Ovozoa 14 No. 1, April 2025 p-ISSN 2302-6464 e-ISSN 2722-967X
Available at https://e-journal.unair.ac.id/OVZ/index

Original article

A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra

Sharveihn Sathindren[1], Suryo Kuncorojakti[2], Suzanita Utama[3*], Tita Damayanti Lestari[3], Wiwik Misaco Yuniarti[4]

[1] Internship Veterinarian in Penang Government Veterinary Clinic, Bukit Tengah, Seberang Perai, Penang, Malaysia
[2] Division of Veterinary Anatomy, [3] Division of Veterinary Reproduction, Faculty of Veterinary Medicine, Universitas Airlangga, Surabaya, Indonesia
[4] Animal Hospital of Universitas Airlangga, Surabaya, Indonesia

[*] Corresponding author, e-mail: suzanita-u@fkh.unair.ac.id
Open access under CC BY – SA license, DOI: 10.20473/ovz.v14i1.2025.8-15
Received February 20 2025, Revised April 6 2025, Accepted April 8 2025
Published online April 2025

ABSTRACT

This study aimed to evaluate the potential benefits of advocating elective spaying (ES) in young nulliparous bitches as a preventive measure for pyometra, a severe and potentially life-threatening condition. Specifically, the study examined whether elective spaying, which eliminates the risk of pyometra and its associated complications, offers significant advantages over the treatment of pyometra once it develops. Generally, the short- and long-term risks associated with elective spaying are minimal when compared to the significant complications and dangers posed by pyometra. A retrospective open-ended study was conducted, collecting data from veterinary clinics across Penang Island using a structured questionnaire. Information was gathered primarily from medical records and interviews with veterinarians and pet owners when data were missing or unclear in the records. The study compared 30 bitches of various breeds who underwent elective spaying with 30 bitches who underwent emergency ovariohysterectomy (EOH) due to pyometra. A standard set of outcomes was evaluated to assess and compare complications. The results showed that the elective spaying group experienced only minor or trivial complications, and owners incurred significantly lower costs compared to those whose bitches underwent emergency surgery for pyometra, which was associated with more severe complications and substantially higher costs. Based on these findings, the study concluded that elective spaying is a safe and cost-effective prophylactic measure against pyometra.

Keywords: anesthetic complication, breed, canine, nulliparous, ovariohysterectomy

INTRODUCTION

Canine pyometra is a feared condition that can develop suddenly, with a mortality rate of 3-4% despite modern treatments. It causes significant suffering in the animal and anxiety for the owner. In many cases, bitches are euthanized either due to advanced disease or because the cost of treatment is unaffordable (Jitpean, 2014). Early elective spaying is a simple and cost-effective solution that prevents the development of pyometra (Rungphattanachaikul *et al.*, 2021). While spaying is commonly performed by responsible pet owners to prevent unintended pregnancies and reduce the uncontrolled growth of the

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

animal population, it is important to note that spaying interferes with the natural reproductive process. Some studies have reported that spaying can lead to certain complications, and there is concern among some owners that spaying may be recommended primarily for financial reasons (Kutzler, 2020; Romagnoli *et al*., 2024). When performed in an elective setting with appropriate patient selection, prophylactic spaying is a relatively simple procedure that can be done in a single day, with minimal stress for the animal, and the patient can typically return home within the same day. The cost is generally low, and the procedure is practical and straightforward to perform in veterinary practice (Romagnoli *et al*., 2024). Therefore, spaying is a highly beneficial preventive measure for both the pet owner and the animal. However, there is some medical evidence suggesting that early spaying may lead to long-term complications in certain animals. Some owners also perceive elective spaying as a means for veterinarians to earn extra income (McKenzie, 2010). The growing reluctance to advocate for elective spaying, due to concerns about potential complications, may result in more bitches presenting with pyometra in veterinary practices (Xavier *et al*., 2023). Thus, there is a need to assess and compare the morbidity associated with elective spaying against the morbidity experienced by bitches undergoing emergency surgery for pyometra. Elective spaying is also a more cost-effective option than emergency pyometra surgery (Gibson *et al*., 2013).

This study aimed to demonstrate that post-spaying morbidity and medium-term complications are relatively rare, and the preventive approach of elective spaying carries only minor risks compared to the emergency treatment of bitches that develop pyometra. Additionally, by comparing the costs of elective spaying with those of emergency pyometra surgery, the study also sought to emphasize the cost-effectiveness of elective spaying. While veterinarians may earn more from emergency surgeries than from elective spaying, recommending the latter is based on scientific evidence and sound principles.

MATERIALS AND METHODS

The study was retrospective in nature, utilizing data from veterinary clinics and hospitals in Penang over a period of three years or longer. Two distinct groups were included: the first group consisted of nulliparous bitches that were spayed before the age of three years (2018-2022), enabling an assessment of long-term complications; the second group included nulliparous bitches that underwent emergency ovariohysterectomy (EOH) for pyometra within the same period. The inclusion criteria for the study comprised veterinary and pet owner consent, the animal being under the same ownership since the procedure, and the animal being alive or deceased within the last three months. Exclusion criteria included changes in ownership and animals that had been deceased for more than six months. Data collection was carried out using a standardized, anonymous questionnaire, with consent obtained from pet owners for phone, email, or face-to-face interviews. Any conflicting data were resolved by prioritizing medical records.

The variables assessed in this study included infection (defined as the use of antibiotics beyond the prescribed preoperative regimen), poorly healed wound complications (characterized by prolonged hospitalization due to wound-related issues), incontinence (manifesting as new or unresolved urinary incontinence following the procedure), internal bleeding (necessitating repeat surgery), ovarian remnant syndrome (confirmed by sonography or repeat surgery), uterine stump pyometra (diagnosed when treatment is required), uterine stump inflammation or granuloma (diagnosed when treatment is required), and weight gain (defined as an increase exceeding 25% within six months post-procedure without an identifiable cause). The veterinary clinics in Penang, Malaysia involved in this study were the Penang Government Veterinary Clinic (Bukit Tengah, Seberang Perai), Penang Government Veterinary Clinic (Jalan Sungai), Gill Veterinary Clinic (Jalan Mano), Cuddles Veterinary Clinic (Jalan Tg Tokong), Animal Hospital Vantage Point

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

(Jalan Tg Tokong) and Acuvet Clinic (Jalan Gottlieb).

Data analysis

The data were analysed descriptively.

RESULTS

The data for this study was collected from common dog breeds found on Penang Island, Malaysia, which predominantly comprises affluent individuals owning a variety of purebred dogs as pets. Efforts were made to gather data from the most common breeds present on the island. The data indicates that more mongrels and crossbreeds were electively spayed compared to purebred dogs (Table 1). One possible explanation provided by veterinarians is that many owners of purebred dogs refrain from spaying in order to preserve the possibility of breeding their bitches in the future, as purebred puppies tend to command higher prices at pet shops. In contrast, crossbred and mongrel owners often spay their dogs early, as they see no economic value in breeding. Additionally, it is possible that crossbred and mongrel dogs suffering from pyometra are euthanized without treatment, leading to a smaller sample size in the pyometra group, as owners may find it more cost-effective to obtain a new puppy.

Table 1 Breakdown of procedures by breed

	spaying (n = 30)	pyometra (n = 30)
Golden Retriever	3 (10.0%)	4 (13.3%)
Jack Russel	1 (3.3%)	2 (6.7%)
Rottweiler	4 (13.3%)	4 (13.3%)
Spaniel	1 (3.3%)	3 (10.0%)
Mastiff	1 (3.3%)	3 (10.0%)
German Shepherd	2 (6.7%)	3 (10.0%)
Shih Tzu	3 (10.0%)	3 (10.0%)
Labrador	2 (6.7%)	3 (10.0%)
Crossbreed/mongrel	13 (43.3%)	3 (10.0%)

The distribution of parameters between spaying and pyometra cases is shown in Table 2. Animals were stratified according to age, with the elective spaying (ES) group consisting of bitches spayed between the ages of 9 to 24 months (mean 14 months). The data for emergency ovariohysterectomy (EOH) did not specify age, but animals in this group ranged between 54 to 72 months (mean 66 months).

Data were collected to determine the cost of elective spaying (ES), which ranged from RM 300 in government-run facilities to RM 450 in private settings, with a mean cost of RM 400. Due to the complexity of elective ovariohysterectomy (EOH), government-run facilities declined to treat such animals and recommended that they be referred to private facilities, leading to a more than 10-fold increase in cost, ranging from RM 3,500 to RM 5,000, with a mean cost of RM 4,200 (RM 1= IDR 3,500). A portion of the cost was attributed to hydration requirements before the procedure, with only 2 animals in the ES group requiring minimal hydration, while all animals in the EOH group needed moderate to prolonged hydration before, during, and after the procedure.

Animals in the ES group did not require pre-procedure admission and were only called in on the day of the procedure. In contrast, animals in the EOH group were admitted and required a stay of 1 to 3 days prior to the procedure. Six animals in the EOH group underwent surgery on the same day, 21 required 1 to 2 days of hydration and stabilization, and 13, who were more ill at presentation, underwent surgery after 3 days of hydration and stabilization. This process involved intravenous lines and close monitoring by veterinarians and assistants. In the ES group, only 5 animals required more than routine antibiotics, whereas in the EOH group, 24 animals required additional antibiotics, which also involved intravenous lines and close monitoring.

The majority of animals in the ES group (27) were discharged on the same day, while 3 were discharged the following day. In the EOH group, the majority of animals required prolonged stays for treatment and monitoring, often for 2 or more days. The relatively short procedure time in the ES group resulted in fewer animals experiencing significant complications from anesthesia, with

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

only 3 cases in the ES group, compared to 14 in the EOH group. Wound complications were more frequent and severe in the EOH group, with significantly more animals (2 in the ES group vs. 8 in the EOH group) requiring further surgical correction. A similar pattern was observed for complications such as internal bleeding, with a fourfold increase in the EOH group (1 in the ES group vs. 4 in the EOH group) requiring surgical exploration.

Urinary incontinence was notably more common in the EOH group, with 2 animals affected compared to none in the ES group. No cases of uterine stump pyometra were reported in the ES group. Both groups exhibited weight gain; however, it was not possible to quantify the amount based on the data collected. The results demonstrate that elective spaying is a relatively simple and cost-effective procedure, requiring basic facilities and resulting in minimal stress and trauma for the dogs involved. The cost of elective spaying is only a tenth of the cost of treating pyometra, with the significant costs of pyometra treatment attributed to longer hospital stays, hydration, antibiotics, and complex care procedures, all of which add to the overall expense and increase trauma for the animals.

The complexity of pyometra surgery also contributed to anesthetic complications, and a substantial number of bitches suffered post-operative complications, as pyometra itself places a heavy burden on the animal's health, nutrition, hydration, and immune system, impeding recovery and causing further strain. Weight gain in both groups could be attributed to multiple factors, but anecdotal evidence from owner interviews suggests that this may be due to a tendency for owners to overcompensate for their animals by overfeeding and under-exercising them after the procedure.

Table 2 Distribution of parameters between spaying and pyometra

	spaying (n=30)	pyometra (n=30)
Ovariohysterectomy age (average)	9-24 months (16.5 ± 4.76)	54-72 months (63 ± 5.63)
Cost of care (average)	RM 300 - RM 450 (RM 375)	RM 3,500 - RM 5,000 (RM 4,250)
Hydration required	2/30 (6.7%)	30 (100%)
Pre-op stays	0 days: 30 (100%)	0 day: 6 (20%) 1 -2 days: 21 (70%) >2 days: 3 (10%)
Any infection > 1 antibiotic	05 (16.7%)	24 (80%)
Post-op stays	0-1 day: 27 (90%) >1 day: 3 (10%)	0-1 day: 0 1-2 days: 5 (16.7%) 2-3 days: 12 (40%) >3 days: 13 (43.3%)
Anesthetic complications	3/30 (10%)	14/30 (46.7%)
Poor wound healing for medical management	6/30 (20%)	12/30 (40%)
Poor wound healing for surgical management	2/30 (6.7%)	8/30 (26.7%)

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

Internal bleeding requiring readmission for medical treatment / monitoring	0	0
Surgical exploration	1/30 (3.3%)	4/30 (13.3%)
Urinary incontinence post procedure >1 week	0	2/30 (6.67%)
Weight gain observed by owners	yes	yes

DISCUSSION

Pyometra is a serious disease primarily affecting middle-aged and older female dogs, generally occurring at a mean age of 7.5 years, with some cases reported as early as 4 months and as late as 18 years (Johnston *et al*., 2001). The incidence rate is 199 per 10,000 at-risk dogs (2%) per year (Hagman, 2022), with breeds such as Rottweilers, Chow Chows, Golden Retrievers, and Miniature Schnauzers being particularly susceptible (Smith, 2006). In Penang, these purebred dogs are commonly kept as pets. Emergency ovariohysterectomy remains the traditional treatment of choice for pyometra. The treatment involves managing bitches in an emergency setting, which includes administering preoperative hydration and antibiotics, prolonged anesthetic and surgical durations, a higher likelihood of requiring blood and plasma transfusions, and significant stress to the patient (Baithalu *et al*., 2010). The mortality rate for bitches with pyometra is estimated to be between three and four percent (Jitpean, 2014).

This study underscores the benefits of elective spaying (ES) as a preventive measure against pyometra. The lower cost, minimal procedure complexity, and reduced risk of complications support the recommendation of ES as a safe and ethical option for dog owners. The study observed that a higher proportion of mongrels and crossbreeds underwent elective spaying compared to purebred dogs. This is likely due to the fact that purebred dogs are often bred for the purpose of producing puppies, as the prevalence of pet dog ownership worldwide, along with the decisions regarding dog acquisition, influences many individuals each year (Holland, 2019). The lower incidence of pyometra in crossbreeds and mongrels in this dataset may be attributed to the possibility that these animals were more likely to be euthanized without receiving treatment.

The cost of elective spaying (ES) versus the treatment of pyometra was also examined, as this provides an important basis for informed decision-making regarding whether to undertake ES when the dog is still young. The estimated cost of ES in Penang ranged from RM 100 to RM 200 in government clinics and RM 300 to RM 500 in private clinics. In contrast, the cost of pyometra treatment ranged from RM 1,000 to RM 3,000, depending on factors such as breed, size, medications used, types and duration of anesthesia, hospitalization days, radiology, and laboratory investigations. According to a study by Rungphattanachaikul *et al*. (2021), some reasons provided by dog owners for not opting for spaying included personal beliefs that ovariohysterectomy was unnecessary, the perception of high costs, concerns about hospitalization for the procedure, and a lack of awareness about the risks of uterine diseases. Therefore, it is essential to ensure that pet owners are informed about the potential costs associated with preventive medicine and responsible pet ownership in order to avoid compromising the welfare and life of their animals (Gibson *et al*., 2013).

Wound complications were found to be more frequent in the emergency ovariohysterectomy (EOH) group compared to the ES group, which has been associated with longer anesthetic and surgical times. Burrow *et al*. (2005) provided evidence that longer surgery times are linked to higher rates of surgical site complications. The

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

relatively low number of cases captured could be attributed to the effectiveness of short-acting preoperative antibiotics. Antimicrobials administered approximately one hour before surgery have been shown to have a favorable effect on wound infection outcomes (Airikkala-Otter *et al*., 2018). A similar pattern was observed for internal bleeding complications, with a fourfold increase in the EOH group (1 in the ES group vs. 4 in the EOH group) requiring surgical exploration. Veterinarians interviewed noted that these numbers might vary depending on the veterinary center, as the skill and experience of the surgeon, as well as the available facilities and equipment, play a significant role.

Urinary incontinence was notably more prevalent in the EOH group compared to the ES group. Potential explanations include significant hormonal changes in pyometra cases, as compared to more subtle hormonal changes in ES. Howe (2015) mentioned that spayed female dogs are at an increased risk for urethral sphincter-mechanism incompetence. In a study of 566 spayed dogs, 5.12% developed urinary incontinence, with the incidence being 1.37% in small dogs and 9.12% in medium and large dogs. The study did not address the risk of urinary incontinence in dogs spayed younger than 3 months, as all the dogs in the study were older than 12 weeks at the time of spaying. However, a review by Beauvais *et al*. (2012) found weak statistical evidence to support the idea that spaying at any age increases the risk of urinary incontinence, concluding that the evidence is insufficient to recommend an optimal age for spaying to avoid incontinence. Pyometra can cause significant derangement of internal anatomy, leading to surgical complications such as hernia, fistulas, and ureteric ligation (Xavier *et al*., 2023). Veterinarians interviewed in this study noted that such complications may vary depending on the facilities and equipment available, as well as the surgeon's skill and experience.

Weight gain was observed in both groups, though it appeared to be similar between them. Interviews with owners suggested that this could be due to a tendency to overcompensate by overfeeding and under-exercising the dogs post-procedure. The general consensus among both veterinary professionals and the public is that spaying can increase the risk of obesity in female dogs. Although strong evidence for this is lacking, Lefebvre *et al*. (2013) found that the risk of weight gain post-spaying was most prominent within the first two years after the procedure. Therefore, it is advisable for owners to closely monitor their pet's weight during this period and avoid overfeeding or under-exercising. Many studies have focused on individual risk factors, but it is important to consider the interaction between multiple factors, such as how obese owners may be less likely to walk their dogs compared to lean owners, or how feeding practices may differ between obese and lean owners (Bjørnvad *et al*., 2019).

One of the main limitations of this study is its retrospective nature, relying on information extracted from clinical records and owner reports. Based on the results alone, it was not possible to determine whether initiating spaying leads to complications arising from the procedure itself, nor its long-term complications such as urinary incontinence. A future prospective study, conducted on a larger scale across Malaysia, involving more clinics and hospitals and a larger sample size, would provide a better understanding. The pyometra population in this study may also have been underestimated, as cases where the animal died prior to surgery, at home, or due to postoperative complications were not recorded. There is considerable heterogeneity in the methodology and quality of studies reporting on complications following ovariohysterectomy in female dogs. This study reaffirms the need for further studies with more comprehensive data, emphasizing prospective epidemiological studies and descriptive quantitative data from the general population. These studies should adjust for variables such as weight, breed, and age, and explore the role of environmental risk factors.

The results of this study confirm that pyometra is a serious condition with high morbidity and mortality rates. The management of pyometra is also associated with high

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

morbidity, and although this study did not specifically examine this, anecdotal interviews with veterinarians during data collection indicated significant mortality, both directly due to the disease or its management failure, as well as due to owners opting for euthanasia. Furthermore, the outcome of treatment is highly dependent on the skill of the veterinarian and the available equipment at the clinic. This emphasizes the importance of early prophylaxis through elective spaying. This study has also established that elective spaying is a relatively minor procedure, with minimal complications compared to emergency ovariohysterectomy for pyometra. All veterinary centers can manage ES, as it is a day-case procedure that requires minimal preparation. In contrast, the treatment of pyometra requires the dog to be admitted for hydration, stabilization, and prolonged postoperative care. Elective spaying requires minimal antibiotics, and short- and medium-term complications are rare. In contrast, emergency ovariohysterectomy for pyometra results in high antibiotic demand, prolonged hospitalization, and significantly more complications. The cost of treating pyometra is more than 10 times higher than that of elective spaying and will continue to increase over time.

CONCLUSIONS

The findings of this study emphasize the severity of pyometra as a condition with high morbidity and mortality rates. The management of pyometra, which involves high treatment costs and significant risks, supports the argument for early elective spaying as a cost-effective and ethically sound preventive measure. Elective spaying is a relatively simple procedure with minimal complications, requiring less post-operative care and significantly lower costs compared to the treatment of pyometra. Therefore, this study conclusively demonstrates that elective spaying is a safe, cost-effective, and recommended prophylactic measure against pyometra.

REFERENCES

Airikkala-Otter I, Gamble L, Mazeri S, Handel IG, Bronsvoort BMC, Mellanby RJ, Meunier NV. 2018. Investigation of short-term surgical complications in a low-resource, high-volume dog sterilisation clinic in India. BMC Vet Res. 14: 56.

Baithalu RK, Maharana BR, Mishra C, Sarangi L, Samal L. 2010. Canine pyometra. Vet World 3: 340-2.

Beauvais W, Cardwell JM, Brodbelt DC. 2012. The effect of neutering on the risk of mammary tumours in dogs--a systematic review. J Small Anim Pract 53: 314-22.

Bjørnvad CR, Gloor S, Johansen SS, Sandøe P, Lund TB. 2019. Neutering increases the risk of obesity in male dogs but not in bitches - A cross-sectional study of dog- and owner-related risk factors for obesity in Danish companion dogs. Prev Vet Med. 170: 104730.

Burrow R, Batchelor D, Cripps P. 2005. Complications observed during and after ovariohysterectomy of 142 bitches at a veterinary teaching hospital. Vet Rec. 157: 829-33.

Gibson A, Dean R, Yates D, Stavisky J. 2013. A retrospective study of pyometra at five RSPCA hospitals in the UK: 1728 cases from 2006 to 2011. Vet Rec. 173: 396.

Hagman R. 2022. Pyometra in small animals 2.0. Vet Clin North Am Small Anim Pract. 52: 631-57.

Holland KE. 2019. Acquiring a pet dog: A review of factors affecting the decision-making of prospective dog owners. Animals (Basel) 9: 124.

Howe LM. 2015. Current perspectives on the optimal age to spay/castrate dogs and cats. Vet med. (Auckland, NZ) 6: 171-80.

Jitpean S, Ström-Holst B, Emanuelson U, Höglund OV, Pettersson A, Alneryd-Bull C, Hagman R. 2014. Outcome of pyometra in female dogs and predictors of peritonitis and prolonged postoperative hospitalization in surgically treated cases. BMC Vet Res. 10: 6.

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

Johnston SD, Root Kustritz MV, Olson PNS. 2001. Canine and feline theriogenology. 1st Ed. Saunders.

Kutzler MA. 2020. Possible relationship between long-term adverse health effects of gonad-removing surgical sterilization and Luteinizing Hormone in dogs. Animals (Basel) 10: 599.

Lefebvre SL, Yang M, Wang M, Elliott DA, Buff PR, Lund EM. 2013. Effect of age at gonadectomy on the probability of dogs becoming overweight. J Am Vet Med Assoc. 243: 236-43.

Mckenzie B. 2010. Evaluating the benefits and risks of neutering dogs and cats. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 5 : 1-18.

Romagnoli S, Krekeler N, de Cramer K, Kutzler M, McCarthy R, Schaefer-Somi S. 2024. WSAVA guidelines for the control of reproduction in dogs and cats. J Small Anim Pract. 65: 424-559. doi:10.1111/jsap.13724.

Rungphattanachaikul S, Akatvipat A, Chia MPC, Lampang KN, Sthitmatee N. 2021. A retrospective study of suspected pyometra causing systemic illness in 348 dogs. Vet Integr Sci. 19: 141-52.

Smith FO. 2006. Canine pyometra. Theriogenology 66: 610-2.

Xavier RGC, Santana CH, de Castro YG, de Souza TGV, do Amarante VS, Santos RL, Silva ROS. 2023. Canine pyometra: A short review of current advances. Animals (Basel) 13: 3310. doi: 10.3390/ani13213310.

How to cite this article: Sathindren S, Kuncorojakti S, Utama S, Lestari TD, Yuniarti WM. 2025. A study on the beneficial effect of advocating prophylactic spaying of young nulliparous bitches to prevent pyometra. Ovozoa: Journal of Animal Reproduction. 14: 8-15.

