The association between health status and body condition score in intensively and extensively reared Skopelos dairy goats

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Introduction

Body condition score (BCS)

- Valuable and inexpensive tool for assessing levels of energy reserves.
- Indicator of health and welfare status
- Indirect proxy trait of nutritional demands and feed efficiency

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Objective:

- To study the association between BCS and various health conditions in goats reared under **intensive** and **extensive** farming systems.

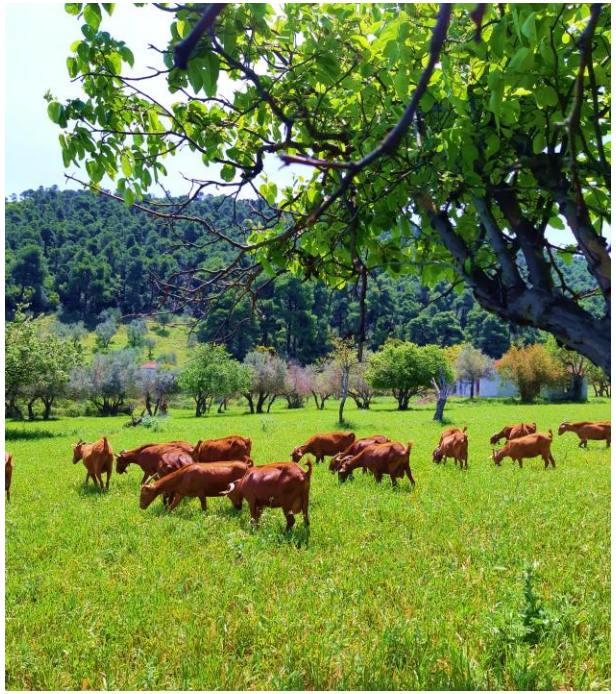
Materials and Methods (I)

- Purebred adult Skopelos goats
  - 153 intensively reared (**zero grazing**)
  - 133 extensively reared (pasture-based)

- Goats had the **same genetic background**

- Goats were prospectively **monitored for two consecutive lactation periods** (February 2022 – August 2023) initiating at post weaning and every 50 days thereafter

Intensive farm
Athens, Greece



Extensive farm
Skopelos island, Greece

Materials and Methods (II)

Each goat was subjected to clinical examination; individual daily milk yield was recorded

Clinical examination

Limbs

- Lameness
- Overgrown hooves
- Arthritis

Head

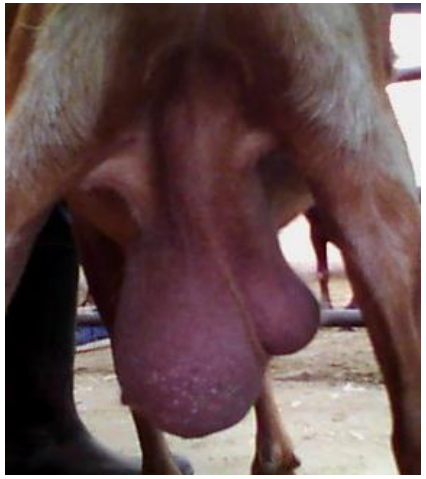
- Anaemia
- Jaw swelling
- Ocular discharge
- Nasal discharge
- Cough

Udder

- Abscesses
- Fibrosis
- Asymmetry
- Swollen supra-mammary lymph nodes
- Cysts

Body

- Hair coat quality
- Swollen lymph nodes
- Abscesses
- Vaginitis
- Meteorism



Udder asymmetry

Lameness

Anaemia

Body abscesses

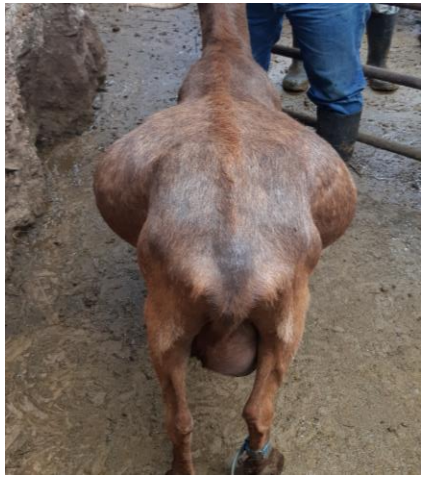
Eye discharge

Overgrown hooves

Nasal discharge

Udder abscess

Poor hair coat quality



Meteorism

Body condition scoring and clinical examination

Materials and Methods (III)

BCS was assessed through the palpation of the lumbar area using a 5-point scale with 0.25 increments

Thin, BCS: < 2.5

Normal, BCS: 2.5 – 3.5

Overweight, BCS: > 3.5

Materials and Methods (IV)

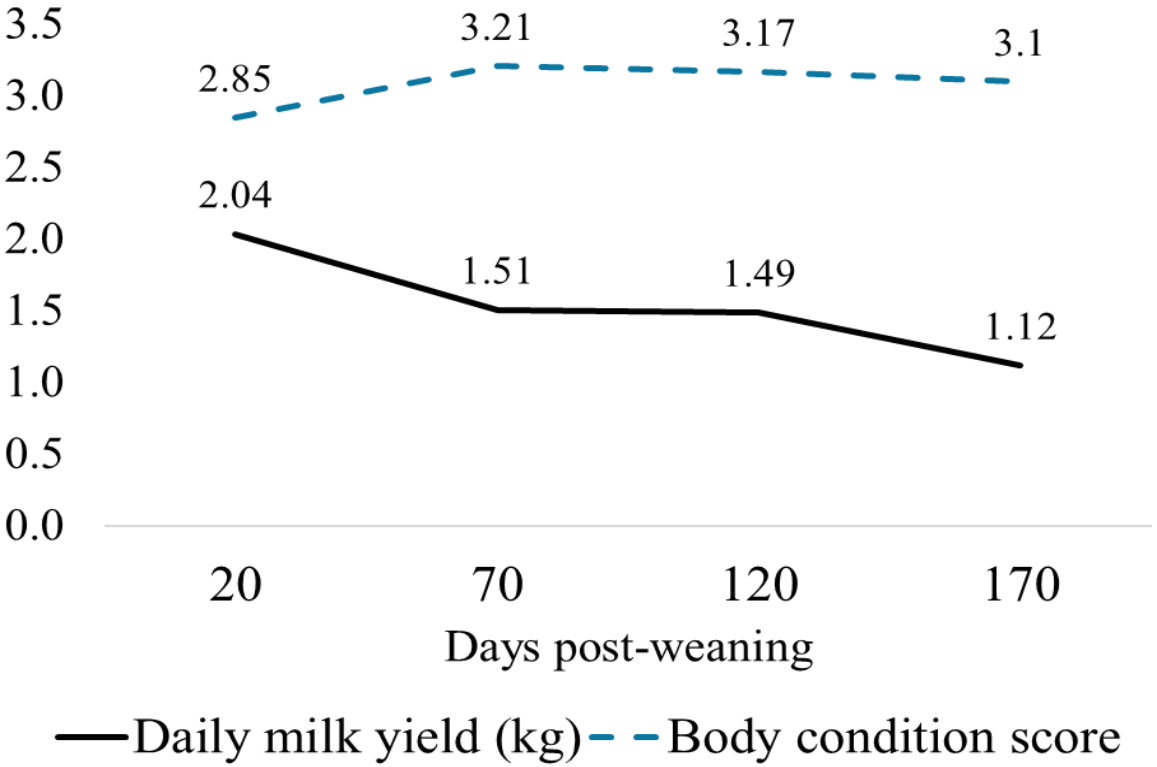
A set of **mixed linear regression models** for each one of the recorded health issues (n = 18) was used as described below:

$$\mathbf{BCS_{gj} = \mu + F_j + Y_{gj} + A_{gj} + S_j + X_{gj} + \beta_1 * DMY + \gamma_j + e_{gj}}$$

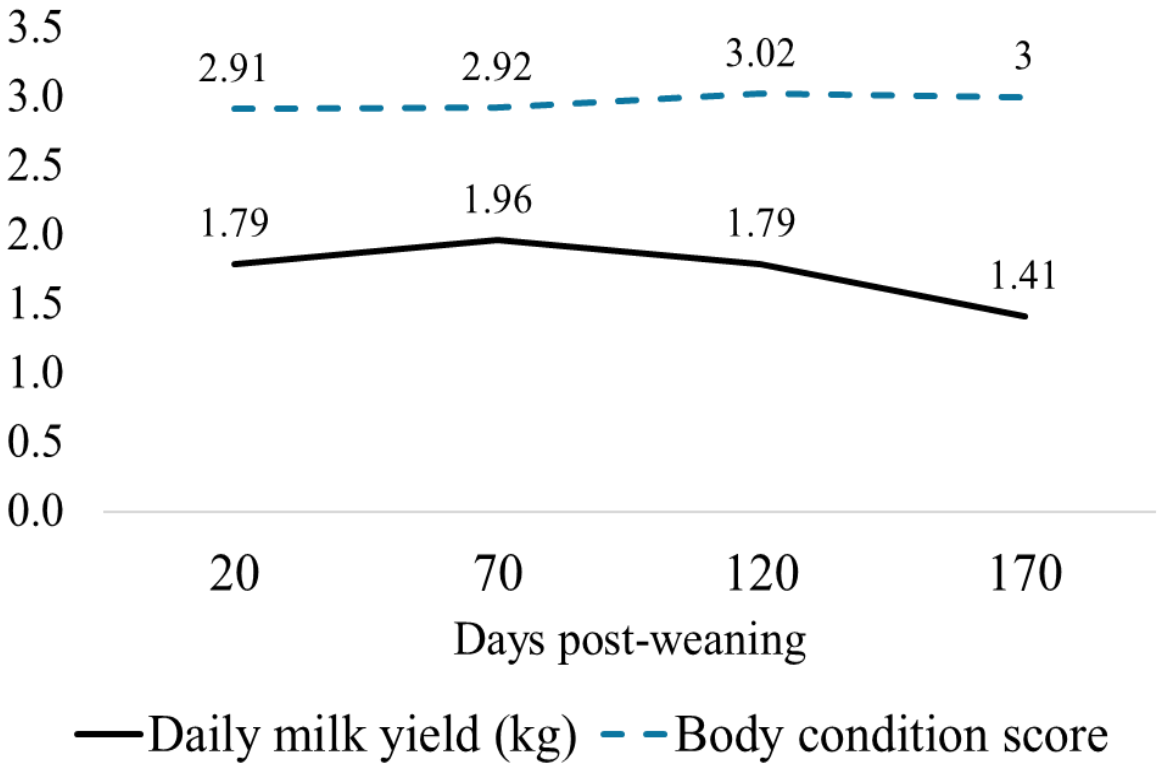
BCS_{jg} = body condition score for the g^{th} sampling occasion of the j^{th} goat
μ = intercept
F_j = fixed effect of the farming system (2 levels; 1 = intensive, 2 = extensive)
Y_{gj} = fixed effect of the year of sampling (2 levels; 1 = 1^{st}, 2 = 2^{nd} year)
A_{gj} = fixed effect of age (4 levels; 1 = 2, 2 = 3, 3 = 4, and 4 $\geq$ 5 years)
S_j = fixed effect of the stage of lactation (4 levels; 1 = 20, 2 = 70, 3 = 120, and 4 = 170 days post-weaning)
X_{gj} = fixed effect of the occurrence of the recorded health issues (2 levels; 0 = absence, 1 = presence)
β_1 = fixed effect of the regression coefficient of body condition score (BCS) (1 to 5 with 0.25 increments)
DMY = daily milk yield
γ_j = repeated variation of the j^{th} goat
e_{gj} = residual error

Results (I)

Intensive farm – Year 1

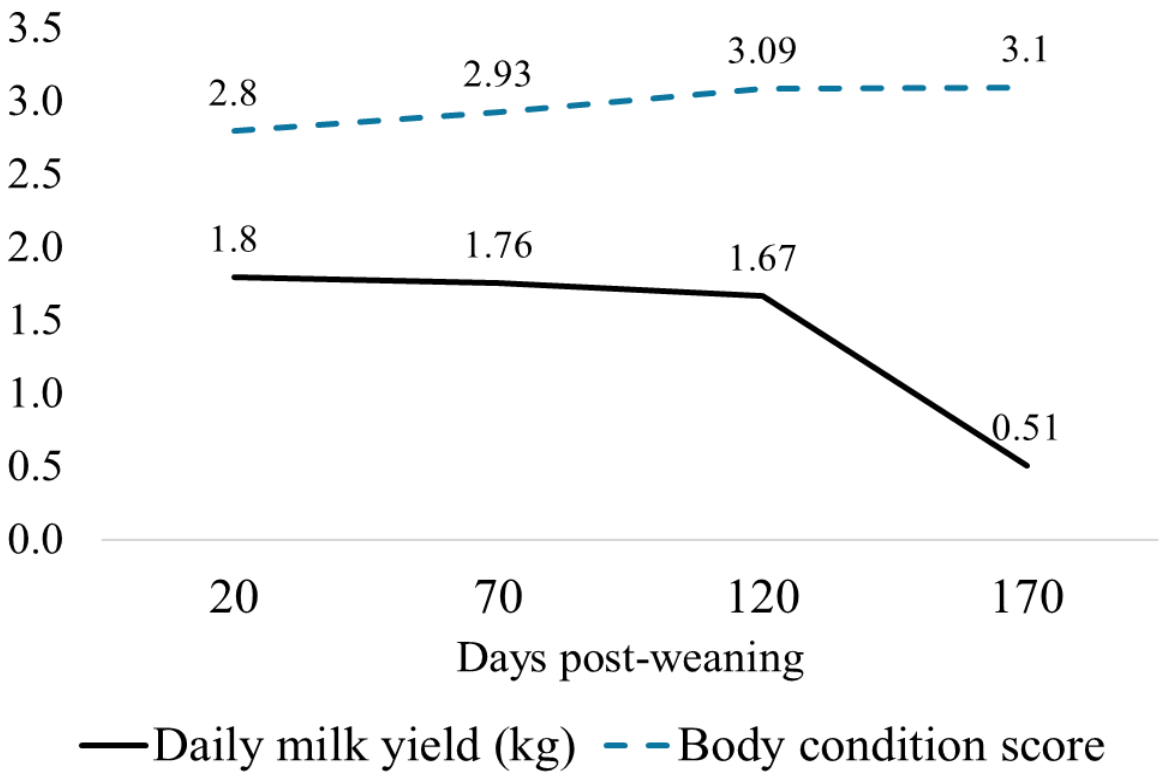


Intensive farm – Year 2

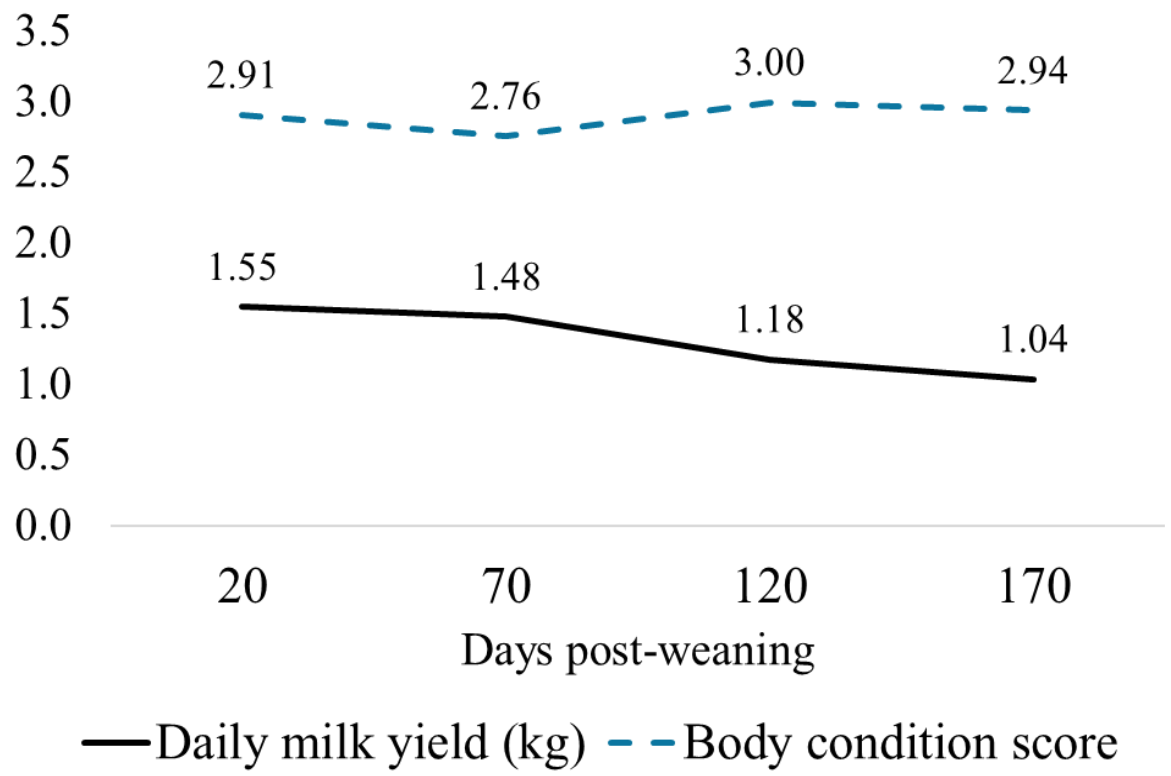


Results (II)

Extensive farm – Year 1



Extensive farm – Year 2



Results (III)

Traits	Period prevalence - Intensive farm (%)	Period prevalence - Extensive farm (%)
Lameness	2.1 – 3.8	0.0 – 1.5
Arthritis	0.7 – 1.9	0.0 – 0.8
Overgrown hooves	29.2 – 42.1	3.8 – 4.4
Anaemia	15.1 – 16.6	48.9 – 71.9
Jaw swelling	5.5 – 9.4	0.9 – 2.3
Ocular discharge	0.0 – 2.1	0.0 – 1.5
Nasal discharge	4.7 – 25.5	12.8 – 43.9
Cough	0.0 – 1.9	0.0 – 0.8
Udder abscesses	2.8 – 4.7	9.6 – 10.5
Udder cysts	0.7 – 1.9	0.9 – 8.3
Udder fibrosis	43.3 – 48.3	56.4 – 68.4
Udder asymmetry	44.1 – 74.5	45.6 – 75.2
Swollen supra-mammary lymph nodes	14.2 – 45.5	24.1 – 51.8
Faecal soiling	3.8 – 6.9	0.9 – 8.3
Poor hair coat quality	30.3 – 48.1	51.8 – 60.9
Vaginitis	0.0 – 1.4	0.0 – 0.8
Meteorism	1.9 – 4.1	1.5 – 1.8
Body abscesses	44.1 – 50.0	38.6 – 45.1
Swollen body lymph nodes (at least one)	36.8 – 40.0	45.9 – 64.9

Results (IV)

Traits	EMM	B-coefficient†	Std. error	Significance	95% Confidence interval Lower	Upper
Lameness	2.94	0.02	0.078	0.840	-0.14	0.17
Arthritis	2.95	0.01	0.145	0.968	-0.28	0.29
Overgrown hooves	2.95	-0.01	0.026	0.768	-0.06	0.04
Anaemia	2.98	0.00	0.019	0.847	-0.04	0.03
Jaw swelling	2.95	-0.04	0.054	0.491	-0.14	0.07
Ocular discharge	2.95	0.16	0.112	0.157	-0.06	0.38
Nasal discharge	2.95	0.01	0.025	0.588	-0.04	0.06
Cough	2.95	-0.01	0.146	0.969	-0.29	0.28
Udder abscesses	**2.94**	**-0.15**	**0.043**	**0.001**	**-0.24**	**-0.07**
Udder cysts	2.95	0.00	0.066	0.964	-0.13	0.13
Udder fibrosis	2.94	-0.03	0.015	0.105	-0.06	0.01
Udder asymmetry	2.94	-0.03	0.015	0.063	-0.06	0.00
Swollen supra-mammary lymph nodes	2.95	0.03	0.018	0.069	0.00	0.07

† Reference category: goats with the health issue
EMM: estimated marginal means

Results (V)

Traits	EMM	B-coefficient†	Std. error	Significance	95% Confidence interval Lower	Upper
Faecal soiling	2.95	-0.07	0.052	0.182	-0.17	0.03
Poor hair coat quality	**2.97**	**0.09**	**0.017**	**0.000**	**0.05**	**0.12**
Vaginitis	2.95	-0.12	0.146	0.418	-0.40	0.17
Meteorism	2.95	0.10	0.073	0.178	-0.05	0.24
Body abscesses	2.95	0.00	0.017	0.838	-0.04	0.03
Swollen body lymph nodes (at least one)	2.98	-0.01	0.019	0.626	-0.05	0.03

† Reference category: goats with the health issue
EMM: estimated marginal means

Results (VI)

Body condition score

- **Negative association with daily milk yield** ($p < 0.001$)
- Higher in intensively reared goats ($p < 0.01$)
- Increasing with age ($p < 0.05$)
- Increasing with stage of lactation ($p < 0.001$)

Conclusions

- Positive association between **poor hair coat quality and BCS** implies a common underlying cause (e.g., nutritional deficiencies).

- Increased BCS in goats with udder abscesses implies decreased milk yield

- Absence of significant associations between specific health issues and BCS
  - Culling of goats with chronic diseases
  - Culling of goats when BCS decreased
  - Good feeding and management practices

- BCS is a good proxy trait of nutritional status and welfare status in dairy goats

- **Next steps:** Hand on image annotation to provide objective context for AI models

Acknowledgements

https://coderefarm.eu/

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Thank you for your attention