



Mortality of dairy sheep during the peri-parturient period: results of a field investigation in Greece

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Table S1. Details of multivariable models employed for the evaluation of the occurrence of peri-parturient deaths in sheep flocks in Greece.

Outcome	Variables offered to the multivariable models (<i>n</i>)	Variables required in the final models
Death before lambing	5	(a) season of the year during which the lambing period took place, (b) number of animals in the flock
Death at lambing	4	(a) breed of ewes, (b) presence of working staff in the farm
Death after lambing	6	(a) number of animals in the flock, (b) breed of ewes, (c) control or reproduction, (d) nutritional modifications performed during the last stage of pregnancy, (e) experience of the farmer
Occurrence of peri-parturient deaths		(a) season of the year during which the lambing period took place, (b) average lambing rate at flock level, (c) inclusion of roughage into the diet
Occurrence of peri-parturient deaths in both years of the study		(a) experience of the farmer, (b) presence of working staff in the farm

Table S2. Incidence risk of peri-parturient deaths in each of 60 sheep flocks during a two-year study in Greece.

Farm reference no.	1st year of the study	2nd year of the study	Both years
1	1.32%	0.00%	0.66%
2	2.00%	5.00%	3.50%
3	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%
6	0.00%	1.80%	0.90%
7	0.00%	0.75%	0.38%
8	3.35%	3.28%	3.32%
9	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%
11	0.00%	0.00%	0.00%
12	0.00%	0.00%	0.00%
13	0.00%	1.56%	0.78%
14	0.00%	0.00%	0.00%
15	0.00%	0.00%	0.00%
16	0.00%	0.00%	0.00%
17	0.00%	0.00%	0.00%
18	0.00%	0.95%	0.47%
19	0.00%	0.00%	0.00%
20	0.00%	0.00%	0.00%
21	1.04%	1.02%	1.03%
22	0.00%	1.31%	0.65%
23	0.00%	2.63%	1.32%
24	0.00%	4.08%	2.04%
25	1.47%	0.47%	0.97%
26	1.33%	2.07%	1.70%
27	0.00%	0.00%	0.00%
28	3.00%	0.00%	1.50%
29	0.00%	0.00%	0.00%
30	0.00%	1.14%	0.57%
31	6.29%	0.00%	3.15%
32	0.00%	0.00%	0.00%
33	0.00%	0.00%	0.00%
34	0.00%	0.00%	0.00%
35	0.00%	0.00%	0.00%
36	7.22%	0.00%	3.61%
37	0.00%	0.00%	0.00%
38	0.00%	0.00%	0.00%
39	0.00%	0.00%	0.00%
40	0.00%	0.00%	0.00%
41	3.39%	3.13%	3.26%
42	0.00%	0.00%	0.00%
43	1.83%	2.28%	2.06%
44	0.00%	1.49%	0.74%
45	0.00%	0.00%	0.00%
46	0.00%	0.00%	0.00%
47	0.00%	0.00%	0.00%
48	0.00%	0.00%	0.00%
49	0.00%	4.46%	2.23%
50	0.00%	0.00%	0.00%
51	8.84%	3.19%	6.01%
52	6.47%	2.87%	4.67%
53	0.00%	3.90%	1.95%
54	0.00%	0.00%	0.00%
55	0.00%	1.31%	0.65%

56	2.44%	0.00%	1.22%
57	0.00%	9.17%	4.58%
58	1.23%	1.75%	1.49%
59	0.00%	0.00%	0.00%
60	0.00%	0.00%	0.00%

Table S3. Frequency ¹ of peri-parturient deaths in relation to the time of lambing, during a two-year study in 60 sheep flocks in Greece.

1 st year of the study			2 nd year of the study			Both years		
Time of death in relation to lambing								
Before	At	After	Before	At	After	Before	At	After
<i>n</i> Total = 89			<i>n</i> Total = 109			<i>n</i> Total = 198		
65	4	20	70	7	32	135	11	52
Proportion of peri-parturient deaths within the respective period								
73.0%	4.5%	22.5%	64.2%	6.4%	29.4%	68.2%	5.5%	26.3%

¹ The figures refer only to deaths that occurred within the 18-day long peri-parturient period.

Table S4. Frequency ¹ of clinical problems associated with peri-parturient deaths, in relation to the time of parturition during a two-year study in 60 sheep flocks in Greece.

Clinical problems	Time of death in relation to lambing		
	Before	At	After
Pregnancy toxemia	82		
Ruminal acidosis	23		
Genital tract problems (genital injury, uterine prolapse, rectal prolapse, metritis)			23
Acute clinical mastitis			21
Respiratory infections	19		
Dystocia		11	
Copper poisoning	7		
Hypocalcaemia			5
Babesiosis	4		
Predation by wild animals			2
Coenurosis			1
Total	135	11	52

¹ The figures refer only to deaths that occurred within the 18-day long peri-parturient period.

Table S5. Incidence risk of deaths of ewes during the ‘before lambing’ component of the peri-parturient period during a two-year study in 60 sheep farms in Greece, in accord with factors ($n = 15$) evaluated for potential association with these deaths.

Management system applied in the flock			
Intensive ($n = 13$) 0.9%	Semi-intensive ($n = 12$) 0.3%	Semi-extensive or extensive ($n = 35$) 0.5%	p 0.002
Season of the year during which the lambing period took place			
Winter ($n = 5$) 1.3%	Spring ($n = 0$) n/a	Summer ($n = 19$) 0.7%	Autumn ($n = 36$) 0.3%
			p <0.0001
Number of animals in the flock			
≤200 ewes ($n = 38$) 0.7%	200–500 ewes ($n = 17$) 0.5%	>500 ewes ($n = 5$) 0.3%	p 0.034
Breed of ewes			
Greek pure-breed animals ($n = 15$) 0.6%	Imported pure-breed animals ($n = 18$) 0.5%	Crossbreds ($n = 27$) 0.5%	P 0.96
Average lambing rate at flock level			
≤1.5 ($n = 45$) 0.5%	>1.5 ($n = 15$) 0.8%		p 0.034
Control of reproduction			
Intravaginal use of progestogen sponges ($n = 13$) 0.4%	Administration of melatonin implants ($n = 9$) 0.5%	No ($n = 38$) 0.6%	p 0.26
Feed origin			
Homemade ($n = 26$) 0.6%	Commercial ($n = 34$) 0.5%		p 0.52
Inclusion of roughage into the diet			
Yes ($n = 58$) 0.6%	No ($n = 2$) 0.4%		p 0.77
Intramammary administration of antibiotics at the end of the previous lactation period			
Yes ($n = 21$) 0.6%	No ($n = 39$) 0.5%		p 0.96
Nutritional modifications performed during the last stage of pregnancy			
Yes ($n = 28$) 0.5%	No ($n = 32$) 0.6%		p 0.39
Administration of anthelmintics at the end of pregnancy			
Yes ($n = 60$) 0.5%	No ($n = 0$) n/a		p n/a
Administration of anti-clostridial vaccination at the end of pregnancy			
Yes ($n = 60$) 0.5%	No ($n = 0$) n/a		p n/a
Administration of anti-mastitis vaccination at the end of pregnancy			
Yes ($n = 25$) 0.5%	No ($n = 35$) 0.6%		p 0.25
Experience of the farmer			
0–10 years ($n = 13$) 0.7%	11–20 years ($n = 30$) 0.3%	>20 years ($n = 17$) 1.0%	P <0.0001
Presence of working staff in the farm			
Yes ($n = 39$) 0.6%	No ($n = 21$) 0.5%		p 0.52

Table S6. Incidence risk of deaths of ewes during the ‘at lambing’ component of the peri-parturient period during a two-year study in 60 sheep farms in Greece, in accord with factors ($n = 15$) evaluated for potential association with these deaths.

Management system applied in the flock			
Intensive ($n = 13$) 0.1%	Semi-intensive ($n = 12$) 0.0%	Semi-extensive or extensive ($n = 35$) 0.1%	p 0.93
Season of the year during which the lambing period took place			
Winter ($n = 5$) 0.1%	Spring ($n = 0$) n/a	Summer ($n = 19$) 1.0%	Autumn ($n = 36$) 0.0%
			p 0.075
Number of animals in the flock			
≤ 200 ewes ($n = 38$) 0.1%	200–500 ewes ($n = 17$) 0.1%	> 500 ewes ($n = 5$) 0.0%	p 0.29
Breed of ewes			
Greek pure-breed animals ($n = 15$) 0.1%	Imported pure-breed animals ($n = 18$) 0.1%	Crossbreds ($n = 27$) 0.0%	P 0.095
Average lambing rate at flock level			
≤ 1.5 ($n = 45$) 0.1%		> 1.5 ($n = 15$) 0.0%	p 0.49
Control of reproduction			
Intravaginal use of progestogen sponges ($n = 13$) 0.0%	Administration of melatonin implants ($n = 9$) 0.1%	No ($n = 38$) 0.0%	p 0.17
Feed origin			
Homemade ($n = 26$) 0.0%		Commercial ($n = 34$) 0.1%	p 0.40
Inclusion of roughage into the diet			
Yes ($n = 58$) 0.1%		No ($n = 2$) 0.0%	p 0.62
Intramammary administration of antibiotics at the end of the previous lactation period			
Yes ($n = 21$) 0.1%		No ($n = 39$) 0.0%	p 0.38
Nutritional modifications performed during the last stage of pregnancy			
Yes ($n = 28$) 0.1%		No ($n = 32$) 0.0%	p 0.69
Administration of anthelmintics at the end of pregnancy			
Yes ($n = 60$) 0.5%		No ($n = 0$) n/a	p n/a
Administration of anti-clostridial vaccination at the end of pregnancy			
Yes ($n = 60$) 0.5%		No ($n = 0$) n/a	p n/a
Administration of anti-mastitis vaccination at the end of pregnancy			
Yes ($n = 25$) 0.1%		No ($n = 35$) 0.1%	p 0.95
Experience of the farmer			
0–10 years ($n = 13$) 0.0%	11–20 years ($n = 30$) 0.1%	> 20 years ($n = 17$) 0.0%	P 0.58
Presence of working staff in the farm			
Yes ($n = 39$) 0.0%		No ($n = 21$) 0.1%	p 0.035

Table S7. Incidence risk of deaths of ewes during the ‘after lambing’ component of the peri-parturient period during a two-year study in 60 sheep farms in Greece, in accord with factors ($n = 15$) evaluated for potential association with these deaths.

Management system applied in the flock			
Intensive ($n = 13$) 0.3%	Semi-intensive ($n = 12$) 0.1%	Semi-extensive or extensive ($n = 35$) 0.2%	p 0.30
Season of the year during which the lambing period took place			
Winter ($n = 5$) 0.3%	Spring ($n = 0$) n/a	Summer ($n = 19$) 0.3%	Autumn ($n = 36$) 0.2%
			p 0.48
Number of animals in the flock			
≤ 200 ewes ($n = 38$) 0.4%	200–500 ewes ($n = 17$) 0.1%	> 500 ewes ($n = 5$) 0.1%	p 0.022
Breed of ewes			
Greek pure-breed animals ($n = 15$) 0.3%	Imported pure-breed animals ($n = 18$) 0.1%	Crossbreds ($n = 27$) 0.2%	P 0.19
Average lambing rate at flock level			
≤ 1.5 ($n = 45$) 0.2%		> 1.5 ($n = 15$) 0.4%	p 0.018
Control of reproduction			
Intravaginal use of progestogen sponges ($n = 13$) 0.2%	Administration of melatonin implants ($n = 9$) 0.4%	No ($n = 38$) 0.2%	p 0.079
Feed origin			
Homemade ($n = 26$) 0.2%		Commercial ($n = 34$) 0.2%	p 0.70
Inclusion of roughage into the diet			
Yes ($n = 58$) 0.2%		No ($n = 2$) 0.5%	p 0.28
Intramammary administration of antibiotics at the end of the previous lactation period			
Yes ($n = 21$) 0.2%		No ($n = 39$) 0.2%	p 0.95
Nutritional modifications performed during the last stage of pregnancy			
Yes ($n = 28$) 0.3%		No ($n = 32$) 0.1%	p 0.005
Administration of anthelmintics at the end of pregnancy			
Yes ($n = 60$) 0.5%		No ($n = 0$) n/a	p n/a
Administration of anti-clostridial vaccination at the end of pregnancy			
Yes ($n = 60$) 0.5%		No ($n = 0$) n/a	p n/a
Administration of anti-mastitis vaccination at the end of pregnancy			
Yes ($n = 25$) 0.2%		No ($n = 35$) 0.2%	p 0.43
Experience of the farmer			
0–10 years ($n = 13$) 0.3%	11–20 years ($n = 30$) 0.1%	> 20 years ($n = 17$) 0.3%	P 0.074
Presence of working staff in the farm			
Yes ($n = 39$) 0.2%		No ($n = 21$) 0.2%	p 0.72

Table S8. Summary of results of analysis for associations with peri-parturient deaths during a two-year study in 60 sheep farms in Greece, with the results of each year of the study considered separately.

Occurrence of deaths: before lambing	
1st year of the study	
Significant variables in the univariable analysis	<i>p</i>
Management system applied in the flock	<0.0001
Season of the year during which the lambing period took place	<0.0001
Experience of the farmer	<0.0001
Significant variables in the multivariable analysis	<i>p</i>
Management system applied in the flock	0.018
Season of the year during which the lambing period took place	0.046
Experience of the farmer	0.025
2nd year of the study	
Significant variables in the univariable analysis	<i>p</i>
Season of the year during which the lambing period took place	<0.0001
Experience of the farmer	0.022
Most significant variable in the multivariable analysis	<i>p</i>
Season of the year during which the lambing period took place	0.095
Occurrence of deaths: at lambing	
1st year of the study	
Significant variables in the univariable analysis	<i>p</i>
Most significant variable in the multivariable analysis	<i>p</i>
Presence of working staff in the farm	0.28
2nd year of the study	
Significant variables in the univariable analysis	<i>p</i>
Season of the year during which the lambing period took place	0.001
Breed of ewes	0.022
Control of reproduction	0.0005
Presence of working staff in the farm	0.002
Significant variable in the multivariable analysis	<i>p</i>
Presence of working staff in the farm	0.030
Occurrence of deaths: after lambing	
1st year of the study	
Significant variables in the univariable analysis	<i>p</i>
Number of animals in the flock	0.004
Breed of ewes	<0.0001
Control of reproduction	0.002
Nutritional modifications performed during the last stage of pregnancy	0.002
Experience of the farmer	0.022
Most significant variable in the multivariable analysis	<i>p</i>
Control of reproduction	0.063
2nd year of the study	
Significant variables in the univariable analysis	<i>p</i>
Number of animals in the flock	0.046
Nutritional modifications performed during the last stage of pregnancy	0.031
Significant variable in the multivariable analysis	<i>p</i>
Nutritional modifications performed during the last stage of pregnancy	0.046