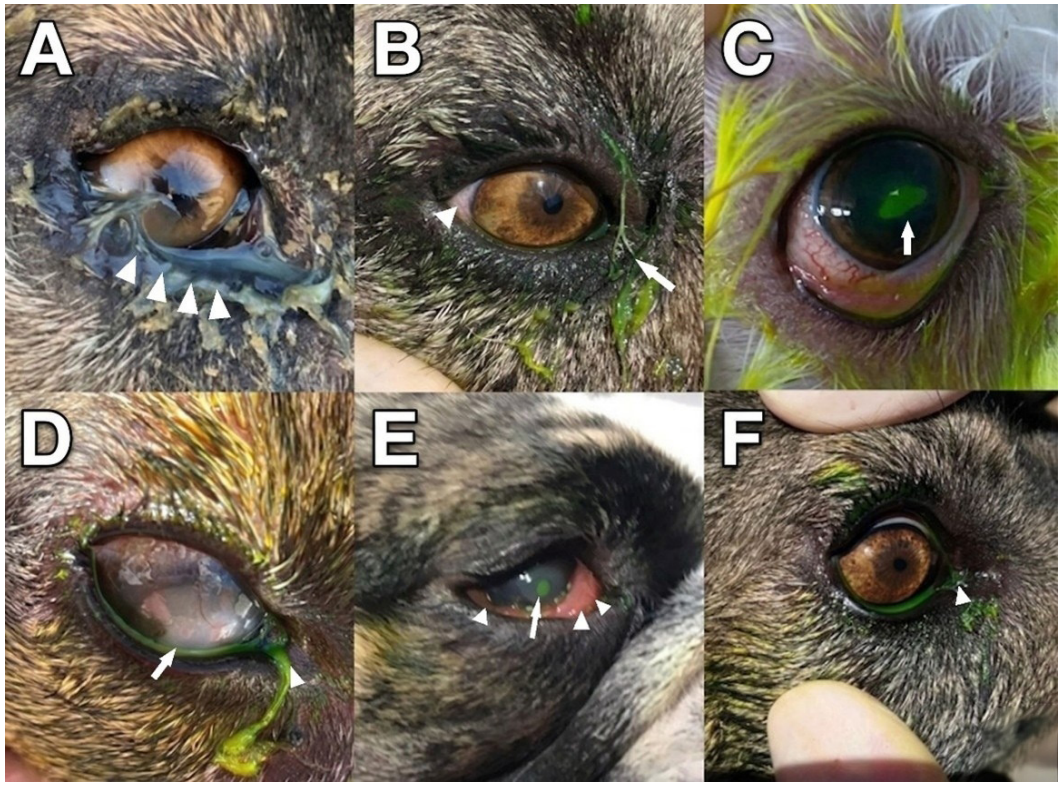


Figure 1. Macroscopic ocular surface findings observed during examinations of shelter dogs. This combined image illustrates various clinical presentations of ocular surface diseases: (A, arrowhead) severe mucopurulent discharge; (B) bulbar conjunctivitis (arrowhead) accompanied by seromucous discharge (arrow); (C, arrow) positive fluorescein staining indicating a corneal defect; (D) a marked increase in corneal opacity and pannus formation associated with severe keratoconjunctivitis (arrow) and seromucous discharge (arrowhead); (E) conjunctival hyperemia, chemosis (arrowhead), and positive fluorescein staining (arrow); and (F, arrowhead) mild seromucous discharge. Fluorescein staining was used to assess corneal integrity. While some cases present with milder symptoms, others exhibit advanced pathological findings associated with chronic ocular surface disorders and reduced tear production

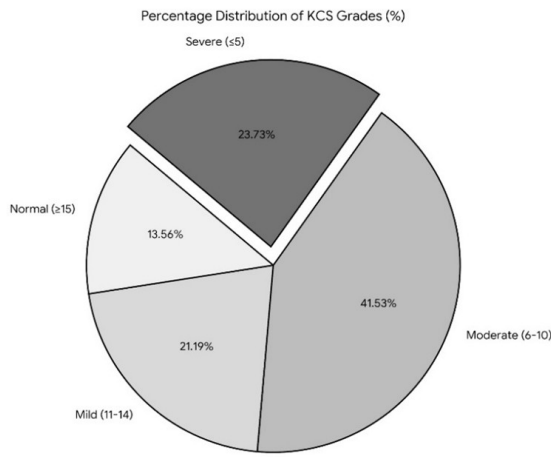


Figure 2. Percentage distribution of STT-I categories in shelter dogs (n=236)

The mean age of the dogs was 4.04 ± 1.67 years, ranging from 1 to 10 years. The mean STT-I value was 8.97 ± 4.18 mm/min. Age and STT-I values did not follow a normal distribution ($p<0.05$). No statistically significant difference was observed in the age distribution between dogs with and without STT-I-defined KCS ($p=0.301$). STT-I-defined KCS was detected in 27.9% of male dogs and in 20.5% of female dogs. However, no statistically significant association was found between sex and the presence of STT-I-defined KCS ($p=0.183$). STT-I-defined KCS was identified in 54.2% of dogs with positive fluorescein staining, whereas it was detected in 15.9% of fluorescein-negative dogs. A statistically significant association was observed between fluorescein positivity and the presence of STT-I-defined KCS ($p<0.001$, Table 2). A statistically significant negative correlation was found between STT-I values and both the corneal opacity score and fluorescein uptake ($\rho=-0.413$, $\rho=-0.425$, $p<0.001$).

Table 2. Association between selected variables and the presence of STT-I-defined KCS in shelter dogs

Variable	Category	Total (n)	STT-I-defined KCS (+) n (%)	STT-I-defined KCS (−) n (%)	p value
Sex	Male	104	29 (27.9)	75 (72.1)	0.183
	Female	132	27 (20.5)	105 (79.5)	
Fluorescein dye	Negative	188	30 (15.9)	158 (84.1)	<0.001***
	Positive	48	26 (54.2)	22 (45.8)	
Age (years)	Median (Min-Max)	4(1-10)	4 (2-8)	4(1-10)	0.301
STT-I (mm/min)	Mean ± SD	8.97 ± 4.18	4.05 ± 0.94	10.51 ± 3.56	-

A statistically significant positive correlation was also observed between the corneal opacity score and the presence of STT-I-defined KCS ($\rho=0.467$, $p<0.001$, Table 3). A weak but statistically significant negative correlation was detected between age and STT-I values ($\rho=-0.153$, $p=0.019$). It also revealed a negative correlation between age and STT-I scores ($B=-0.415$, $p=0.011$). Accordingly, each one-year increase in age was associated with an approximate decrease of 0.415 mm/min in STT-I values (Figure 3). In addition, no statistically significant association was found between STT-I values and sex ($\rho=-0.051$, $p=0.439$).

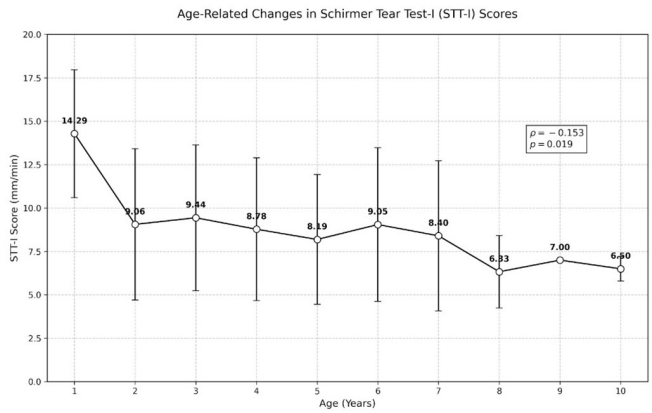


Figure 3. Distribution of STT-I scores across different age groups (1-10 years). The line graph illustrates a downward trend in tear production with advancing age. Statistical analysis revealed a significant negative correlation ($\rho=-0.153$, $p<0.05$), suggesting a gradual decline in lacrimal gland function as age increases. SD: Standard deviation

Table 3. Spearman correlation analysis between ocular parameters in shelter dogs

Variables	Spearman ρ	p value
STT-I vs Corneal opacity score	-0.413	<0.001***
STT-I vs Fluorescein uptake	-0.425	<0.001***
Corneal opacity score vs STT-I-defined KCS	0.467	<0.001***
STT-I vs Age	-0.153	0.019*
STT-I vs Sex	-0.051	0.439

Spearman's rank correlation coefficient (ρ) was used to assess the relationship between variables. Positive values indicate a direct correlation, whereas negative values indicate an inverse relationship. Significance levels were defined as follows: *p<0.05; **p<0.01; ***p<0.001. STT-I: Schirmer tear test I

The overall model in the study was statistically significant (χ^2=47.22, p<0.001). The model explained approximately 27% of the variation in STT-I-defined KCS (Nagelkerke R^2=0.272). Corneal opacity score emerged as an independent predictor of STT-I-defined KCS (OR=11.28, p=0.001). In contrast, sex, age, and fluorescein staining results were not significantly associated with STT-I-defined KCS (p>0.05, Table 4).

Table 4. Multivariable logistic regression analysis of factors associated with KCS in shelter dogs

Variable	OR	95% CI	p value
Sex	1.26	0.63-2.53	0.513
Age	0.97	0.79-1.19	0.765
Fluorescein uptake	0.96	0.26-3.51	0.948
Corneal opacity score vs STT-I-defined KCS	11.28	2.75-46.24	0.001**

OR: Odds ratio, CI: Confidence interval, KCS: Keratoconjunctivitis sicca

Discussion

KCS is an important ophthalmic disorder in dogs that can markedly compromise ocular surface health and may lead to corneal complications if not diagnosed at an early stage. In this study, tear production in shelter dogs was measured using STT-I, and the association between STT-I-defined KCS prevalence and indicators of ocular surface health was evaluated. The findings showed that 23.7% of the examined dogs were affected by STT-I-defined KCS, corresponding to severe aqueous tear deficiency. However, this classification was based solely on STT-I values and was not supported by full clinical confirmation. Therefore, these findings reflect severe tear deficiency rather than a definitive diagnosis of KCS. According to the STT-I classification, tear production in a considerable proportion of the dogs was below normal limits, with moderate tear reduction representing the most common category within the population. A weak but statistically significant negative correlation was observed between age and STT-I values. In contrast, a significant association was observed between fluorescein positivity and the presence of STT-I-defined KCS. Furthermore, the moderate negative correlation between tear production and both corneal opacity scores and fluorescein positivity indicates that decreasing tear volume progresses in parallel with deterioration of ocular surface integrity. Although this finding reflects an expected pathophysiological association, it is important as it quantitatively demonstrates the association between reduced tear production and corneal alterations. Consistent with this observation, logistic regression analysis revealed that the corneal opacity score was an

independent predictor of STT-I-defined KCS, indicating that increasing corneal opacity substantially elevates the likelihood of STT-I-defined KCS.

In dogs, the diagnosis of KCS is primarily based on the combined evaluation of Schirmer Tear Test-I values and compatible clinical findings, and studies reporting the prevalence of KCS in dogs remain limited. According to widely accepted diagnostic criteria, an STT-I value below 5 mm/min is considered diagnostic for severe KCS, values between 5 and 10 mm/min indicate moderate KCS, and measurements between 10 and 15 mm/min may be consistent with early or compensated disease when compatible clinical signs are present (Gelatt, 2014). The reference values reported for STT-I in clinically healthy dogs generally range between 18.89 ± 2.62 mm/min and 21.7 ± 4.9 mm/min, depending on breed, testing conditions, and the characteristics of the study population (Bolzanni et al., 2020; Hamor et al., 2000). In the present study, the mean STT-I value of the dogs was 8.97 ± 4.18 mm/min, which was notably lower than the established reference ranges. In particular, the mean STT-I values observed in our study population were lower than those reported in studies involving privately owned and clinically normal dogs (Bolzanni et al., 2020; Hamor et al., 2000). Such differences have previously been attributed to environmental and physiological factors such as ambient humidity, temperature, transport-related stress, and housing conditions (Yoon et al., 2020). In our study population, 98 of the 236 dogs were classified as having moderate tear reduction (6-10 mm/min), 50 as mild (11-14 mm/min), and 32 as normal (≥15 mm/min). When these results are considered together, it becomes evident that, aside from dogs with STT-I-defined KCS, a large proportion of shelter dogs (41.5%) fell within the "suspected KCS (STT-I 5-10 mm/min, based solely on STT-I classification)" category. This finding suggests that tear production impairment in shelter dogs may often appear in early or subclinical stages. Consistent with this observation, previous reports indicate that corneal alterations associated with KCS tend to become more pronounced during the chronic stages of the disease (Dodi, 2015). Therefore, dogs presenting borderline STT-I values should be monitored more carefully, particularly in populations considered to be at risk. A large population-based study conducted in the United Kingdom, involving 363,898 dogs receiving veterinary care across 300 clinics, identified 1,456 KCS cases in 2013, corresponding to an annual prevalence of 0.40% (O'Neill et al., 2021). Notably, the animals included in that study consisted of privately owned dogs. Similarly, Lodhi et al. (2025) reported a KCS prevalence of 0.75% in a study involving 2,375 dogs examined in veterinary clinics and an animal hospital (Lodhi et al., 2025). Higher prevalence values, however, have been reported in breed-specific or brachycephalic populations; for example, the prevalence of KCS in a pug population in Australia was reported to be 3.3%. In contrast, the present study reflects KCS data obtained from dogs housed in a municipal shelter within a specific local region. Among the 236 dogs evaluated (from a shelter population of N=700), 56 animals had STT-I values ≤5 mm/min, resulting in a STT-I-defined KCS prevalence of 23.7%. The markedly higher prevalence observed in this study is most likely related to the characteristics of the study population, which consisted of shelter dogs exposed to chronic environmental stressors, potential nutritional deficiencies, and possible subclinical diseases. Stress-related factors in shelter conditions can lead to a decrease in tear production. An increase in sympathetic nervous system activity, stress caused by physical contact, and environmental changes can affect tear gland function, leading to a temporary or permanent decrease in tear secretion. Supporting this interpretation, similar temporary reductions in tear production have been reported in dogs housed in shelters or hospitalized environments, even in the absence of pharmacological intervention (Avci et al., 2025; Chandler et al., 2013).

Lodhi et al. (2025) evaluated the relationship between age and KCS in dogs and reported that although KCS prevalence varied with increasing age, the association was not statistically significant (Lodhi et al., 2025). Similarly, Kulualp et al. (2019) and Avci et al. (2025) reported no statistically significant relationship between age and tear production (Avci et al., 2025; Kulualp et al., 2019). On the other hand, Hartley et al. (2006) demonstrated that STT-I values

decrease with age in normal dogs and reported an average reduction of 0.4 mm/min per year of age (Hartley et al., 2006). Consistent with these findings, our study identified a significant negative correlation between age and STT-I values, and linear regression analysis indicated that tear production decreased by approximately 0.415 mm/min for each additional year of age. This reduction may be explained by age-related declines in the functional capacity of the lacrimal and tarsal glands, which may lead to decreased aqueous tear production. Similar observations in other species further support the possibility that this mechanism is related to the physiological aging process (Mathers et al., 1996; Moss et al., 2004). Longitudinal studies monitoring dogs over extended periods may help to better define the age range in which KCS is most likely to develop in predisposed individuals.

Studies investigating the relationship between tear production and sex have generally been conducted in retrospective KCS populations or clinical case series (Kaswan et al., 1991; Sansom & Barnett, 1985). Barnett et al. (1988) reported a higher frequency of KCS in females compared with males (Barnett, 1988). Similarly, Sansom and Barnett (1985) found that female dogs showed a higher prevalence of KCS (Sansom & Barnett, 1985). Kaswan et al. (1991) suggested that this difference may be related to age-related decreases in testosterone and androgen levels, which could impair lacrimal gland function and contribute to the development of KCS (Kaswan et al., 1991). Hartley et al. (2006) also reported that KCS occurred more frequently in females than in males (Hartley et al., 2006). Conversely, our study did not find a significant association between sex and the presence of KCS. Similar to the findings in our study, numerous previous studies have indicated that sex is not a significant risk factor for the development of KCS (Kaswan et al., 1985; Kern & Erb, 1987; Lodhi et al., 2025). The absence of a sex-related difference in our findings may be related to population characteristics, sample size, the shelter-based nature of the study population, and overall population structure. However, the potential effect of sex hormones on lacrimal gland function should not be ignored. Future studies involving larger sample groups-including not only neutered animals but also females in different stages of estrus and during pregnancy-may provide a clearer understanding of the role of sex hormones in lacrimal gland physiology.

In chronic KCS cases, clinical signs often develop insidiously and include the accumulation of thick mucoid or mucopurulent discharge, pigmentary keratitis, corneal neovascularization, and occasionally corneal ulceration. In contrast, acute cases are more frequently associated with severe clinical signs, typically involving central corneal ulceration and even perforation (Dodi, 2015). Dubin et al. (2013) reported that corneal sequestrum formation in dogs may be associated with chronic KCS (Dubin et al., 2013). Furthermore, Dodi (2015) noted that corneal pathological changes tend to increase as STT values decline (Dodi, 2015). In the present study, STT values showed a negative correlation with both corneal opacity scores and fluorescein uptake, indicating that lower tear production was associated with increased fluorescein positivity and higher corneal opacity scores. Additionally, an increase in corneal opacity score showed a positive correlation with the occurrence of KCS. These findings are consistent with previous studies (Hardefeldt et al., 2026). We also found a strong association between corneal opacity and KCS. Dogs with higher corneal opacity scores had an approximately 11-fold increased likelihood of KCS. These findings highlight the close relationship between reduced tear production and corneal surface alterations such as corneal opacity.

Study Limitations

This study has several limitations. First, STT-I was measured only once and not repeated. Since tear production can vary depending on stress and environmental factors, this may have influenced the results. Second, more specific dyes, such as rose bengal or lissamine green, were not used. This may have limited the diagnosis of early-stage or mild epithelial damage. Third, this study focused only on measuring tear production; therefore, parameters of tear film quality, such as tear film break-up time, were not evaluated. Fourth, the diagnosis in this study was

based only on STT-I values and was not supported by comprehensive clinical evaluation. Fifth, this study examined only the right eye. Although KCS is typically bilateral, unilateral or asymmetric cases may also occur. Therefore, this method may have limited the detection of interocular differences. Sixth, fluorescein staining was evaluated using a penlight without magnification. This may have reduced the sensitivity in detecting subtle corneal epithelial defects.

Conclusion

In conclusion, this study demonstrated a relatively high prevalence of STT-I-defined KCS in shelter dogs, based solely on STT-I classification without comprehensive clinical confirmation, and revealed a significant association between reduced tear production and changes in the corneal surface, particularly corneal opacity. Unlike many studies conducted in hospital settings or on pet dogs, this study focused on shelter dogs, where eye diseases may go unnoticed due to the limited nature of routine examinations. Therefore, these findings may be particularly important for veterinarians working in shelter medicine. Regular ophthalmic examinations, including simple tear production tests such as the STT-I, may help diagnose affected animals earlier and prevent chronic corneal complications. However, these findings should be interpreted considering the STT-I-based definition used in this study. Further studies involving larger populations and more comprehensive ophthalmic examinations are needed to more clearly establish the relationship between tear film insufficiency and ocular surface disease.

Conflict of Interest

The authors stated that they did not have anyreal, potential or perceived conflict of interest.

Ethical Approval

The study was approved by the Local Ethics Committee of Yozgat Bozok University (decision no: 3, 2/2026, date: 11.03.2026).

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Similarity Rate

We declare that the similarity rate of the article is 3% as stated in the report uploaded to the system.

Author Contributions

Motivation/Concept: Y.K., Design: Y.K., Control/Supervision: Y.K., Data Collection and/or Processing: Y.K., İ.S.K., M.Ç.A., T.U., D.A., Analysis and/or Interpretation: Y.K., Literature Review: F.T., İ.S.K., V.A.C., Writing the Article: Y.K., Critical Review: Y.K.

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