Pakistan Veterinary Journal

ISSN: 0253-8318 (PRINT), 2074-7764 (ONLINE)
DOI: 10.29261/pakvetj/2024.142

RESEARCH ARTICLE

Determination of Subclinical Mastitis Prevalence in Dairy Cows in Türkiye through Meta-Analysis and Production Loss Calculation

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ARTICLE HISTORY (23-267)

Received:	July 15, 2023
Revised:	March 4, 2024
Accepted:	March 6, 2024
Published online:	March 20, 2024

Key words:
Meta-analysis
Prevalence
Subclinical
Mastitis
Cost-analysis

ABSTRACT

In recent years, many studies have been conducted on mastitis, and preventive measures have been taken to curb it. However, mastitis continues to cause great economic losses in dairy farms and negatively affects high-yielding dairy cows. The current study aims to consolidate the prevalence of subclinical mastitis among dairy cows in Türkiye and to estimate economic losses due to mastitis. The random-effects model (Sidik-Jonkman Knapp and Hartung method) was used for the meta-analysis to determine between-study and within-study variances. Economic losses due to subclinical mastitis were calculated on the prevalence value calculated by meta-analysis. Analyses revealed a high heterogeneity between studies based on cows ($Q = 1{,}590.86$, $df = 25$, $p < 0.01$, $I^2 = 98.21$) and udder lobes ($Q = 732{,}802$, $df = 21$, $p < 0.001$, $I^2 = 97.83$). The pooled estimate of subclinical mastitis prevalence in 10,334 cows from 26 studies was 44.13% (95% confidence interval [CI]: 36.00–52.50). A meta-analysis consisting of 21,745 udder lobes from 22 studies revealed the prevalence of udder lobe-based subclinical mastitis to be 31.44% (95% CI: 27.00–36.20). The meta-analysis yielded statistically high heterogeneity for prevalence estimates in published studies. The economic analysis revealed an economic loss of 1,095.88, 3,221.26, and 8,455.91 TL (equivalent to 233.17, 685.37, and 1,799.13 L of milk, 84.3, 247.8 and 650.5 USD$) per animal in mild, moderate, and severe cases, respectively. In this study, Meta-analysis in Türkiye reveals varying subclinical mastitis prevalence, addressing inconsistencies across studies. These economic loss calculations provide producers, policymakers, and other stakeholders in the industry with the scientific information necessary to develop effective strategies to combat subclinical mastitis.

To Cite This Article: Arikan MS, Mat B, Alkan H, Çevrimli MB, Akin AC, Başar EK and Tekindal MA, 2024. Determination of subclinical mastitis prevalence in dairy cows in türkiye through meta-analysis and production loss calculation. Pak Vet J, 44(2): 391-399. http://dx.doi.org/10.29261/pakvetj/2024.142

INTRODUCTION

Mastitis is an inflammatory response of the udder caused by microbial infection or physical trauma (Baştan, 2019). Mastitis is the most prevalent disease in dairy farms and causes considerable economic losses (Cheng and Han, 2020). Based on changes in the udder, mastitis is classified as clinical or subclinical. The subclinical form of mastitis is economically the most important form owing to its long-term negative effects on milk yield (Baştan, 2019; Zavadilová *et al.*, 2021). The main causes of economic losses include decreased milk production and quality, early livestock culling and increased veterinary and drug costs (Cheng and Han, 2020; Zavadilová *et al.*, 2021). Although several programs have been developed against mastitis in dairy cows to prevent these losses, mastitis remains a major problem in dairy farms (Yalçın *et al.,* 2000; Halasa *et al.*, 2007; Sharma, 2010).

Many studies on mastitis have reported its adverse effects on milk production quantity and quality. The decrease in milk quality affects both the price and the amount of milk that can be sold. In some cases, milk is discarded because of antibiotics used to treat mastitis. Subclinical mastitis makes up to 78% of all mastitis cases, which causes significant economic losses due to treatment and veterinary expenses (Seegers *et al.*, 2003; Çelik and Akçay 2024) and the spread of the disease in the herd makes it a severe problem (Cobirka *et al.*, 2020).

The loss incurred owing to subclinical mastitis is USD$222 per cow (Yalçın *et al.,* 2006); during lactation in cows with mastitis, >10% of the milk yield may be lost, ranging from 350 to 750 L/head (Hortet and Seegers, 1998). In mild/moderate and severe mastitis cases, economic loss is equivalent to 310 and 710 L of milk, respectively (Sarıözkan, 2019). Despite differences in estimated costs of mastitis, its effect on the economy of enterprises is significant. Moreover, mastitis not only affects the operating income but also increases costs associated with the dairy processing chain, negatively affecting processors' profitability as well (Geary *et al.*, 2013).

Studies on animal health economics have not only supported decisions taken in the fight against diseases but have also raised awareness regarding costs related to diseases. Although mastitis is defined as a production disease, manufacturers underestimate its cost. Due to the chronic nature of mastitis, the economic damage it causes to a business spreads over many years (Hogeveen *et al.*, 2011).

In this study, a systematic review and meta-analysis were performed to obtain a pooled estimate of the prevalence of cow-based and udder lobe-based subclinical mastitis among dairy cows in Türkiye between 1996 and 2020. Furthermore, economic losses due to mastitis were calculated based on disease severity.

MATERIALS AND METHODS

The study material consisted of data on the prevalence of cow-based and udder lobe-based subclinical mastitis cases in dairy cows obtained from 26 studies conducted between 1996 and 2020 in Türkiye.

Literature review: For the literature review, 312 studies were identified. Removal of duplicates yielded 279 articles; their abstracts were reviewed for their research strategies and exclusion/inclusion criteria, which led to the elimination of 233 articles. Furthermore, 20 studies that did not provide statistical data through the literature review strategy were excluded. Finally, 26 studies were examined for their content and transferred to the predeveloped coding form. Literature review results are presented in Fig. 1 (Moher *et al.,* 2009). The meta-analysis included the results of 21,745 udder lobes of 10,334 dairy cows in studies on the subject.

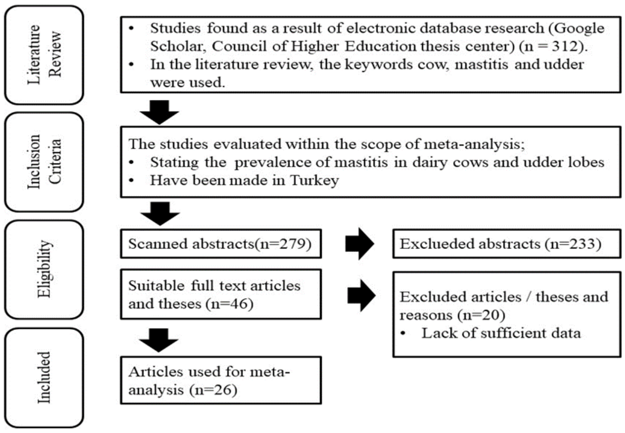

Fig. 1: Flow chart on the inclusion criteria of studies in meta-analysis

Meta-analysis: The random-effects model (Sidik-Jonkman Knapp and Hartung method) was used to determine between-study and within-study variances (Sidik and Jonkman, 2002; Knapp and Hartung, 2003; IntHout *et al.,* 2014). Cochran's Q test with (k-1) degrees of freedom was used to evaluate the heterogeneity of the effect sizes of the studies, I^2 statistic was used to determine the heterogeneity level, and τ^2 statistic was used to determine the true variance between studies (Cochran, 1954). The I^2 value was evaluated using three categories (low heterogeneity, <25%; moderate heterogeneity, 25%–50%; and high heterogeneity, >50%) proposed by Patsopoulos *et al.* (2008).

One of the methods used in modeling proportion data in meta-analysis is logit transformation (Nyaga *et al.,* 2014). The logit transformation of the data is performed particularly for the meta-analysis of prevalence studies (Bangar *et al.,* 2015). Furthermore, the asymmetry in the funnel chart of the dairy cow prevalence studies with logit transformation was considered (Borenstein *et al.,* 2011).

Calculation of production losses: The standard prevalence value obtained through the meta-analysis was used to calculate production losses. Furthermore, lactation milk yield loss, early culling cost, waste milk cost, loss of milk premium, and treatment costs were considered (Sarıözkan, 2019). Treatment expenses include drug costs, veterinarian expenses, extra labor, and control expenses (Yıldız and Yalçın, 2014). In the study, the reduction in concentrate feed consumption of the infected animal was calculated in terms of concentrate feed. However, economic losses due to milk quality deterioration and disease recurrence were ignored. Potential production losses due to mastitis were included in the economic analysis. Economic loss items and calculation procedures are presented in Table 1.

Production losses due to mastitis were calculated using 2021 current prices. The details of the technical and financial data used in the analysis are presented in Table 2.

The details of the parameters used in the calculations based on mild, moderate, and severe mastitis are presented in Table 3.

In the comparison of economic losses due to mastitis, currency and cost differences among countries were considered and the losses were calculated in terms of liters of milk and USD$ (1 USD$ calculated as 13 TL for 2021).

Table 1: Estimation method of production losses due to mastitis

Loss Component	Calculation Method
Loss of milk yield	Lactation milk yield (L)*Decrease in lactation milk yield (L)*[Milk price (TL/L)+Milk incentive premium (TL])
Feed saving (due to decrease in milk yield)	Amount of feed consumed (kg/day)*Feed cost (TL/day)*Reduction in concentrate feed consumption (%)
Cost of early culling	Reformed animal value (TL)*Ratio of culling due to mastitis (%)
Waste milk costs	Milk yield (L/day)*Treatment time (day)*[Milk price (TL/L)+Milk incentive premium (TL)]
Drug costs	Calculation
Veterinarian expenses	Calculation
Extra labor expenses	Calculation
Control expenses	Calculation

Table 2: Technical and financial parameters used in the estimation of production losses due to mastitis

Parameters Used in the Analysis	Value	References
Technical Parameters		
Prevalence of mastitis (%)	44.13	Meta-analysis
Lactation milk yield (L)	5,456	Yıldız and Yalçın, 2014
Daily milk yield (L)	17.89	Calculation
Amount of feed consumed (kg/day)*	18	Sarıözkan, 2019
Caring for sick animals (hours)	0.25	Yıldız and Yalçın, 2014
Time spent by the producer for the treatment of the sick animal (hours)	0.5	Yıldız and Yalçın, 2014
Financial Parameters		
Milk price (TL/L)	4.7	TNDC, 2021
Feed cost (TL/day)	40.03	Calculation
Reformed animal price (TL/head)	7,000	CBAT, 2021
Milk incentive premium (TL/lt)	0.5	TNDC, 2021
Labor cost (TL/day)	137.60	Calculation
Cost of producer labor (TL/hour)	18.35	Calculation

*Given in terms of dry matter

Table 3: Parameters used in calculations based on mastitis severity

Parameters	Mild	Moderate	Severe	References
Incidence (%)	0.37	0.41	0.22	Yıldız and Yalçın, 2014
Mastitis-induced culling rate (%)	0	0	0.004	Yıldız and Yalçın, 2014
Average treatment time (days)	2.3	4.5	6.4	Yıldız and Yalçın, 2014
Decrease in lactation milk yield (%)	0.024	0.05	0.25	Bennett, 2003*
Decrease in concentrate feed consumption of infected animals (%)	0.2	0.2	0.3	McInerney *et al.,* 1992
Veterinarian fees (TL/case)	130	130	150	Calculation
Drug costs (TL/case)	120	300	440	Calculation
Control expenses (TL)	80	80	80	Calculation

*The average of the low and high values specified by the authors was used.

RESULTS

Heterogeneity exists among the studies examined in our study. The funnel and forest plots of the studies examining the proportion of animals with mastitis are presented in Figs. 2 and 3 and the summary statistics of publication bias are presented in Table 4.

A heterogeneity test revealed that the meta-analysis of the included studies was not homogeneous because the p-value was <0.05 and the Q value was more significant than the value corresponding to the df value (Table 4). Because the I^2 statistical value we used to determine the heterogeneity level was 98.64%, bias exists in the study. Therefore, logit transformation was performed. The values obtained from the logit transformation are presented using a funnel plot (Fig. 2b) and a forest plot (Fig. 3b). Furthermore, logit-transformed summary statistics of publication bias are presented in Table 4.

Heterogeneity level I^2 value was calculated to be 98.21% and therefore, the random-effects model was preferred. According to the Q test, the actual results are heterogeneous (Q (25) = 1,590.86, p < 0.01, tau^2 = 0.7497, I^2 = 98.21%). The actual results are between 0.360 and 0.525, with an estimated range of 95%. Therefore, the average result reflects the actual results. Diagnostic plots of the study are given in Fig. 4. Based on all the values, no study can be said to be overly effective. Neither rank correlation coefficients nor regression tests revealed any funnel plot asymmetry (p = 0.440 and p = 0.479, respectively).

The parameters of the random effects model obtained from the logit transformation are presented in Table 5.

In total, 26 studies were included in the analysis. Because the values given in Table 5 are the results of the logit transformation, the parameters should be interpreted through an anti-logarithm transformation.

$$P = \frac{e^{\beta_0}}{1+e^{\beta_0}} = \frac{e^{-0.235}}{1+e^{-0.235}} = 0.4413$$

The ratio estimated based on the random-effects model is 0.441 (95% confidence interval [CI]: 0.360–0.525). The observed rate varies between 0.360 and 0.525, and most of the estimates are positive (44.1%).

The effect sizes, relative weights, and findings of the forest plot of each study are summarized. Özenç (2019), Çelik (2020) and Tel *et al.* (2009) reported the highest rate of animals with mastitis and thus had the highest effect size (Fig. 2b). In the forest plot, the squares on the left indicate the effect size of each study, the sizes of the squares indicate the study sizes, and the bars extending to the right or left indicate the 95% lower and upper limits, respectively, of the effect size of each study. The diamond on the x-axis in the plot indicates the overall effect size (0.441). In Fig. 2b, the closeness or distance of the squares (indicating the studies) to the diamond (indicating the overall effect) presents abstract information.

The fit statistics and information criteria of the created model are presented in Table 6.

The information criteria and model fit data in Table 6 suggest that the model fits well and can be a guide for further studies.

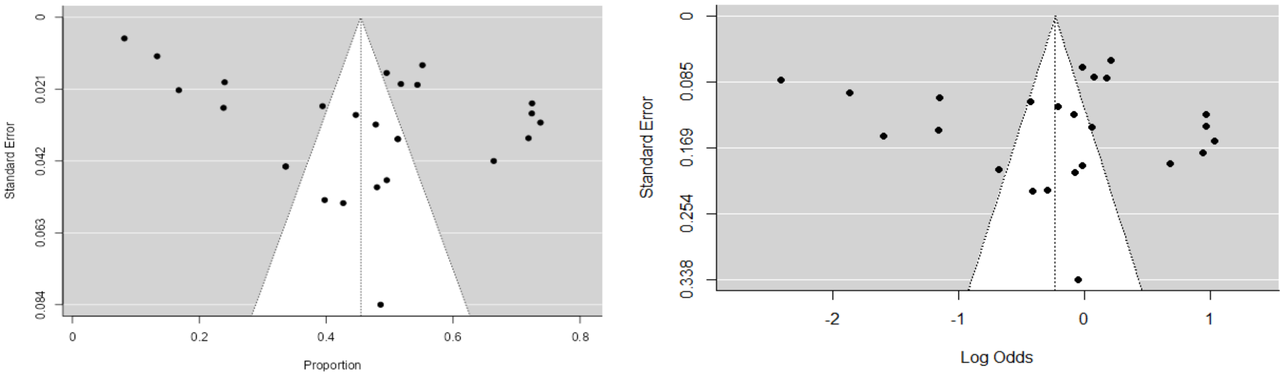

Fig. 2: (a) Funnel plot of studies examining the proportion of animals with mastitis and (b) logit-transformed funnel plot.

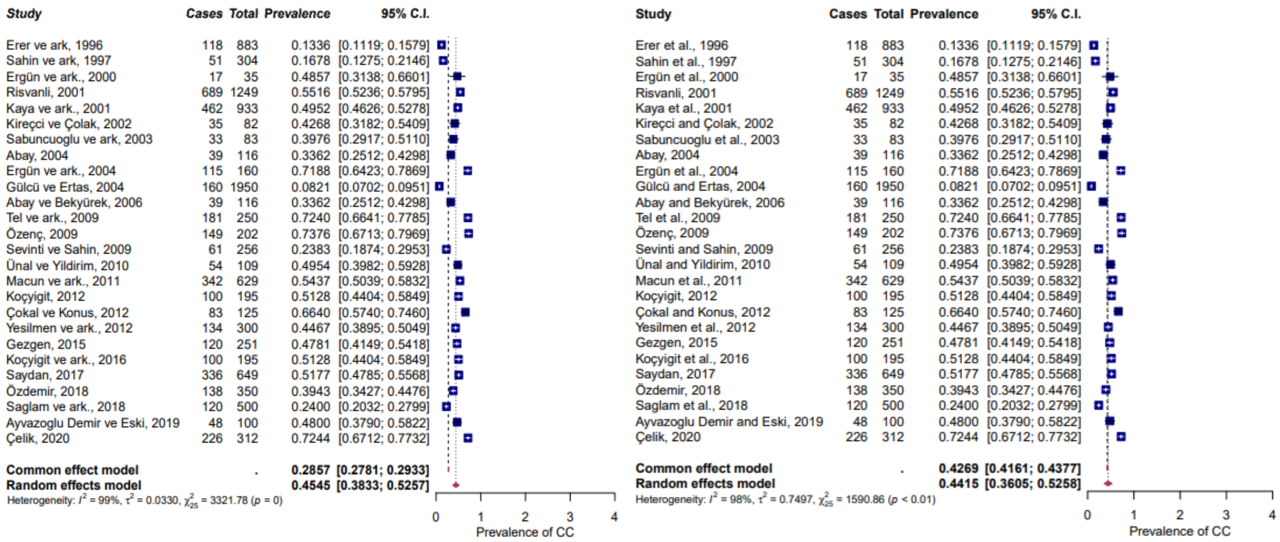

Fig. 3: (a) Forest plot of studies examining the proportion of animals with mastitis and (b) logit-transformed forest plot.

Table 4: Normal and logit-transformed summary statistics of publication bias

					Heterogeneity Statistics						
	Test Name	Fail-Safe N	Kendall's Tau Rank Correlation	Egger's Regression	Tau	Tau²	I²	H²	df	Q	p
Normal	Value	65,850	−0.090	1.217	0.182	0.033 (SE = 0.0097)	98.64	73.37	25	3,321.78	<0.001
	p	<0.001	0.522	0.223							
Logit	Value	1,207	−0.108	0.707	0.865	0.7497 (SE = 0.0097)	98.21	55.871	25	1,590.86	<0.01
	p	<0.0001	0.440	0.479							

Table 5: Statistical values of the random-effects model (logit transformation results)

	Random-Effects Model (k = 26)					
	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	−0.235	0.172	−1.361	0.173	−0.573	0.103

Table 6: Model fit statistics and information criteria (logit-transformed data)

	Log-likelihood	Deviance	AIC	BIC	AICc
Maximum-Likelihood	−32.937	121.472	69.875	72.391	70.397
Restricted Maximum-Likelihood	−32.156	64.312	68.312	70.749	68.857

In this study, studies reporting the number of udder lobes with mastitis were also examined to determine subclinical mastitis prevalence on the basis of udder lobes. Normal and logit-transformed summary statistics of publication bias of these studies are presented in Table 7.

The heterogeneity test revealed that the meta-analysis of the included studies was not homogeneous because the p-value was <0.05 and the Q value was greater than the value corresponding to the df value (Table 7). Because the I^2 statistical value we used to determine the heterogeneity level was 99.52%, bias exists in the study. Therefore, logit transformation was performed. The values obtained from the logit transformation are presented in Table 7, and the forest plot is given in Fig. 5. The heterogeneity level I^2 value was 97%, and therefore, the random-effects model was preferred.

According to the Q test, the actual results are heterogeneous (Q (25) = 1,471.48, p < 0.01, tau² = 1.0159, I² = 99.38%). Actual results are between 0.360 and 0.525, with an estimated range of 95%. Therefore, the average result clearly reflects the actual results. Diagnostic plots of the study are given in Fig. 6. According to all these values, the 19th study is an effective observation. Therefore, it was excluded from the study.

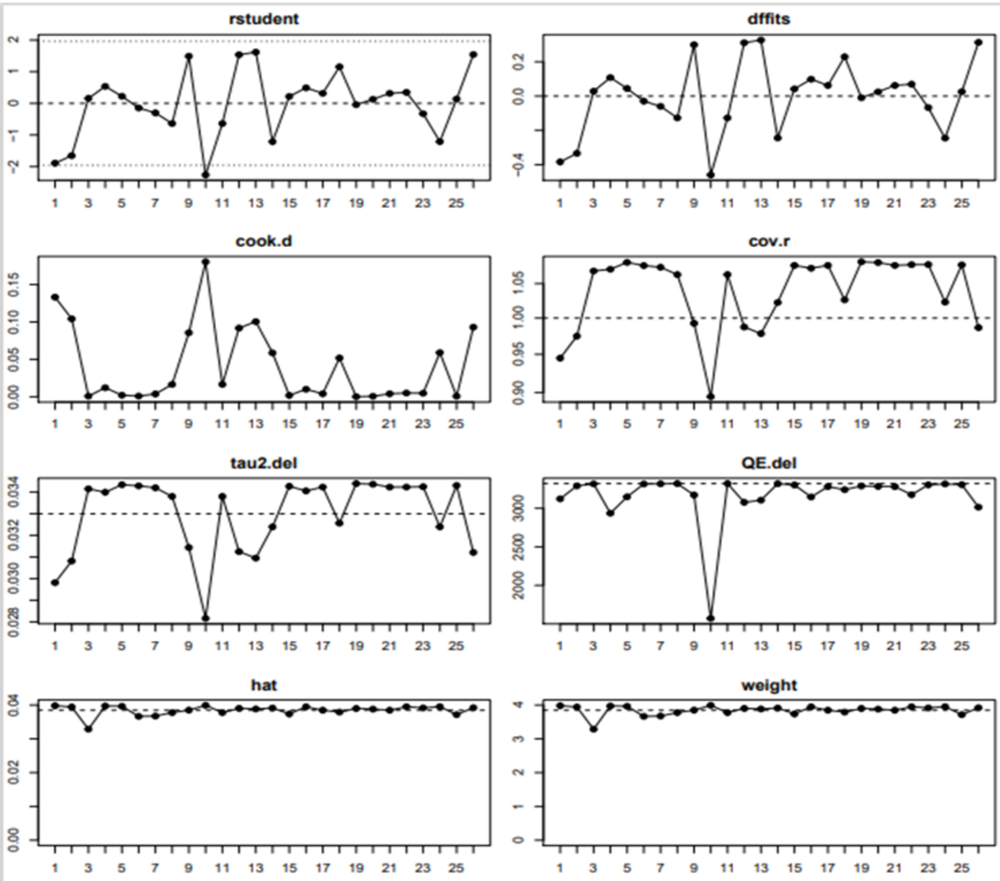

Fig. 4: Diagnostic plots

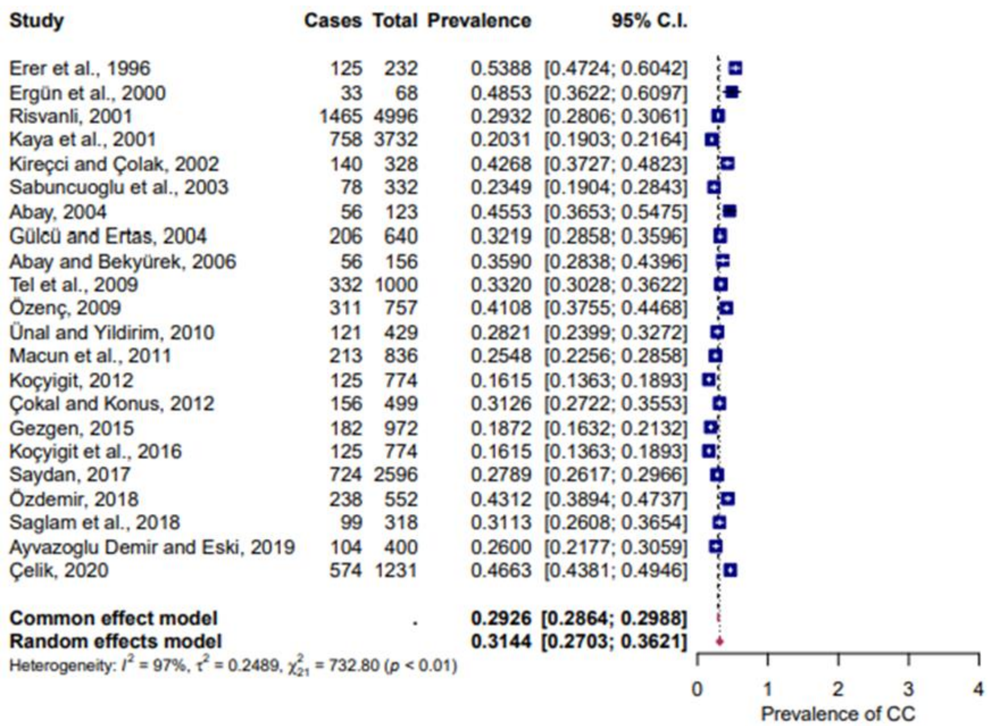

Fig. 5: Logit-transformed forest plot of studies reporting the rate of udder lobe with mastitis

According to the diagnostic plots in Fig. 6a, studies 2, 9, and 14 were also determined as effective observations and were excluded from the study. The final diagnostic plot is given in Fig. 6b.

Neither the rank correlation values nor the regression test revealed any funnel plot asymmetry (p = 0.429 and p = 0.077, respectively). The logit-transformed funnel plot of the studies reporting the rate of mastitis based on udder lobes is presented in Fig. 7.

The parameters of the random-effects model obtained from the logit transformation are presented in Table 8.

A total of 22 studies were included in the analysis. Because the values given in Table 8 are the results of the logit transformation, the parameters should be interpreted through an anti-logarithm transformation.

$$P = \frac{e^{\beta_0}}{1 + e^{\beta_0}} = \frac{e^{-0.780}}{1 + e^{-0.780}} = 0.3144$$

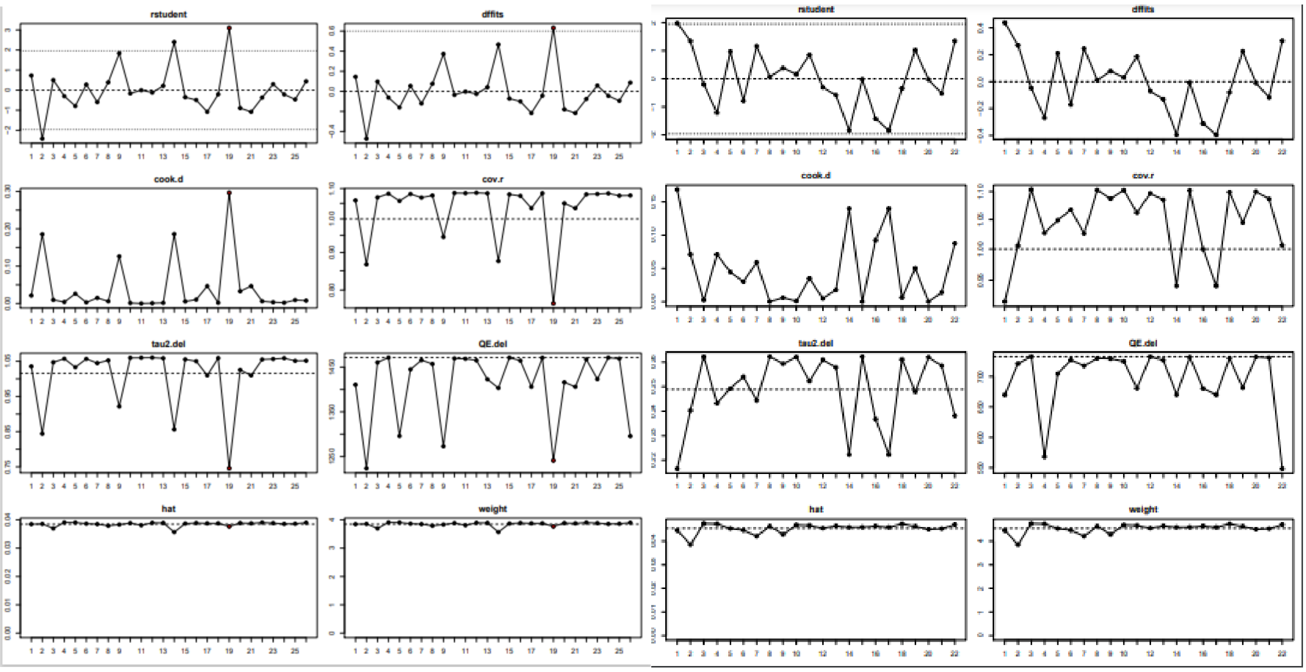

Fig. 6: (a) Diagnostic plots and (b) diagnostic plots after studies 2, 9, 14, and 19 were removed.

Table 7: Summary statistics of publication bias

					Heterogeneity Statistics						
	Test Name	Fail-Safe N	Kendall's Tau Rank Correlation	Egger's Regression	Tau	Tau²	I²	H²	df	Q	p
Normal	Value	95,216	0.122	1.766	0.203	0.041 (SE = 0.0118)	99.52	208.170	25	3,374.18	<0.001
	P	<0.001	0.429	0.0077							
Logit	Value	95,216	0.122	1.766	0.499	0.2489 (SE = 0.0805)	97.83	46.133	21	732.802	<0.001
	P	<0.001	0.429	0.0077							

Table 8: Statistical values of the random-effects model (logit transformation results)

	Random-Effects Model (k = 22)					
	Estimate	se	Z	p	CI Lower Bound	CI Upper Bound
Intercept	−0.780	0.109	−7.16	<0.001	−0.993	−0.566

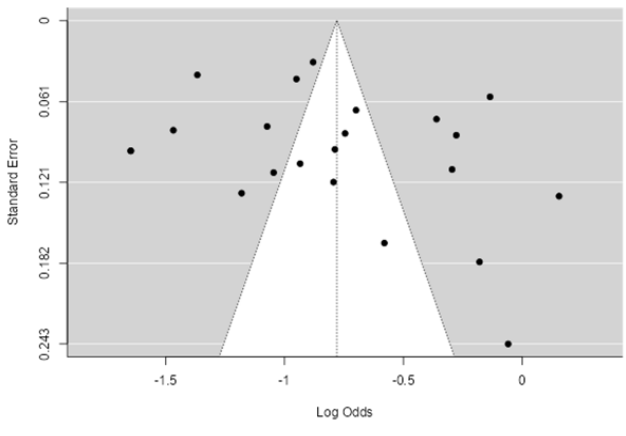

Fig. 7: Logit-transformed funnel plot of the studies reporting the rate of mastitis based on udder lobes

The ratio estimated based on the random-effects model is 0.314 (95% CI: 0.270–0.362). The observed rate varies between 0.270 and 0.362, and most of the estimates are positive (31.4%).

The fit statistics and information criteria of the created model are presented in Table 9.

The information criteria and model fit data in Table 9 suggest that the model fits well and can be a guide for further studies.

In the study, economic losses per infected animal due to mild, moderate and severe mastitis are presented in Table 10.

Economic losses calculated in mild, moderate, and severe cases were 1,095.88, 3,221.26, and 8,455.91 TL, respectively (equivalent to 233.17, 685.37 and 1799.13 L of milk, 84.3, 247.8 and 650.5 USD$ respectively; Table 10.

DISCUSSION

Mastitis is a major infectious disease that causes great economic losses and negatively affects high-yielding dairy cows (Baştan, 2019). This study showed the prevalence pattern of subclinical mastitis (based on cows and udder lobes) in dairy cows in Türkiye over the past two decades. The economic analysis based on this model suggests that the economic dimension of the disease cannot be ignored.

The number of studies on subclinical mastitis prevalence is higher than that of studies on clinical mastitis prevalence, which indicates the importance of subclinical mastitis in dairy cattle breeding. Subclinical mastitis does not cause any physical change in milk and requires detailed diagnostic methods for the differential diagnosis. Therefore, most studies focus on the early and correct diagnosis of subclinical mastitis. The number of studies examining the prevalence of subclinical and clinical mastitis cases has been increasing recently. This increase raises awareness regarding raw milk quality and improved milk quality enables producers to sell their

Table 9: Model fit statistics and information criteria (logit-transformed data)

	log-likelihood	Deviance	AIC	BIC	AICc
Maximum-Likelihood	−16.036	96.860	36.072	38.255	36.704
Restricted Maximum-Likelihood	−15.789	31.578	35.578	37.667	36.245

Table 10: Economic losses due to mastitis (TL)

Economic losses	Mild (TL)	Loss Percentage %	Moderate (TL)	Loss Percentage %	Severe (TL)	Loss Percentage %
a. Financial value of loss of milk*	680.91		2,411.55		7,092.80	
b. Feed saving (decrease in milk yield)	144.11		144.11		216.16	
Net milk yield loss (a − b)	536.80	48.98	2,267.44	70.39	6,876.64	81.32
Discard loss	0.00	0.00	0.00	0.00	280.00	3.31
Waste milk costs	213.95	19.52	418.59	12.99	595.33	7.04
Drug costs	120.00	10.95	300.00	9.31	440.00	5.20
Veterinary expenses	130.00	11.86	130.00	4.04	150.00	1.77
Extra labor expenses	15.14	1.38	25.23	0.78	33.94	0.40
Control expenses	80.00	7.30	80.00	2.48	80.00	0.95
Total loss	1,095.88	100.00	3,221.26	100.00	8,455.91	100.00

*Including the loss of milk incentive premium

products in the market for a better price (Birhanu *et al.,* 2017; Gonçalves *et al.,* 2018; Krishnamoorthy *et al.,* 2021; Ranasinghe *et al.*, 2021).

This study results point to high heterogeneity among studies on subclinical mastitis. Variation in mastitis prevalence in dairy cows is likely due to differences in mastitis-causing microorganisms, diagnostic methods, herd-level factors (cross genetics, breed, number of births, and lactation periods), seasons (summer or winter), regions, climates and dairy farm management practices (Joshi and Gokhale 2006; Hiitiö *et al.,* 2017; Mpatswenumugabo *et al.,* 2017; Baştan 2019; Krishnamoorthy *et al.,* 2021).

In the study, the prevalence of subclinical mastitis was calculated to be 44.13% (36.00%–52.50%) and 31.44% (27.00%–36.20%) on the basis of cows and udder lobes, respectively. The results indicate that the prevalence of cow-based subclinical mastitis is higher than that of udder lobe-based subclinical mastitis. The prevalence of subclinical mastitis on the basis of cows and udder lobes was reported to be 15%–75% and 5%–40%, respectively (Cynthia, 2005). Çelik and Akçay (2024) were reported that the prevalence values calculated in studies conducted in Türkiye on subclinical mastitis showed a wide range between 5% and 78% in cow-based studies, and between 2% and 78% in udder lobe-based studies. A study conducted in India reported that the prevalence of cow- and udder lobe-based subclinical mastitis ranged from 20.73% to 78.55% and 11.65% to 56.51%, respectively (Bangar *et al.,* 2015). Krishnamoorthy *et al.* (2021), in their meta-analysis study conducted worldwide, Krishnamoorthy *et al.* (2021) found subclinical mastitis prevalence to be 42% and reported that subclinical mastitis had a higher prevalence than clinical mastitis. In this study, the prevalence of subclinical mastitis in Türkiye was found to be similar to or even higher than in the aforementioned countries where the studies were conducted for the same purpose (Çelik and Akçay, 2024). In Türkiye, the fact that dairy cattle farmers are engaged in other businesses in addition to their current business (polyculture structure) causes them not to allocate enough time for dairy cattle farming and deficiencies in specialization. Besides, their low level of technical and formal education causes them not to follow the current information and developments related to their field of activity sufficiently. This situation leads to disruption of follow-up and controls in the enterprise, increase in mastitis rate and thus production losses (Sarıözkan, 2019).

The annual economic losses due to mastitis per cow were reported to be USD$444 in the USA (Rollin *et al.,* 2015), €363 in Austria (Fuerst-Waltl *et al.,* 2016), €70.65 in Slovakia (Krupová *et al.,* 2016) and €193 (Krupová *et al.,* 2019) in Czechia. Wilson *et al.* (1997) reported that when subclinical mastitis prevalence is assumed to be 45%, the cost per case varies from USD$180 to USD$320. In this study, the economic loss per infected animal corresponds to 4.27% (233.17 L), 12.55% (685.37 L), and 32.97% (1,799.13 L) of lactation milk yield in mild, moderate and severe cases, respectively. Hogeveen *et al.* (2019) reported that the highest economic loss due to mastitis in dairy farms is the loss in milk production. Furthermore, they stated that 58% of the total losses from mastitis stemmed from a decrease in the milk yield of cows (Hogeveen *et al.,* 2019). On the basis of the economic loss rates calculated in this study, milk yield loss is the highest (48.98%–81.32%), followed by the waste milk cost (7.04%–19.52%). Wilson *et al.* (1997) reported that 70% of the losses due to mastitis resulted from a decrease in milk yield. Hogeveen *et al.* (2019) reported that assuming a cow gives 8,500 kg of milk, 11%–18% of the losses of dairy farms are due to mastitis. However, some of the losses caused by mastitis in cows are avoidable, which can be prevented through disease control and eradication programs and resource allocation decisions. Studies have revealed that 50%–68% of the economic losses due to mastitis are avoidable (Yıldız and Yalçın, 2014; Sarıözkan, 2019).

Differences in methodological approaches to estimating these losses may arise from factors such as considering lower feed costs in animals with lower milk yields, the reduction in milk production during the lactation period after mastitis treatment, and the cost of milk disposal (Kvapilík *et al.,* 2015).

Economic losses arising from a decrease in milk yield due to mastitis are alleviated to some degree by the decrease in feed costs (Nielsen, 2009). Although a decrease in the concentrate feed consumed by the infected animal seems to be negligible in local cases, the infection significantly reduces the concentrate feed intake in systemic cases (Bareille *et al.,* 2003). In this study, feed savings due to a decrease in milk yield in mastitis cases were found to be 3.6 kg (144.11 TL) in mild and moderate cases and 6.64 kg (266.16 TL) in severe cases.

Milk produced by dairy cows with subclinical mastitis during treatment is discarded. Because discarded milk is produced by cows, it is associated with feed costs, and the unit cost of discarded milk is higher than that of unproduced milk (Hogeveen and Østeras 2005; Halasa *et al.,* 2007). Our study revealed that 41.15, 80.5, and 114.5 L of milk were discarded from mild, moderate, and severe cases, respectively, during the treatment.

Conclusion: In conclusion, this study used a random-effects model to provide a pooled estimate of the prevalence of cow-based and udder lobe-based subclinical mastitis in dairy cows in Türkiye. Significant differences were observed in the disease prevalence in the analyzed studies. The meta-analysis conducted in this study enabled the elimination of inconsistencies in subclinical mastitis prevalence reported by studies conducted in Türkiye in various years.

This Meta-analysis, conducted to determine the prevalence of subclinical mastitis in dairy cows in Türkiye, provides more reliable estimates by combining data from many studies. This data increases the reliability of the information obtained and provides a detailed perspective on the prevalence of subclinical mastitis throughout Türkiye. Meta-analysis is used to calculate production losses caused by subclinical mastitis quantitatively. These data are critical to evaluate the economic impact of the disease on the dairy sector and make scientifically based decisions to reduce losses. These calculations provide producers, policymakers, and other stakeholders in the industry with the scientific information necessary to develop effective strategies to combat subclinical mastitis.

Subclinical mastitis with a high prevalence causes economic losses in dairy farms at varying rates depending on disease severity. The economic analysis of production losses and knowledge of factors associated with economic losses are crucial for the manufacturer to develop a control mechanism. Considering that some economic losses are avoidable, dairy producers, under the guidance of field veterinarians, can reduce the prevalence of subclinical mastitis and subsequent economic losses.

Authors' contributions: All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by BM, ACA, MBÇ, EKB and MAT. The first draft of the manuscript was written by MSA, HA, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding: The research was not supported by any institution.

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

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