JIVS
The Chamber of Veterinary Surgeons, Istanbul
e-ISSN: 2602-3490
Abbr. Title: J Ist Vet Sci

Journal of Istanbul Veterinary Sciences (JIVS)

Journal home page: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net
Since 2017

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Volume 5; Issue 2, August 2021 E-ISSN: 2602-3490

Indexes and Platforms

Turkey citation index, Google scholar, ResearchBib, Bielefeld Academic Search Engine, Cosmos IF, İnternational Institute of organized research(I2OR), Scientific İndexing service, CrossRef, Eurasian Scientific Journal Index, Open AIRE, General Impact factor, Directory of Research Journals Indexing (DRJI), ASOS index.

Journal homepage: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Contents

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Effects of castration on IFN-γ and TNF-α expression in the adrenal gland of Angora goat

Tuğrul Ertuğrul[1*], Ahmet Ceylan[2], Alev Gürol Bayraktaroğlu[3], Asuman Özen[4] Şerife Tütüncü[5]

1. Ondokuz Mayis University, Faculty of Veterinary Medicine, Department of Histology and Embryology, Samsun, Turkey. **2.** Ankara University, Faculty of Veterinary Medicine, Department of Histology and Embryology, Ankara, Turkey. **3.** Ankara University, Faculty of Veterinary Medicine, Department of Histology and Embryology, Ankara, Turkey. **4.** Ankara University, Faculty of Veterinary Medicine, Department of Histology and Embryology, Ankara, Turkey. **5.** Ondokuz Mayis University, Faculty of Veterinary Medicine, Department of Histology and Embryology, Samsun, Turkey. Ertuğrul, T.: ORCID: 0000-0002-9310-1200, Ceylan, A.: ORCID: 0000-0001-5878-8775, Bayraktaroğlu A. G.: ORCID: 0000-0001-9248-8370, Özen, A.: ORCID: 0000-0002-9678-0018, Tütüncü, Ş.: ORCID: 0000-0001-6834-7244.

Research Article

Volume: 5, Issue: 2
August 2021
Pages: 66-71

ABSTRACT

In the adrenal gland, there is a mutual interaction between the cells in the cortex and medulla and the cells of the immune system. Sex hormones regulate immune cell functions as well as reproductive and metabolic processes throughout life. Interferon-gamma (IFN-γ) is a cytokine that regulates the maturation and differentiation of many cell types. Tumor necrosis factor-alpha (TNF-α) is a multifunctional cytokine that plays an important role in various physiological and pathophysiological processes and orchestrates cytokines. This study was conducted to investigate the effects of castration on the expression of IFN-γ and TNF-α in the adrenal gland of Angora goat. A total of 16 Ankara goat kids were used as material for the study. Healthy animals were selected for the study by clinical examination. At an average age of 75 days, eight animals were randomly selected from the institute herd and castrated. 85 days after castration (after approximately 160 days old), eight control and eight castrated Angora goats were slaughtered and their adrenal glands were removed. In the analysis of each group, IFN-γ expression was found in the cytoplasm of cells in the adrenal cortex and medulla. The adrenal glands of the castrated group showed a decrease in IFN-γ expression in the zona fasciculata. A distinct brown staining was seen in the cytoplasm of TNF-α-positive responsive secretory cells. TNF-α expression was found to be increased in the zona glomerulosa, zona fasciculata and zona reticularis of the adrenal gland in the castrated group. Accordingly, androgen hormone deficiency was able to increase TNF-α expression, whereas it did not significantly affect IFN-γ expression in the adrenal tissue of the Angora goat.

Article History

Received: 24.05.2021
Accepted: 19.07.2021
Available online: 25.08.2021

Keywords: adrenal gland, Angora goat, castration, interferon-gamma, TNF-α

DOI: https://doi.org/10.30704/http-www-jivs-net.942018

To cite this article: Ertuğrul, T., Ceylan, A., Bayraktaroğlu, A. G., Özen, A., Tütüncü, Ş. (2021). Effects of castration on IFN-γ and TNF-α expression in the adrenal gland of Angora goat. ***Journal of Istanbul Veterinary Sciences, 5*(2),** 66-71.
Abbreviated Title*: J. İstanbul vet. sci.*

Introduction

The adrenal glands are embryologically originating in two different regions: the mesodermal cortex and the ectodermal origin medulla (Kerr, 2010). The adrenal cortex consists of three histological zones, which are named according to the arrangement of the secretory cells zona glomerulosa, zona fasciculata, and zona reticularis. These regions secrete hormones such as steroid hormones, glucocorticoids, and mineralocorticoids (Young et al., 2006). The medulla comprises chromaffin cells, which are large epithelioid

*Corresponding Author: Tuğrul Ertuğrul
E-mail: tugrulertugrul06@hotmail.com

Journal home page: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net

cells, connective tissue, sinusoid blood capillaries, and nerves (Ross and Pawlina, 2016). There is a mutual interaction between the cells in the cortex and medulla and the immune system's cells in the adrenal gland (Kanczkowski et al., 2016).

There is an interaction between the immune system and the endocrine system. This interaction involves both the inhibitory and stimulatory effects of hormones on the immune system (Imura and Fukata, 1994). Cytokines and other mediators play a role in the interaction between these two systems (Blalock, 1994). Tumor necrosis factor-alpha (TNF-α) and interferon-gamma (IFN-γ) are known to induce endocrine and metabolic effects in addition to their effects on the immune system (De Metz et al., 1999).

IFN-γ is a cytokine that controls the maturation and differentiation of various cell types (Schroder et al., 2004). One of the main physiological activities of IFN-γ is its ability to upregulate the expression of MHC class I and II proteins in various cell types during the formation of immune responses (Teixeira et al., 2005). IFN-γ has been shown to increase natural killer cell activity (Mann-Chandler et al., 2005), regulate T cell activation and differentiation and control B cell functions such as immunoglobulin formation (Schroder et al., 2004). In addition to modulating immunological factors, IFN-γ can perform metabolic reprogramming of immune cells (Wang et al., 2018).

TNF-α is a pleiotropic cytokine produced by various cell types (Aggarwal, 2003). It is known to be released as preliminary mediators that activate neutrophils, stimulate other effector cells, and increase chemokine synthesis (Metcalfe et al., 2009). Furthermore, TNF-α is a multifunctional cytokine that plays an important role in various physiological and pathophysiological processes and orchestrating cytokines in a variety of inflammatory conditions (Parameswaran and Patial, 2010).

Throughout life, sex hormones influence immune cell functioning as well as reproductive and metabolic processes (Gilliver, 2010). Steroid hormones like estrogen, progesterone, and glucocorticoids may influence innate and adaptive immunity (Klein and Flanagan, 2016). There is a close relationship between the hormone and cell apoptosis. Androgens are known to stimulate cell proliferation and differentiation (Isaacs, 1984) Furthermore, studies have shown that castration reduces cell proliferation and promotes apoptosis (Hussain et al., 2012).

The aim of the present study was to investigate the effects of castration on the expression of IFN-γ and TNF-α in the adrenal gland of the Angora goat.

Materials and Method

Animal Material: The research was carried out within the ethical committee decision scope taken from the Livestock Central Research Institute (27.06.2013/82). A total of 16 Angora goat kids were used as materials in the study. Healthy animals were selected for the study by clinical examination. At an average age of 75 days, eight heads were randomly selected from the institute herd and castrated with burdizo forceps. Before castration, 0.02mg/ml local anesthesia was applied percutaneously into the funiculus spermaticus. 85 days after castration (after approximately 160 days old), eight control and eight castrated Angora goats were slaughtered and their adrenal glands were removed.

The adrenal glands of the Agrora goat were fixed in 10% formaldehyde solution for histological examination. Following this, they were blocked in paraffin after undergoing routine tissue processing procedures.

Immunohistochemical staining: The presence of IFN-γ and TNF-α was demonstrated in 5 µm thickness adrenal gland sections from paraffin blocks using the streptavidin-biotin complex method (True, 1990). Rabbit monoclonal IFN-γ (1/500 dilution, Shanghai YL Biotech, YID2791) and rabbit polyclonal TNF-α (1/200 dilution, Abcam, AB-9739) primary antibodies were used for immunohistochemical staining. Histostain Plus (Zymed kit: 85-6743) kit was used as a secondary antibody. Serial sections were dewaxed in xylene and hydrated through graded alcohols. Endogenous peroxidase activity was blocked with H2O2 3% in absolute methanol for 15 min. The sections were rinsed with phosphate buffered saline (PBS, pH 7.2) and subsequently heated in citrate buffer (pH 6) in a microwave oven (700 W) for 10 min for antigen retrieval. After washing with phosphate buffer solution (PBS), sections were incubated with primary antibody at +4 ^{0}C for one night. After brief rinsing, the biotinylated secondary antibody was applied to the sections and incubated in the streptavidin-horseradish peroxidase complex. 3,3' diamino-benzidine (DAB) was used as chromogen and sections were counterstained with haematoxylin for 1 min, rinsed with tap water, and mounted with entellan mounting medium. Primary antibodies were omitted from negative control sections, which were incubated with PBS.

Immunoreactivity density:

After immunohistochemical staining, IFN-γ and TNF-α staining intensity in each cell was analyzed as follows: 0, no immunostaining detected; +/-, weak positive staining present; +, moderate positive staining

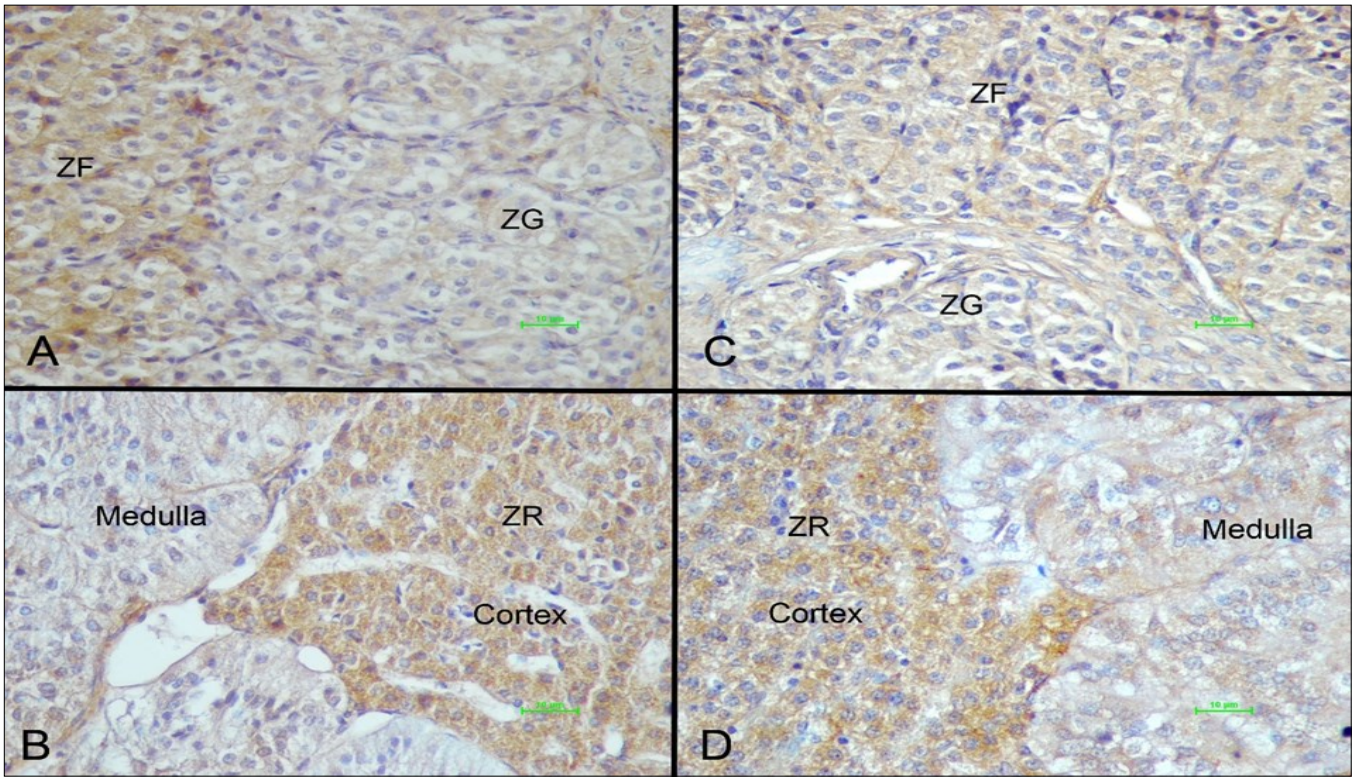


Figure 1. A/B: Control group adrenal gland; C/D: Castration group adrenal gland; Zona Glomerulosa (ZG), Zona Fasciculata (ZF), Zona Reticularis (ZR); expression of IFN-γ, original magnification x40; range bar, 10 µm.

present; ++, strong positive staining present (Platt and Hunt, 1998).

Results

IFN-γ immunohistochemistry: In the analysis of each group, IFN-γ expression was found in the cytoplasm of secretory cells in the adrenal cortex and medulla (Figure 1). There was no significant difference in staining between the two groups in the zona glomerulosa, zona reticularis, and medulla. The zona glomerulosa and medulla were weakly stained, while the zona reticularis was moderately stained. The adrenal glands of the castrated group showed a decrease in IFN-γ expression in the zona fasciculata (Table 1).

Table 1. Immunoreactivity of IFN-γ in histological zones of adrenal glands; +/-, weak positive staining present; +, moderate positive staining present; ++, strong positive staining present.

	Control group	Castration group
Zona Glomerulosa	+/-	+/-
Zona Fasciculata	+	+/-
Zona Reticularis	+	+
Medulla	+/-	+/-

TNF-α immunohistochemistry: A distinct brown staining was seen in the cytoplasm of TNF-α-positive responsive secretory cells (Figure 2). There was a strong expression of TNF-α in the medulla of both groups. TNF-α expression was found to be increased in the zona glomerulosa, zona fasciculata and zona reticularis of the adrenal gland in the castrated group (Table 2).

Discussion

Many pathways connect the immune system with the endocrine and neural systems and integrate the functions of the adrenal glands, gonads, and autonomic nervous systems (González-Díaz et al., 2017). The interaction between the endocrine and immune systems maintains the immune system to function more efficiently (Ortona et al., 2016). TNF-α is known to induce the secretory response of the adrenal cortex by stimulating hypothalamic-pituitary corticotropin-releasing hormone (Judd, 1998). TNF-α contributes to the interaction of the immune system and spermatogenesis by playing a role in communication between Sertoli and germ cells (Miao et al., 2001). IFN-γ is a multifunctional cytokine that acts as an antiviral, anticancer, and immunomodulator. Furthermore, it is critical in the coordination of both innate and adaptive immune responses (Mendoza et al., 2019). IFN-γ activates the immune response and promotes the elimination of pathogens in an inflammatory environment; it also prevents immune system overactivation and tissue damage (Zhang, 2007).

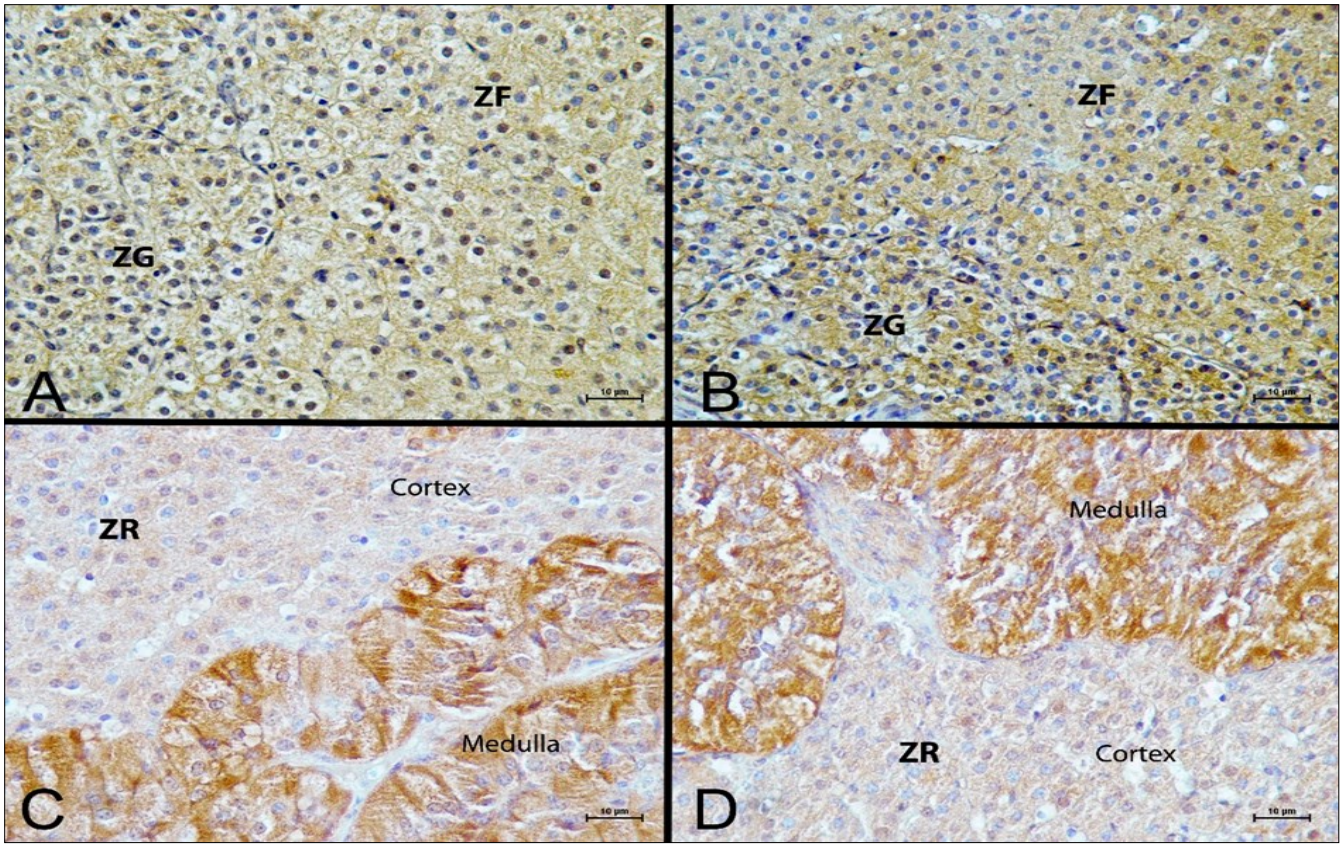


Figure 2. A/C: Control group adrenal gland; B/D: Castration group adrenal gland; Zona Glomerulosa (ZG), Zona Fasciculata (ZF), Zona Reticularis (ZR); expression of TNF-α, original magnification x40; range bar, 10 µm.

Table 2. Immunoreactivity of TNF-α in histological zones of adrenal glands; +/-, weak positive staining present; +, moderate positive staining present; ++, strong positive staining present.

	Control group	Castration group
Zona Glomerulosa	+	++
Zona Fasciculata	+	++
Zona Reticularis	+/-	+
Medulla	++	++

Glucocorticoid hormones are one of the most important anti-inflammatory hormones in the body, and this hormone can also regulate immunity (Bereshchenko et al., 2018). Sex hormones influence both the innate and adaptive immune systems. These hormones act as a transcriptional complex when they bind to their receptors inside cells (Beato and Klug, 2000). Testosterone may modulate the secretion of cytokines from adipose tissue and immune cells to achieve its anti-inflammatory effects (Mohamad et al., 2018). Adrenal cells in the cortex and medulla have been reported to stain intracytoplasmically with IFN-γ (Li et al. 2007). The effects of castration-induced stress on IFN-γ levels have been studied in castrated calves (Fisher et al., 1997) and cattle (Ting et al., 2003). These studies reported no significant difference in IFN-γ levels between castrated animals and the control group. In our study, we observed no significant association between castration and IFN-γ cytokine in the secretory cells of the zona glomerulosa, zona reticularis, or medulla, which is consistent with previous studies. Only the zona fasciculata region of the castrated group showed a decrease in IFN-γ expression. We concluded that the expression of IFN-γ in the adrenal gland of the Ankara goat might be partially affected by castration.

TNF-α has different effects on the adrenal gland depending on the species or developmental stage (Van der Meer et al., 1996). TNF-α is a potent regulator of steroidogenesis and apoptosis in adrenocortical cells (Mikhaylova et al., 2007) and an effective promoter of cell viability (Liu et al., 2004). According to studies, cytokines such as IL-6 and TNF-α influence stress hormone release via direct effects on adrenal cells (Seckl, 2004). TNF-α may act as an important link between the endocrine and immune systems by inhibiting the stimulatory effect on adrenal cells and reducing the synthesis of steroid hormones (Jaattela et al., 1990). Different regulators of adrenal steroids regulate TNF-α expression in different ways. Therefore, it is likely that the cytokine pattern of the adrenal gland changes depending on the physiological situation (Judd et al., 2000). Experimental studies report that TNF-α can inhibit testosterone secretion by modulating the hypothalamic-pituitary-gonadal axis (Norata et al., 2006). TNF-α has been reported to

be expressed by the secretory cells of the zona glomerulosa, zona fasciculata, and zona reticularis in the bovine adrenal gland (Call et al., 2000). TNF-α expression in the prostate of castrated rats is increased according to a study in rats (Jia et al., 2015). Moreover, studies indicated that ovariohysterectomy and estrogen deprivation increased TNF-α expression in response to inflammatory signals (Raehtz et al., 2017). In our study, we observed that TNF-α expression increased in the secretory cells of the zona glomerulosa, zona fasciculata, and zona reticularis in the castrated group. The results of our study on TNF-α expression were similar to those of the previous studies. Taken together, based on the results of this study, we can say that castration increases TNF-α expression in a specific region of the adrenal gland of the Angora goat. Furthermore, we can postulate that castration increases TNF-α expression in secretory cells in the cortex of the Angora goat adrenal gland.

Conclusion

As a result, we observed that androgen hormone deficiency increased TNF-α expression in the adrenal tissue of the Angora goat but did not have a major effect on IFN-γ expression. To our knowledge, this is the first study to investigate the association between TNF-α and IFN-γ cytokines and castration in the adrenal gland of the Angora goat. We anticipate that this research will help future cytokine studies in the adrenal gland and contribute to the literature.

Acknowledgements

The tissue samples used in our study were obtained from the project named “Fattening Performance, Slaughter, Carcass Traits and Some Meat Quality Traits at Different Slaughter Weights of Male and Castrated Angora Goat Kids”. (TAGEM 13/A-07/P-01/04). The authors would like to thank Necmettin ÜNAL and Halil EROL for providing the material of the study.

Financial Support

This research received no grant from any funding agency/sector.

Conflict of Interest

Author has no conflict of interest to declare.

References

Aggarwal, B. B. (2003). Signalling pathways of the TNF superfamily: a double-edged sword. *Nature Reviews Immunology, 3*(9), 745-756.

Beato, M., & Klug, J. (2000). Steroid hormone receptors: an update. *Human Reproduction Update, 6*(3), 225-236.

Bereshchenko, O., Bruscoli, S., & Riccardi, C. (2018) Glucocorticoids, sex hormones, and immunity. *Frontiers in Immunology, 12*, 9:1332.

Blalock, J. E. (1994). The syntax of immune-neuroendocrine communication. *Immunology Today, 15*, 504-511.

Call, G. B., Husein, O. F., McIlmoil, C. J., Adams, A., Heckmann, E. A., & Judd, A. M. (2000). Bovine adrenal cells release IL-6 and tumor necrosis factor in vitro. *General and Comparative Endocrinology, 118*(2), 249-261.

De Metz, J., Sprangers, F., Endert, E., Ackermans, M. T., Ten Berge, I. J. M., Sauerwein, H. P., & Romijn. J. A. (1999). Interferon-g has immunomodulatory effects with minor endocrine and metabolic effects in humans. *Journal of Applied Physiology, 86*(2), 517-522.

Fisher, A. D., Crowe, M. A., O'nualláin, E. M., Monaghan, M. L., Larkin, J. A., O'kiely, P., & Enright, W. J. (1997). Effects of cortisol on in vitro ınterferon-gamma production, acute-phase proteins, growth, and feed intake in a calf castration model. *Journal of Animal Science, 75*(4), 1041-1047.

Gilliver, S. C. (2010). Sex steroids as inflammatory regulators. *The Journal of Steroid Biochemistry and Molecular Biology, 120*(2–3), 105-115.

González-Díaz, S. N., Arias-Cruz, A., Elizondo-Villarreal, B., & Monge-Ortega, O. P. (2017). Psychoneuroimmunoendocrinology: clinical implications. *World Allergy Organization Journal, 10*(1), 19.

Hussain, S., Lawrence, M. G., Taylor, R. A., Lo, CY-W., BioResource, A. P. C., Frydenberg, M., Ellem, S. J., Furic, L., & Risbridger, G. P. (2012). Estrogen receptor β activation impairs prostatic regeneration by inducing apoptosis in murine and human stem/progenitor enriched cell populations. *PLoS One, 7*(7), e40732.

Imura, H., & Fukata, J. (1994). Endocrine-paracrine interaction in communication between the immune and endocrine systems. Activation of the hypothalamic-pituitary-adrenal axis in inflammation. *European Journal of Endocrinology, 130*(1), 32-37.

Isaacs, J. T. (1984). Antagonistic effect of androgen on prostatic cell death. *Prostate, 5*(5), 545-557.

Jaattela, M., Carpen, O., Stenman, U. H., & Saksela, E. (1990). Regulation of ACTH-induced steroidogenesisin human fetal adrenals by rTNF-alpha. *Molecular and Cellular Endocrinology, 68*(2-3), 31-36.

Jia, Y. L., Liu, X., Yan, J. Y., Chong, L., Li, L., Ma, A., Zhou, L., & Sun, Z. (2015). The alteration of inflammatory markers and apoptosis on chronic prostatitis induced by estrogen and androgen. *International Urology and Nephrology, 47* (1), 39-46.

Judd, A. M. (1998). Cytokine expression in the rat adrenal cortex. *Hormone and Metabolic Research, 30*(6-7), 404-410.

Judd, A. M., Call, G. B., Barney, M., McIlmoil, C. J., Balls, A. G., Adams. A., Gustavo. K., & Oliveira, G. K. (2000). Possible function of IL-6 and TNF as intraadrenal factors in the regulation of adrenal steroid secretion. *Annals of the New York Academy of Sciences, 917*, 28-37.

Kanczkowski, W., Sue, M., & Bornstein, S. R. (2016). Adrenal Gland Microenvironment and Its Involvement in the Regulation of Stress-Induced Hormone Secretion during Sepsis. Frontiers in Endocrinology, 14(7), 156.

Kerr, J. B. (2010). Functional histology 2th ed. Australia: Elsevier.

Klein, S. L., & Flanagan K. L. (2016). Sex differences in immune responses. *Nature Reviews Immunology, 16*(10), 626-638.

Li, Q., Zhang, X., Nie, L., Chen, G., Li, H., Zhang, F., Zhang, L., Hong, L., Wang, S., & Wang, H. (2007). Expression of interferon-gamma in human adrenal gland and kidney tumours. *British Journal of Cancer, 97*(3), 420-425.

Liu, J., Li, X. D., Ora, A., Heikkila, P., Vaheri, A., & Voutilainen, R. (2004). cAMPdependent protein kinase activation inhibits proliferation and enhances apoptotic effect of tumor necrosis factor-α in NCI-H295R adrenocortical cells. *Journal of Molecular Endocrinology, 33*(2), 511-522.

Mann-Chandler, M. N., Kashyap, M., Wright, H. V., Norozian, F., Barnstein, B. O., Gingras, S., Parganas, E., & Ryan, J. J. (2005). IFN-gamma induces apoptosis in developing mast cells. *The Journal of Immunology, 175*(5), 3000-3005 .

Mendoza, J. L., Escalante, N. K., Jude, K. M., Bellon, J. S., Su, L., Horton, T. M., Tsutsumi, N., Berardinelli, S. J., Haltiwamger, R. S., Piehler, J., Engleman, E. G., & Garcia, K. C. (2019). Structure of the IFN-γ receptor complex guides design of biased agonists. *Nature, 567,* 56-60.

Metcalfe, D. D., Peavy, R. D., & Gilfillan, A. M. (2009). Mechanisms of mast cell signaling in anaphylaxis. *The Journal of Allergy Clinical Immunology, 124*(4), 639-646.

Miao, J., Panesar, N. S., Chan, K. T., Lai, F. M., Xia, N., Wang, Y., Johnson, P. J., & Chan, J. Y. (2001). Differential Expression of a Stress-modulating Gene, BRE, in the Adrenal Gland, in Adrenal Neoplasia, and in Abnormal Adrenal Tissues. *The Journal of Histochemistry and Cytochemistry, 49*(4), 491-499.

Mikhaylova, I. V., Kuulasmaa, T., Jaaskelainen, J., & Voutilainen, R. (2007). Tumor Necrosis Factor-α Regulates Steroidogenesis, Apoptosis, and Cell Viability in the Human Adrenocortical Cell Line NCI-H295R. *Endocrinology, 148(*1), 386-392.

Mohamad, N. V., Wong, S. K., Hasan, W. N. W., Jolly, J. J., Nur-Farhana, M. F., Ima-Nirwana, S., & Chin, K. Y. (2018). The relationship between circulating testosterone and inflammatory cytokines in men. *The Aging Male*, 22(2), 129-140.

Norata, G. D., Tibolla, G., Seccomandi, P. M., Poletti, A., & Catapone, A. L. (2006). Dihydrotestosterone decreases tumor necrosis factor-a and lipopolysaccharide-induced inflammatory response in human endothelial cells. *The Journal of Clinical Endocrinology and Metabolism. 91*(2), 546-554.

Ortona, E., Pierdominici, M., Maselli, A., Veroni, C., Aloisi, F., & Shoenfeld, Y. (2016). Sex-based differences in autoimmune diseases. *Annali dell'Istituto Superiore di Sanità, 52*(2), 205-212.

Parameswaran, N., & Patial, S. (2010). Tumor necrosis factor-α signaling in macrophages. Critical Reviews in Eukaryotic *Gene Expression, 20*(2): 87-103.

Platt, J. S., & Hunt, J. S. (1998). Interferon-γ gene expression in cycling and pregnant mouse uterus: temporal aspects and cellular localization. *Journal of Leukocyte Biology, 64,* 393-400.

Raehtz, S., Bierhalter, H., Schoenherr, D., Parameswaran, N., & McCabe, L. R. (2017). Estrogen deficiency exacerbates type 1 diabetes–induced bone tnf-α expression and osteoporosis in female mice. *Endocrinology, 158*(7), 2086 -2101.

Ross, M. H., & Pawlina, W. (2016). *Histology a Text and Atlas With Correlated Cell and Molecular Biology 7th ed.* China: Wolters Kluwer Health.

Seckl, J. R. (2004). 11 b-hydroxysteroid dehydrogenases: changing glucocorticoid action. *Current Opinion in Pharmacology, 4*(6), 597-602.

Schroder, K., Hertzog, P. J., Ravasi, T., & Hume, D. A. (2004). Interferon-gamma: an overview of signals, mechanisms and functions. *Journal of Leukocyte Biology, 75*(2), 163-189.

Teixeira, L. K., Fonseca, B. P., Barboza, B. A., & Viola, J. P. (2005). The role of interferon-gamma on immune and allergic responses. *Memórias do Instituto Oswaldo Cruz, 1*, 137-144.

Ting, S. T. L., Earley, B., Hughes, J. M. L., & Crowe, M. A. (2003). Effect of ketoprofen, lidocaine local anesthesia, and combined xylazine and lidocaine caudal epidural anesthesia during castration of beef cattle on stress responses, ımmunity, growth, and behavior. *Journal of Animal Science, 81*(5), 1281-1293.

True, L. D. (1990). *Principles of immunohistochemistry*, New York: Gower Medical Publishing.

Van der Meer, M. J., Sweep, C. G. J., Rijnkels, C. E. M., Pesman, G. J., Tilders, F. J. H., Kloppenborg, P. W. C., & Hermus, A. R. (1996). Acute stimulation of the hypothalamic-pituitary-adrenal axis by IL-1, TNF-α and IL-6: a dose response study. Journal *of Endocrinological Investigation, 19*(3), 175-182.

Wang, F., Zhang, S., Jeon, R., Vuckovic, I., Jiang, X., Lerman, A., Folmes, C. D., Dzeja, P. D., & Herrmann, J. (2018). Interferon Gamma Induces Reversible Metabolic Reprogramming of M1 Macrophages to Sustain Cell Viability and Pro-Inflammatory Activity. *EBioMedicine, 30,* 303-316.

Young, B., Lowe, J. S., Stevens, A., & Heath, J. W. (2006). *Wheater's functional histology a text and colour atlas 5th ed. China:* Churchill Livigstone Elsevier.

Zhang, J. (2007). Yin and yang interplay of IFN-γ in inflammation and autoimmune disease. *The Journal of Clinical Investigation, 117*(4), 871–873.

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

A Research on some socio-demographic characteristics of companion animal veterinarians and economic structures of companion animal clinics in Istanbul *

Canberk BALABAN[1**] Halil GÜNEŞ[1]

1. Istanbul University-Cerrahpaşa, Büyükçekmece Campus, Faculty of Veterinary Medicine, Department of Animal Breeding and Husbandry, 34500 Büyükçekmece-Istanbul, Turkey.
Balaban, C.: ORCID: 0000-0001-7510-7724; Güneş, H.: ORCID: 0000-0002-4154-7104.

Research Article
Volume: 5, Issue: 2
August 2021
Pages: 72-86

ABSTRACT

Having a pet has become an important phenomenon in recent years and Istanbul stands out as the largest market. The aim of the study is to shine a spotlight on both the veterinarians working in this field and the students who plan to work by examining the economic status of clinics and the socio-demographic structures of veterinarians in Istanbul. Studies were conducted mostly face-to-face in 225 clinics between April 2019 and April 2021. The questionnaires were sent to a small number of veterinarians via e-mail. The first findings were that 42.4% and 63.6% of the mean age of the clinicians are male and the majority were Istanbul University graduates with 77.3%. Vast majority had a negative attitude towards the opening of new faculties (24.9% Bad - 75.1% Very Bad), and the majority (79.1%) had a negative attitude towards the provision of veterinary medicine education in foundation universities. According to the study, for the year 2020 the average monthly earning was 17618 TL (2499 USD) and 28.4% were less than 10000 TL (1418 USD). The largest income item was vaccination with 28.8%, and the largest expense item was drug expenditures with 23.9%. It had been determined that the average rental price paid was 9569 TL (1357 USD). According to the results, the average annual expenditure was 2822 TL (400 USD) for cats and 4516 TL (641 USD) for dogs. In addition, the annual average uncollectible receivables per clinic has been determined as 28444 TL (4034 USD), which meant a large loss of approximately 21 million TL (approx. 3 million USD) on a provincial basis. In general, the research concluded that veterinarians were satisfied with their professions with deficiencies in basic business information and could spend little time on their social lives due to long hours of work. From this point of view, it is of utmost importance to regulate the working conditions and to increase education programs in business matters during university year and beyond.

Keywords: veterinary medicine, management, income, cost, economics

Article History
Received: 07.07.2021
Accepted: 03.08.2021
Available online: 25.08.2021

DOI: https://doi.org/10.30704/http-www-jivs-net.942018

To cite this article: Balaban, C., Güneş H. (2021). Effects A Research on some socio-demographic characteristics of companion animal veterinarians and economic structures of companion animal clinics in Istanbul . ***Journal of Istanbul Veterinary Sciences, 5*(2),** 72-86. **Abbreviated Title*: J. İstanbul vet. sci.***

*This study was prepared from a part of the data obtained from the first author's doctoral thesis titled "Some Socio-Demographic Parameters of Companion Animals Veterinary Medicine in Turkey and Technical and Economic Analysis of The Clinics".

Introduction

The relationship between pets and their owners is both unique and two-way. While their owners give love and compassion to cats and dogs, cats and dogs respond with love, commitment, peace, and health. Studies in this direction have shown that having a pet has many benefits such as increasing the amount of physical activity and accordingly reducing stress (Harvard Medical School, 2014), providing an active lifestyle and maintaining a healthy body structure (Ratschen et al., 2020), contributing to the emotional development process with the ability of children to empathize (Vidovic et al., 1999) and reducing the rates of developing certain chronic diseases such as allergic rhinitis (Hesselmar et al., 1999). Due to these and

**Corresponding Author: Canberk Balaban
E-mail: canberkbalaban@gmail.com

Journal home page: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net

some other similar benefits there have been recent increases in cat and dog adoption worldwide, and in parallel with this increase, the pet sector is growing in commercial volume. The commercial volume in the pet sector reached a high point of 223 billion dollars in 2019, and it is seen that the United States has the largest share in this large business volume with 95.8 billion dollars (Global Market Insights, 2020).

The pet sector breaks down into 4 sub-basic groups as Food - Drug/Vaccine - Nutrition Support and Other Services. The biggest share within the categories belongs to pet foods. Drugs and vaccines are in the second place and nutritional support products are in the third place. Other services including training, pension, insurance, etc. are in the fourth place. The structure of the pet industry in the United States also reflects this ranking. Pet food ranks first in the United States market with 39%. The drug-vaccine category ranks second (31%), nutrient-support products rank third (20%) and other services rank fourth (11%) (APPA, 2020).

The pet sector has also developed in Turkey in recent years in parallel with the development worldwide and has reached a size of approximately 2 billion dollars with an average growth rate of 15% every year (HEKTAŞ, 2018). In parallel with commercial growth, cat-dog ownership also shows a continuous increase. According to the report published by the European Pet Food Industry Association in 2016, there are 4.3 million owned cats and dogs in Turkey, 3.2 million of which are cats and 1.1 million of which are dogs (FEDIAF, 2016). According to the report in 2020, the total number of cats and dogs reached 5 million, 3.8 million for cats and 1.2 million for dogs (FEDIAF, 2020). As the reports show, the total number of cats and dogs in Turkey increased by 16% between 2016 and 2020.

According to the statistics of the Ministry of Agriculture and Forestry, there are a total of 7915 ministry licensed enterprises throughout Turkey (Ministry of Agriculture and Forestry, 2021a), 749 of which are located in Istanbul (Ministry of Agriculture and Forestry, 2021b). Considering that clinics in Istanbul mostly serve companion animals and there are around 1,700 pet clinics in Turkey, the importance of Istanbul for the sector is clearly evident. For this reason, Istanbul province has been selected as the research area.

Although pet clinics were established mainly to provide diagnostic, treatment and care services, they are also commercial enterprises and establishing a business has economic and social purposes such as having an independent business, providing profit, serving the consumer and the public, and reducing unemployment (Kaygısız and Akdağ, 2004). For this reason, this study aims to analyse the socio-demographic characteristics of veterinarians working on companion animals in Istanbul and to evaluate the economic structures of the clinics with various parameters.

Materials and Method

The material of the research consists of the data collected and processed in computer environment through a questionnaire from veterinary clinics working exclusively for companion animals established in Istanbul.

Simple Random Sampling method was used in the selection of clinics to be surveyed. Simple random sampling is the selection of an "*n*" unit sample from an "*N*" unit main mass by giving an equal chance to all "*n*" unit samples (Orhunbilge, 2000). In this study, in random selection, the main mass is considered as a whole and is not divided into a certain group and clusters. Sample size represents around 30% of respective market.

Microsoft Office Excel 2010 and IBM SPSS Statistics 22 for Windows programs were used for data processing and analysis, and since the study is descriptive, the results are presented as frequency distribution, ratios, and graphics.

In the analysis of the survey results, arithmetic mean method was used in general. Before calculating the averages of the answers to the grouped questions, frequency tables were created and their averages were calculated over the frequencies with the midpoints of the ranges. The incidence of an observation value or measurement result within observation units is determined as the frequency of this value. In frequency tables, frequencies for one or several variables are presented in a structured manner (Evrim and Güneş, 2000; Demir, 2017).

While converting all respective data from Turkish Lira to United States Dollar The Central Bank of the Republic of Turkey records were used. Average USD foreign exchange rate was 7,05 TL during the period that study was conducted, between April 2019 – April 2021.

Results

Using the data obtained from 225 pet veterinary clinics in Istanbul participating in the study, the findings are given below in titles according to the subjects examined in the questionnaire.

1. Age distribution: Within the scope of the study, the average age of veterinarians working for companion animals in Istanbul was calculated as 42.4 years old; the youngest veterinarian was 25 years old and the oldest veterinarian was 60 years old.

Table 1. Average age of veterinarians in Istanbul (Year)

n	Mean	SD	Min.	Max.	Med.
225	42.4	7.17	25.0	60.0	43.0

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median

Table 2. Age groups and distribution of veterinarians

Age Range	Frequency	Percent (%)
Age 25 - 30	13	5.8
Age 31 - 40	60	26.7
Age 41 - 50	126	56.0
Age 51 and above	26	11.5

2. Gender distribution: According to results, 63.6% of the veterinarians in the participating clinics are male and 36.4% are female.

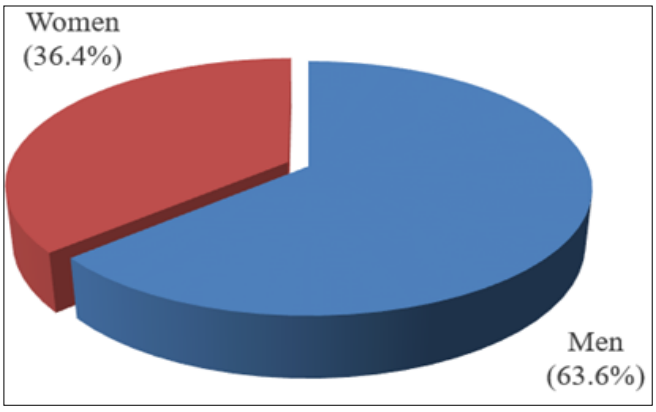


Figure 1. Gender distribution of veterinarians.

3. Marital status: According to results, 88.9% of the veterinarians participating in the study are married and 11.1% are single.

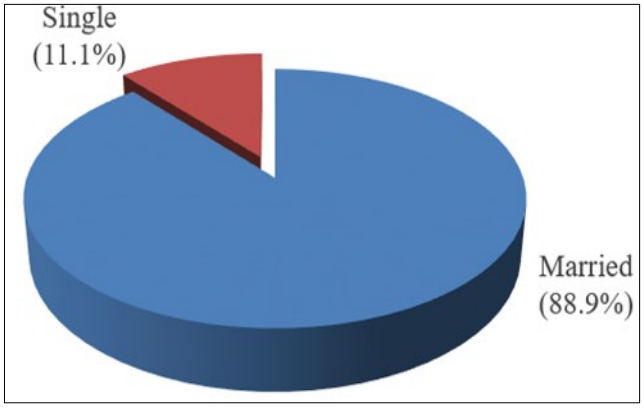


Figure 2. Marital status of veterinarians.

4. University status: Data obtained shows that 77.3% of the veterinarians who participated in the study and worked in the clinics in Istanbul are graduates of Istanbul University. Ankara University ranks second with 11.6%.

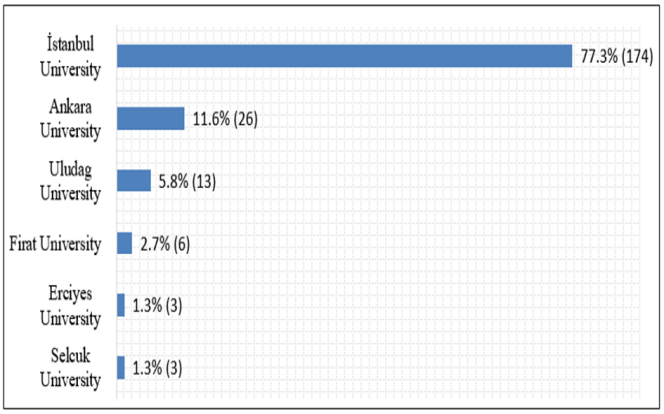


Figure 3. University status.

5. Experience status: The average duration of experience of the veterinarians participating in the study was found to be 17.1 years. The least experienced veterinarian has been in the profession for 3 years and the most experienced veterinarian has been in the profession for 35 years.

Table 3. Experience status of veterinarians (Year).

n	Mean	SD	Min.	Max.	Med.
225	17.1	7.68	3.0	35.0	18.0

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median

Table 4. Experience groups of veterinarians (Year).

Experience	Frequency	Percent (%)
0-5 years	20	8.9
6-10 years	38	16.9
11-20 years	94	41.8
20-30 years	68	30.2
31 years and more	5	2.2

6. Educational status : According to results, 84.9% of the veterinarians who participated in the study completed their faculty, 14.2% completed their doctoral education, and 0.9% started working in the clinic after their academic studies.

Table 5. Educational groups and distribution of veterinarians.

Educational Status	Frequency	Percent (%)
DVM	191	84.9
Doctorate	32	14.2
Academician	2	0.9

7. In which order the faculty they graduated is seen : Results shows that 16.9% of the veterinarians who participated in the study stated that they evaluated the faculty they graduated from at the top, 31.5% above the middle and 37.8% at the highest level.

Table 6. In which order the graduated faculty is seen

Order	Frequency	Percent (%)	Cumulative Percent (%)
At the top	38	16.9	16.9
Above Middle	71	31.5	48.4
Middle	85	37.8	86.2
Below Middle	31	13.8	100.0
Total	225	100.0	

8. Recommendation status of the faculty they graduated : According to data obtained 56.5% of the veterinarians who participated in the study stated that they recommended the faculty they graduated from and 17.3% stated that they would not recommend it.

Table 7. Recommendation status of faculty they graduated

Recommendation	Frequency	Percent (%)	Cumulative Percent (%)
Yes	127	56.5	56.5
No	39	17.3	73.8
Undecided	59	26.2	100.0
Total	225	100.0	

9. Communication status of with the academic members and assistants of the faculty : According to results, 16.0% of the veterinarians who participated in the study stated that they were in constant communication with the faculty members and assistants in the faculty they graduated from, and some of them (16.4%) stated that they had no communication at all (Table 8).

Table 8. Communication status of with the academic members and assistants of the faculty.

Contact	Frequency	Percent (%)	Cumulative Percent (%)
Continuous	36	16.0	16.0
Occasionally	61	27.1	43.1
Rarely	91	40.5	83.6
Never	37	16.4	100.0
Total	225	100.0	

10. Thoughts on the impact of increasing the number of faculties on the quality of education : Results show that 24.9% of the veterinarians participating in the study stated that opening new faculties would be a bad improvement on the quality of education and 75.1% stated that it would be a very bad development (Table 9).

Table 9. The impact of increasing the number of faculties on the quality of education.

Impacts	Frequency	Percent (%)
Very Good	0	0
Good	0	0
Poor	56	24.9
Very Poor	169	75.1
Neutral	0	0
Total	225	100.0

11. Thoughts on the impact of opening faculties in foundation Universities on quality of education : According to results, 16.9% of the veterinarians participating in the study stated that opening new faculties in foundation universities would be a bad development and 79.1% stated that it would be a very bad development.

Table 10. Impact of opening faculties in foundation universities on the quality of education.

Impacts	Frequency	Percent (%)	Cumulative Percent (%)
Very Good	0	0	0
Good	4	1.8	1.8
Poor	38	16.9	18.7
Very Poor	178	79.1	97.8
Neutral	5	2.2	100.0
Total	225	100.0	

12. Willingness to work in a pet clinic before graduation : According to data obtained 78.7% of the veterinarians participating in the study stated that they wanted to work on companion animals before graduating from the faculty.

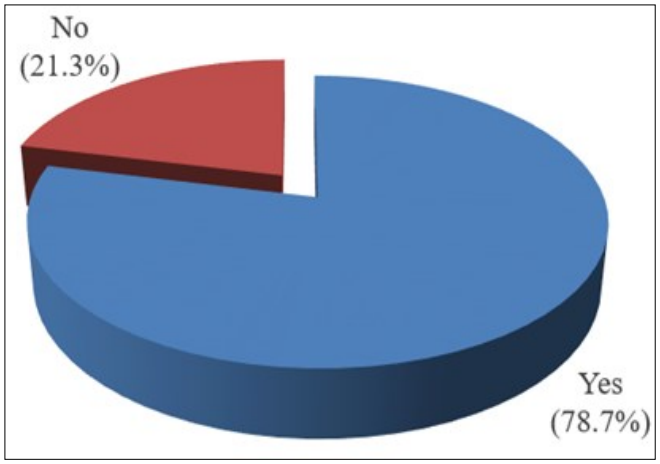


Figure 4. Willingness to work in a pet clinic before graduation.

13. The first sector after graduation: Results show that 68.0% of the veterinarians who participated in the study stated that they started working in the pet clinic after graduation.

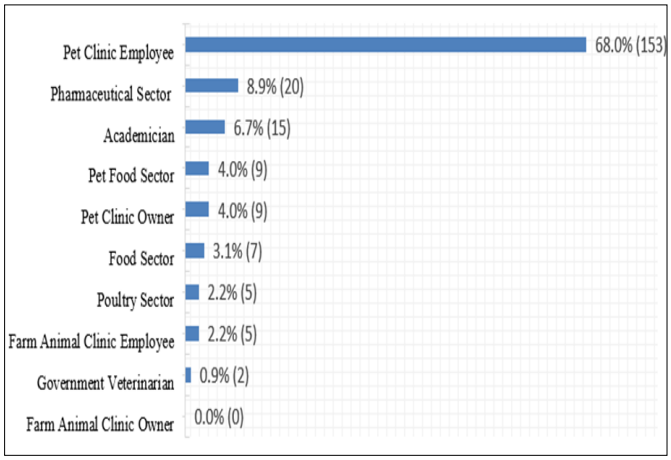


Figure 5. The first sector after graduation.

14. Initial employment time after graduation : As a result of the research, it was determined that veterinarians started working 3.8 months after graduation on average.

Table 11. Initial employment time after graduation (Month).

n	Mean	SD	Min.	Max.	Med.
225	3.8	5.27	0	48	2.00

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median

15. Wage on the first employment: It was determined that 70.2% of the veterinarians who participated in the study stated that they started their first job with chambers' minimum wage after graduation.

Table 12. Wage on the first employment.

First salary	Frequency	Percent (%)	Cumulative Percent (%)
Chamber Minimum Wage	158	70.2	70.2
Double/Twice Chamber Minimum wage	44	19.6	89.8
More	23	10.2	100.0
Total	225	100.0	

16. Job satisfaction status : The majority of veterinarians who participated in the study stated that they were satisfied with their profession. Only 3.1% said they were dissatisfied.

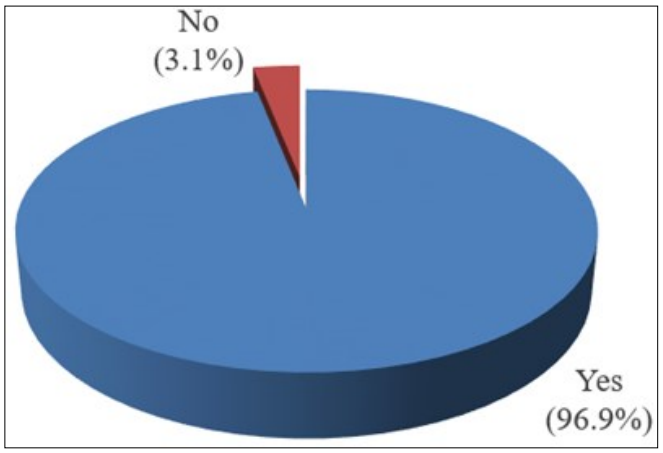


Figure 6. Job satisfaction status –general.

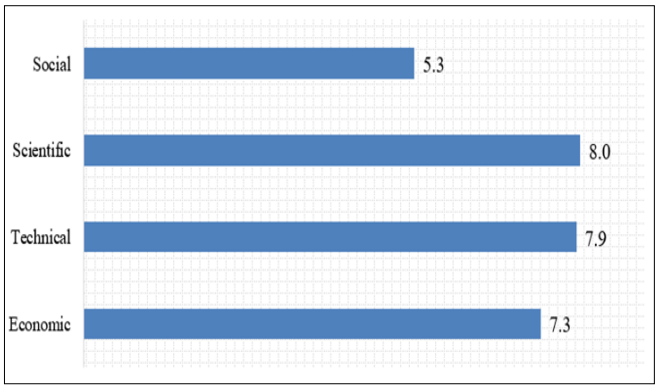


Figure 7. Job satisfaction status of veterinarians – Satisfaction level over 10 points

17. Status of recommending veterinary medicine : The vast majority of veterinarians who participated in the study reported that they recommended being veterinarian.

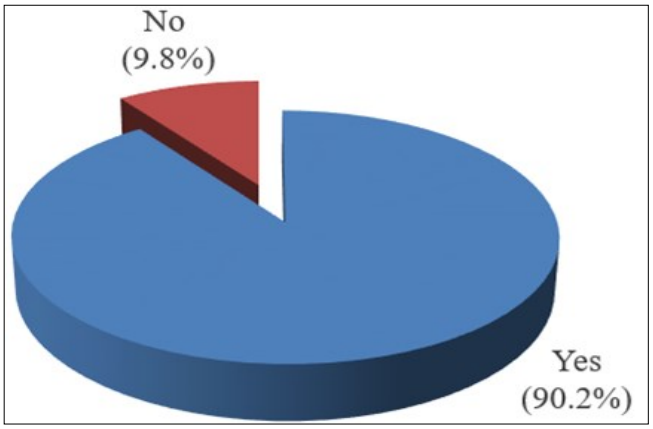


Figure 8: Status of recommending veterinary medicine

18. Status of recommending veterinary medicine for companion animals : Results show that 79.1% of the veterinarians participating in the study reported that they recommended being companion animal clinician.

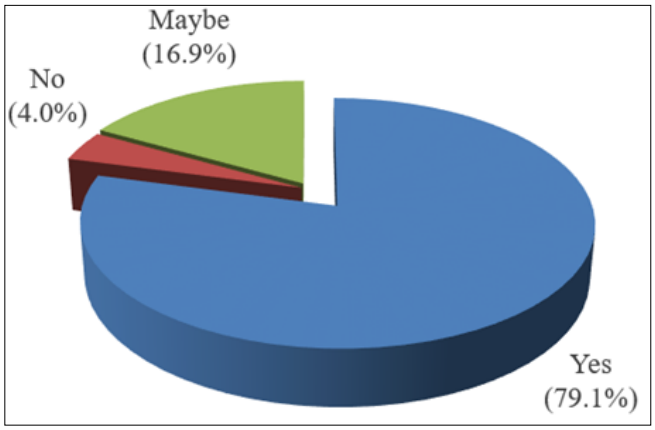


Figure 9: Status of recommending veterinary medicine for companion animals.

19. Reason for choosing veterinary medicine : According to results 68.9% of the participants stated that they chose veterinary medicine due to job satisfaction.

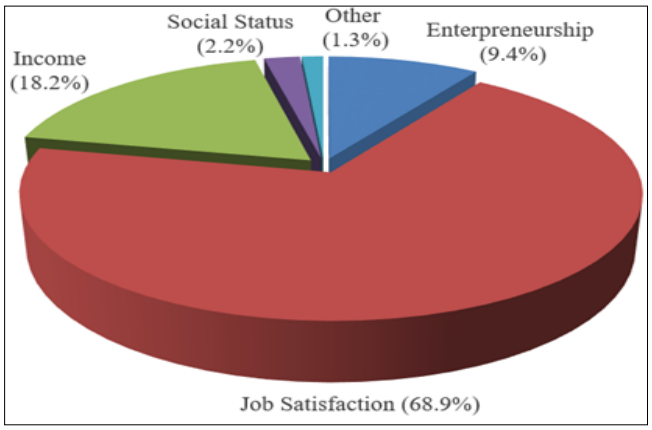


Figure 10. Reason for choosing veterinary medicine

20. Reason for choosing to work as companion animal clinician in veterinary medicine profession : It was determined that 57.4% of the veterinarians who participated in the study reported that they chose this form of work because they wanted to be a pet clinician.

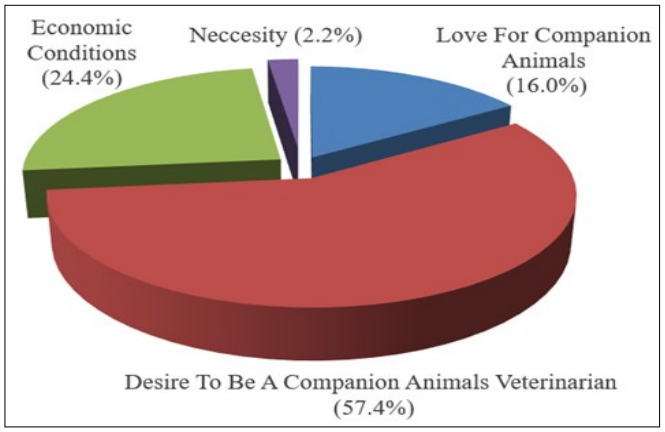


Figure 11. Reason for choosing companion animal clinician in veterinary medicine.

21. Status of choosing veterinary medicine again in occupational selection : Results show that 76.4% of the veterinarians who participated in the study stated that they would choose veterinary medicine again as a profession if they had to make a decision now.

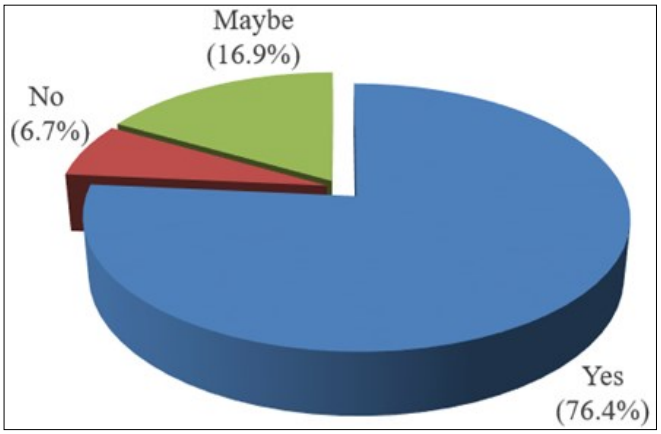


Figure 12. Status of choosing veterinary medicine again in occupational selection.

22. Daily working hours : The average daily working hours of the veterinarians participating in the study is 10.5 hours.

Table 13. Daily working hours.

n	Mean	SD	Min.	Max.	Med.
225	10.5	1.33	7.0	12.0	10.00

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median

23. Being able to spare time to private life : Only 7.6% of the veterinarians who participated in the study stated that they could always spare enough time for their private lives, while 33.3% stated that they could not spare any time.

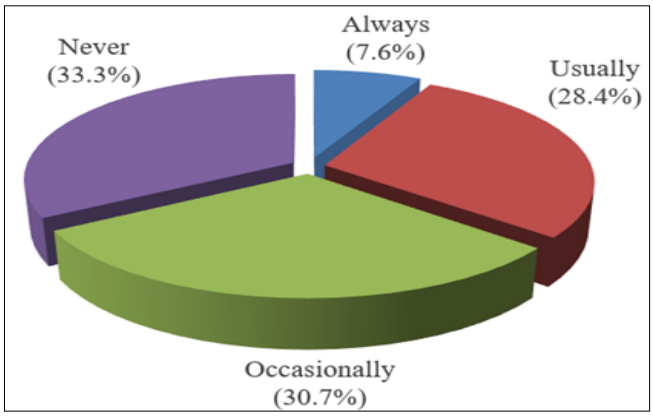


Figure 13. Being able to spare time to private life.

24. Solidarity with other veterinarians and clinics in the region : According to results, 57.7% of the veterinarians participating in the study stated that there was a weak solidarity between other clinics and veterinarians.

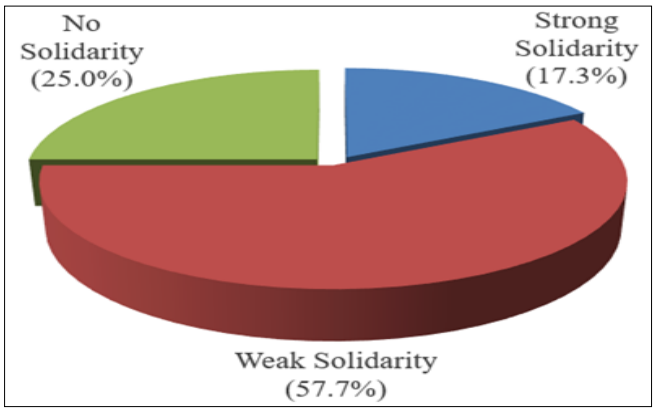


Figure 14. Solidarity status.

25. Future status of veterinary medicine : Results show that 40.9% of the veterinarians who participated in the study stated that the status of the profession would be moderate in the future.

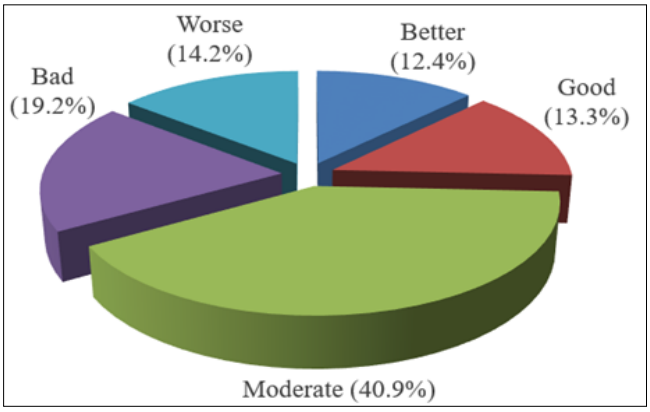


Figure 15. Future status of veterinary medicine.

26. Participation in occupational organizations : According to data obtained 78.2% of the veterinarians participating in the study stated that they participated in the organizations held. The most frequently attended organizations are organized by associations with 33.0%.

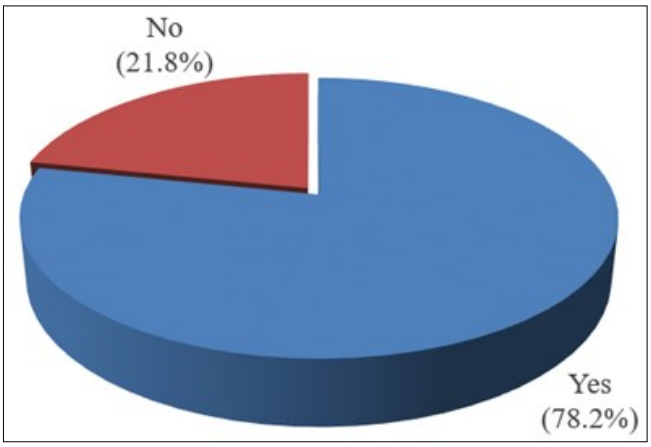
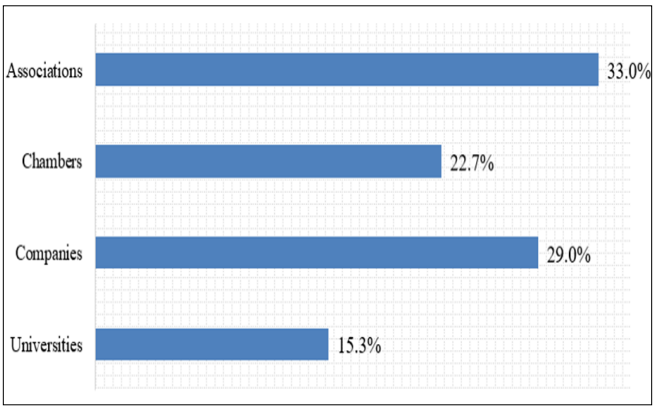


Figure 16. Participation in occupational organizations

Figure 17. Distribution of participation in organizations held.



27. Benefits of occupational organizations : Results show that 50.4% of the veterinarians participating in the study stated that they think that the most important benefit of the occupational organizations is occupational education.

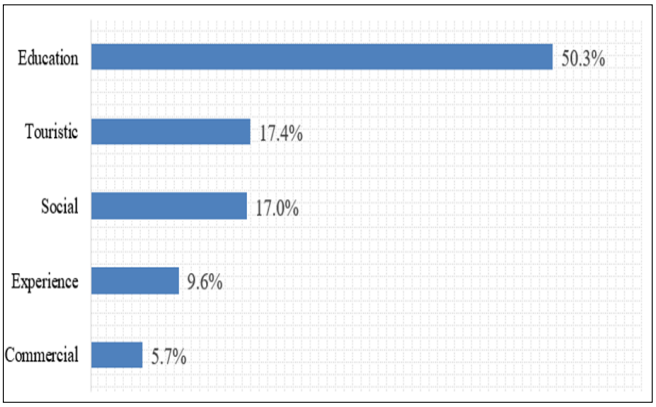


Figure 18. Benefits of occupational organizations.

28. Scientific and professional publications followed regularly : Only 17.8% of the veterinarians participating in the study stated that they regularly follow scientific or professional publications.

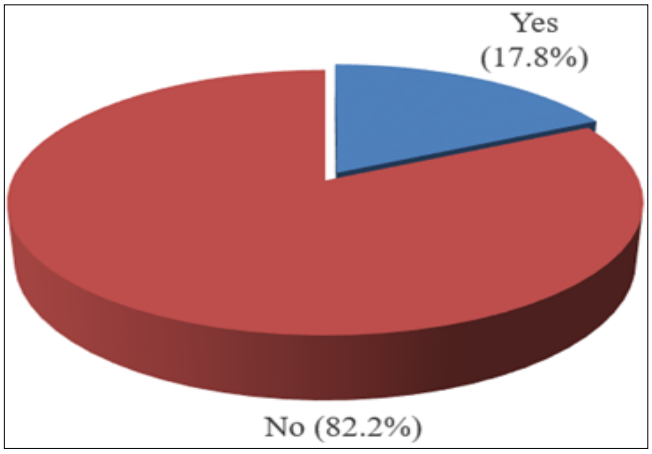


Figure 19. Regular scientific and professional publication follow-up rate.

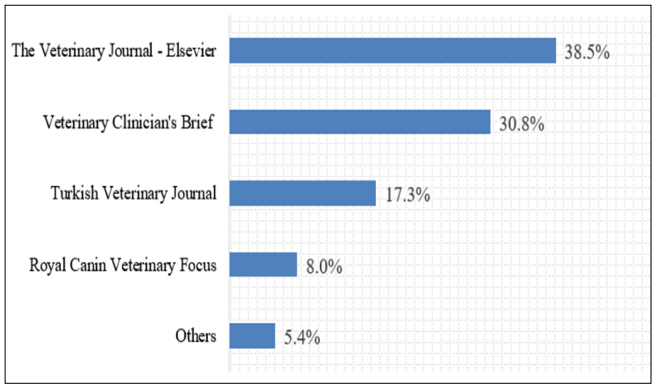


Figure 20. Distribution of regularly followed scientific and professional publications.

29. Number of employees : As a result of the study, it was determined that an average of 2.3 veterinarians and 0.8 veterinary technicians/technicians worked in the clinics. Average total number of employees is 4.8.

Table 14. Number of employees.

Group	*n*	Mean	SD	Min.	Max.	Med.
Veterinarian	225	2.3	1.55	1.0	9.0	2.0
Technician	225	0.8	0.85	0.0	4.0	1.0
Total	225	4.8	4.29	1.0	25.0	4.0

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median

30. Service status outside the clinic : At the end of the study, it was determined that 69.8% of the clinics also served outside the clinic.

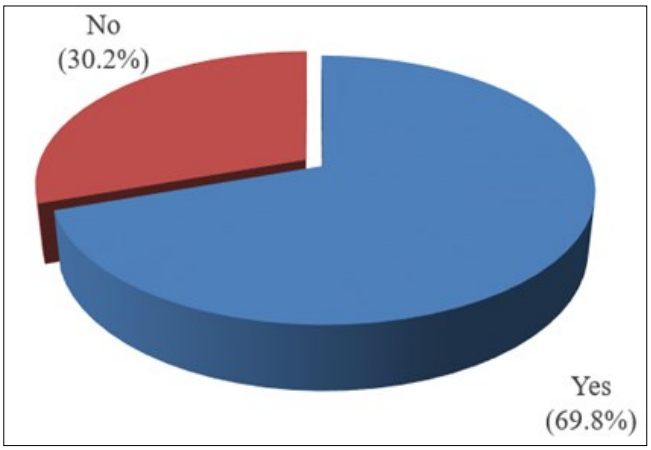


Figure 21. Service status outside the clinic.

31. Preferability criteria of clinics : According to results 66.7% of the veterinarians participating in the study stated that the criterion that the patient owners attach the most importance to when choosing clinics was the reference. The closeness of the clinic is the second criterion with a rate of 20.4%.

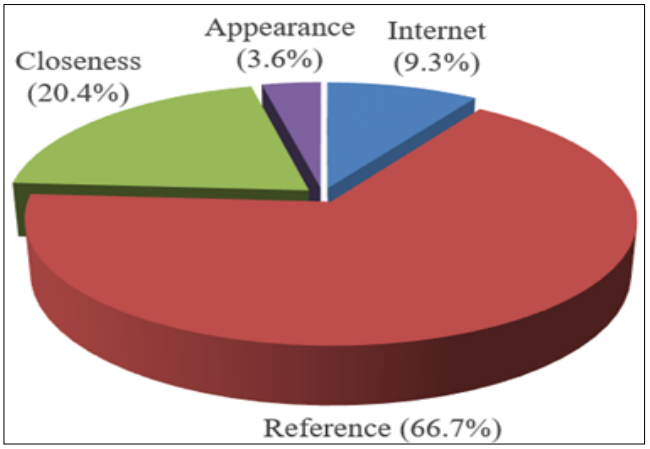


Figure 22. Preferability criteria of clinics.

32. Annual expenditure amounts of patients: The veterinarians who participated in the study stated that the average annual expenditure of the patients was 2822 TL (400 USD) for cats and 4516 TL (641 USD) for dogs

Table 15. Annual expenditures of patients brought to the clinic (TL).

Group	*n*	Mean	SD	Min.	Max.	Med.
Cat	225	2822	611.9	1500	5000	2500
Dog	225	4516	967.5	2500	7000	4500

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median.
Average USD FX rate was 7,05 TL during the period that study was conducted.

33. Monthly net earnings: The average monthly earnings of the veterinarians participating in the study were calculated as 17618 TL (2499 USD). In this study reported 86.7% of veterinarians an average monthly income of less than 30000 TL (426 USD).

Table 16. Monthly net earnings (TL).

Income Range	Frequency	Percent (%)	Median	Frequency* Median
0 - 10000	64	28.4	5000	320000
11000 - 20000	67	29.9	15000	1005000
21000 - 30000	64	28.4	25000	1600000
31000 - 40000	20	8.9	35000	700000
41000 - +	10	4.4	45000	450000
Average Monthly Earnings			17618	

Average USD FX rate was 7,05 TL during the period that study was conducted.

34. Monthly average rent paid : With the study, it was determined that 217 of 225 clinics paid an average monthly rent of 9569 TL (1357 USD) to their clinics as lessee.

Table 17. Monthly average paid rent (TL).

Rental Range	Frequency	Percent (%)	Median	Frequency* Median
0 - 5000	54	24.9	2500	135000
6000 - 10000	106	48.8	8000	848000
11000 - 20000	44	20.3	15500	682000
21000 - 30000	5	2.3	25500	127500
31000 - 40000	8	3.7	35500	284000
Average Month Lease			9569	

Average USD FX rate was 7,05 TL during the period that study was conducted

35. Distribution of income and expense items : The clinics participating in the study reported that the biggest income item was vaccination applications (28.8%) and the biggest expense item was medicine expenses (23.9%).

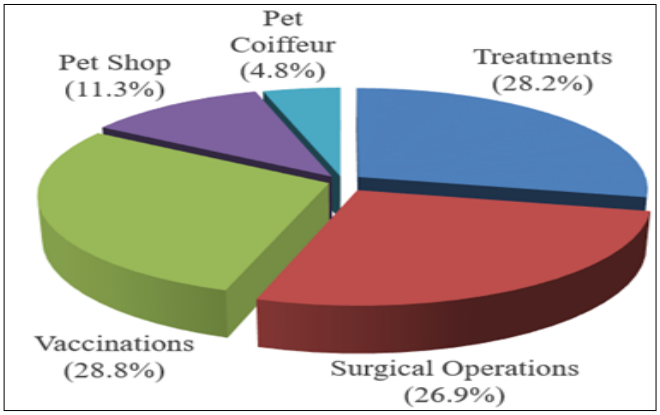


Figure 23. Distribution of income items.

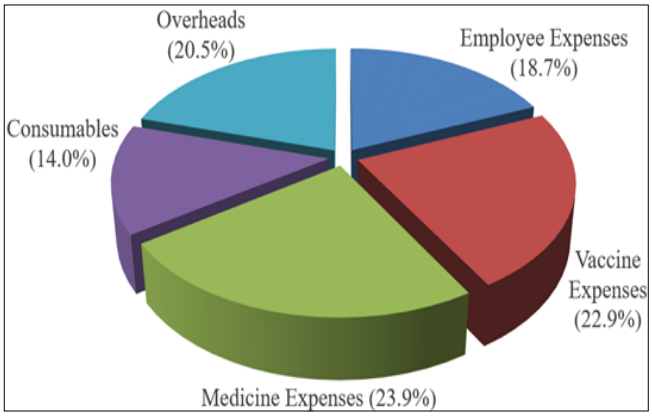


Figure 24. Distribution of expense items.

36. Medical devices in the clinic and total value : As a result of the research, it was determined that all clinics had microscopic examination set and 95% had X-ray units. The average value of medical devices in clinics is 287422 TL (40770 USD).

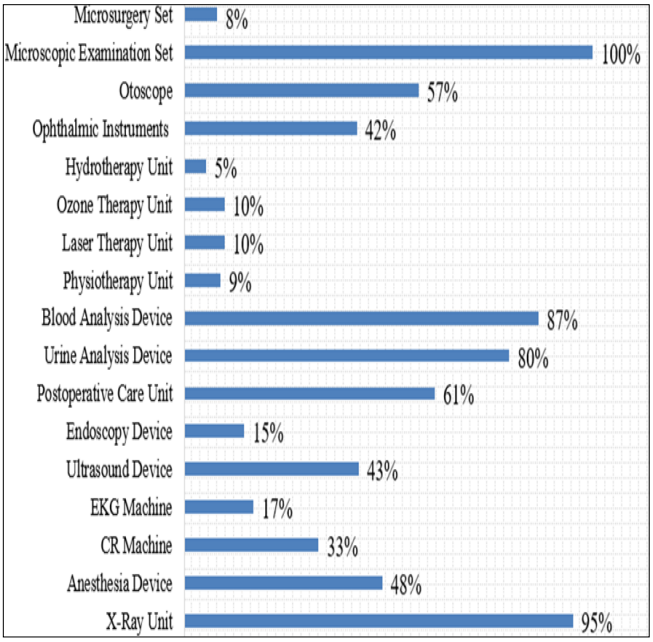


Figure 25. Ratios of medical devices found in clinics.

Table 18. Total value of medical devices in clinics (TL).

n	Mean	SD	Min.	Max.	Med.
225	287422	351904.9	75000	2500000	200000

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median.
Average USD FX rate was 7,05 TL during the period that study was conducted.

37. Rental medical device status : It has been determined that only 2.0% of the clinics have medical devices for hire.

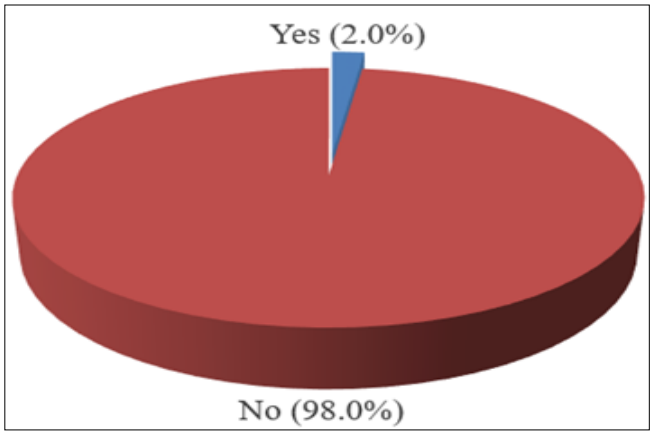


Figure 26. Rental medical device status.

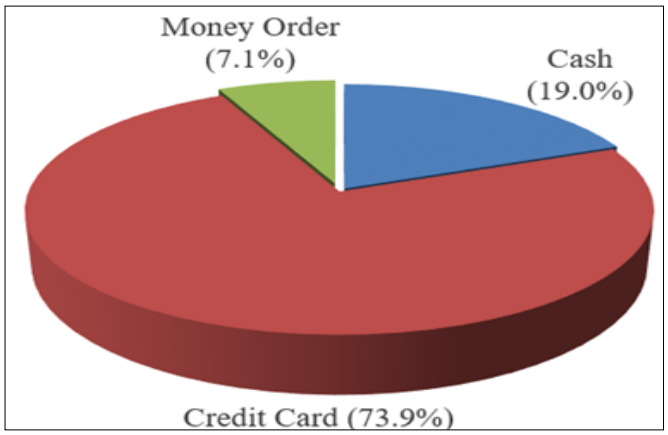


Figure 29. Collection methods.

38. Collection status of the requested fee for the service provided : The veterinarians who participated in the study reported that 73.0% of them usually collected the fee they demanded for the service they provided.

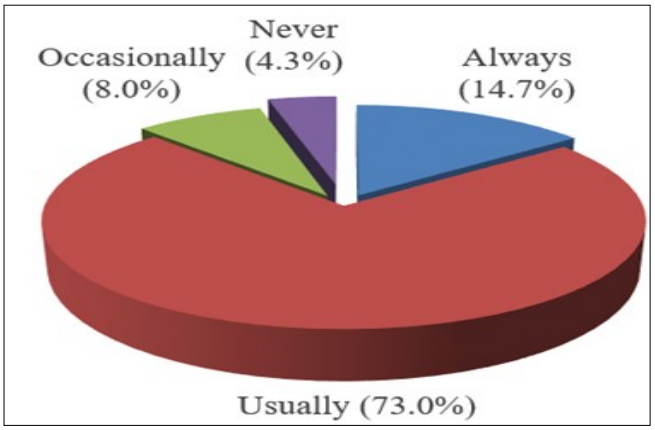


Figure 27. Collection status of the requested fee

39. Payment and collection method preferences : With the research, it was determined that the clinics made their payments with a credit card at the rate of 47.2% and their receivables were collected with a credit card at the rate of 73.9%.

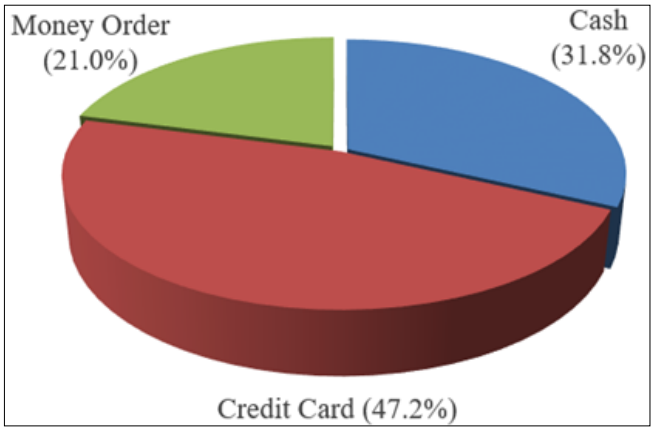


Figure 28. Payment methods.

40. Uncollected receivables : With the research, it has been determined that clinics have uncollected receivables of 28444 TL (4034 USD) on average annually.

Table 19. Average annual amount of uncollected receivables (TL).

n	Mean	SD	Min.	Max.	Med.
225	28444	19388.6	0	80000	25000

SD = Standard deviation, Min = Minimum, Max = Maximum
Med = Median.
Average USD FX rate was 7,05 TL during the period that study was conducted.

Discussion

According to the results of the demographic study, the mean age of the veterinarians who serve companion animals in Istanbul was determined as 42.4 years. In the United States, the average age is 44.3 years and is in parallel with the situation in Turkey (Data USA, 2018). In parallel with the average age in the study, 56% of veterinarians are between the ages of 41-50. The youngest clinic owner is 25 and the oldest clinic owner is 60 years old. 88.9% of veterinarians in Istanbul are married and 63.6% are male and 36.4% are female. In an another study conducted in Ankara in 2010, 71.9% of veterinarians were male and 28.1% were female (Aral et al., 2010). From this point of view, it is important that the rate of female veterinarians has increased.

When the universities graduated from the veterinarians in the clinics operating in Istanbul were examined, it was determined that the vast majority (77.3%) were Istanbul University. Ankara University ranks second with 11.6% and Uludağ University ranks third with 5.8%. According to this result, it is seen that those who graduated from Istanbul University In

generally start their business life in Istanbul. In order to evaluate this more accurately, it is necessary to know from which cities those who receive education at Istanbul University come.

The average experience of veterinarians in the companion animal sector was 17.1 years. Considering that companion animal sector started to develop in our country in the mid-90s, it has been seen that the experience periods determined by the research are parallel to the development of the sector. In a previous study conducted in 56 clinics in Istanbul, İzmir, Konya and Aydın provinces, it was reported that the average duration of experience of veterinarians was 18.6 years (Mat et al., 2018) and shows parallelism with this study. Considering the distribution, 41.8% of veterinarians have 11-20 years of experience and 30.2% of veterinarians have 20-30 years of experience. The proportion of clinicians who are newly admitted to the profession and have up to 5 years of experience is 8.9%. The least experienced veterinarian has been in the profession for 3 years and the most experienced veterinarian has been for 35 years.

When examined in terms of educational status, it was determined that the vast majority of veterinarians (84.9%) were faculty graduates. Those with doctorate level education have 14.2% and those with academicians have 0.9%.

In this study, the opinions of veterinarians about the faculties they graduated from and their communication status were also examined. According to the results, 16.9% of veterinarians consider their faculties to be at the top and 31.6% consider them to be below the middle. A total of 51.6% of veterinarians consider their faculties to be medium and below average. More than half (56.5%) of the veterinarians state that they recommend their faculties, but 40.5% rarely communicate the faculty members and assistants of the faculties they graduated and 16.4% never communicate them. In this study, the opinions of veterinarians about the faculties they are educated and their communication status with the faculty members were examined in general due to the wide scope. Both the fact that more than half of the veterinarians do not see their faculties on top and that their communication levels with the faculty members are low despite the abundance of all kinds of communication channels in our age clearly reveals the necessity of evaluating these points on a faculty basis by conducting more detailed studies in the future.

All of the veterinarians participating in the study saw the establishment of new faculties in public universities as a negative development, while 1.8% of the veterinarians approached the establishment of veterinary faculties in foundation universities positively, while 2.2% stated that they remained undecided. It seems important from a professional point of view to conduct detailed studies on why veterinarians look positively at foundation universities while completely opposed to public universities and to question this issue.

According to results, 78.7% of the veterinarians stated that they wanted to work on companion animals before graduating from the faculty and 68% stated that they started working in the pet clinic after graduation. These values indicate that veterinarians chose to work in the pet clinic knowingly and by planning. However, since the vast majority of veterinarians in this study are educated in Istanbul, the issue of the effect of choosing this field and when it occurred should be determined by examining separately.

When the sectors that started the first job after graduation are examined, it is noteworthy that the pharmaceutical sector ranks second with 8.9%, academician ranks third with 6.7% and the food sector ranks fourth with 4.0%. The average period of starting the profession after graduation is 3.8 months. This period is of utmost importance especially in the unemployment problem. Accordingly, veterinarians can start working in clinics immediately after graduation. However, considering that the vast majority of clinician veterinarians have already wished to work in a companion animal clinic since the student period, it can be considered that not all veterinarians may be able to start work in such a short time. For this, it is also necessary to know about veterinarians working in other sectors.

When the initial earnings status after graduation was examined, 70.2% of veterinarians stated that they started their first job after graduation with the minimum wage determined by the chambers. The rate of those who start with a wage higher than the chambers' minimum wage is 29.8%. At this point, it seems necessary to examine the start-up fees and the structures of the enterprises in detail with other studies. In these examinations, the analysis of which level of enterprises started with high wages and which level of enterprises with low wages will provide important results.

Almost all of the veterinarians (96.9%) who participated in the study stated that they were generally satisfied with their professions. When the satisfaction status is examined in detail, it is seen that it is quite satisfied in scientific (8.0 points) and

technical aspects (7.9 points) and satisfied in economic aspects (7.3 points). The average social score was found to be quite low and 5.3 out of 10. 90.2% of the veterinarians who are satisfied with their professions stated that they can recommend veterinary medicine and 79.1% stated that they can recommend pet clinic. The rate of those who stated that they would not recommend companion animals as a field of study is only 4.0%.

In terms of choice of profession, veterinarians stated that 68.9% preferred veterinary medicine for job satisfaction and 18.2% preferred it for profit. Those who are veterinarians to become entrepreneurs have 9.4% and those who choose for social status have 2.2%. The most important criterion in the selection of pet clinic is the desire to become a pet clinician with 57.4%. The economic reason is the second and third reasons with 24.4% and the love of pets with 16.0%. In general, the vast majority of veterinarians stated that they would choose veterinary medicine again if they had to make a decision today. The rate of those who approach this question negatively is only 6.7%.

The average daily working time of veterinarians is 10.5 hours and only 7.6% of veterinarians reported that they could continuously devote sufficient time to their private lives due to this long working time. The rate of veterinarians who never spend time in their private lives is determined as 33.3%. This situation indicates that the fact that veterinarians cannot devote time to their social lives and environments together with the obligation to work individually and that the status of the profession in social life will need longer. In short, this should be seen as a professional problem rather than an individual problem.

Professions can be seen in a better position by society, not only by fulfilling the requirements of the profession they perform, but also by other social activities of colleagues. Therefore, it may be a longer time before veterinarians and the veterinary profession who cannot devote enough time to social life rank higher.

When the general situation of the profession is examined, it is determined that communication is generally weak. 57.7% of the veterinarians participating in the study stated that there is a weak solidarity between colleagues in their regions and 25.0% stated that there is no solidarity at all. The future status of veterinary medicine is seen as moderate with 40.9%. Only 25.7% (13.3% good and 12.4% better) see the future positively.

Results show that 78.2% of the veterinarians participating in the study stated that they regularly participate in professional organizations and 21.8% stated that they do not participate. The most frequently attended organizations are organized by associations with 33% and companies with 29%. In the third place are the organizations organized by the chambers with 22.7% and in the fourth place are the organizations organized by the universities with 15.3%. The benefits of these organizations were also asked in the research and it was determined that the most important benefit with 50.3% contributed to vocational education. The rate of being considered as a tourist trip activity is 17.4% and the rate of being considered as contributing to socialization is 17.0%. Experience gaining is fourth with 9.6% and commercial contribution is fifth with 5.7%.

When the scientific and professional publications were examined, only 17.8% of the veterinarians participating in the research stated that they regularly follow scientific or professional publications. It is noteworthy that the majority of these publications are in English. In terms of the most-followed publications, The Veterinary Journal – Elsevier ranked first with 38.5%, Veterinary Clinician's Brief ranked second with 30.8%, Turkish Veterinary Journal ranked third with 17.3% and Royal Canin Veterinary Focus ranked fourth with 8.0%. Although the proportion of veterinarians who regularly follow scientific publications is not very high, it can be stated that scientific meetings are useful for veterinarians to renew themselves.

When the number of employees, which is one of the determinants of service quality, was examined, it was determined that 4.8 people worked in a clinic on average. While the minimum number of employees is 1, the maximum number of employees is 25. The average number of veterinarians working in clinics was 2.3 and the number of technicians was 0.8. In addition, 69.8% of the clinics reported that they provided services by making visits outside the clinic through their staff.

When asked why clinics were preferred by patient owners, 66.7% of the veterinarians participating in the study stated that the criterion that patient owners attach the most importance to when choosing clinics was the reference. The closeness of the clinic is the second important criterion with 20.4%, online research was the third important criterion with 9.3% and appearance is the fourth important criterion with 3.6%.

The annual expenditure amounts of the patient owners are also examined in this research. At the end of the study, it was determined that the patient owners spent 2822 TL (400 USD) annually for cats and

t4516 TL (641 USD) annually for dogs. According to a study conducted in 2012 among cat-dog owners in Istanbul, routine health practices (annual vaccinations, antiparasitic applications, etc.) have been reported to be around 600 TL for cats and 1000 TL for dogs each year (Onur, 2012). In a study conducted in 2014, it was stated that the average annual expenditure for cats was 1173 TL and for dogs was 2013 TL (Demir and Uğurlu Koç, 2014). The increase amounts in recent years and the ratios between cat-dog expenditures are in parallel with the results of this study.

For the year 2020 the average monthly earnings of the veterinarians participating in the study were calculated as 17618 TL. In this study reported 86.7% of veterinarians an income of less than 30000 TL. According to the survey published by the European Federation of Veterinarians in 2018 (FVE, 2018), the average monthly income of veterinarians in Turkey is stated as 3000 Euros. Considering that the average annual Euro exchange rate for 2020 is 8.18 TL (The Central Bank of the Republic of Turkey, 2020) according to The Central Bank of the Republic of Turkey, monthly earnings are calculated as 24540 TL. Since FVE's surveys cover entire animal health industry it is understandable that there are differences in results.

When the rental expenses of the clinics are examined, it has been determined that the amount of rent paid is 9569 TL (1357 USD) on average per month. The vast majority of clinics, 73.7%, pay rent up to 10000 TL (1418 USD). The fact that almost all of the veterinary clinics in Istanbul (96.4%) are tenants is considered an interesting issue to be evaluated. The study which was conducted in 2010 monthly amount of rent of the clinics was around 450 USD (Aral, 2010). This difference could come from the difference in economic sizes between İstanbul and Ankara.

The items that have the largest share in terms of income items are vaccination applications, operations, and treatments. These three practices account for 83.9% of the revenues of clinics. Similar to our findings according to study which was conducted in Hungary, in terms of source of income most important items were surgical operations vaccination applications (Ozsvari, 2014). The largest share in expense items is drug expenditures with a ratio of 23.9%. Vaccination expenses are second with 22.9% and general expenses are third with 20.5%. The rates here are important in terms of showing how much of the income and expenses of veterinarians in clinics are over their own medicine.

Since medical devices are important for clinics and require investment, this point has also been examined in detail in the research. As a result of the research, it was determined that all clinics have microscopic examination equipment, 95.0% have X-rays, 87.0% have blood analysers and 80.0% have urine analysers. It has been determined that the average value of medical devices owned by a clinic is 287422 TL (40769 USD). In addition, only 2.0% of clinics have rental devices. When the results are analysed, it is seen that the majority of the clinics have microscopic examination equipment, X-ray, blood analyser and urine analyser, which are the basic laboratory equipment. Further examination equipment such as ECG, CR and ultrasound are also available in almost 50% of the clinics. The reasons for the presence of such a variety of equipment in clinics in the presence of analysis laboratories should be examined separately. In addition, it is also important to know how long the equipment investment turns into profit, how necessary the investment is, the effective use of the equipment, how long it is renewed and the ratio of the clinic in income and expenses. Determining the average value calculated in the study and how much equipment can be obtained may also indicate the level of average equipment ownership of clinics.

In order to examine the collection and payment status of the clinics, questions were directed to the veterinarians in this direction. According to results 73.0% of the veterinarians who participated in the study stated that they generally collected the fee they demanded for the service they provided, and 12.0% stated that they had difficulty in collecting. With the research, the average uncollectible annual receivable of a clinic was determined as 28444 TL (4034 USD). Considering that there are 749 clinics in Istanbul, it is noteworthy that the sector has a large commercial loss of approximately 21 million TL (approx. 3 million USD). Examining this problem in detail and determining its causes will prevent major financial problems in the sector in the long term. When examined in terms of collection and payment, the use of credit card stands out. The most common payment method used by clinics is credit card with 47.2% and the collection method is credit card with 73.9%.

Conclusion

In the pet sector, veterinary clinics, which have started to develop since the 1990s, have an important place as one of the most basic components of the sector due to both employment opportunities and the turnover and added value they produce. The number of clinics -also due to the opening of new faculties- is increasing very rapidly, which makes the competition harder.

Although veterinarians generally state that they

happy with their profession, being in a socially negative situation and lack of communication both with the faculties they graduated from and among themselves may have a negative impact on the profession in the long term.

The fact that the pet sector has developed considerably in parallel with the general education level in our country and despite the increase in opportunities, problems such as the low rate of women, working more than 10 hours a day, opening a large number of clinics, and experiencing a high amount of collection shortage clearly reveal that communication management and business knowledge are required in addition to professional knowledge to have a successful clinic today (in 2021). Although management in the veterinary profession is not a very focused area in the educational process, development in this field has always been very important for success (Draper and Uhlenhopp, 2002). In the current situation in Turkey, in spite of providing adequate education in faculties, studies should be carried out for students to graduate in a more equipped way in the future, veterinarians, educational institutions and professional organizations should develop detailed and long-term plans.

References

APPA - American Pet Products Association (2020). *Pet industry market size & ownership statistics.* Retrieved from: https://www.americanpetproducts.org/press_industrytrends.asp [Accessed 2 June 2021].

Aral, Y., Cevger, Y., Pınar, D., & Aydın, E. (2010). Ankara ili evcil hayvan veteriner kliniklerinin yönetimsel ve ekonomik açıdan değerlendirilmesi. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi, 16*(3), 503-508.

Data USA (2018). *Veterinarians, age by gender.* Retrieved from: https://datausa.io/profile/soc/veterinarians#demographics [Accessed 1 June 2021].

Demir, E. (2017). *İstatistik Ders Notları*. Ankara. Turkey: Ankara Üniversitesi Eğitim Bilimleri Fakültesi, 14.

Demir, P., & Uğurlu Koç, A. (2014). Pet hayvan (kedi-köpek) sahiplerinin veteriner kliniklerine ilişkin beklentileri. *İstanbul Üniversitesi Veteriner Fakültesi Dergisi, 40*(2), 168-175.

Draper, D. D., & Uhlenhopp, E. K. (2002). A Veterinary business curriculum model. *Journal of Veterinary Medical Education, 29*, 73-74.

Evrim, M. ve Güneş, H. (2000). *Biyometri.* İstanbul, Türkiye: Üniversitesi Veteriner Fakültesi Yayını, Ders Notu No: 113

FEDIAF-The European Pet Food Industry (2016). *Annual report 2016*. Retrieved from: https://fediaf.org/images/FEDIAF_Annual_Report_ 2016_cor.pdf [Accessed 2 June 2021].

FEDIAF-The European Pet Food Industry (2020). Annual *report 2020*. Retrieved from: https://fediaf.org/images/FEDIAF_Annual_Report_ 2020_cor.pdf [Accessed 31 May 2021].

FVE-Federation of Veterinarians of Europe (2018). *Vet survey 2018*. Retrieved from: http://fvesurvey.com/download/148/ [Accessed 29 May 2021].

Global Market Insights (2020). *Pet care market.* Retrieved from: https://www.gminsights. com/industry-analysis/pet-caremarket?utm_source=globenewswire.com&utm_medium=referral&utm_campaign=Paid_globenewswire [Accessed 29 May 2021].

Harvard Medical School (2014). Why *having a pet is good for your health.* Retrieved from: https://www.health.harvard.edu/staying-healthy/why-having-a-pet-is-good-for-your-health [Accessed 27 May2021].

HEKTAŞ (2018). Rakamlarla *Pet sektörü: 2 milyar dolarlık pazarda HEKTAŞ hamlesi [Basın bülteni, April 25*]. Retrieved from: https://www.dunya.com/sirketler/2-milyar-dolarlik-pazarda-hektas-hamlesi-haberi-413047 [Accessed 21 May 2021].

Hesselmar, B., Aberg, N., Aberg, B., Eriksson, B., & Björkstén, B. (1999). Does early exposure to cat or dog protect against later allergy development? *Clinical & Experimental Allergy Journal, 29*(5), 611-617.

Kaygısız, F., & Akdağ, F. (2004). İstanbul ilindeki veteriner klinik işletmelerinin teknik ve mali yapıları ile işletmecilik sorunları üzerine bir araştırma. *İstanbul Üniversitesi Veteriner Fakültesi Dergisi, 30* (2), 63-78.

Mat, B., Çevrimli, M. B., & Günlü, A. (2018). Current problems and suggestions for the marketing and use of medical products in the field of animal health and breeding. *Eurasian Journal of Veterinary Sciences, 34*, 4, 233-241.

Onur, E. (2012). Socio-economical parameters of cat and dog ownership in Istanbul (*PhD. Thesis*). Istanbul University, Istanbul, Turkey.

Orhunbilge, N. (2000). *Örnekleme yöntemleri ve hipotez testleri*. İstanbul, Türkiye: Avcıol Basım Yayın, 4.

Ozsvari, L. (2014, October 22). *Practise management in the Hungarian small animal veterinary clinics.*

Paper presented at the *New Trends in Management in the 21th Century Conference,*, Czestochowa, Poland.

Ratschen, E., Shoesmith, E., Shahab, L., Silva, K., Kale, D., Toner, P., Reeve, C., & Mills, D. S. (2020). Covid-19 lockdown phase in the UK: Investigating links with mental health and loneliness. *PLoS ONE 15* (9): e0239397.

Ministry of Agriculture and Forestry (2021a). *Tarım ve Orman Bakanlığı 2020 faaliyet raporu.* Retrieved from: https://www.tarimorman.gov.tr/Konular/Plan-Program-Ve-Faaliyet-Raporlari/faaliyet-raporlar%c4%b1 [Accessed 07 June 2021].

Ministry of Agriculture and Forestry (2021b). *Veteriner hizmetleri.* Retrieved from: https://www.tarimorman.gov.tr/ Konular/Veteriner-Hizmetleri/Serbest-Veterinerlik-Ve-Veteriner-Laboratuvarlari [Accessed 20 May 2021].

The Central Bank of the Republic of Turkey (2020). *Türk Lirası yükümlülükler için tesis edilen döviz cinsinden zorunlu karşılık tutarlarının hesaplanmasında esas alınacak ortalama döviz alış kurları, 3*. Retrieved from: https://www.tcmb.gov.tr/wps/wcm/connect/TR/TCMB+TR/Main+Menu/Istatistikler/Bankacilik+Verileri/Zorunlu+Karsiliklar/ [Accessed 20 May 2021].

Vidovic, V., Stetic, V. V., & Bratko, D. (1999). Pet ownership, type of pet and socio-emotional development of school children. *Anthrozoos A Multidisciplinary Journal of the Interactions of People & Animals, 12*, 211-217.

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Analysis of companion animal clinics in Istanbul in terms of some physical structures, technical equipment, patients and management *

Canberk BALABAN[1**] **Halil GÜNEŞ**[1]

1. Istanbul University-Cerrahpaşa, Büyükçekmece Campus, Faculty of Veterinary Medicine, Department of Animal Breeding and Husbandry, 34500 Büyükçekmece-Istanbul, Turkey.
Balaban, C.: ORCID: 0000-0001-7510-7724; Güneş, H.: ORCID: 0000-0002-4154-7104.

Research Article
Volume: 5, Issue: 2
August 2021
Pages: 87-97

ABSTRACT

With the increasing in companion animal (pet) adoption in the recent years, clinics are now becoming businesses enterprises. In parallel with this increase in ownership, a significant number of veterinarians have started to choose companion animal area. According to records there is a total of 7915 ministry licensed enterprises in Turkey (Ministry of Agriculture and Forestry, 2021a) and 749 of them are established in Istanbul (Ministry of Agriculture and Forestry, 2021b). For this reason, Istanbul has been determined as the study site. In this research, it is aimed to determine the physical structures, technical equipment, patient distribution and to analyze the business activities and problems encountered of the companion animal veterinary clinics in Istanbul. Survey studies were conducted mostly face-to-face (96%) in 225 clinics in Istanbul between April 2019 and April 2021. At the end of the research, it was determined that the majority of the clinics in Istanbul were 100-200 square meters in size, single storey, with 1 examination room. In addition, 96,0% of the clinics are rental and 74,2% of which are sole corporation. In terms of investment, all clinics has a microscopic examination set. Vast majority (95.0%) have X-ray devices and 87.0% analysers. In terms of patient distribution, cats represents 61.9% and dogs represents 33.0%. In the age distribution, those between the ages of 2-5 constitute the largest group for both cats and dogs. The most common reason for the first visit is vaccination with 39.6%. With the research, it has been observed that clinics are generally small-medium in size (81,3%) and independent clinics. The fact that large and chain enterprises are almost non-existent causes both the amount of investment and the expenditure required for promotional activities to be high. From this point of view, it is clearly seen that clinics should become more professional enterprises. In order to do that veterinarians always try to improve business and administrative capabilities by attending to training events.

Article History
Received: 07.07.2021
Accepted: 03.08.2021
Available online: 25.08.2021

Keywords: veterinary clinic, management, technical analysis, investment, istanbul

DOI: https://doi.org/10.30704/http-www-jivs-net.964767

To cite this article: Balaban, C., Güneş H. (2021). Analysis of companion animal clinics in Istanbul in terms of some physical structures, technical equipment, patients and management. ***Journal of Istanbul Veterinary Sciences, 5*(2),** 87-97.
Abbreviated Title*: J. İstanbul vet. sci.*

*This study was prepared from a part of the data obtained from the first author's doctoral thesis titled "Some Socio-Demographic Parameters of Companion Animals Veterinary Medicine in Turkey and Technical and Economic Analysis of The Clinics".

Introduction

Pet ownership has increased continuously in the last 20-25 years in Turkey as well as in the world and the total number of cats and dogs has reached 5 million (FEDIAF, 2020). This development in Turkey has started to be felt seriously especially after the second half of the 1990s, primarily in big cities such as İstanbul, İzmir and Ankara, and over time, the pet ownership approach has spread throughout the country. It can be said that the biggest contribution to this development is the diversification of communication channels, especially television channels, radio channels and social media. In addition, the opinions of experts on the benefits of having a pet have had positive effects on individuals and families in terms of having a pet

**Corresponding Author: Canberk Balaban
E-mail: canberkbalaban@gmail.com

Journal home page: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net

(Erten et al., 2019).

Pet clinics are also commercial enterprises and businesses have various aspects such as technical, psycho-technical, social, humanitarian, administrative, economic, financial, psychological, and political. Enterprises will be able to maintain their existence by working effectively and efficiently in all aspects (Kaygısız and Akdağ, 2004). Veterinary clinics and animal hospitals need to be able to meet patient expectations at the highest level and increase their level of satisfaction. It plays an important role in the profitability, productivity and sustainability of animal health service providers (Çevrimli et al., 2019). From that perspective in order for veterinary clinics to work effectively and efficiently, clinical owners need to be familiar with points such as physical structure, technical equipment and detailed information about patients. In addition, business knowledge is also necessary for successful commercial management. Even in the United States, which is the largest market in this field, many clinicians still lack both knowledge and practice in this field (Kieves et al., 2007).

When pet clinics are examined, it is seen that the vast majority of them are of a small structure. It is in the form of many clinical person companies or 2-partner businesses. In addition, clinics in the form of family businesses, both owned by spouses who are veterinarians, are frequently encountered. This distribution is similar both worldwide and to the United States. When examined worldwide, it is observed that 65% to 80% of commercial enterprises, including veterinary clinics, are in the family business structure (Bakan et al., 2006). Almost all businesses in the United States (99%) are in the form of small businesses (Adoukonou, 2019). Although pet clinics have limited business volume and employment opportunities due to their structure, it should be accepted that they contribute significantly to the economic and social development in their country like other family businesses (Yıldırım, 2007). In this respect, in addition to many enterprises in the animal health sector, pet clinics have become one of the important elements of the country's economy.

Due to the increase in pet ownership in recent years and the potential of the region, it is important to examine patient clinics in Istanbul in terms of physical structure, investment, and patient characteristics. With the research it is aimed to determine the physical structures, technical equipment, patient distribution and to analyze the business activities and problems encountered of the companion animal veterinary clinics. Having detailed information about the general situation within the province will shed light the on future planning of both current clinicians and veterinarians and also students who want to progress in this direction.

Materials and Method

The material of the study is the data collected by filling out the questionnaire prepared in veterinary clinics established in Istanbul only for the purpose of serving pets and the data processed in computer environment. The questionnaires were sent to 4% of veterinarians who could not be interviewed face-to-face via e-mail in the form of Excel file.

The clinics selected for the survey were determined using Simple Random Sampling method. The units in the main mass were listed and numbered according to the simple random sampling method and then randomly selected (Etikan, 1989). This choice has the advantages of being used in large masses, giving each point an equal chance and not needing weighting. Total of the sample for survey represents 29,6% of respective the market.

In the analysis of the survey results, arithmetic mean method was used in general, and frequency tables were created for the answers to the questions asked with the options grouped. The incidence of an observation value or measurement result within all observation units is determined as the frequency of this value. In frequency tables, frequencies for one or several variables are presented in a structured manner (Evrim and Güneş, 2000; Demir, 2017). For the grouped answers, the midpoints of the groups and their averages over the frequencies were calculated and evaluated with Microsoft Office Excel 2010 and IBM SPSS Statistics 22 for Windows.

Results

Findings obtained by using data from 225 companion animal veterinary clinics for the analysis in terms of some physical structure, technical equipment, patients, and management are given below in titles according to the subjects examined in the questionnaire.

1. Classification of clinics: With the research, it has been determined that 97.8% of the veterinary clinics in Istanbul province are in the clinic structure.

Table 1. Classes of clinics.

Types	Frequency	Percent (%)	Cumulative Percent (%)
Clinic	218	97.8	97.8
Policlinic	3	1.3	99.1
Hospital	2	0.9	100.0
Total	225	100.0	

2. Legal Status of clinics: With the research, it has been determined that 25.8% of the veterinary clinics in Istanbul province are in the partnership company and 74.2% are a sole corporation company.

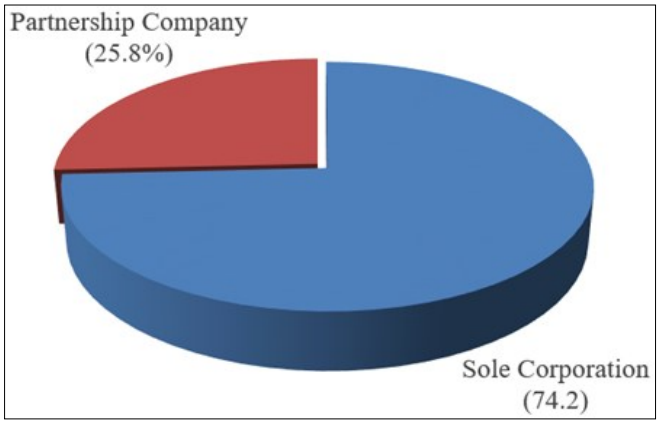


Figure 1. Legal status of clinics.

3. Distribution of clinics by year of establishment: In the study, it was determined that the majority of the veterinary clinics in Istanbul were established between 2001 and 2010 with a rate of 52.9%.

Table 2. Distribution of clinics by year of establishment.

Year	Frequency	Percent (%)	Cumulative Percent (%)
Between 1990–2000	34	15.1	15.1
Between 2001–2010	119	52.9	68.0
Between 2011–2020	72	32.0	100.0
Total	225	100.0	

4. Indoor use of clinics: The indoor area of 52.9% of the clinics where the survey was conducted is between 100 and 200 square meters.

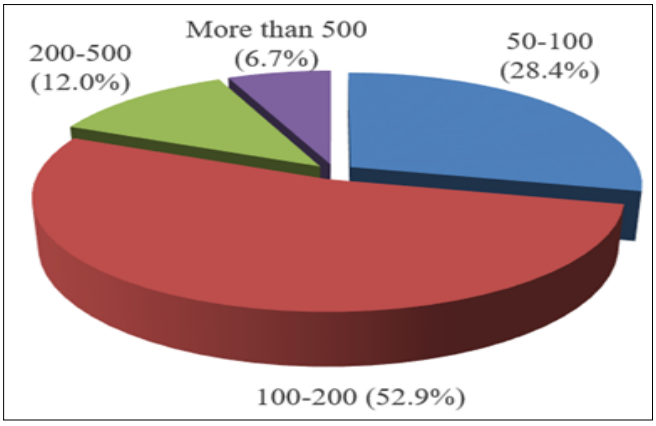


Figure 2. Indoor area of the clinics (Square meters).

5. Floor status of clinics: As a result of the research, it has been determined that the majority of veterinary clinics are single-storey with 59.5% and 33.8% are two -storey in terms of usage area.

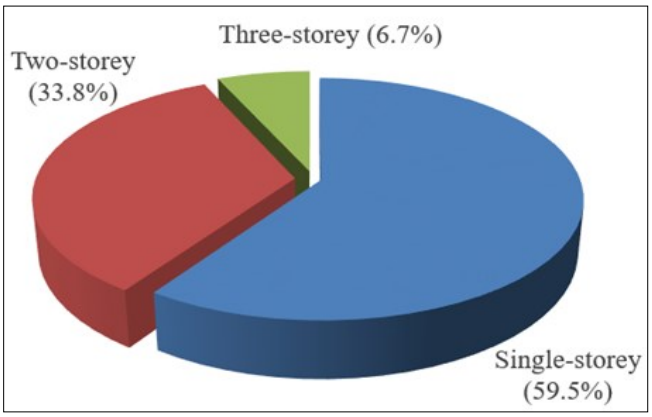


Figure 3. Floor status of clinics.

6. Examination room numbers: In the study, it was determined that 32.0% of the veterinary clinics had 1 examination room and 54.2% had 2 examination rooms.

Table 3. Examination room numbers

Examination Room	Frequency	Percent (%)	Cumulative Percent (%)
1 Rooms	72	32.0	32.0
2 Rooms	122	54.2	86.2
3 Rooms	31	13.8	100.0
Total	225	100.0	

7. Number of operation rooms: In the study, it was determined that 90.7% of the veterinary clinics had 1 operation room and 8.9% had 2 operation rooms.

Table 4. Number of operation rooms.

Operation Room	Frequency	Percent (%)	Cumulative Percent (%)
1 Rooms	204	90.7	90.7
2 Rooms	20	8.9	99.6
3 Rooms	1	0.4	100.0
Total	225	100.0	

8. Competence of clinic sizes: According to results, 53.3% of the veterinarians participating in the study stated that they found the sizes of their clinics sufficient and 46.7% stated that they did not find them sufficient.

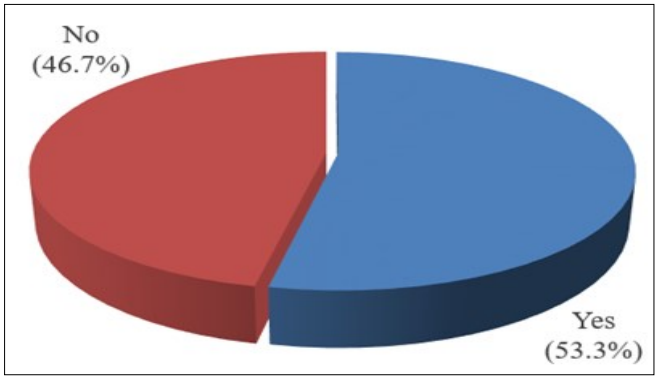


Figure 4. Competence of clinical sizes.

9. Property status: In the study, it was determined that almost all of the veterinary clinics (96.0%) were rented and the proportion of the owner veterinarians was only 4.0%.

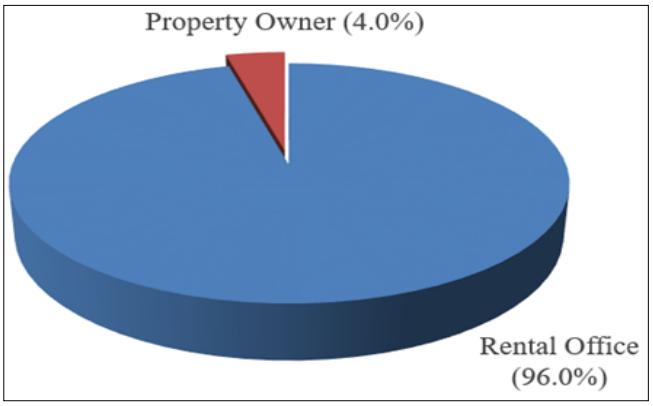


Figure 5. Property status.

10. Medical devices in the clinic: It was determined that all clinics participating in the study (100%) had microscopic examination set and 95% had X-ray unit.

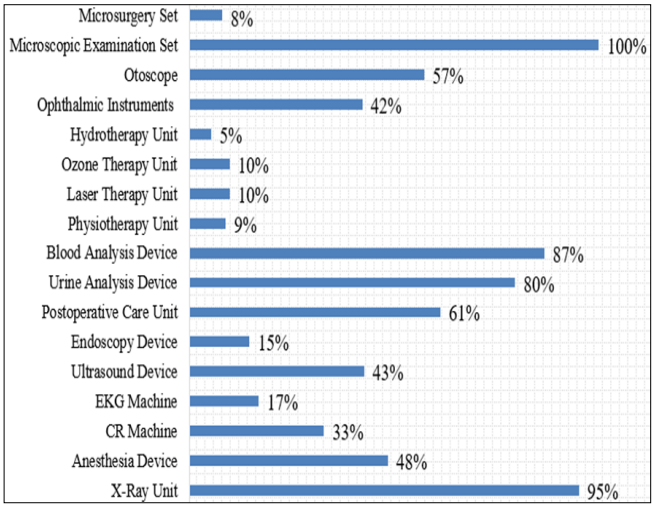


Figure 6. Ratios of medical devices in the clinic.

11. Parking lot, ambulance, pet boarding and pet coiffeur services status of clinics: As a result of the research, it was determined that 21.3% of the veterinary clinics had parking lots, 19.1% had ambulances, 65.8% had pensions and 64.4% had coiffeur.

Table 5. Parking lot, ambulance, pet boarding and pet coiffeur service status.

Facilities	Yes		No	
	Frequency	Percent (%)	Frequency	Percent (%)
Parking Lot	48	21.3	177	78.7
Ambulance	43	19.1	182	80.9
Pet Boarding	148	65.8	77	34.2
Pet Coiffeur	145	64.4	80	35.6

12. Basic problems encountered during the establishment phase: In the study, it was determined that veterinarians mostly encountered financial problems with 38.6% during the establishment of their clinics. The second place is to find a suitable establishment place with 30.5%.

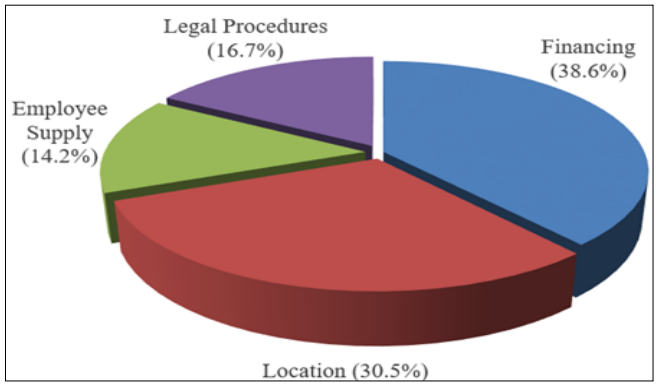


Figure 7. Basic problems encountered during the establishment phase.

13. Factors effective in location selection: As a result of the research, 31.5% of the veterinarians participating in the study reported that they mostly paid attention to whether there was another clinic nearby during the period of opening their clinic.

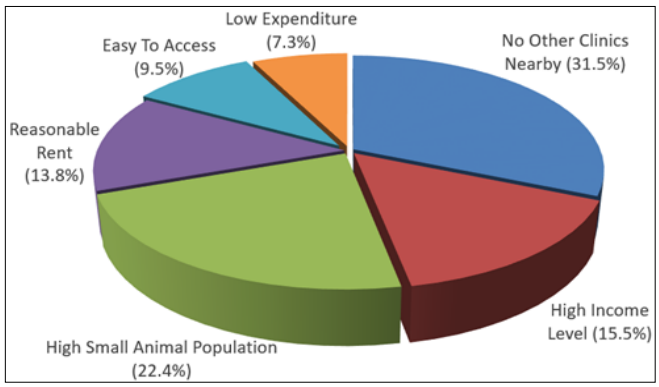


Figure 8. Factors effective in location selection.

14. Specie distribution of animals: Clinics participating in the research questionnaire reported that cats constituted the largest share among their patients with 61.9%. Dogs ranked second with 33.0%.

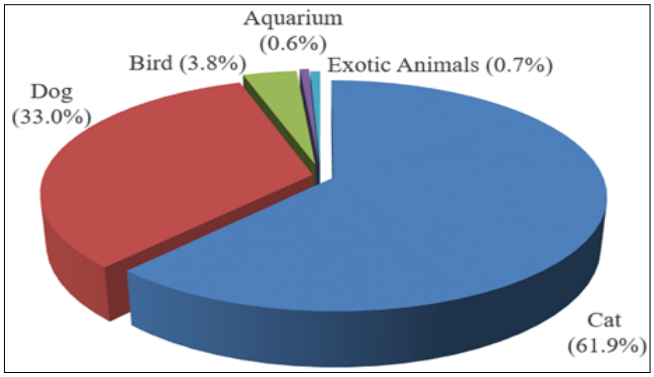


Figure 9. Distribution of incoming animals by species.

15. **Age distribution of cats and dogs visiting clinics:** According to the results of the study, the majority of both cats and dogs visiting the clinics constitute the group between the ages of 2-5.

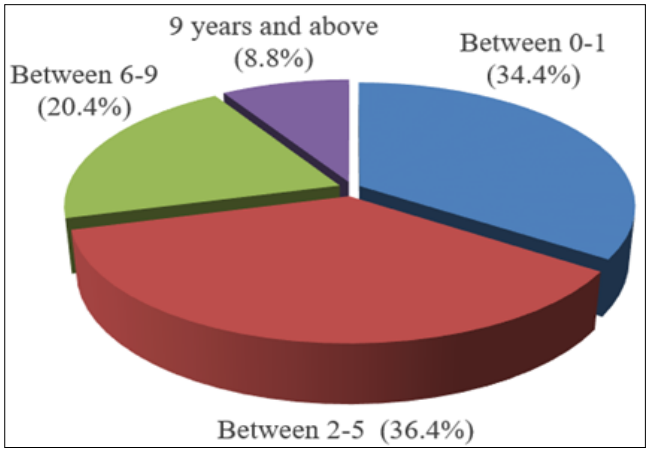


Figure 10. Age distribution of cats visiting the clinic.

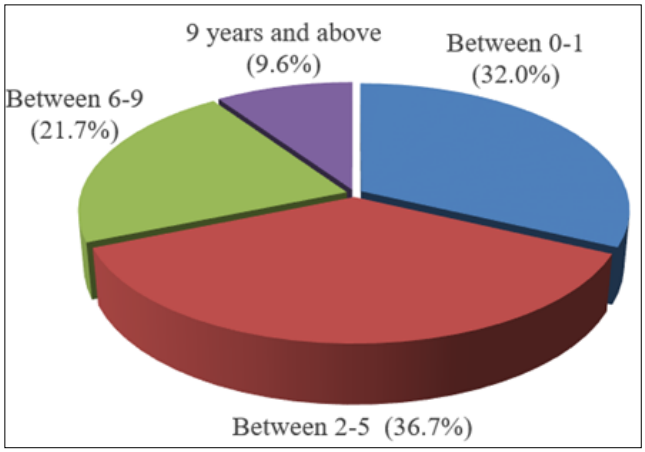


Figure 11. Age distribution of cats visiting the clinic.

16. Breed size distribution of dogs: Veterinarians participating in the study reported that the largest group of dogs visiting clinics consisted of mini-small breed dogs with 48.0%.

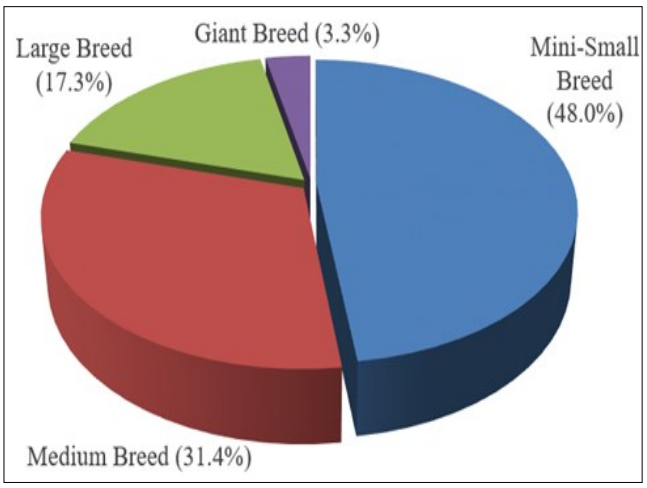


Figure 12. Breed size distribution of dogs.

17. Gender distribution of cats and dogs visiting clinics: It was determined that the gender distribution was balanced among both cats and dogs visiting the clinics in the study, and the females were higher with very little difference.

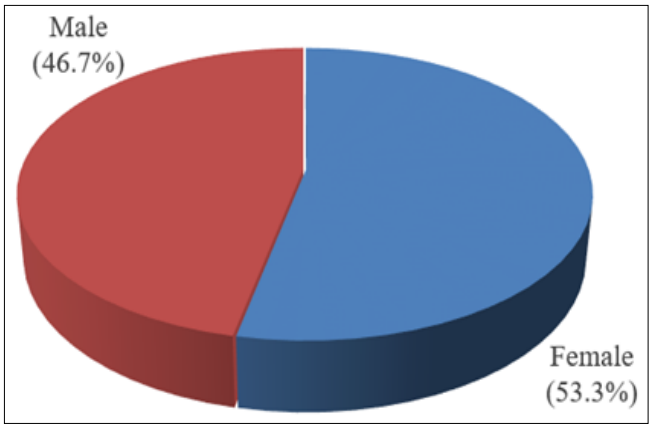


Figure 13. Gender distribution of cats visiting the clinic.

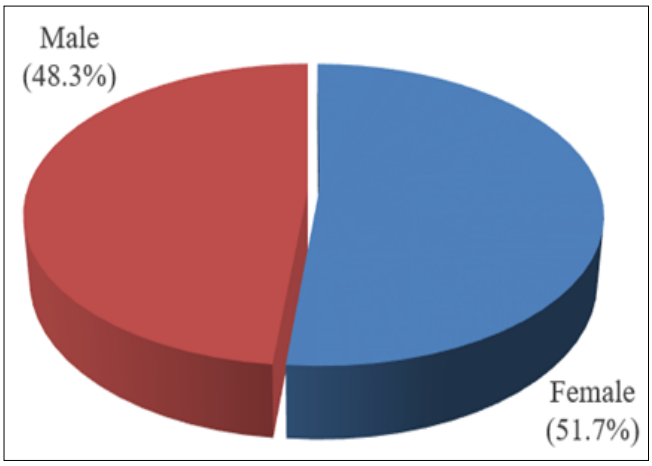


Figure 14. Gender distribution of dogs visiting clinics.

18. Distribution of regular and accidental patients: With the study, it was determined that 73.1% of the cats visited and 65.0% of the dogs visited in the clinics regularly.

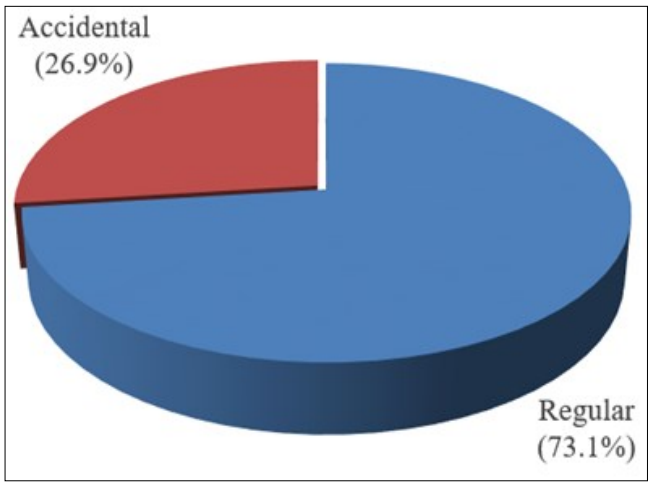


Figure 15. Regular and random distribution of cats.

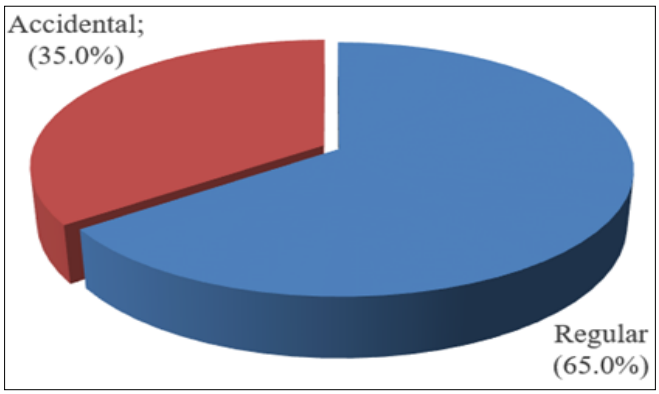


Figure 16. Regular and random distribution of dogs.

19. Patients' first visit purpose: Veterinarians participating in the study stated that the reason for their patients' first visit to clinics was vaccination with 39.6%. Prophylaxis ranks second with 32.4%.

Table 6. Patients' first visit purpose.

Visit Purpose	Frequency	Percent (%)	Cumulative Percent (%)
Prophylaxis	73	32.4	32.4
Adoption	27	12.0	44.4
Vaccination	89	39.6	84.0
Treatment	12	5.3	89.3
Antiparasitic App.	24	10.7	100.0
Total	225	100.0	

20. Annual general control number of animals: According to the study, the number of regular annual controls for both dogs and cats is very close to each other and about 3 times a year.

Table 7. Number of regular annual control

Pet	*n*	Mean	SD	Min.	Max.	Med.
Cat	225	2.7	2.21	0.0	10.0	2.0
Dog	225	2.6	2.22	0.0	10.0	2.0

SD = Standard deviation, Min = Minimum, Max = maximum, Med = Median

21. Number of annual antiparasitic applications: At the end of the study, it was determined that the annual number of protection applications against internal and external parasites applied to dogs was higher than cats.

Table 8. Number of annual antiparasitic applications.

Pets	Parasite Prevention	*n*	Mean	SD	Min.	Max.	Med.
Cats	Endoparasite	225	5.1	1.11	3.0	8.0	6.0
	Ectoparasite	225	6.9	2.02	3.0	12.0	6.0
Dogs	Endoparasite	225	5.7	1.33	4.0	8.0	6.0
	Ectoparasite	225	8.0	2.30	4.0	12.0	8.0

22. Annual number of vaccinations: In the study, it was determined that the number of vaccinations given to both dogs and cats was very close and approximately 3 times a year.

Table 9. Number of vaccinations per year.

Vaccination	*n*	Mean	SD	Min	Max	Med
Cats	225	2.8	0.41	1.,0	3.0	3.0
Dogs	225	3.1	0.37	2.0	4.0	3.0

SD = Standard deviation, Min = Minimum, Max = maximum, Med = Median

23. Annual pet food purchase frequency: According to the study, cat owners purchase pet food 9.1 times a year on average, while dog owners purchase 9.7 times a year.

Table 10. Annual pet food purchase frequency

Vaccination	*n*	Mean	SD	Min	Max	Med
Cats	225	9.7	2.35	4.0	12.0	10.0
Dogs	225	9.1	1.97	4.0	12.0	8.0

SD = Standard deviation, Min = Minimum, Max = maximum, Med = Median

24. The Purpose of animals' first arrival to the clinic: In the study, it was determined that 76.4% of the animals visited the clinics as soon as the illness occurs. In the second place, 8.9% came to the clinic after the treatment of other veterinarians.

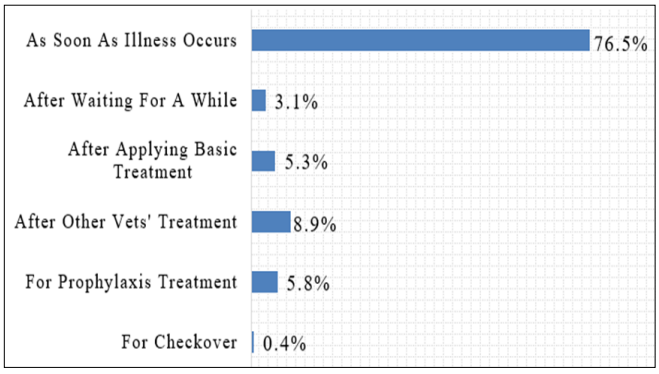


Figure 17. The purpose of patients' first arrival to the clinic.

25. Distribution of basic practices encountered in the clinic by species: While 63.4% of the internal medicine practices encountered in the clinic were related to cats, 58.8% of the surgical practices were related to cats.

Table 11. Distribution of the basic practices encountered in the clinic by species (%)

Basic Applications	Cats	Dogs	Total
Internal Medicine	63.4	36.6	100.0
Surgery	58.8	41.2	100.0
Obstetrics & Gynaecology	55.7	44.3	100.0
Prophylaxis	58.0	42.0	100.0

26. Expectations from pet owners: The veterinarians who participated in the study stated that their biggest expectations from the patient owners were to make an appointment and pay their fees in full.

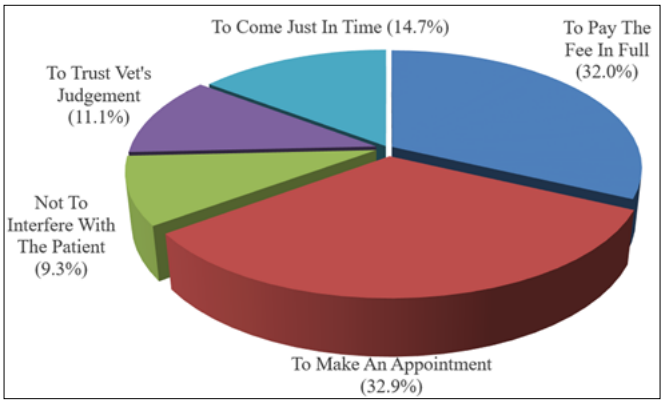


Figure 18. Expectations from pet owners.

27. Opinions on company representatives' visits and appropriate visit frequency: While 94.7% of the veterinarians participating in the study stated that they found the visits of company representatives beneficial, the ideal visit frequency was 1.3 times a month.

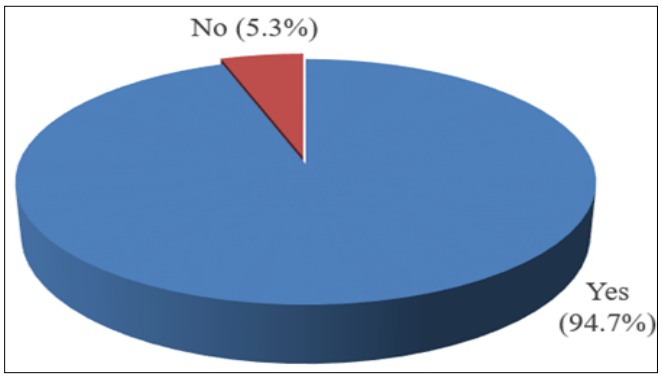


Figure 19. Whether the visits of company representatives are beneficial.

Table 12. Suggestion of appropriate monthly visit frequency

n	Mean	SD	Min.	Max.	Med.
225	1.3	0.65	0.0	4.0	0.04

SD = Standard deviation, Min = Minimum, Max = maximum, Med = Median

28. Occupational safety and health risks and problems encountered: All of the veterinarians who participated in the study stated that they thought that the profession contained risks regarding occupational health and safety, and 95.0% stated that they had problems in this regard at least once while performing the profession. The most common problems are physical problems with 94.7% and ergonomic problems with 32.0%.

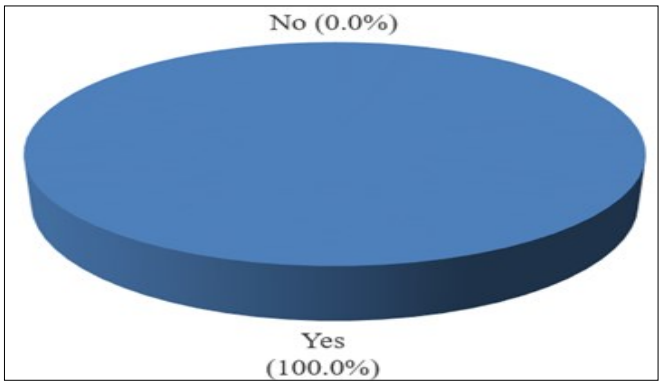


Figure 20. Occupation involves risks in occupational health and safety.

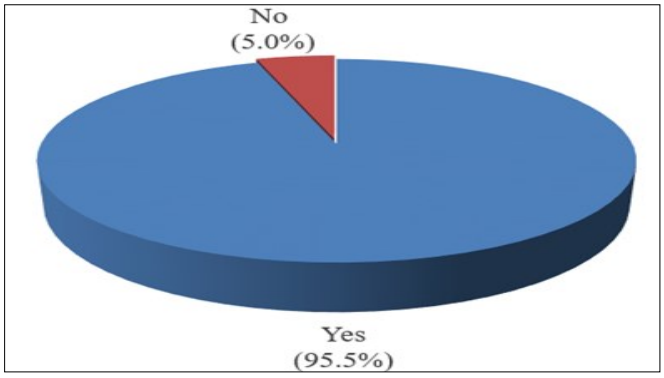


Figure 21. Having problems with occupational health and safety while performing the profession.

Table 13. Distribution of problems encountered.

Occupational Risks	*n*	Frequency	Percent (%)
Zoonotic Diseases	225	21	9.3
Ergonomic Problems	225	72	32.0
Radiology Problems	225	10	4.4
Chemical Problems	225	44	19.6
Physical Problems	225	213	94.7

Discussion

At the end of the research, it has been determined that 97.8% of the veterinary clinics in Istanbul are clinics. Polyclinics rank second with 1.3% and hospitals rank third with 0.9%, and these rates are compatible with the country.

According to the Ministry of Agriculture and Forestry data, 98.2% of the clinics in Turkey are clinics, 1.0% are polyclinics and 0.8% are animal hospitals (Ministry of Agriculture and Forestry, 2021a). In addition, in the study, it has been determined that 74.2% of these enterprises are in the partnership company and 25.8% are sole corporations.

With the research, it was determined that 15.1% of the clinics were established between 1990-2000, 52.9% between 2001-2010 and 32% between 2011-2020. Considering that the pet sector in Turkey has been on the rise since the second half of the 90s, it seems understandable that the majority of clinics were established after 2000.

When the physical characteristics of the clinics are evaluated, it is seen that 28.4% have an indoor area between 50-100 square meters and 52.9% have an indoor area between 100-200 square meters. The rate of clinics with a closed area of 200-500 square meters, which is larger areas, is 12.0% and the rate of clinics larger than 500 square meters is 6.7%. Since Istanbul is now a metropolis and its real estate values are high, most of the clinics are expected to be small and medium sized. As a result of a study conducted in Hungary in this area, it has been reported that the average indoor area of the clinics is 93.4 square meters (Ozsvari, 2014) and it shows parallelism with the results of this study. As a result of the research, it was determined that the majority of the clinics (59.6%) were single-storey similar to the indoor results. The proportion of two-storey clinics is 33.8% and the proportion of three-storey and more storey clinics is only 6.7%. When examined in terms of the examination room, it was seen that 32.0% had one examination room, 54.2% had two examination rooms and 13.8% had three examination rooms. In a study conducted in this direction in the United States, the average number of examination rooms was reported to be 3.1 (AVMA, 2018). In this respect, the result of the study is similar to the United States. When the number of operation rooms was analysed, it was determined that the vast majority (90.7%) were single operation rooms. Only 8.9% have two operating rooms and 0.4% have three operating rooms. According to the Veterinary Examination and Polyclinic Regulation (Official Gazette, 2011), which regulates the conditions for the opening of clinics and outpatient clinics, at least 1 examination room is required and there is no operation room requirement and the results obtained in the study are in line with this regulation.

When veterinarians were asked about their opinions about the adequacy of these physical characteristics, 53.3% of the veterinarians stated that they thought it was sufficient and 46.7% stated that they thought it was insufficient.

Investment is significant for the development of a business. Studies conducted in this direction report that those who prefer to take risks in corporate investors and those who avoid taking risks in individual investors are predominant (Yılmaz, 2009). Since veterinary clinics are mostly individual investments, questions analysing this aspect have also been included in the research. As a result of the research, it was determined that almost all of the clinics were rented with 96.0%. The proportion of veterinarians who own the workplace is only 4.0%.

When the investments in medical equipment were examined, it is determined that all of the clinics have microscopic examination sets, 95.0% have X-ray units, 87.0% have blood analysers and 80.0% have urine analysers. When the services provided were examined, it was determined that 21.3% of the veterinary clinics had parking lots, 19.1% had ambulances, 65.8% had pensions and 64.4% had coiffeur.

Since the establishment period of a clinic is also an important process, these points were also examined in the study. According to the results, veterinarians mostly encountered financial problems with 38.6% during the establishment of their clinics. The second place is to find a place of establishment with 30.5%. Legal legislation has a rate of 16.7% and staff supply has a rate of 14.2%. According to the study, veterinarians stated that they mostly paid attention to not having any other clinics in the vicinity with 31.5% in the location selected during the establishment phase. The excess number of cats and dogs in the region is second at 22.4% and the income level of the region is third at 15.5%.

The study also examined various demographic characteristics of cats and dogs visiting clinics. As a result of the study, 61.9% of the patients were cats and 33.0% were dogs. The recent increase in life in high-rise apartments and sites in Istanbul can be considered as an important reason explaining the high number of cats. When the age group is examined, the largest group for both cats and dogs is those between the ages of 2-5. The rates are 36.4% for cats and 36.7% for dogs. The second group of puppies -cats 34.4% and dogs 32.0%- is also ranked second for both species. When the breed dimensions of dog patients are examined in detail, the largest group consists of small breeds with 48.0%. Medium breeds rank second with 31.4%, large breeds rank third with 17.3% and giant breeds rank fourth with 3.3%. The reason for this distribution can be associated with city and living conditions, such as the fact that cats are more

common than dogs. In terms of gender, it was determined that the female and male ratios were very close to each other and the female ratio was higher with little difference. These rates are 53.3% female and 46.7% male for cats; 51.7% female and 48.3% male for dogs. Among the patients, cats were found to visit clinics regularly in 73.1% and accidentally in 26.9%; dogs were found to visit clinics regularly in 65.0% and accidentally in 35.0%. Characteristics of patients visiting clinics such as age, species, breed, size, and gender are important information in terms of both medical equipment and managerial success. By regularly monitoring and analysing these points, more accurate development opportunities can be followed in terms of science and business decisions such as investment, stock, and physical opportunities can be made more accurately.

With the research, it was determined that the reason for the first visit to the clinics of the patients was vaccination with 39.6%. Prophylaxis ranks second with 32.4% and adoption ranks third with 12.0%. Antiparasitic application is the fourth reason for the visit with 10.7% and treatment is the fifth reason for the visit with 5.3%. The study found that dogs visit clinics 2.6 times a year and cats 2.7 times a year for regular check-ups. This means that they are checked approximately every 4 months, which is a good rate. The number of annual vaccinations in cats and dogs was determined to be approximately 3 times, similar to the number of controls. The frequency of food purchases is 9.7 times a year for dogs and 9.1 times a year for cats.

Parasites are one of the most common problems encountered by pets all over the world (Blagburn et al., 1996), and this issue was therefore analysed in the research. At the end of the study, it was determined that protective applications were applied to cats 6.9 times a year and to dogs 8.0 times a year against external parasites. ESCCAP (European Scientific Council Companion Animal Parasites), which carries out studies on parasites in companion animals throughout Europe, recommends monthly application in regions with high flea and tick density (ESCCAP, 2018). Likewise, CAPC (Companion Animals Parasite Council), which carries out activities on parasites in companion animals in the United States, recommends 12 times a year (CAPC, 2021). In order to protect against internal interference, it was found that 5.1 times a year was applied to cats and 5.7 times a year to dogs. Although the region experienced in the frequency of ESCCAP internal interference application reports that there are many variables such as frequency of going out and eating other animal-insect, it recommends to apply it 4-12 times a year on average (ESCCAP, 2020). When the data obtained as a result of the study are evaluated, it is seen that both internal and external interference application frequencies in Turkey are close to the frequencies recommended by ESCCAP and CAPC.

At the end of the study, it was determined that 76.5% of the patients visited the clinics as soon as the disease was visible and 8.9% of them applied to the clinic after the treatment of another veterinarian. In the basic practices encountered in clinics, the density is generally in favour of cats. Distribution of internal medicine applications is 63.4% in cats and 36.6% in dogs, distribution of surgical applications is 58.8% in cats and 41.2% in dogs, distribution of obstetrics and gynaecology practices is 55.7% in cats - 44.3% in dogs the distribution of prophylaxis practices is 58.0% in cats and 42.0% in dogs. In this study, the distribution of species within internal medicine, surgery, obstetrics and gynaecology, prophylaxis and other applications is given. In addition, in another study, it would be useful to give distributions of applications within the species. Although cats and dogs are the patients of veterinarians, it is the owners who decide for them. Considering this situation, the expectations of veterinarians from patient owners were also examined in the study. According to the results of the research, the patients are expected to make the most appointments with 32.9%, and they are asked to pay their fees in full of 32.0%. In addition, other important expectations are that they arrive on time, trust vet's judgement and do not interfere with the patients.

In the study, field personnel of the companies that provide various services to the clinics were also examined. At the end of the study, 94.7% of veterinarians stated that they found company representatives' visits beneficial, while only 5.3% stated that they did not consider it necessary. In addition, the ideal visit frequency recommendation has been determined as 1.3 times a month.

Since veterinary medicine is a profession involving various risks, this issue has also been examined in the study. According to the results, all veterinarians stated that they thought that the profession contained risks in terms of occupational health and safety, and 95.0% stated that they had at least one problem in this regard while performing the profession. The most common problems are physical problems with 94.7% and ergonomic problems with 32.0%. Chemical problems rank third with 19.6% and zoonotic diseases rank fourth with 9.3%.

Conclusion

Istanbul province is the most important region of the pet sector in terms of both the number of clinics and

commercial business volume. The fact that a total of 749 clinics are concentrated in certain areas, that the majority of them are single-storey and have an area between 100-200 square meters and that there are no multibranch chain enterprises constitutes a fragmented market structure. In general, since the workplaces in the agricultural and livestock sectors are small-medium in size, the markets are fragmented and there is a unique intense competitive environment in such markets (Jarl Borch and Brastad, 2003). In addition to medical knowledge and practice, the opportunities offered in clinics are of utmost importance to take the lead in an intense competitive environment in veterinary medicine. When the possibilities are examined, medical devices that play a critical role in diagnosis come to the fore. In addition, facilities such as parking, ambulance, pension, and hairdresser are also remarkable services for cat and dog owners. In addition, the location of the clinic is appropriate in terms of various factors.

In order to run a successful clinic, it should be established in the appropriate region, investments should be made and many services should be provided. Considering that veterinarians experience the most financial problems during the establishment phase and considering the increasing number of new graduates in the pet sector day by day, it is clear that the conditions are getting more difficult. For this reason, veterinarians working on pet clinics should never neglect continuous development both in student and postgraduate medicine as well as in the veterinary clinics management.

References

Adoukonou, V. (2019). *Strategies for Small Business Sustainability* (PhD Thesis). Walden University, College of Management and Technology, Minnesota, USA.

AVMA – American Veterinary Medical Association (2018). *The Market For Veterinary Services, 18*. Retrieved from: https://www.google.com.tr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiNk6yI9PvwAhXQ5KQKHYnmCDcQFjAAegQIAxAD&url=https%3A%2F%2Fwww.avma.org%2Fsites%2Fdefault%2Ffiles%2Fresources%2F2018-econ-rpt3-veterinary-services.pdf&usg=AOvVaw3dkJjrc8rH2hBOnvbZlcB_ [Accessed 01 June 2021].

Bakan, İ., Çelik, A., Büyükbeşe, T., & Basım, N. (2006). Aile işletmelerinde yeni neslin eğitimi: Bir alan çalışması. *İstanbul Kültür Üniversitesi 2. Aile İşletmeleri Sempozyumu, Kongre Kitabı*, 332-337, 14 -15.Nisan.2006, İstanbul.

Blagburn, B. L., Lindsay, D. S., & Vaughan, J. L. (1996). Prevalence of canine parasites based on fecal flotation. *Compendium on Continuing Education for the Practising Veterinarian*, 18, 483–509.

CAPC - Companion Animals Parasite Council (2021). *The case for year-round flea and tick control*. Retrieved from: https://capcvet.org/articles/the-case-for-year-round-flea-and-tick-control/ [Accessed 27 January 2021].

Çevrimli, M. B., Burak, M. A. T., Günlü, A., Tekindal, M. A., & Günlü, Z. (2019). Hayvan hastanelerinde acil, veteriner klinik hizmetleri ve hasta sahibi memnuniyet kriterleri ölçekleri: Geçerlik ve güvenirlik çalışması. *Ankara Üniversitesi Veteriner Fakültesi Dergisi, 66*(3), 247-254.

Demir, E. (2017). *İstatistik Ders Notları*. Ankara Türiye : Üniversitesi Eğitim Bilimleri Fakültesi.

Erten, Ö., Öztürk, Y., & Yılmaz, O. (2019). Türkiye'de pet hayvan sahiplerinin sosyo-demografik yapıları ve pet hayvancılığına bakışları; Alanya-Mardin örneği. *Burdur Mehmet Akif Ersoy Üniversitesi Veteriner Fakültesi Dergisi*, *4*(2), 76-83.

ESCCAP - European Scientific Council Companion Animal Parasites (2018). *ESCCAP Guideline 03 Sixth Edition Control of Ectoparasites in Dogs and Cats.* Retrieved from: https://www.google.com.tr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiq3ZaDwPjuAhUHfBoKHa6lC_oQFjABegQIARAD&url=https%3A%2F%2Fwww.esccap.org%2Flinkdocument%2F63%2F&usg=AOvVaw1exmxwnRMCUDPphIB55z8c [Accessed 27 January 2021].

ESCCAP - European Scientific Council Companion Animal Parasites (2020). *ESCCAP Guideline 01 Sixth Edition Worm Control in Dogs and Cats.* Retrieved from: https://www.esccap.org/guidelines/gl1/ [Accessed 27 January 2021].

Etikan, İ. (1989). Küme örneklemesinde alt örnekleme yöntemi ve sonuçlara etkisi (*Msc. Thesis*). Hacettepe University, Graduate School of Health Sciences, Department of Biostatistics, Ankara, Turkey.

Evrim, M., & Güneş, H. (2000). *Biyometri.* İstanbul, Türkiye. Üniversitesi Veteriner Fakültesi Yayını, Ders Notu .

FEDIAF - The European Pet Food Industry (2020). *Annual Report 2020*. Retrieved from: https://fediaf.org/images/FEDIAF_Annual_Report_2020_cor.pdf [Accessed 20 January 2021].

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

Jarl Borch, O., & Brastad, B. (2003). Strategic turnaround in a fragmented industry. *Journal of Small Business and Enterprise Development,* 10 (4), 2, 393-407.

Kaygısız, F., & Akdağ, F. (2004). İstanbul ilindeki veteriner klinik işletmelerinin teknik ve mali yapıları ile işletmecilik sorunları üzerine bir araştırma. *İstanbul Üniversitesi Veteriner Fakültesi Dergisi*, 30 (2), 63-78.

Kieves, N. R., Roark, A. W., & Sparks, T. K. (2007). Business Education in Veterinary Schools: The Potential Role of the Veterinary Business Management Association. *Journal of Veterinary Medical Education*, 34, 5, 678-682.

Ozsvari, L. (2014). Practise management in the Hungarian small animal veterinary clinics. *New Trends in Management in the 21th Century Conference*, pp. 347-358, January 2014, Czestochowa, Poland.

Official Gazette (2011). Veteriner hekim muayenehane ve poliklinik yönetmeliği. *Türkiye Cumhuriyeti Resmi Gazete*, Date: 15/10/2011, Number: 28085.

Ministry of Agriculture and Forestry (2021a). *Tarım ve orman bakanlığı 2020 faaliyet raporu*. Retrieved from: https://www.tarimorman.gov.tr/Konular/Plan-Program-Ve-Faaliyet-Raporlari/faaliyet-raporlar%c4%b1 [Accessed 07 June 2021].

Ministry of Agriculture and Forestry (2021b). *Veteriner hizmetleri.* Retrieved from: https://www.tarimorman.gov.tr/ Konular/Veteriner-Hizmetleri/Serbest-Veterinerlik-Ve-Veteriner-Laboratuvarlari [Accessed 20 May 2021].

Yıldırım, A. F. (2007). *Türk Aile İşletmelerinde Kurumsallaşmayı Engelleyen Aile Değerleri Üzerine Isparta İlinde Bir Çalışma* (Msc. Thesis). Süleyman Demirel University, Graduate School of Social Sciences, Department of Business Administration, 108, Isparta, Turkey

Yılmaz, N. (2009). Yatırımcı Davranışını Etkileyen Faktörlerle Yatırım Kararları Arasındaki İlişki Bireysel – Kurumsal Yatırımcı Farklılaşması (*Msc. Thesis*). Yıldız Technical University, Graduate School of Social Sciences, Department of Business Administration, 98, Istanbul, Turkey.

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Evaluation of animal rescue activities in Tekirdağ city, Turkey

Mehmet Yardımcı

Department of Biostatistics, Faculty of Veterinary Medicine, Tekirdağ Namık Kemal University, Değirmenaltı Campus, 59030, Süleymanpaşa, Tekirdağ, Türkiye. Yardımcı M: ORCID: 0000-0001-5650-437X .

Research Article

Volume: 5, Issue: 2
August 2021
Pages: 98-106

ABSTRACT

This study was conducted to evaluate the response readiness for disasters based on the current animal rescue activities performed in Tekirdağ city. The material of this research contained the data of the animal rescue operations in Tekirdağ in 2019 and 2020. Results showed that a total of 2201 (82.7%) animals were saved in 2663 operations while 251 (9.4%) animals couldn't be saved in 2020. The average intervention time was around half an hour. The majority of the animals (2118; 79.5%) were released to nature while some of the others were handed over to the owner (24; 0,9%), delivered to the local veterinarian (31; 1.2%), to the shelter (35; 1.3%) or Forestry Waterworks (1; 0.04%). Nothing was done to the rest (454; 17.1%) because they were not found, inaccessible or found dead. This study emphasizes the need for a standardized monitoring system with appropriate data routinely collected from all rescue groups. International standards should be adopted by providing correct information to the rescue teams of each district. In this context, readiness, response and recovery stages should be first developed at the local level and applied to large events for better incident management.

Keywords: animal rescue, disaster, emergency, fire-department

Article History

Received: 24.05.2021
Accepted: 11.07.2021
Available online: 25.08.2021

DOI: https://doi.org/10.30704/http-www-jivs-net.941665

To cite this article: Yardımcı, M. (2021). Evaluation of animal rescue activities in Tekirdağ city. ***Journal of Istanbul Veterinary Sciences, 5*(2),** 98-106. **Abbreviated Title*: J. İstanbul vet. sci.***

Introduction

Animals face risks in disasters, just as humans do. Because we live with them by sharing homes, gardens or workplaces, we have a responsibility to help animals in case of danger (Glassey 2020; Irvine 2006) and keep them safe from the negative impacts of natural disasters. Any potential danger threatening human life is also likely to put animals at risk, too. Emergency responders aim to keep all human beings safe from the negative impacts of natural disasters, accidents or all hazardous events (Thompson 2018). Organizational problems in human social systems become compounded during disaster events and this is true with animal response and rescue operations (Farmer et al. 2016).

Among all rescue units, fire services are mainly responsible for rescuing animals during emergencies. The rescue process covers the period from the beginning of the emergency, through response, scene setup, extrication, transport and follow-on veterinary care involving all species of animals. Depending on the severity of the emergence provincial directorates, security forces, civil defense search and rescue directorates, regional directorates of forestry and waterworks also take part in animal rescue operations.

Successful recovery from natural disasters depends on strong animal rescue infrastructure. However, there is a limited source of information on routine rescue operations and there is no national system for monitoring the data of rescued animals in many countries. Since records of animal rescue operations are not taken properly and not kept in a digital medium, there is no information on the available

*Corresponding Author: Mehmet Yardımcı
E-mail: dr.yardimci@gmail.com

Journal home page: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net

capacity and experience as well as the kind of cases encountered. In addition to these gap areas in the existing rescue practices, there are other problems such as insufficient equipment, lack of knowledge and experience with animals, personnel who are not permanent in the same task and lack of species-specific rescue technical knowledge. Therefore, a good system based on scientific recording and comprehensive planning in the light of the experiences that covers the possibility of any hazard or disaster is the first step to make correct animal rescue operations.

Anticipating the potential consequences of disasters can help determine the actions that need to be started before the disaster strikes to minimize its effects. During planning, the risks in the region that causes endangering animal life such as the collapse of buildings, fires, flooding of barns, stables and domes along with wildfires and disorganized cityscape should be considered first (Aslım and Biricik 2018; Knight 2009).

When scientific studies on the subject are examined, it is not easy to come across articles that have reported numerical data, considering case types, regional distribution, intervention time, animal species or seasonal effects during animal rescue activities. Therefore, the level of awareness on the subject does not exceed a certain threshold. There is a gap in up-to-date information sharing on topics such as digital reporting, types of cases encountered in rescue operations, difficulties experienced and techniques used.

In short, there is a real need to keep animals safe before, during and after natural disasters. The existing national arrangements and framework for animal emergency management do not currently meet international best practices.

In this research, the records of animal rescue operations were examined and the existing infrastructure, case types, performance of the rescue team in responding to cases and post-rescue operations were investigated.

Materials and Method

Tekirdağ was chosen as the exemplary city due to the regular and disciplined work of the fire department and the sensitivity of the city people to animals as well as the opportunity to access the records. The data of the animal rescue operations regarding the years 2019 and 2020 obtained from the Tekirdağ Metropolitan Municipality Fire Department were used in this study. The data were predominantly in the form of written reports with a content of the notifications of cases based on days, locations, information about the person making the notification, crime scene information, dispatch and arrival times of the teams, intervention times, operation results, animal species, case types and return times of the teams. The data were sorted and classified as numerical data for statistical analysis. The variables extracted from the different data sets were incidents by districts and month, case types, distribution of animal species, intervention time, results of the operations, and process after operations and incidents by species. Since the data of Süleymanpaşa, which is the central district, for the years 2019 and 2020 were more useful in terms of the diversity and amount, this district was focused on in the analyzes to compare the 2019 and 2020 cases. The data for 2020 was also evaluated within itself. There was no record based on the gender of the animals, therefore evaluations were made based on species. Time until the process is completed after reaching the scene was considered as the intervention time. The team involved in the operations gave information about the methods used during the rescue through face-to-face interviews. Regarding the team involved in the operations and methods used during operations, there was no personnel with special training in animal rescue and rescue was done with the tools they developed and the facilities available. The main equipment used was a dog catcher for dogs, catch net, carriers and cages for cats, rescue belts for cattle and some other tools like a bag, rope, cutting-separating scissors. There was no natural disaster during the rescue operations mentioned in this paper. Statistical analyzes regarding the descriptive statistics such as distribution of animal species by months, average intervention time and result of the operations by species were made using SPSS statistical package v25 (SPSS Inc., Chicago, IL, USA).

Results

Animal rescue operations across Tekirdağ city: Animal rescue operations were mostly centered in Süleymanpaşa (32.48%, n=865), Çorlu (23.17%, n=617) and Çerkezköy (15,85%, n=422) districts with a total percentage of 71.5% in 2020 (Fig 1). When the district population size is taken into consideration with the incident frequencies, more or less a similar picture was seen in the rank since Çorlu, Süleymanpaşa, and Çerkezköy were the most populated districts with 279.251, 203.617, and 185.234 people respectively in 2020 (Anonymous, 2021).

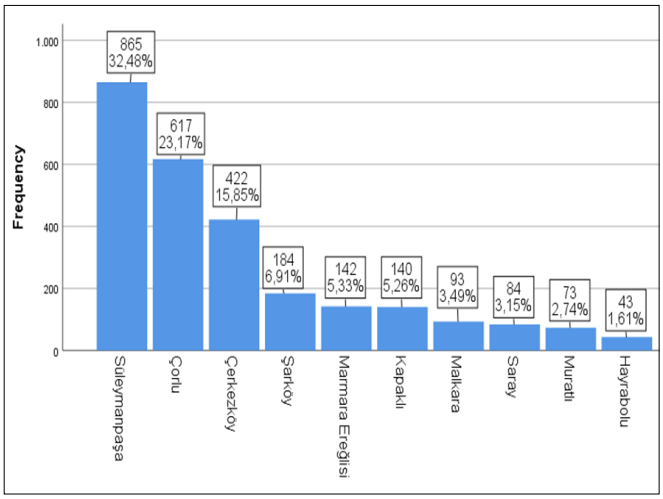


Figure 1. Distributions of the animal rescue incidents by districts

Looking at the distribution of operations within the year, it was seen that the frequency of the operations was significantly higher in the summer months (Figure 2).

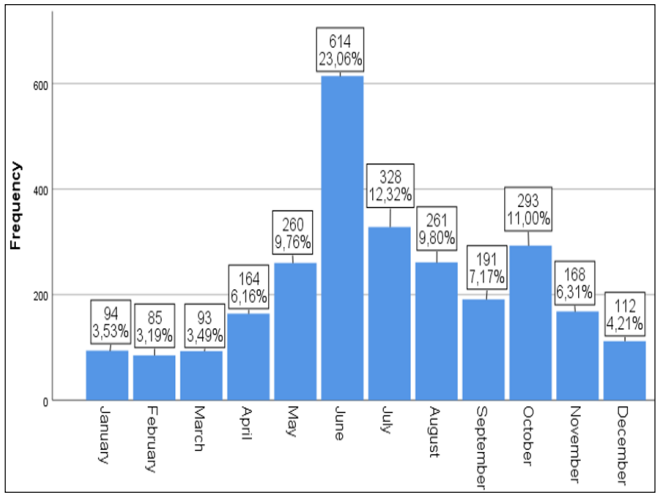


Figure 2. Distribution of the frequency of animal rescue cases by months in 2020.

Just over half (58%) of the calls were responding to cats, 23% birds including crow and seagulls, 7% snakes and 6% dogs. As can be seen from Table 1, cats were the most frequently reported animal species throughout the year in rescue operations.

Considering the response times, the rescue team immediately reached the scene in all cases in 2-10 min but the specific nature of the events led to the difference in the time of intervention. The average intervention time for species was approximately around half an hour during the rescue operations (Table 2). Data under 10 cases might not give correct information due to the variability of the situations.

Most of the rescue operations were ended successfully. A total of 2201 (82.7%) animals out of 2663 operations were saved while only 251 (9.4%) animals couldn't be saved, 141 (5.3%) could not be found, 13 were inaccessible (0.5%) and 6 of the notifications were false (0.2%) ones. In 13 cases (0.5%), the team was called back due to no intervention was required and two animals were found dead when the team reached the scene (Figure 3).

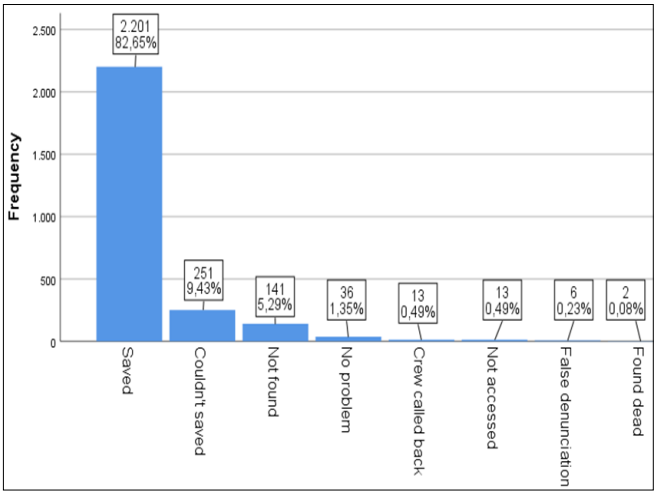


Figure 3. Distribution of the animal rescue results after rescue operations

After the rescue, animals were either released to nature or delivered to appropriate addresses. The majority of animals (2118; 79.5%) were released to nature while others were handed over to the owner (24; 0.9%), delivered to vet (31; 1.2%), shelter (35; 1.3%) or Forestry Waterworks (1; 0.04%). Nothing was done for the rest (454; 17.1%) due to not being found, being inaccessible or found dead (Figure 4).

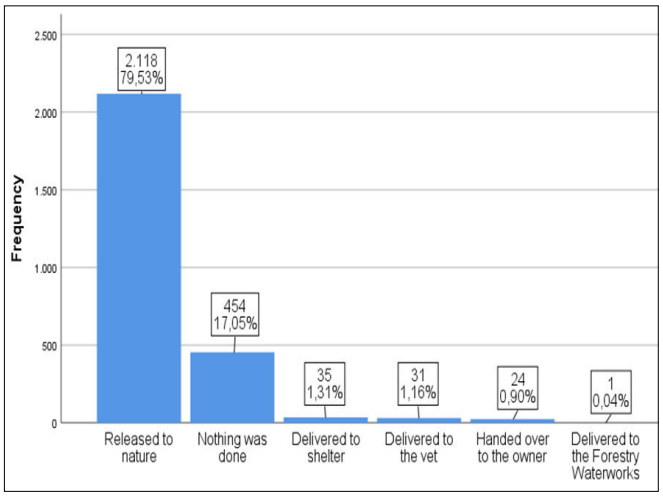


Figure 4. Distribution of the process applied after animal rescue operations

Animal rescue operations in the central district (Süleymanpaşa): Case types could be classified as falling into somewhere (an apartment, a ventilation space, sea, stream, pool), stuck in somewhere (tree, pole, vehicle, roof, chimney, wires, branches,

Table 1. Distribution of animal species by months in 2020

Species	Month												Total	%
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec		
Cat	68	64	52	77	137	266	165	166	121	228	132	77	1553	58.32
Bird	8	3	25	43	60	175	71	31	14	8	6	12	456	17.12
Snake	0	0	0	2	17	82	48	24	11	1	1	1	187	7.02
Dog	12	8	5	18	20	15	15	13	14	15	14	13	162	6.08
Crow	1	4	6	13	15	46	6	1	2	7	1	3	105	3.94
Seagull	2	2	3	4	5	14	7	3	7	7	2	3	59	2.22
Bat	0	0	1	2	0	7	5	11	11	3	3	0	43	1.61
Cattle	2	1	0	0	1	2	2	3	3	4	1	0	19	0.71
Sheep	0	0	0	2	0	0	5	2	1	0	1	0	11	0.41
Horse	0	1	0	2	0	1	3	2	0	3	0	0	12	0.45
Mouse	1	1	0	1	1	0	1	2	0	0	2	0	9	0.34
Hedgehog	0	0	0	0	2	3	0	1	1	0	0	0	7	0.26
Goat	0	0	0	0	1	1	0	0	0	0	0	0	2	0.08
Grasshopper	0	0	0	0	0	1	0	1	0	0	0	0	2	0.08
Weasel	0	0	1	0	1	0	0	0	0	0	0	0	2	0.08
Fox	0	1	0	0	0	0	0	0	0	1	0	0	2	0.08
Goose	0	0	0	0	0	0	0	1	0	1	0	0	2	0.08
Bee	0	0	0	0	0	1	0	0	0	0	0	0	1	0.04
Pigeon	0	0	0	0	0	0	0	0	4	11	6	1	22	0.83
Otter	0	0	0	0	0	0	0	0	1	0	0	0	1	0.04
Hawk	0	0	0	0	0	0	0	0	0	1	0	1	2	0.08
Duck	0	0	0	0	0	0	0	0	0	0	0	1	1	0.04
Dolphin	0	0	0	0	0	0	0	0	0	1	0	0	1	0.04
Parrot	0	0	0	0	0	0	0	0	1	1	0	0	2	0.08
Total	94	85	93	164	260	614	328	261	191	293	168	112	2663	100

transformer, pit, manhole, well, canal, swamp), being stranded in somewhere (a confined space, balcony, cliff), jamming in somewhere (a fence, wall, shutter, pipe), squeezed into something (stones, sea cliffs), free-range animal or wild animal in the residential area. This variety resulted in variable intervention time, equipment and post-operation process. When species diversity was added to the situation, each case seemed to have a different character. Therefore, a general view was given to provide the range and extent of challenges faced by rescue services personnel in their interactions with animals (Figure 5).

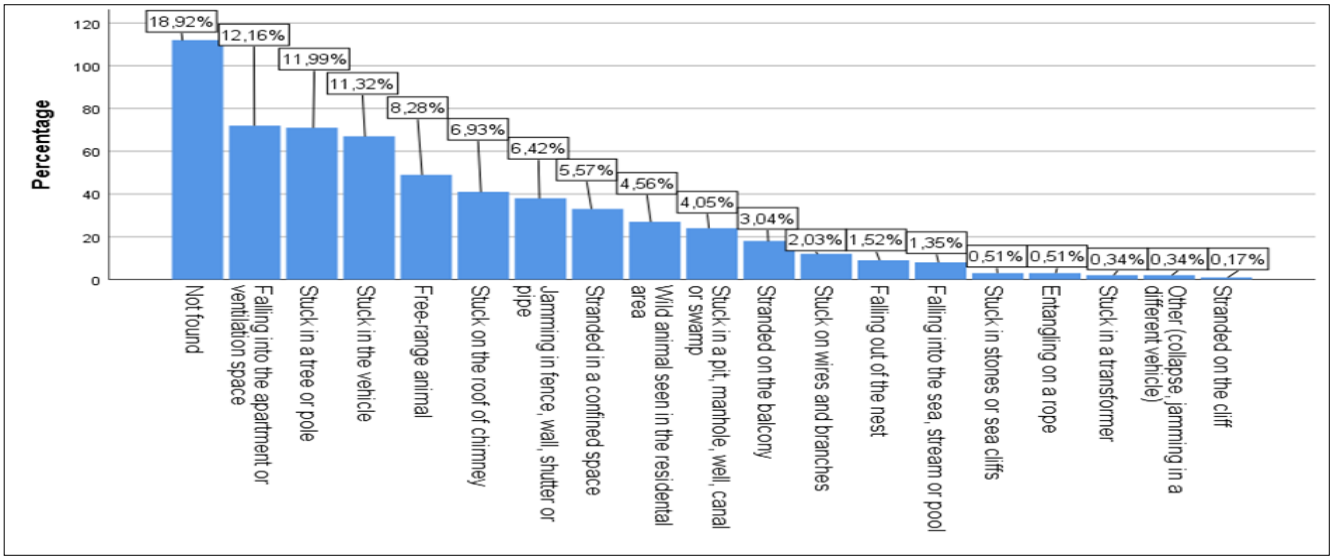


Figure 5. Occurrence of the animal rescue case types in the central district in 2019

Table 2. Average intervention time by species during animal rescue operations in 2020

Species	n	Intervention time (min) ±SD	Min	Max	Range
Cat	1553	25.54 ± 15.6	1	74	71
Bird	456	26.95 ± 14.2	2	72	70
Snake	187	29.19 ± 14.8	3	70	67
Dog	162	26.09 ± 15.6	3	70	67
Crow	105	28.37 ± 15.3	6	73	67
Seagull	59	22.95 ± 11.9	6	61	55
Bat	43	22.12 ± 11.3	4	51	47
Pigeon	22	32.45 ± 19.5	6	64	60
Cattle	19	37.95 ± 17.1	10	74	64
Sheep	11	29.36 ± 18.9	8	68	60
Horse	12	22.25 ± 17.8	4	60	56
Mouse	9	23.67 ± 8.5	9	37	28
Hedgehog	7	20.29 ± 23.0	6	71	65
Fox	2	22.50 ± 27.6	3	42	39
Goat	2	26.00 ± 1.4	25	27	2
Grasshopper	2	18.00 ± 2.8	16	20	4
Weasel	2	19.50 ± 0.7	19	20	1
Goat	2	26.00 ± 1.4	25	27	2
Goose	2	27.00 ± 29.7	6	48	42
Hawk	2	30.00 ± 16.9	18	42	24
Parrot	2	19.50 ± 6.4	15	24	11

The distribution of rescue operations by species for 2019 and 2020 is shown in Figure 6.

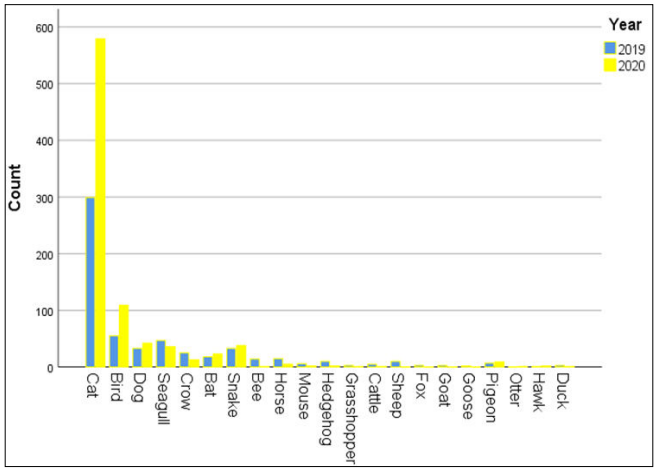


Figure 6. Comparing the incidents by species in the central district in 2019 and 2020.

In the face-to-face interviews, it was understood that many cases were based on the reports of citizens who could not fully define the incident whether urgent intervention was required due to lack of information. Among the indicators of this, animals saved by themselves, rescued by their owners, false denunciations, rescued by the citizens, free-range animals can be counted (Table 3).

After the rescue operations, most of the animals without health problems were released to nature, some of them were handed over to their owners, the injured ones were taken to the veterinarian and those in need of care were delivered to the animal shelter (Figure 7).

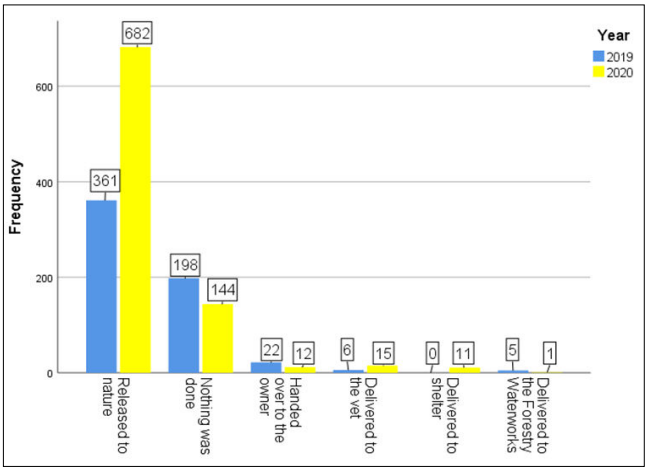


Figure 7. Comparing the process after rescue operations in the central district in 2019 and 2020

Table 3. Result of the operations by species during animal rescue operations

Species	Year	n	Saved	Survived itself	Owner saved	Died	Service called	Owner not permitted	Someone saved	No problem detected	Not found	Rescued wounded	False denunciation	Could not accessed
Cat	2019	374	248	8	0	2	6	5	3	45	5	2	50	0
	2020	579	474	59	35	4	2	0	5	0	0	0	0	0
Bird	2019	41	17	0	0	1	0	3	0	1	1	0	18	0
	2020	109	94	8	7	0	0	0	0	0	0	0	0	0
Snake	2019	17	15	0	0	0	0	0	0	0	0	0	2	0
	2020	38	29	4	5	0	0	0	0	0	0	0	0	0
Dog	2019	49	24	2	0	0	0	0	1	2	0	0	20	0
	2020	42	38	2	1	0	1	0	0	0	0	0	0	0
Crow	2019	26	23	0	0	0	0	0	0	0	0	0	3	0
	2020	13	12	1	0	0	0	0	0	0	0	0	0	0
Seagull	2019	41	40	0	0	0	0	0	0	0	0	1	0	0
	2020	36	31	4	0	0	0	0	1	0	0	0	0	0
Bat	2019	13	10	1	0	0	0	0	0	0	0	0	2	0
	2020	23	19	1	0	0	0	0	0	0	0	1	0	2
Cattle	2019	4	1	0	1	0	0	0	1	0	0	0	1	0
	2020	1	1	0	0	0	0	0	0	0	0	0	0	0
Sheep	2019	4	3	0	1	0	0	0	0	0	0	0	0	0
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0
Horse	2019	1	0	0	0	0	0	0	0	0	0	0	1	0
	2020	5	4	1	0	0	0	0	0	0	0	0	0	0
Mouse	2019	1	0	0	0	0	0	0	0	0	0	0	0	1
	2020	2	2	0	0	0	0	0	0	0	0	0	0	0
Hedgehog	2019	1	0	0	0	0	0	0	0	0	0	0	1	0
	2020	2	2	0	0	0	0	0	0	0	0	0	0	0
Goat	2019	2	1	0	0	0	0	0	0	0	0	0	1	0
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0
Grasshop-per	2019	0	0	0	0	0	0	0	0	0	0	0	0	0
	2020	1	1	0	0	0	0	0	0	0	0	0	0	0
Weasel	2019	2	1	0	0	0	0	0	0	0	0	0	1	0
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0
Fox	2019	2	1	0	0	0	0	0	0	0	0	0	1	0
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0
Goose	2019	1	0	0	0	0	0	0	0	0	0	0	1	0
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0
Bee	2019	0	0	0	0	0	0	0	0	0	0	0	0	0
	2020	1	0	1	0	0	0	0	0	0	0	0	0	0
Pigeon	2019	5	2	0	0	0	0	0	0	0	0	1	1	1
	2020	9	9	0	0	0	0	0	0	0	0	0	0	0
Otter	2019	0	0	0	0	0	0	0	0	0	0	0	0	0
	2020	1	1	0	0	0	0	0	0	0	0	0	0	0
Hawk	2019	0	0	0	0	0	0	0	0	0	0	0	0	0
	2020	2	2	0	0	0	0	0	0	0	0	0	0	0
Duck	2019	0	0	0	0	0	0	0	0	0	0	0	0	0
	2020	1	1	0	0	0	0	0	0	0	0	0	0	0
Parrot	2019	3	1	0	0	0	0	1	0	0	0	0	0	1
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0
Stork	2019	5	3	0	0	0	0	0	0	0	0	0	2	0
	2020	0	0	0	0	0	0	0	0	0	0	0	0	0

Discussion

The fact that there were significantly more animal rescue operations in crowded settlements (Çorlu, Süleymanpaşa and Çerkezköy), the extent to which the people were intertwined with animals and the predominantly species of rescued animals, such as cats and dogs, indicates that there was a high level of awareness towards them (Figure 1).

Under the current circumstances, it is difficult to say that animal rescue operations have been carried out professionally, considering both the profile of the rescue personnel and the equipment used. It is an undeniable fact that serious dedication has been given, but this job requires expertise and a structure that meets international standards on the basis of good models. Animal rescue operations need to be carried out by trained personnel who have the necessary competencies to not only handle animals but also work in an emergency response environment (Glassey 2010). This will result in successful management by synchronized behavior of the person, shorter time and accurate method.

Although not recorded regularly, according to the information obtained from the officials, approximately similar cases were encountered each year. These cases are also common in major disasters. However, there may be variations in the distribution of animal species.

Regarding the results of the current study, increased operations during the summer months (from 6% to 23%) are understandable in terms of the environmental changes for hibernating, grazing, hunting or migrating animals (Figure 2). Additionally, since it is the holiday season and people go out of the city, the surveillance of houses and street animals is weakening. Cats, dogs, crows, and seagulls were reported at the expected rate since these species are found in large numbers in the region. On the other hand, bees, otter, duck and dolphin were less numerous among all species. The difference in the number of the rescued animals reflects the existence and diversity of animal species close to humans in the city.

The most frequently reported animal species throughout the year (58%) in rescue operations showed that the cat has a greater place in people's social life and that humans interact most closely with cats (Table 1). While running away from dogs or playing with other cats, they climb walls, trees, roofs and enter narrow and secluded places. They are noticed more quickly due to their proximity to humans and their high displacement. Due to these active and mobile characteristics, it is one of the most difficult animal species to access in disasters. Many people are concerned about the pets and domestic animals that could not be evacuated simultaneously during disasters and therefore refuse to evacuate (Holcer et al. 2015). They are not considered unfair because animal rescue operations are not yet carried out professionally. On the other hand, since the city is by the sea, it is normal for birds such as crows and seagulls (23%) to be the subject of animal rescue operations due to their high amount. Snakes and bats were probably the most surprising animals ranking in the 3rd and 7th place and mostly reported in summer because it is not normal to see them in settlements.

Average intervention time by species during animal rescue operations gives information about what kind of situation will be faced while planning animal rescue operations, how long it will take to intervene in which cases, how many people will be needed for appropriate intervention. Therefore, intervention time should be properly recorded during routine practice. Data of similar cases belonging to the same species in this paper show that the incidents are not intervened by following certain protocols. It is thought that the gap between the minimum and maximum response time will decrease in cases where there are more professional interventions.

Considering the range of intervention times, there was a range of 1 minute to more than 1 hour (Table 2). The type of event, location of the incident and the environmental conditions were thought to be effective in that variability. Besides, it was not surprising that the time spent on rescued ones would be different from those who could not be rescued, not found, false reports and those found dead. The critical point here is to be able to make a fast and correct decision. Whether there is a serious problem in the reported case, which will be the most effective method in rescue situations and which equipment should be used will shorten the intervention time. Thus, the experience gained in routine applications can be used effectively in times of disaster.

One of the measures that can be considered to increase the success rate (82.7% in this case) is to find a solution for false notices (Figure 3). Both the false notifications and the reports made with the assumption that there is a problem cause time and labor loss. Since the fire department quickly arrived at the scene after each notification, it was not possible to verify the accuracy of the report. It is obvious that something is missing here or something needs to be fixed. Confirmation of the case through people other than those who made the report can provide a solution. Having a volunteer in each neighborhood and communicating with him quickly can be offered

offered as a suggestion or considering to get support from the headman might be helpful. However, since timing is very important in such events, a more effective suggestion is to use the technology effectively. Video communication, drone, security cameras can be used to verify the incident.

The release of the majority of rescued animals (2118; 79.5%) to nature who do not have visible health problems such as injury, bleeding, limitation of movement does not mean that all of them survived the incident without any problems (Figure 4). A correct assessment of the health status of these animals can only be made by a veterinarian. Considering the current situation, no veterinarians work actively in fire departments. Veterinarians take a role, if necessary, after the operations are completed. However, the nature of an incident may identify the level of competency of the rescue team. The person involved in the animal rescue must know how to approach the animal, be able to predict the reaction of the animal when feeling threatened or fearful. Sliding, lifting, carrying or manipulating an animal, either manually or with mechanical equipment requires technical information. On the other hand, the release or evacuation of an animal in an uncontrolled manner could worsen the existing incident or cause a secondary incident, resulting in harm to people or the animal. Moreover, it may be necessary to control or restrain the animal using physical or chemical methods. Monitoring food safety, prevention and management of infectious diseases are other issues in which vets take active roles. Before an incident is closed, the released or evacuated animal needs to be handed over to its owner, if appropriate. If the animal does not have an owner, it may need to be placed into the care of a veterinary surgeon, or other animal care specialist. Considering all these issues, as Lesch-Hollis (2008) reported, it is undoubtedly a fact that veterinarians play an important part in emergency management and should be integrated into emergency planning and response. Authorities responsible for rescue operations should employ veterinarians while developing their strategic risk management plans.

Taxonomic distributions of the rescued animals in the current study were composed of 69% mammals, 25% of birds and 7% of reptiles. Romero et al. (2019) reported that 86% of the rescued animals were birds, 12% were mammals and 2% were reptiles in Chile over 5 years. Swana et al. (2019) classified the rescued animal species as reptiles (43%), mammals (42%) and the remaining 15% representing amphibians and birds in Panama during the 2007-2010 period. The fact that different animal groups were the subject of operation in these studies was thought to be related to their habitats and environmental conditions.

Considering the distribution of cases, it is noteworthy that there was an increase in the number of cases with cat, bird, snake and bat species compared to the previous year (Fig 6). The rescue operation of each animal species will provide the opportunity to develop the experience specific to that species and to intervene quickly in case of need. These experiences are of particular importance in dealing with situations of despair or not knowing what to do, especially in major disasters. It also indicates which equipment will be used effectively.

There is a need to create an online digital database for all animal rescue operations throughout the country with one standard entry form for effective preparations for disasters. This could facilitate the evaluation of the magnitude of the disaster problem and allow assessment of strategies aiming to reduce hazards that occur in the future. More participation in animal rescue activities may occur when people attribute similar meanings to events (Every et al. 2016). All kinds of information, which could be easily obtained before a disaster, could prove vital to those responding to a disaster (Darroch and Adamson 2016). If the rescue activities carried out by institutions such as the fire brigade are regularly recorded and shared with stakeholders, the possibility of being prepared for bigger disasters increases. In this context, detailed records regarding the animal rescue operations should be properly and digitally kept and shared at the national level. On the other hand, all personnel working in animal rescue operations should be trained in issues of conscious rescue practice.

Another noteworthy issue is the animals left behind during disasters because of a lack of suitable places for them. The ability to overcome such problems depends on taking precautions before disaster strikes. In current practice, rescued animals are often released into nature. If suddenly there are massive needs for care, feeding and housing, there is no means to respond. This indicates a weakness in the management of animals in disasters and emergencies after the rescue. In the same context, McCarthy and Taylor (2018) indicated that many people were not still motivated to do training before an event creating considerations of how to resource future responses.

Most of the data presented in this study was obtained and analyzed through written documents

(incident reports). The reason why this and similar information is not available in the digital environment is thought to be that it is not known or needed for what purpose it will be used in practice. In a world where the importance of data-based information is increasing day by day, the fact that such important information is only in written documents makes them useless. Since all disaster response begins at the local level, the transition to a more professional system will also be shaped in parallel with the developments at the local level. International standards also need to be established step by step by providing correct and detailed information to the rescue teams of each district. In this context, readiness, response and recovery stages should be developed by rehearsing at the local level and applied to large events for better incident management comprehension. It is hoped that the results from this study will contribute to guiding the development of a regular reporting system and establishing appropriate infrastructures for disaster preparedness.

Conclusions

For more effective animal rescue, appropriate infrastructure should be established, records should be properly and digitally kept and shared at the national level and veterinarians should be included in the rescue team. Assessment of the health status of the rescued animals, verifying the accuracy of the notifications and taking precautions before disaster strikes should be considered in animal emergency management.

References

Anonymous (2021). Population of Tekirdağ districts (Tekirdağ İlçeleri Nüfusu). https:// www.nufusu.com/ilceleri/tekirdag-ilceleri-nufusu (accessed 29 April 2021).

Aslım, G., & Biricik, H. S. (2018). Evaluation of "animal rescue" in Turkey. *Ankara Üniversitesi Veteriner Fakültesi Dergisi,* 65, 15-19.

Darroch, J., & Adamson, C. (2016). Companion animals and disasters: The role of human services organisations. *Aotearoa New Zealand Social Work, 28*(4), 100-108.

Every, D., Due, C., Thompson, K., & Ryan, J. (2016). Conflicting perspectives on nonhuman animal rescues in natural disasters. *Society and Animals, 24*(4), 358-382.

Farmer, A. K., DeYoung, S. E., & Wachtendorf, T. (2016). Pets and evacuation: An ongoing challenge in disasters. *Journal of Homeland Security and Emergency Management, 13*(4), 13.

Glassey, S. (2010). Recommendations to enhance companion animal emergency management in New Zealand, Wellington: Mercalli Disaster Management Consulting.

Glassey, S. (2020). Lessons from USA summit can help protect animals and people. *Australian Journal of Emergency Management, 35*(1), 16-17.

Holcer, N. J., Jeličić, P., Bujević, M.G., & Važanić, D. (2015). Health protection and risks for rescuers in cases of floods. *Arhiv za Higijenu Rada i Toksikologiju, 66*, 9-13.

Irvine, L. (2006). Animals in Disasters: Issues for Animal Liberation Activism and Policy. *Animal Liberation Philosophy and Policy Journal, 4*(1).

Knight, A. P. (2009). *Elements of a disaster plan for animals. Veterinary disaster response*. (edited by) Wingfield WE, Palmer SB, Wiley Blackwell, Iowa, USA, ISBN: 978-0-8138-1014-0

Lesch-Hollis, A. (2008). Thoughts on protecting veterinary responders following natural disasters. *Journal of the American Veterinary Medical Association, 232*(8), 1131.

McCarthy, M., & Taylor, M. (2018). Animal emergency management in South Australia: a case study of the Sampson Flat bushfire. *Australian Journal of Emergency Management, 33*(2), 60-65.

Romero, F., Espinoza, A., Sallaberry-Pincheira, N., & Napolitano, C. (2019). A five-year retrospective study on patterns of casuistry and insights on the current status of wildlife rescue and rehabilitation centers in Chile. *Revista Chilena de Historia Natural,* 92, 6.

Swana, J. L., Carvera, A., Correac, N., & Nielsen, C. K. (2019). Wildlife rescue and relocation efforts associated with the Panama Canal Third Locks Expansion Project. *Tropical Zoology, 32*(2), 58-79.

Thompson, K. (2018). Facing disasters together: how keeping animals safe benefits humans before, during and after natural disasters. Revue *Scientifique et Technique (International Office of Epizootics), 37*(1), 223-230.

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Some foodborne and waterborne protozoa

Güneş Dinç

Ataşehir, İstanbul, Türkiye. Güneş Dinç: ORCID: 0000-0001-7564-516X

Review Article

Volume: 5, Issue: 2
August 2021
Pages: 107-112

Article History

Received: 12.06.2021
Accepted: 02.08.2021
Available online: 25.08.2021

ABSTRACT

Pathogenic parasites including helminths and protozoa are responsible for foodborne diseases in developed and developing countries. Reports of foodborne and waterborne protozoan infections are very rare. Food and waterborne zoonotic protozoa and their transmission stages are listed in this review and it is aimed to give brief information about the food-borne zoonotic protozoa.

Keywords: food-borne, parasite, protozoa, water-borne, zoonosis.

DOI: https://doi.org/10.30704/http-www-jivs-net.948361

To cite this article: Dinç, G. (2021). Some foodborne and waterborne protozoa. ***Journal of Istanbul Veterinary Sciences, 5 (2),*** 107-112 **Abbreviated Title*: J. İstanbul vet. sci.***

Introduction

Pathogenic parasites including helminths and protozoa are responsible for foodborne diseases in developed and developing countries (Torgerson et al., 2015). Some reports of foodborne and waterborne protozoan infections are found. *Balantidium coli* is one of the most prevalent protozoans in humans (Ronald, 2001). *Giardia intestinalis* has been described more frequently than other pathogens in waterborne outbreaks in the United States (Ronald, 2001). There is also an increase in parasitic foodborne outbreaks in developed and developing countries due to the increasing consumption of fresh vegetables and fruits (Amoah et al., 2007; Dixon, 2015). Various parasites have been detected in ready-to-eat (RTE) food (Caradonna et al., 2017). For example, an outbreak of foodborne cryptosporidiosis was associated with contamination of ready-to-eat salads in the UK in 2012 (McKerr et al., 2015). This case reflects that the infectious stages of the parasite can be highly resistant to cleaning and disinfection processes used in food production (Almeria Seal, 2021). Foodborne parasites can be passed on to new hosts including humans by several ways including consuming some tissues of infected mammals, fish or invertebrates, contaminated fruit and vegetables, and drinking waters contaminated infectious stages of different parasites (WHO, 2014). Table1 lists food and waterborne protozoan parasites. In this review, it is aimed to give brief information about some food- and waterborne zoonotic protozoa.

Some food- and waterborne zoonotic protozoa and their transmission stages are listed in Table 1.

Toxoplasma gondii

The members of Felidae including cats are the final hosts of Toxoplasma gondii. Intermediate hosts consisted of a lot of domestic and wild ruminant animals such as sheep, goat, pigs, cattle, cats, dogs, rodents, poultry, rabbits, marine mammals and humans. *Toxoplasma gondii* is known to have three infectious stages: tachyzoite, bradyzoite (within tissue cyst) and sporozoite (within oocyst) (Dubey, 2010). Sexual development occurs only in the intestinal epithelial cells of Felidae. Oocysts only excrete with the final host's feces. After completed the sporogony stage in a very short time in the outside, the oocyst become infectious for the intermediate hosts (Guy et al., 2012). Asexual development of the parasite occurs in the many tissues of the intermediate hosts. During acute infection, tachyzoites are found in nearly all cells of the organism. Tissue cysts develop in intracellularly in

*Corresponding Author: Güneş Dinç
E-mail: gunes_karakurt@hotmail.com

Journal home page: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net

Table 1. Parasite species main food sources and infective parasite forms. (WHO, 2014).

Parasite	Food/Water	Stage
Toxoplasma gondii	Ruminant, Pork, Beef, Game Meat (Meat and Organs)	Bradyzoites
Toxoplasma gondii	Water	Oocysts
Toxoplasma gondii	Fresh Produce	Oocysts
Toxoplasma gondii	Milk	Tachyzoites
Cryptosporidium spp.	Water	Oocysts
Cryptosporidium spp.	Fresh Produce	Oocysts
Cryptosporidium spp.	Fruit Juice	Oocysts
Cryptosporidium spp.	Milk	Oocysts
Giardia intestinalis	Water	Cysts
Giardia intestinalis	Fresh Produce	Cysts
Entamoeba histolytica	Water	Cysts
Entamoeba histolytica	Fresh Produce	Cysts
Balantidium coli	Fresh Produce	Cysts
Balantidium coli	Water	Cysts
Cyclospora cayetanensis	Water	Oocyst
Cyclospora cayetanensis	Fresh Produce (Berries)	Oocyst
Sarcocystis spp.	Beef, Pork Meat	Bradyzoites
Trypanosoma cruzi	Fruit Juice	Trypomastigotes

ranged between 5 µm to 100 µm in size. The tissue cysts are responsible for prevalence of toxoplasmosis in humans (Kijlstra and Jongert, 2008). The main transmission route of toxoplasmosis in humans and animals is considered to be carnivorism. Humans and carnivorous animals become infected by consuming the raw or undercooked meat of intermediate host such as sheep and pigs that contain tissue cysts (Kijlstra and Jongert, 2008).

The clinical picture in Toxoplasma infections is related to the immune status of the person. In general, clinical symptoms may cause mild to moderate illness, including low-grade fever, fatigue, sore throat, myalgia, lymphadenopathy, and headache (Petersan et al.,2012). Although clinical symptoms do not develop in latent infections, it has been determined that it can be a factor that contributes or even causes various psychological disorders such as depression, anxiety and schizophrenia (Henriquez et al., 2009; Flegr, 2013).

Considering the situation of the disease in Turkey, in a study conducted in Istanbul, tests were performed in 23,731 cases who applied with the request of *T. gondii* IgM/IgG antibody test between 2013 and 2018. *Toxoplasma gondii* IgG positive rate was 32.5% and IgM positive rate was 2.2% (Demir et al., 2020). Again, in the Black Sea region, the IgG positivity of toxoplasmosis was determined as 14.5% only in pregnant women (Eroglu and Asgin, 2020). As seen in these studies, the parasite, which is not insignificant in Turkey, is thought to be transmitted by contaminated raw meat, mostly due to eating habits, as mentioned above.

Cryptosporidium spp.

Cryptosporidium species, apicomplexan parasites, possess monoxene life cycle. The parasites inhabit in the gastrointestinal epithelium of numerous vertebrate species, including humans (Egyed et al., 2003). Asexual, sexual development, and also sporogony are observed within the host (Fayer et al., 2008). Infection begins after ingestion of some food or drink water contaminated with oocysts excreted by the feces of infected animals or humans infected with zoonotic *Cryptosporidium* spp. (Ülgen and Balcıoğlu, 2007). People working in livestock, veterinarians, laboratory personnel, children and the elderly, and those traveling to endemic areas are risky groups. Development of clinical signs are often related to immunity of the host. The percentage of infection is high in people living in areas with inadequate hygienic conditions and in close contact with infected people. Outbreaks of cryptosporidiosis originating from public swimming pools, communal large meals, well water, and unhygienic drinking water sources have been reported (Miron et al. 1991; Çeliksöz and Çelik, 2003). Disease symptoms; watery diarrhea, abdominal pain, weight loss, nausea, vomiting, fever and malaise (Chalmers and Davies, 2010).

Considering the situation of cryptosporidiosis in Turkey, between 2010 and 2018, 723 samples were

studied in Van Province with the ELISA method with the suspicion of cryptosporidiosis. *Cryptosporidium* spp. antigen positive was detected in 2.8% of the samples (Bayhan and Yilmaz, 2020). In another study conducted in Malatya, the prevalence of *Cryptosporidium* in fungal patients was determined to be 11.4% (Erturk et al., 2021).

Giardia intestinalis

Giardia intestinalis has a wide range of hosts, such as humans, ruminants and other mammals (Thompson, 2004; Ryan and Caccio, 2013; Bilgic et al. 2020). Worldwide, *G. intestinalis* is one of the ten most common enteric parasites in humans (Sulaiman and Cama 2006). The main risk factors are food and water contaminated with *G. intestinalis* cysts. Other associated risk factors are; poor living conditions, polluted environment, low socioeconomic income and poor sewerage systems (Savioli et al. 2006; Naz et al. 2018). Giardiasis is on the "Neglected Diseases" list of the World Health Organization due to its effects on public health, especially in developing countries (Savioli et al. 2006).

Although it is not yet fully understood why some individuals develop clinical giardiasis while others do not, host factors and strain variants are thought to have an effect. Giardia causes a disease characterized by diarrhea, abdominal cramps, weight loss and malabsorption (Caeiro et al., 1999; Cantey et al., 2011).

In a study conducted in İzmir, Turkey between 2014-2018, the rate of *G. intestinalis* was determined as 11.4% (Bilman and Yetik, 2019).

Entamoeba histolytica

Entamoeba histolytica is an intestinal protozoan that has been identified as a secondary cause of protozoan death worldwide (Haque et al., 2003; Stanley, 2003). The parasite possess monoxene life cycle. Humans and some primates act as hosts in the life cycle. Infection is generally developed after ingestion of water or food contaminated with *E. histolytica* cysts (Weinke et al.,1990; Nozaki, 2000).

Less than 10% of *E. histolytica* infections in humans develop symptoms (Haque et al., 2003; Stanley, 2003; Ali and Nozaki, 2007). Clinical symptoms of amoebic colitis; mucoid stools, bloody diarrhea, abdominal pain and tenderness. Fulminant amoebic colitis is characterized by severe bloody diarrhea, fever, severe abdominal pain and marked leukocytosis. Amoebic liver abscess is the most common extraintestinal manifestation. Symptoms associated with amoebic liver abscess; right upper abdomen pain, fever, hepatic tenderness and sometimes cough, loss of appetite and weight loss. Occasionally, pleuropulmonary amoebiasis, amoebic brain abscess, and amoebic skin abscess may also occur (IASR, 2007).

In a study conducted in İzmir, Turkey between 2014-2018, *E. histolytica* was found to be positive with a rate of 12.9% (Bilman and Yetik, 2019).

Balantidium coli

Balantidium coli is a species of protozoan parasite that is pathogenic in humans (CDC, no date; Anon., 2003a). *Balantidium coli* is localized in the caecum and colon. *Balantidium coli* has two developmental stages; trophozoite and cyst. Trophozoites proliferate and become cysts in the intestines. Humans are infected consuming food or water contaminated with the cysts. If the balance develops between the parasite and host, clinical signs may not be seen in infected humans. The infection is most likely to occur in people who are malnourished, with low stomach acid, or in people with weakened immune systems (Anon., 2003b; Schuster and Ramirez-Avila, 2008).

Common symptoms of infection; chronic diarrhea, nausea, occasional dysentery (diarrhea with the passage of blood and mucus), halitosis, colitis, abdominal pain, weight loss, deep intestinal ulcers and possibly intestinal perforation. Bleeding may occur in fulminant acute balantidiasis, which can lead to shock and death. It is reported that there is a 30% mortality rate in untreated acute diseases. If the disease is left untreated, diarrhea leads to high fluid loss and dehydration, and if abdominal bleeding occurs it can lead to death (Schuster and Ramirez-Avila, 2008).

In the study conducted in Hatay province between 2006 and 2010, the positive rate of *Balantidium coli* was determined as 0.1% (Culha and Gulhan, 2011).

Cyclospora cayetanensis

Cyclospora cayetanensis, a coccidian, can be transmitted by ingestion through contaminated raw products (vegetables, herbs and fruits) and drinking water. Asexual and sexual development occur in the epithelium of the small intestine and oocysts excreted with feces (Ortega and Sanchez, 2010). The oocysts have been identified in some waters that used for human consumption (Rabold et al., 1994). Moreover, foodborne contamination has been reported more frequently than waterborne transmission. Foodborne contamination has been associated with basil, snow peas, strawberries (raspberries and blackberries) and lettuce (Shields and Olson, 2003).

The disease is characterized by watery diarrhea, abdominal pain, nausea and anorexia. Biliary disease, Reiter's Syndrome and Guillain-Barrè Syndrome have been reported to develop after Cyclospora infections

(Ortega and Sanchez, 2010). In the study conducted in Van Province in Turkey 2018-2019, the detection rate of *C. cayetanensis* was found to be 12% (Ekici et al., 2021).

Sarcocystis spp.

Protozoans of the genus *Sarcocystis* are obligate intracellular parasites, with two-host life cycles. The final hosts of this parasite are carnivores and humans, intermediate hosts are usually cattle, sheep, goats, poultry, pigs whose meat is consumed by the final host. Intestinal sarcocytosis in humans is known to be caused by the species *Sarcocystis hominis* and *S. suihominis*, in which humans are the final hosts of the parasites (Fayer et al., 2004; Saki et al., 2010). In intermediate hosts, sarcocytes are mostly found in striated muscles, oesophagus, diaphragm, tongue, pharynx, larynx and skeletal muscles (Lindsay et al., 1995). Infection in humans occurs by consuming raw or undercooked beef and pork containing cysts (Fayer et al., 2004).

As a conclusion, food- and waterborne parasitic diseases are most important for humans in the world. The importance of these diseases will increase in the future, especially due to the decrease in clean water resources.

There is no publications recently on human sarcosporidiosis cases were found in Turkey.

Trypanosoma cruzi

Chagas disease or American trypanosomiasis is a human infection in the Americas caused by the vector-borne protozoan parasite *Trypanosoma cruzi*. In addition to vectors, the transmission of the disease includes transfusion, congenital and oral routes. (WHO, 2003; Bern et al., 2011). Outbreaks have been reported in endemic areas of the Americas (Brazil, Colombia and Venezuela), caused by blood transfusions and orally consumed contaminated fruit, sugarcane, and palm wines (Nóbrega et al., 2009; PAHO, 2009 Alarcón de Noya et al., 2010; Dias et al. 2011; Toso et al. 2011).

There is no publications on human T. cruzi cases were found in Turkey.

References

Ali, V., & Nozaki, T. (2007). Current therapeutics, their problems, and sulfur-containingamino-acid metabolism as a novel target against infections by “amitochondriate” protozoan parasites. *Clinical Microbiology Reviews, 20,* 164-187.

Almeria, S., Robertson, L., & Santin, M. (2021). Why foodborne and waterborne parasites are important for veterinarians. *Research in Veterinary Science 136,* 198-199.

Amoah, P., Drechsel, P., Henseler, M., & Abaidoo, R. C. (2007). Irrigated urban vegetable production in Ghana: microbiological contamination in farms and markets and associated consumer risk groups. *Journal of Water and Health 5*, 455-466.

Anonymous. (2003a). Balantidium coli. -e Disease: Balantidiasis. Introduction. http:// www.stanford.edu/group/parasites/ParaSites2003/ Balantidium/Balantidium_coli_ParaSite.htm.

Anonymous (2003b). Balantidium coli. -e Disease: Balantidiasis. Morphology.

http://www.stanford.edu/group/parasites/ ParaSites2003/Balantidium/Morphology.htm

Bern, C., Kjos, S., Yabsley, M. J., & Montgomery, S. P. (2011). Trypanosoma cruzi and Chagas’ Disease in the United States. *Clinical Microbiology Reviews, 24* (4): 655-681.

Beyhan, Y. E., & Yılmaz, H. (2020). Dışkı örneklerinde Cryptosporidium spp. antijen varlığının ELISA yöntemi ile araştırılması: Dokuz yıllık değerlendirme. *Turkiye Parazitol Dergisi, 44*(2), 68-71.

Bilgic, B., Bayrakal, A., Dokuzeylul B, Dodurka T, & Or ME (2020). Zoonotic importance of giardia spp. infections in asymptomatic dogs. *Van Veterinary Journal. 31*(3), 158-160.

Bilman, B. F., & Yetik, M. (2019). Bağırsak parazitlerinin epidemiyolojisi: Beş yıllık değerlendirme, *İstanbul Kanuni Sultan Süleyman Tıp Dergisi, 11,* 184-189.

Caradonna, T., Marangi, M., Del Chierico, F., Ferrari, N., Reddel, S., Bracaglia, G., Normanno, G., Putignani, L., & Giangaspero, A. (2017). Detection and prevalence of protozoan parasites in ready-to-eat packaged salads on sale in Italy. *Food Microbiolgy, 67,* 67–75.

Caeiro, J. P., Mathewson, J. J., Smith, M. A., Jiang, Z. D., Kaplan, M. A., & Dupont, H. L. (1999). Etiology of outpatient pediatric nondysenteric diarrhea: a multicenter study in the United States. *Pediatric Infectious Disease Journal, 18(*2), 94-97.

Cantey, P. T., Roy, S., Lee, B., Cronquist, A., Smith, K., Liang, J., & Beach, M. J. (2011). Study of nonoutbreak giardiasis: novel findings and implications for research. *American Medical Journal, 124*(12), 1175.e1-8.

CDC (Centres for Disease Control and Prevention). (2020). Parasites and Health: Balantidiasis [Balantidium coli]. Online. See: http://

Accessed 2013-06-18.

Chalmers, R. M., & Davies, A. P. (2010). Minireview: clinical cryptosporidiosis. *Experimental Parasitology, 124*, 138-146.

Çeliksöz, A., & Çelik, S. (2003). Cumhuriyet Üniversitesi Hastanesi'nde gastroenteritli ve malnütrisyonlu hastalarda Cryptosporidium spp. Araştırması. *Türkiye Parazitoloji Dergisi. 27,* 85-88.

Çulha, G., & Gülkan, B. (2011). 2006-2010 yıllarında Mustafa Kemal Üniversitesi Tıp Fakültesi Parazitoloji Laboratuvarı'na başvuran hastalarda bağırsak parazitlerinin dağılımı. *Türk Hijyen ve Deneysel Biyoloji Dergisi, 68*(4), 165-174.

Demir, E., Dinç, H. Ö., Özbey, D., Akkuş, S., Ergin, S., & Kocazeybek, B. S. (2020). İÜ-C Cerrahpaşa Tıp Fakültesi Hastanesi'ne başvuran hastalarda, 2013-2018 yılları arasında toxoplasma gondii, rubella ve sitomegalovirus seropozitifliği ile avidite test sonuçlarının retrospektif olarak değerlendirilmesi. *Türk Mikrobiyoloji Cemiyeti Dergisi, 50*(1), 35-43

Dias, J. C., Amato Neto V., & Luna, E. J. (2011). Alternative transmission mechanisms of Trypanosoma cruzi in Brazil and proposals for their prevention Article in Portuguese, *Revista da Sociedad Brasileira de Medicina Tropical, 44*(3), 375-379.

Dixon, B. R. (2015). *Transmission dynamics of foodborne parasites on fresh produce (chapter 13).* In: Gajadhar, A.A. (Ed.), Foodborne Parasites in the Food Supply Web. Woodhead Publishing Series in Food Science, Technology and Nutrition. Woodhead Publishing, pp. 317-353.

Dubey, J. P. (2010). *Toxoplasmosis of Animals and Humans. 2 nd ed.* Boca Raton, FL: CRC Press.

Egyed, Z., Sréter, T., Széll, Z., & Vargab, I. (2003). Characterization of Cryptosporidium spp.—recent developments and future needs. *Veterinary Parasitology, 13*, 103-114.

Ekici, A., Ünlü, A. H., Yılmaz, H., Tas, C. Z., & Beyhan Y. E. (2021). Investigation of Cyclospora cayetanensis by modified acid-fast staining and nested PCR in some patient groups. *Parasitologists United Journal,* doi: 10.21608/PUJ.2021.55459.1101

Eroglu, S., & Asgin, N. (2020). Awareness, knowledge and risk factors of Toxoplasma gondii infection among pregnant women in the Western Black Sea region of Turkey, *Journal of Obstetrics and Gynaecology,* DOI: 10.1080/01443615.2020.1789954

Erturk, E. Y., Karaman, U., Colak, C., Direkel, S., & Arici, Y. K. (2021). Prevalence of Cyclospora cayetanensis and Cryptosporidium spp. children according to some variables*. Medicine, 10*(2), 338-345.

Fayer, R. (2004). Sarcosystis spp. in human infections. *Clinical Microbiology Reviews. 17*, 894-902.

Fayer, R., Santin, M., & Trout, J. M. (2008). Cryptosporidium ryanae n. sp. (Apicomplexa:Cryptosporidiidae) in cattle (Bos taurus). *Veterinary Parasitology. 156*, 191-198.

Flegr, J. (2013). How and why Toxoplasma makes us crazy. Trends in Parasitology, 29(4): 156–163.

Guy, E., Dubey, J. P., & Hill, D. E. (2012). *Toxoplasma gondii. pp.* 167–188 (Ch. 6), in: L.J. Robertson and H.V. Smith (editors). Food-borne Protozoan Parasites. Nova Biomedical.

Haque, R., Huston, C. D., Hughes, M., Houpt, E., & Petri, W. A. Jr. (2003). Amebiasis. *New England Journal of Medicine. 348*, 1565-1573.

Henriquez,, S. A., Brett, R., Alexander, J., & Pratt, J., Roberts, C. W. (2009). Neuropsychiatric disease and Toxoplasma gondii infection. *Neuroimmunomodulation, 16*, 122-133.

Hill, D. E., Chirukandoth, S., & Dubey, J. P. (2005). Biology and epidemiology of Toxoplasma gondii in man and animals, *Animal Health Research Reviews. 6*(1):41-61.

IASR (Infectious Agents Surveillance Reports). (2007). Amoebiasis 2003–2006. *Infectious Agent Surveillance Reports*, *28*, 103-104.

Kijlstra, A., & Jongert, E. (2008). Control of the risk of human toxoplasmosis transmitted by meat. *International Journal for Parasitology. 38*, 1359-1370.

Lindsay, D. S., Blagburn, B. L., & Braund, K. G. (1995). Sarcocystis spp. and sarcocystosis. *Basic Applied Myology. 5*, 249-254.

McKerr, C., Adak, G. K., Nichols, G., Gorton, R., Chalmers, R. M., Kafatos, G., Cosford, P., Charlett, A., Reacher, M., Pollock, K. G., Alexander, C. L., & Morton, S. (2015). An outbreak of Cryptosporidium parvum across England and Scotland associated with consumption of fresh pre-cut salad leaves, *PLoS One 10*, e0125955.

Miron, D., Kenes J., & Dagan, R. (1991) Calves as a source of an outbreak of cryptosporidiosis among young children in an agricultural closed community. *Pediatr Infect Disorders Journey. 10*, 438-441

Naz, A., Nawaz, Z., Rasool, M. H., & Zahoor, M. A. (2018) Cross-sectional epidemiological investigations of Giardia lamblia in children in Pakistan. *Sao Paulo Medical Journal. 136*, 449-53.

açaí palm fruit, Brazil. Emerging Infectious *Diseases, 15*(4), 653–655.

Nozaki, T. (2000). Current problems of amebiasis in Japan and recent advances in amebiasis research. *Japan Journal of Infectious Disease. 53,* 229–237.

Ortega, Y. R., & Sanchez, R. (2010). Update on Cyclospora cayetanensis, a food-borne and waterborne parasite. *Clinical Microbiology Reviews, 23,* 218-234.

PAHO/WHO (2012). Fact sheet. Estimación cuantitativa de la enfermedad de Chagas en las Américas, In Spanish Doc. OPS/HDM/CD/425.06. Available at http://new. paho.org/hq/index.php?option =com_ content&view=article&id=5856&Itemid=41 96&lang =es Accessed 2013-06-23.

Toso M., A., Vial F., U., & Galanti, N. (2011). Oral transmission of Chagas' disease. *Revista Medica de Chile, 139*(2), 258-266.

Petersen, E., Kijlstra, A., & Stanford, M. (2012). Epidemiology of ocular toxoplasmosis. Ocular *Immunology and Inflammation, 20*(2), 68–75.

Rabold, J. G., Hoge, C. W., Shlim, D. R., Ke-ord, C., Rajah, R., & Echeverria, P. (1994). Cyclospora outbreak associated with chlorinated drinking water. *Lancet, 344*, 1360–1361.

Saki, C. E., Değer, S., & Özer, E. (2010). Sarcosporidiosis in Turkey. *Yüzüncü Yıl Üniversitesi Veteriner Fakültesi Dergisi. 21*, 129-134.

Savioli, L., Smith, H., & Thompson, A. (2006). Giardia and Cryptosporidium join the 'Neglected Diseases Initiative'. *Trends Parasitol. 22*, 203-208.

Schuster, F. L., & Ramirez-Avila, L. (2008). Current world status of Balantidium coli. *Clinical Microbiology Review, 21*(4), 626–638.

Shields, J. M., & Olson, B. H. (2003). Cyclospora cayetanensis: a review of an emerging parasitic coccidian. *International Journal of Parasitology, 33*, 371-391.

Stanley, S. L. Jr. (2003). Amoebiasis. *Lancet. 361*(9362): 1025–1034.

Sulaiman, I. M., & Cama, V. (2006) *The biology of Giardia parasites. Foodborne parasites*: Springer. p.15-32.

Thompson, R. C. A. (2004). The zoonotic significance and molecular epidemiology of Giardia and giardiasis. *Veterinary Parasitology. 126*, 15-35.

Torgerson , P. R., Devleesschauwer, B., Praet, N., Speybroeck, N., Willingham, A. L., Ryan U, & Cacciò SM. (2013). Zoonotic potential of Giardia. *International Journal for Parasitology. 43(*12-13), 943-56.

Ülgen, Z., & Balcıoğlu, İ. C. (2007). Cryptosporidiosis. Özcel'in Tıbbi Parazit Hastalıkları. *Tıbbi Parazitoloji Derneği,* 363-376.

Weinke, T., Friedrich-Jaenicke, B., Hopp, P., Janitschke, K. (1990). Prevalence and clinical importance of Entamoeba histolytica in two high-risk groups: travellers returning from the tropics and male homosexuals. *Journal of Infectious Diseases. 161*, 1029–1031.

WHO. 2003. Control of Chagas disease: second report of the WHO Expert Committee. Prepared by WHO Expert Committee on the control of chagas disease. OMS serie de informes técnicos, no. 905. 117 p. Available at http://apps.who.int/iris/ bitstream/10665/42738/1/WHO_TRS_905_spa.pdf Accessed 2013-06-23.

WHO. (2014) Food and Agriculture Organization of the United Nations/World Health Organization] Multicriteria-based ranking for risk management of food-borne parasites. Rome. 302 pp.

JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Postnatal development of duodenum in broiler

Sabuj Kanti Nath[1], Swarup Kumar Kundu[2]*, Mohi Uddin[3]

1. Department of Animal Nutrition, Faculty of Veterinary, Animal and Biomedical Sciences, Khulna Agricultural University, Khulna-9202, Bangladesh.

2. Department of Anatomy and Histology, Faculty of Veterinary, Animal and Biomedical Sciences, Khulna Agricultural University, Khulna-9202, Bangladesh.

3. Department of Anatomy and Histology, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Science University (CVASU), Bangladesh.

Nath S K. ORCID: 0000-0002-4930-7519, Kundu S. K. ORCID: 0000-0003-2951-2010.

Research Article

Volume: 5, Issue: 2
August 2021
Pages: 113-116

ABSTRACT

Present experiment was undertaken to find out the postnatal development (gross) of the duodenum in broiler chicken with regard to their location, shape, size and weight. A group of five chickens, each at day 1 (D1), day 7 (D7), day 12 (D12), day 24 (D24) and day 34 (D34), total 5, were killed and their digestive tracts were dissected. After that, samples of duodenum were prepared and the length, width and muscle diameter of duodenum of different ages were recorded. The average length of duodenum were significantly higher in broilers at day 34(30.55cm) than that at day 24(28.12cm), day 12(19.50cm), day 7 (17.25cm) and day 1(14.95cm). On the other hand, the width were significantly higher in broilers at day 34(7.1mm) than that at day 24(5.25mm), day 12 (4.70mm), day 7(4.35mm) and day 1(2.75mm). In diameter of the muscle of duodenum also maintain this order. Hence, it can be concluded that, length, width and muscle diameter of duodenum might be increased with the age of broiler.

Article History

Received: 20.05.2021
Accepted: 25.08.2021
Available online: 31.08.2021

Keywords: postnatal growth, duodenum, different criteria, gross study, broiler.

DOI: https://doi.org/10.30704/http-www-jivs-net.940185

To cite this article: Nath, S. K., Kundu, S. K., Uddin, M. (2021). Postnatal development of duodenum in broiler. ***Journal of Istanbul Veterinary Sciences, 5*(2),** 113-116. **Abbreviated Title*: J. İstanbul vet. sci.***

Introduction

In avian species food conveys via digestive tract to stomach. This digestive tract comprises of mouth cavity, crop (temporary store house of food), esophagus, proventriculus (glandular stomach), gizzard (muscular stomach), intestine and vent or cloaca (Hassouna, et al., 2001). The anterior portion of digestive tract is responsible for ingestion, storage and partial digestion of food. The structure of the avian digestive system is very simple compare to other animals, so the high quality diet should provide for their easy digestion if the birds is used for productive performance (Noy et al., 2001). Nutrient absorption is very much important for growth and production that mainly takes place in small intestine especially intestinal crypts and villi of the epithelium (Choct, 2009; Barszcz and Skomiał, 2011). The total length and

*Corresponding Author: Swarup Kumar Kundu
E-mail: swarupkundu95@gmail.com.

Journal home page: www.jivs.net
http://dergipark.gov.tr/http-www-jivs-net

weight of the small intestine varied among the different species of birds (Hassouna et al., 2001). Development of the absorptive epithelium may be responsible for changes in absorption capacity of birds (Verdal et al., 2010). In broilers, morphological development and consequent maturation of the small intestine occur during the first 10 days of life. Villi area and size rapidly increase between five and 10 days post-hatch (Uni et al., 1995). After hatching, the small intestine of poultry grows faster, weight-wise, than total body mass. In broiler, relative growth of small intestine reaches its peak between six and 10 days of age (Sklan, 1978; Zavarize et al., 2012). However, feed intake stimulates the development of the gastrointestinal tract (GIT) (Jiménez-Moreno et al., 2009), and duodenum develops earlier than the jejunum and the ileum (Uni et al., 1998). After the duodenum, the small intestine forms a coil and is suspended from the dorsal wall of the abdominal wall by a thin membrane- the mesentery. This membrane carries the blood vessels associated with the intestine (Yamauchi et al., 1992). The duodenum starts at the gizzard and forms and elongated loop about 20 centimeters long. The pancreas lies between the arms of the loop and being attached to each arm of the duodenum actually holds the arms together (Noy et al., 1995). Therefore, the current study was conducted to describe the anatomical changes (length, width and muscle diameter) of duodenum of broilers at different ages of groups that may be depend on several criteria like location, shape, size, nutrition, management and weight of chicken.

Materials and Method

A total of five chickens (broilers) from each of 1st day, 7th day, 12th day, 25th day, and 34th day old were collected from poultry farm of Bangladesh. All the chickens were reared in the Department of Anatomy and Histology with food and water adlibitum. After Cervical subluxation, the digestive tracts were collected for gross and histological study.

Length, width and muscle diameter of the segments of digestive tract (duodenum) of broilers were considered for gross study. The present experiment was undertaken to find out the postnatal development of the small intestine (duodenum) of broilers. The experiment was carried out in the laboratory of Department of Anatomy and Histology, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Science University (CVASU). All procedures were approved by the Animal care and Welfare Committee of the institute.

Study population: A total of 05 (five) chickens-"Cobb-500" broiler chickens of both sexes were collected from "CP poultry farm",Mirsarai upazilla, Chittagong. Physical examinations of the broilers were performed that had no developmental disorders and detectable diseases which may influence this study. Then sample (duodenum) was collected from the selected broilers.

Design of the experiment: After collecting the samples, they were carried directly to the laboratory of Department of Anatomy and Histology, Faculty of Veterinary Science, Chittagong Veterinary and animal Sciences University (CVASU), these birds were divided into five sections. Section-1(day 1), Section-2(day 7), Section-3(day 12), Section-4(day 24), Section-5 (day 34).

Sacrificing of boilers: There are several methods of slaughtering .The birds were sacrificed by Halal method.

Sample collection: After cessation of respiration and heartbeat, the abdomen was cut open, and entire small intestine from the pylorus to the ileo-cecal sphincter was removed for gross and histological study. The small intestine comprises 3 segments. The first segment, termed the duodenum, extends from the pylorus to extend from the distal portion of the duodenal loop to Meckel's diverticulum. The third segment is the ileum that extends Meckel's diverticulum to the ileocecal junction, with its distal portion connected to a pair of ceca via mesenteric tissue. The total length and diameter of the duodenum was determined in those broilers of different ages.

Results and Discussion

Post natal development (gross characteristics) of the small intestine (duodenum) of broilers: The duodenum started at the gizzard and formed an

an elongated loop. The pancreas lies between the arms of the loop and being attached to each arm of the duodenum actually holds the two arms together. After the duodenum, the small intestine formed a coil and was suspended from the dorsal abdominal wall by a thin membrane- the mesentery.

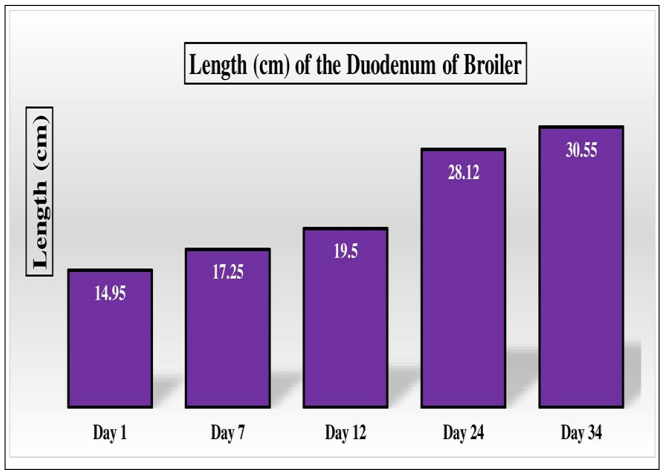


Figure 1. Comparative representation of the length (cm) of duodenum according to age. The chart illustrates the length of five different ages of duodenum that was highest at day 34 and lowest at day 1.

This membrane carried the blood vessels associated with the intestine. Present study also revealed that the length and diameter of the duodenum increase with the ages of the broilers (Table 1; Figure 1-2), this finding is similar to Wang and Peng, (2008), where the author stated that the average length of duodenum increased gradually with the ages of birds.

Table 1. Gross morphometric of duodenum of broiler chicken

Age (Days)	Length (cm)	Width (mm)	Muscle diameter (cm)
1	14.95	2.75	20.44
7	17.25	4.35	26.24
12	19.50	4.70	27.4
24	28.12	5.25	30.46
34	30.55	7.1	30.75

On the other hand, muscle diameter was recorded highest at day 34 (D34) and lowest at day 1 (D1) (Table 1; Figure 3). This observation was also similar with Hassonuna (2001), where the author stated that length of the duodenal loop and its parts as its shape and extension varied in birds with ages.

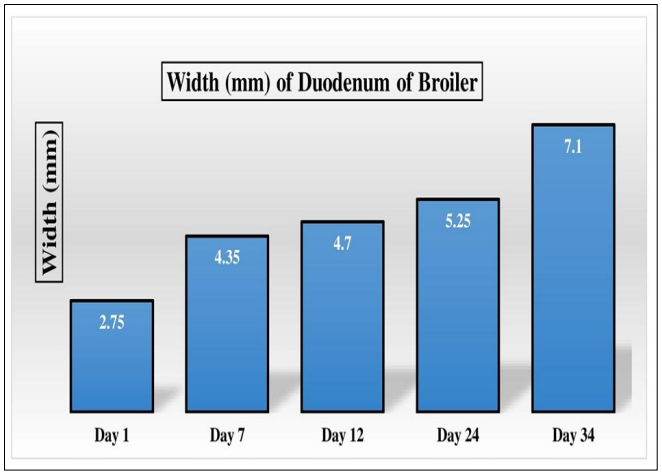


Figure 2. Comparative representation of the width of duodenum according to age. The chart shows the width of five different ages of duodenum was recorded highest at day 34 and lowest at day 1.

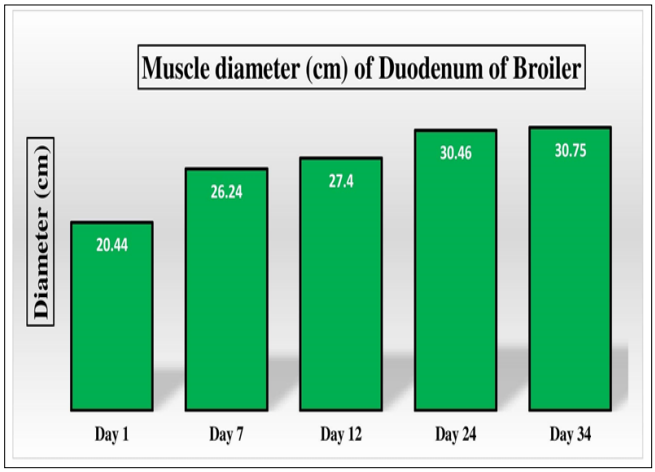


Figure 3. Comparative representation of the muscle diameter of duodenum according to age. The chart provides the information of muscle diameter of five different ages of duodenum specifically recorded highest at day 34 and lowest at day 1.

Conclusion

The average length, width and muscle diameter during postnatal development of the Cob-500 broilers increased day by day with their age. The average lengths, width and muscle diameter of Duodenum of small intestine were significantly higher at day 34 than that at day 24, day 12, day 7 & day 1. This gradual growth may depends on their daily diet. So, further study also needed to clarify how this development occurs in broiler with age.

Acknowledgements

Special thanks to the Department of Anatomy and Histology, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Science University (CVASU), Bangladesh for technical support during the research tenure and heartiest gratitude to the all involved respected members for their great efforts and valuable guidance to make the research fruitful

References

Barszcz, M., & Skomiał, J. (2011). The development of the small intestine of piglets-chosen aspects. *Journal of Animal and Feed Sciences,20*(1), 3-15.

Choct, M. (2009). Managing gut health through nutrition. *British poultry science, 50*(1), 9-15.

Hassouna, E. M. A. (2001). Some anatomical and morphometrical studies on the intestinal tract of chicken, duck, goose, turkey, pigeon, dove, quail, sparrow, heron, jackdaw, hoopoe, kestrel and owl. *Assiut Veterinary Medical Journal, 44*(88), 47-78.

Jiménez-Moreno, E., González-Alvarado, J. M., de Coca-Sinova, A., Lázaro, R., & Mateos, G. G. (2009). Effects of source of fibre on the development and pH of the gastrointestinal tract of broilers. *Animal Feed Science and Technology, 154*(1-2), 93-101.

Noy, Y., & Sklan, D. (1995). Digestion and absorption in the young chick. *Poultry science, 74*(2), 366-373.

Noy, Y., Geyra, A., & Sklan, D. (2001). The effect of early feeding on growth and small intestinal development in the posthatch poult. *Poultry Science, 80*(7), 912-919.

Sklan, D., Shachaf, B., Baron, J., & Hurwitz, S. (1978). Retrograde movement of digesta in the duodenum of the chick: extent, frequency, and nutritional implications. *The Journal of nutrition, 108(*9), 1485-1490.

UNI, Z., Noy, Y., & SKLAN, D. (1995). Posthatch changes in morphology and function of the small intestines in heavy-and light-strain chicks. *Poultry Science, 74* (10), 1622-1629.

Uni, Z., Platin, R., & Sklan, D. (1998). Cell proliferation in chicken intestinal epithelium occurs both in the crypt and along the villus. *Journal of Comparative Physiology B, 168(*4), 241-247.

Verdal H, Mignon-Grasteau S, Jeulin C, Le Bihan-Duval E, Leconte M, Mallet S, Martin C, Narcy A. (2010). Digestive tract measurements and histological adaptation in broiler lines divergently selected for digestive efficiency. *Poultry Sciences,* 89(9), 1955-1961.

Wang, J. X., & Peng, K. M. (2008). Developmental morphology of the small intestine of African ostrich chicks. *Poultry science, 87*(12), 2629-2635.

Yamauchi, K., Iida, S., & Isshiki, Y. (1992). Post-hatching developmental changes in the ultrastructure of the duodenal absorptive epithelial cells in 1, 10 and 60-d-old chickens, with special reference to mitochondria. *British Poultry Science, 33*(3), 475-488.

Zavarize, K. C., Sartori, J. R., Gonzales, E., & Pezzato, A. C. (2012). Morphological changes of the intestinal mucosa of broilers and layers as affected by fasting before sample collection. *Brazilian Journal of Poultry Science, 14*(1), 21-25.