

SHORT COMMUNICATION

A PRELIMINARY SURVEY OF THE NUTRITION AND HEALTH OF GERMAN PET RABBITS

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ABSTRACT

This survey aimed to investigate the nutrition and health of German pet rabbits with a special emphasis on dental diseases and the impact of diet on dental health. The questionnaire yielded 82 responses (n=57 online and n=25 in-person interviews). Most rabbits were ≥ 7 years old (32.9%), followed by 3-4 years old (30.5%). The sex ratio was almost 50-50%, and most rabbits were neutered (65.8%). Complete pelleted feed was the most fed concentrate (71.9%) followed by muesli-type mixed feed (11.0%). The majority of rabbits (95.1%) had *ad libitum* access to hay, and 45.1% received fresh vegetables daily. Dental disorders were reported in 26 rabbits (31.7%), primarily affecting the cheek teeth (20.6%), compared to the incisors (9.5%) or both (3.2%). Of the other diseases and symptoms, epiphora (n=12, 13.3%), obesity (n=8, 9.7%), and weight loss (n=7, 7.8%) were the most common. Fisher's exact test did not show a significant association between age (≤ 4 years old, > 4 years old), breed (dwarf or other), sex (male or female) and the number of diagnosed health problems (≤ 3 or more) and forms of diseases or symptoms. Also, the incidence of obesity was not higher in neutered rabbits. The reported feeding practices suggest a relatively high standard of nutrition, though objective nutrient analysis was not performed. As another limitation, survey data might show a bias towards committed rabbit owners.

Keywords: Feeding, hay, incisor, malocclusion

INTRODUCTION

Improper nutrition of pet rabbits leads to common disorders, such as dental diseases, diarrhoea, or other gastrointestinal problems (Huynh et al., 2014; Oneill et al., 2020). All teeth are open-rooted and grow continuously lifelong. For maintaining the shape of the continually growing teeth tooth-to-tooth contact plays a major role (Harcourt-Brown, 2003; Reiter, 2008). Because of too short maxilla in combination with a normal mandible, brachycephalic breeds are 3.19 times at risk of dental disease compared to normal breeds (Harcourt-Brown, 2009; Siriporn and Weerakhun, 2014). Numerous studies have

shown that diet influences dental growth and wear, especially hay promoting adequate movement and wear during chewing, while rabbits without access to hay develop dental disease more frequently (Palma-Medel et al., 2023). Rabbits consuming muesli-type mixes also have a higher incidence of dental problems (Harcourt-Brown, 2003; Reiter, 2008; Martin et al., 2022). The survey aimed to investigate the nutrition and health of German pet rabbits, with a special emphasis on dental diseases and the impact of diet on dental health. The survey was part of Melina Berger's thesis.

MATERIAL AND METHODS

The questionnaire was shared in German in Facebook groups "Veterinary Exotic Small Talk" (23.853 members), "Pet rabbit keepers and friends" (20.010 members) and "Pet rabbit advice" (40.406 members). Beside that, responses were collected through personal interviews with rabbit owners. Respondents were told to answer rabbit-related questions about their oldest owned rabbit. Ethical approval was not required as data collection was anonymized, and participation was voluntary. Data were collected from April 30, 2023, to August 31, 2023.

The questionnaire consisted of 24 questions that were presented in both single-choice, multiple-choice, and free-text formats. The questionnaire was divided into 4 sections:

Section 1. Age and gender of the respondent.

Section 2. The number of currently owned rabbits. Breed, sex age and neutering of the rabbit.

Section 3. Access to/type of concentrates, vegetables, and treats. Access to hay.

Section 4. Past diseases. Reasons for veterinary visits. Details of dental diseases.

Fisher's exact test was used to evaluate the association between the age (≤ 4 years old, > 4 years old), breed (dwarf or other), or sex (male or female) and the number of diagnosed health problems (< 3 or more) and diseases. The same test was used to check the association between neutering status and obesity. R statistical program (version 4.3.1, 2023) was used for the calculations; p-values lower than 0.05 were significant. Beside that – because of the number of records – we only made descriptive statistics.

RESULTS

The questionnaire yielded 82 responses ($n=57$ Facebook and $n=25$ personal interviews). Female pet rabbit owners formed the majority in this study ($n=70$, 85%) and most of the participants owned two rabbits ($n=27$, 32.9%). Twenty owners (24.4%) had one rabbit, seven (8.5%) had three rabbits and seven owned more than three animals (8.5%). The majority of the pet rabbit owners were between 25 and 34 years old ($n=36$, 45.0%), 21.9% ($n=18$) were <18 –24 years, 25.6% ($n=21$) were 35–54 years and five (6.1%) >55 years old. Figure 1 shows the rabbit breeds.

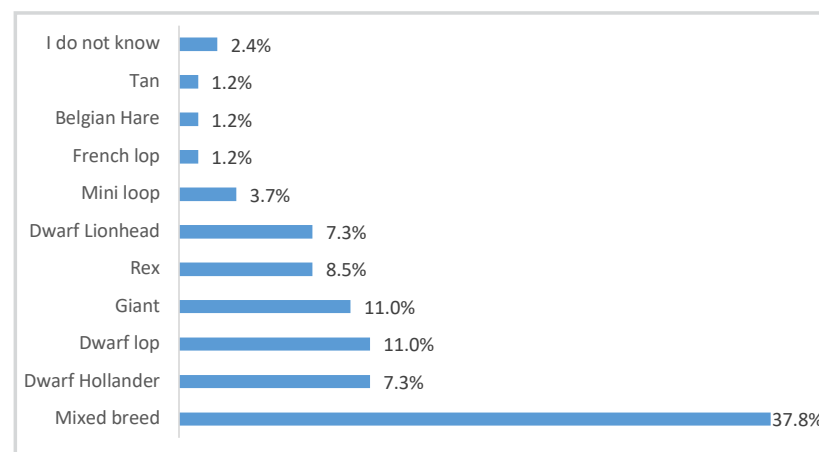


Figure 1 Breed of the rabbits ($n=82$)

Most rabbits in this study were ≥ 7 years old ($n=27$, 32.9%), followed by 3-4 years old ($n=25$, 30.5%), 5-6 years old ($n=16$, 19.5%) and ≤ 2 years old ($n=9$, 11%). Five owners (4.9%) were unsure about the age of the rabbit. The sex ratio was close to 50-50% (female $n=36$, 43.9% vs. male $n=40$, 48.8%; six owners were unsure). The majority of the rabbits were neutered ($n=54$, 65.8%), twenty (24.4%) were intact and not planning to be neutered, and 2.4% ($n=2$) were intact, but planning to be neutered. Six owners (7.3%) did not respond. There was no association between neutering status and obesity ($p>0.05$).

Table 1 shows the frequency of access to feeds. Most of the owners fed their rabbits with concentrates ($n=68$, 82.9%). Complete pelleted feed (extruded pellets with homogenous appearance) was the most fed concentrate ($n=59$, 71.9%), followed by muesli-type mixed feed (a mixture of pellets and other ingredients, non-homogenous appearance; $n=9$, 11.0%) and 12.2% ($n=10$) did not feed concentrates. Figure 2 shows the most and least preferred ingredients of mixed feeds. The fed vegetables and treats are shown in Figure 3 and Figure 4.

Table 1 The frequency of access to feeds

	Hay		Concentrate		Vegetables		Treats	
	n	%	n	%	n	%	n	%
<i>Ad libitum</i>	78	95.1%	7	8.5%	7	8.5%	0	0%
Once a day	1	1.2%	44	53.6%	37	45.1%	19	23.2%
More than once a day	1	1.2%	8	9.7%	22	26.8%	3	3.6%
Less than once a day	1	1.2%	13	15.8%	12	14.6%	46	56.1%
Never	0	0%	10	12.2%	0	0%	7	8.5%
Non-respondents	1	1.2%	0	0%	4	4.9%	7	8.5%

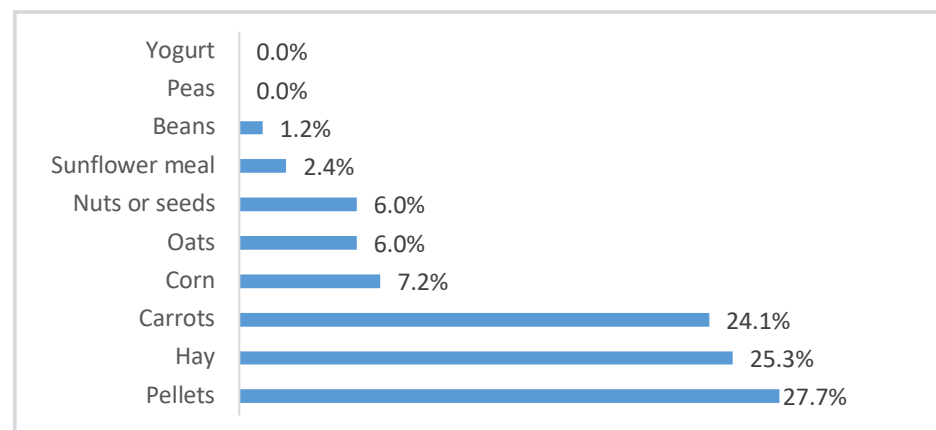


Figure 2
Preferred ingredients of mixed feed (multiple-choice question, $n=83$)

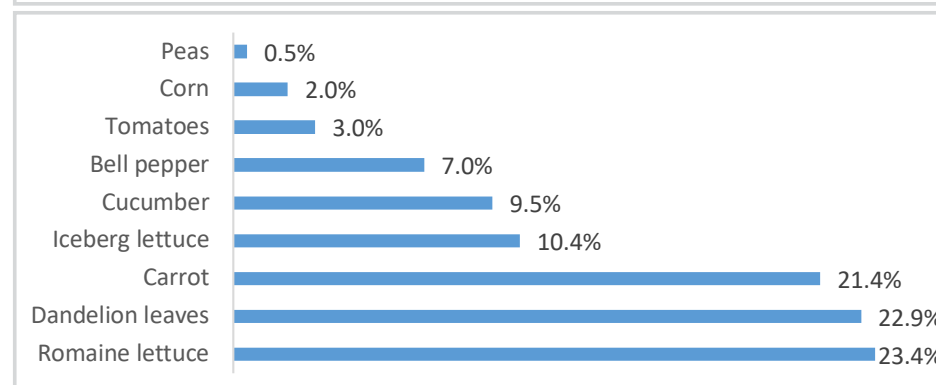
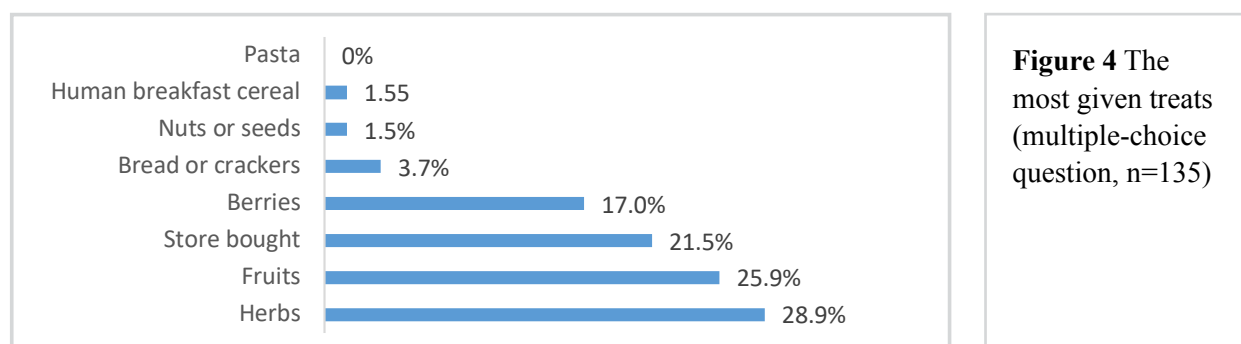
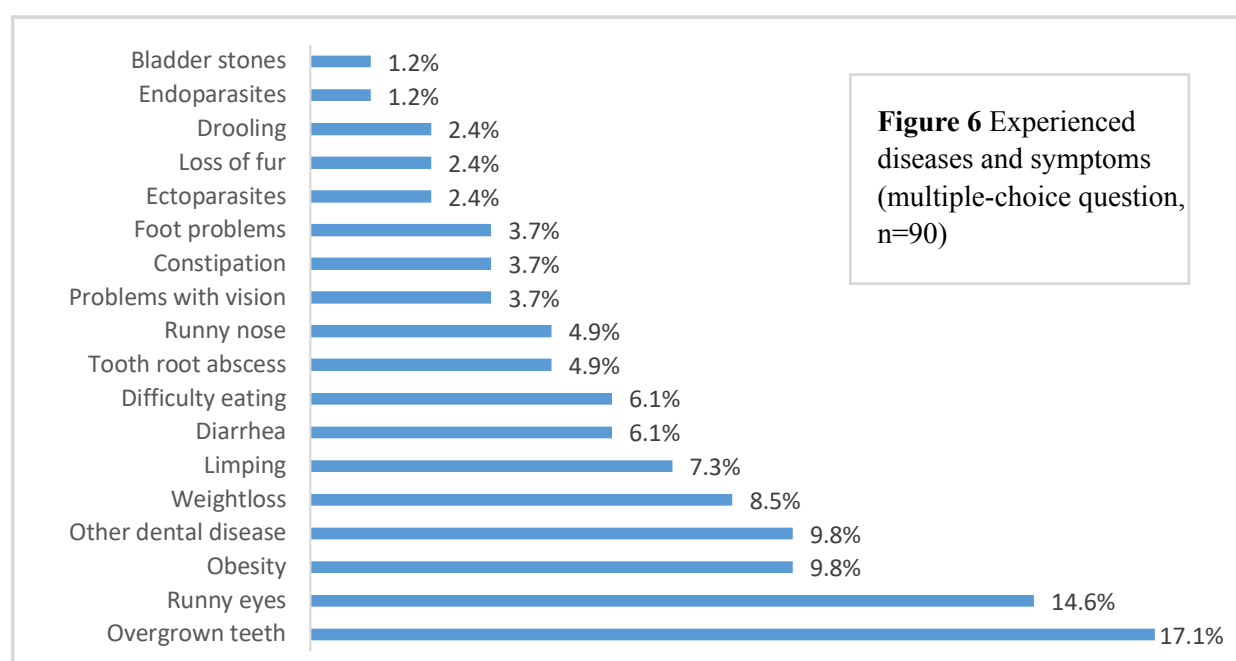
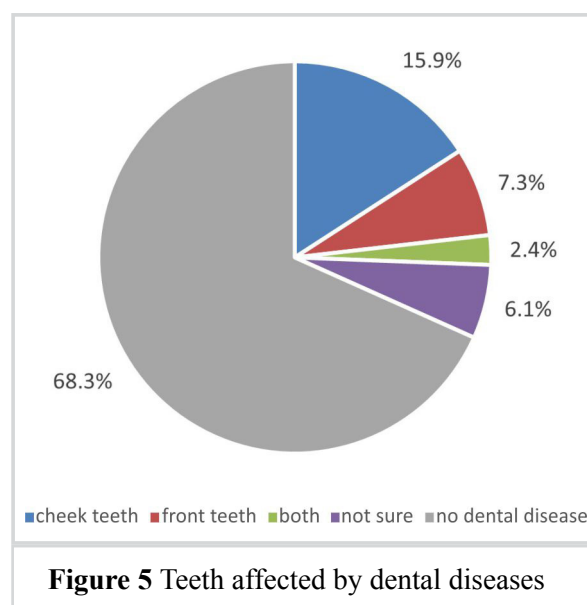


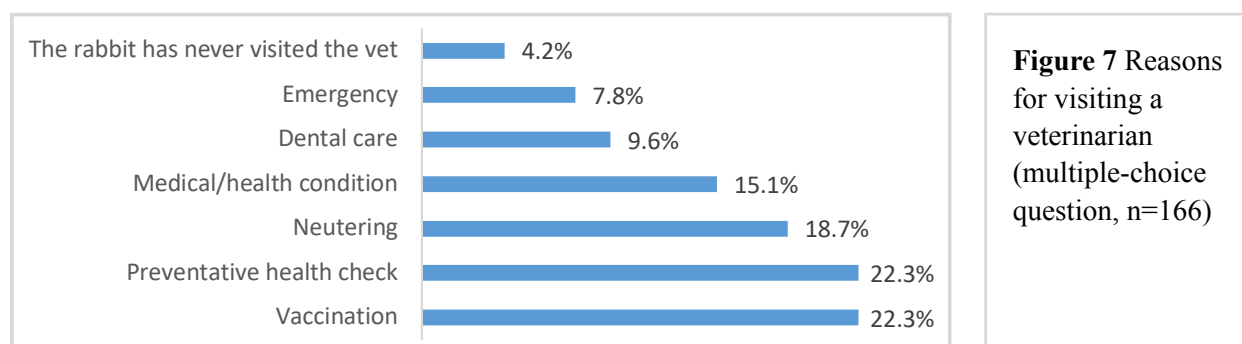
Figure 3 The most commonly fed vegetables (multiple-choice question, $n=201$)



Most of the owners considered their rabbits healthy at the current moment ($n=64$, 78.0%). Dental disorders were reported in 26 rabbits (Figure 5). Overgrown teeth ($n=10$ vs. $n=4$), tooth root abscesses ($n=4$ vs. $n=0$) and other dental diseases ($n=7$ vs. $n=1$) were more common in rabbits over 4 years of age, but it was not significant. Except for other dental diseases ($n_{\text{male}}=5$, $n_{\text{female}}=3$), dental disorders were more common in males (overgrown teeth: $n_{\text{male}}=8$, $n_{\text{female}}=6$; tooth root abscess: $n_{\text{male}}=4$, $n_{\text{female}}=0$). However, none of these differences were significant. Eleven rabbits (13.4%) had dental surgery in the past, and in 90.9% ($n=10$) the surgery was successful.

Figure 6 shows the other diseases and symptoms. Figure 7 shows the reasons for visiting a veterinarian.





DISCUSSION AND CONCLUSION

Like in other surveys, most of the owners in the present study were female (Rooney et al., 2014; Welch et al., 2017; Kristensen, et al., 2023). As in the study of Kristensen et al. (2023), rabbits were mostly mixed breeds (39.2%). Among the purebred rabbits, the dwarf lop was the most common breed, as in other surveys (Mullan and Main, 2006; Edgar and Mullan, 2011; Mäkitaipale et al., 2015; Hetényi and Sátorhelyi, 2021). Likewise, the dispersal of female and male rabbits was approximately 50-50 in this study, which is also shown in the previous data collections (Mullan and Main, 2006; Mäkitaipale et al., 2015; Hetényi and Sátorhelyi, 2021; Kristensen, et al., 2023).

Only nine (11%) owners gave muesli-type mixed feed, contrary to the survey of Edgar and Mullan (2011) with 45% and Harcourt-Brown (1996) with 99%. Beside the type of concentrate (complete extruded pellet), another sign of a relatively high standard of nutrition in this survey is the controlled access to it. Typically, the muesli-type mixed feed is higher in carbohydrate and lower in fibre than the complete extruded pellets. Perhaps the owners taking part in this present study were aware of the health risks (selective feeding and dental problems) connected to this kind of feed (Harcourt-Brown, 1996; Prebble and Meredith, 2014). Selective feeding was observed, but except for carrots, the energy and carbohydrate-rich components were not preferred by the rabbits. The most and least preferred ingredients of the mixed feed as well as the provided treats and fruits, were similar to the findings of Kristensen et al. (2023). Among the

most commonly fed vegetables, Romaine lettuce and dandelion are adequate, but carrots should be limited because of their high carbohydrate content. Starch-rich human foods and energy-rich nuts and seeds are not recommended for rabbits, and these were not commonly fed by the owners. The most adequate treats are herbs that were used by the majority. It was closely followed by fruits, which are also not optimal because of their high carbohydrate content. The fact that hay was a regular part of the diet of almost all rabbits corresponds with other studies (Mullan and Main, 2006; Rooney et al., 2014; Hetényi and Sátorhelyi, 2021; Kristensen et al., 2023).

Neutering procedures and routine health assessments were the most commonly cited reasons for veterinary consultations in the present study, similar to a previous study by Kristensen et al. (2023). Epiphora was a common problem that corresponded with the literature, as in the study by Artiles et al. (2020) and Mäkitaipale et al. (2015). Increased ocular discharge is caused by the elongation of the maxillary incisor, which constricts the nasolacrimal duct (Harcourt-Brown, 2009). Poor teeth cause insufficient grooming; consequently, fur balls can develop and small intestinal blockage (Mosallanejad et al., 2010). Gastrointestinal problems were less common than in some other surveys (Mullan and Main, 2006; Hetényi and Sátorhelyi, 2021) and similar to the results of Rooney et al. (2014) and Kristensen et al. (2023). Other health issues were also less common (Mullan and Main, 2006; Rooney et al., 2014; Mäkitaipale et al., 2015; Hetényi and Sátorhelyi, 2021; Kristensen et al., 2023).

The prevalence of dental disease correlates with previous studies (Mullan and Main, 2006; Mäkitaipale et al., 2015; Böhmer and Böhmer, 2017; Hetényi and Sátorhelyi, 2021). Considering these results, most of the rabbits having dental disease corresponded to the older age group (>4 years). At older ages, there is a longer exposure time for factors like diet or genetic predisposition, resulting in dental alterations (Artiles, et al., 2020; Mosallanejad et al. 2010). In contrast, Palma-Medel et al. (2023) described the dental disease in young rabbits. This may be explained by the fact that juveniles have a higher demand for calcium for growth. Thus, suboptimal calcium intake can lead to dental alterations, such as enamel defects (Harcourt-Brown, 1996). In this survey, no female was presented with the tooth root abscess. Several studies demonstrated that male rabbits showed an increased risk of dental disease compared to females (Siriporn and Weerakhun., 2014; O'Neill et al., 2020; Palma-Medel et al., 2023). This can be related to the hormone estrogen, which increases the serum calcium concentration, consequently facilitating the formation of the enamel and dentin (Palma-Medel et al., 2023). No rabbits under 4 years of age developed dental abscesses in this survey. This might be explained by the lower incidence of dental diseases in this age group.

The association between concentrate feeding and dental disease remains a subject of debate in the current literature. Pellets - in contrast to the natural diets - are crushed between the teeth, followed

by much higher axial strain on the cheek teeth. Lateral gliding movements as well as chewing duration are decreased, resulting in insufficient tooth wear and a tendency to retrograde elongation (Reiter, 2008; Böhmer and Böhmer, 2017). The tougher and stiffer hay requires more chewing, which results in longer chewing periods compared to pellets (Böhmer and Böhmer, 2017). On the other hand, a study by Müller et al. (2014) showed that pellets with high fiber content did not increase the risk of dental disease in the short term. For the prevention of dental disease, a diet of grass and/or good quality hay with plenty of leafy green plants is recommended. The present study could not evaluate the quality of each ingredient in the diet, which may answer the discrepancy in the results, according to the literature. A more common involvement of the cheek teeth compared with the front teeth was also observed by the other studies (Artiles et al., 2020; Palma-Medel et al., 2023).

Further studies involving a higher number of participants would be important to evaluate the health and nutrition of pet rabbits. The reported feeding practices suggest a relatively high standard of nutrition, though objective nutrient analysis was not performed. As another limitation, data might show a bias towards committed rabbit owners. A more detailed survey recording the type of hay, the manufacturer of the concentrate and its portion size would be necessary to see the potential connection between diet and dental health.

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PRELIMINARNO ISTRAŽIVANJE O ISHRANI I ZDRAVLJU NJEMAČKIH KUNIĆA KAO KUĆNIH LJUBIMACA

SAŽETAK

Cilj ovog istraživanja je ispitati ishranu i zdravlje njemačkih kunića kao kućnih ljubimaca s posebnim naglaskom na dentalna oboljenja i djelovanje ishrane na dentalno zdravlje. Upitnik je sadržavao 82 odgovora (n=57 elektronska i n=25 intervju uživo). Većina kunića je bila starija od ≥ 7 godina (32.9%), potom 3-4 godine (30.5%). Omjer spolova je iznosio skoro 50-50%, a većina kunića je prethodno sterilizirana (65.8%). Kompletan čvrsta hrana je predstavljena koncentratom (71.9%), potom miješanom hranom tipa žitarica (11.0%). Većina kunića (95.1%) je imala ad libitum pristup sijenu, a 45.1% je dobivalo svježe povrće svaki dan. Dentalni poremećaji su zabilježeni kod 26 kunića (31.7%), zahvatajući prvenstveno obrazne zube (20.6%), potom sjekutiće (9.5%) ili oboje (3.2%). Od ostalih bolesti i simptoma, najčešći su bili epifora (n=12, 13.3%), gojaznost (n=8, 9.7%) i gubitak težine (n=7, 7.8%). Fisherov egzaktni test nije dokazao statistički signifikantnu povezanost između starosti (≤ 4 godine, > 4 godine), pasmine (patuljasta ili druga), spola (mužjaci ili ženke), broja dijagnosticiranih zdravstvenih problema (≤ 3 ili više) i oblika bolesti ili simptoma. Također, incidenca gojaznosti nije bila viša kod steriliziranih kunića. Zabilježeni načini ishrane sugeriraju relativno visok standard, iako nije izvedena objektivna nutritivna analiza. Drugo ograničenje istraživanja je potencijalna pristrasnost s vlasnicima kunića kao uzrokom.

Ključne riječi: Malokluzija, prehrana, sijeno, sjekutić