



UNIVERSITI PUTRA MALAYSIA

***PREVALENCE, PLASMA LIPID AND ADIPONECTIN CONCENTRATIONS
OF OBESE DOGS IN KLANG VALLEY, MALAYSIA***

RIYOUKO LIM

FPV 2015 12

**PREVALENCE, PLASMA LIPID AND ADIPONECTIN CONCENTRATIONS
OF OBESE DOGS IN KLANG VALLEY, MALAYSIA**

RIYOUKO LIM

A project submitted to the
Faculty of Veterinary Medicine, Universiti Putra Malaysia
In partial fulfillment of the requirement for the
DEGREE OF DOCTOR OF VETERINARY MEDICINE
Universiti Putra Malaysia
Serdang, Selangor Darul Ehsan

March 2015

It is hereby certified that we have read this project paper entitled “Prevalence, Plasma Lipid, and Adiponectin Concentration of Obese Dogs in Klang Valley, Malaysia,” by Riyouko Lim and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4901-Project.

Professor, Dr. Rasedee Abdullah

BSc (Hons) (West Australia), MSc (New England, Australia),
PhD (California, Davis),
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Supervisor)

Professor Dr. Tashiro Arai

Laboratory of Veterinary Medicine
Dean, Department of Veterinary Medicine
Nippon Veterinary and Life Science University
(Co-supervisor)

Associate Professor, Dr. Malaika Watanabe

Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Co-supervisor)

ACKNOWLEDGEMENTS

I am very grateful and would like to express my great gratitude to Professor Dr. Rasedee Abdullah for being patient and supportive throughout my project. I would like to give a special appreciation to Professor Dr. Toshiro Arai and Dr. Nobuko Mori from Nippon Veterinary and Life Science University for giving me support and advice to improve my project. I would also like to thank Associate Professor Dr. Malaika Watanabe for providing me with wise opinion and encouragement. In addition, I would like to express my extreme gratitude especially to Dr. Lian Tan Mei, Dr. Ku Chi Ling, Dr. Prem Anand, Dr. Yeoh Eng Cheong, and staff members at the clinics to make this study possible. I gratefully would like to thank Dr. Mahdi Ebrahimi for great help in his expertise and facilitating the study as well as assistance with experiments. Lastly, I am very thankful for my parents, Lim Eng Leong and Kaeko Lim, and an older sister, Maniko Lim for their endless support and allowing me to have this opportunity to occur.

CONTENTS

	Page
TITLE	i
CERTIFICATION	ii
ACKNOWLEDGEMENTS	iii
CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vi
ABSTRAK	viii
ABSTRACT	x
1.0 INTRODUCTION	1
2.0 LITERATURE REVIEW	3
2.1 Obese dogs in the world	3
2.2 Methods of fat measurement	4
2.3 Fat deposition	5
2.4 Plasma parameters	6
3.0 MATERIAL AND METHODS	7
3.1 Animals	7
3.2 Blood sampling	8
3.3 Plasma biochemical parameters	9
3.4 Adiponectin	9
3.5 Statistical analysis	9
4.0 RESULTS	10
4.1 Prevalence of obesity in dogs	10
4.2 Body condition score versus age	11

4.3 Body condition score versus sex status	12
4.4 Fat percentage versus body condition score	14
4.5 Fat percentage versus age	15
4.6 Fat percentage versus sex status	16
4.7 Plasma parameter and body condition score of lean and obese dog	18
4.7.1 Fat percentage and body condition score of lean and obese dog	20
4.7.2 Plasma alanine aminotransferase concentration of lean and obese dogs	21
4.7.3 Plasma total cholesterol concentrations in lean and obese dog	21
4.7.4 Plasma triglyceride concentrations of lean and obese dog	22
4.7.5 Plasma adiponectin concentration of lean and obese dogs.	23
5.0 DISCUSSION	25
6.0 CONCLUSION	26
7.0 FUTHER STUDIES	27
REFERENCES	28
APPENDICES	32

LIST OF TABLES

	Page
Table 1: Demography of 172 dogs used in the study.	10
Table 2: Physical parameters of lean and obese dogs	19
Table 3: Plasma biochemical parameters of lean and obese dogs	19

LIST OF FIGURES

Figure 1: Prevalence of obesity by age based on body condition score	11
Figure 2: Prevalence of obesity by sex status in dogs based on body condition score	13
Figure 3: Comparison of body condition score of dogs among sex status	14
Figure 4: Mean fat percentage comparison between lean and obese dogs	15
Figure 5: Prevalence of obesity based on fat percentage of dogs in different ages	16
Figure 6: Prevalence of obesity in dogs by sex status based on fat percentage	17
Figure 7: Comparison of fat percentage among sex status of dogs	18
Figure 8: Fat percentage of lean and obese dogs	20
Figure 9: Plasma alanine aminotransferase concentrations of lean and obese dogs	21

Figure 10: Plasma total cholesterol concentration in lean and obese dogs 22

Figure 11: Plasma triglyceride concentrations of lean and obese dogs 23

Figure 12: Plasma adiponectin concentrations of lean and obese dogs 24



ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4901- Projek

PREVALENS, KEPEKATAN LIPID DAN ADIPONEKTIN DALAM ANJING OBES DI LEMBANG KLANG, MALAYSIA

Oleh

Riyoko Lim

2015

Penyelia: Professor. Dr. Rasedee Abdullah

Dengan meningkatnya standard kehidupan rakyat Malaysia, keobesan di kalangan haiwan kesayangan, terutama sekali anjing, semakin nyata. Kini, belum ada kajian terhadap ciri keobesan anjing di Malaysia. Kajian ini bertujuan untuk menentukan prevalens anjing obes di Lembah Klang, Malaysia. Bioelectric impedance device (BID) telah diguna untuk menentukan lemak badan pada anjing tegap kurus and obes untuk perbandingan. Juga, biopenanda keobesan, kepekatan adiponektin plasma, ditentukan bersama kepekatan alanina aminotranferase (ALT), kolesterol sepenuh and trigliserida ditentukan untuk pembezaan di antara anjing tegap kurus dan obes. Satu ratus tujuh-puluh-dua ekor anjing yang nampak sihat telah dipilih untuk kajian ini; daripadanya 12 ekor anjing tegap kurus dan 13 ekor anjing obes dipilih untuk penentuan kepekatan parameter plasma. Skor keadaan badan skala 5-mata (BCS) dan sukatan peratus lemak juga diguna kepada semua

anjing ini. Kajian ini menunjukkan yang prevalens anjing berat badan lampau dan obes melalui sukatan BSC adalah 46.5% dan melalui BID adalah 56%. Ada korelasi tererti statistik di antara BCS dengan peratus lemak ($r = 0.70$, $N = 172$, $p < 0.01$) di kalangan anjing. Berasaskan BCS dan peratus lemak, ada korelasi positif di antara umur dan keobesan (BCS: $r = 0.22$, $N = 172$, $p < 0.01$), peratus lemak ($r = 0.38$, $N = 172$, $p < 0.01$), dan di antara status jantina ($p < 0.01$). Walaupun tiada kelainan tererti statistik dalam kepekatan ALT dan kolesterol sepenuh di kalangan anjing, peratus lemak ($p < 0.01$), kepekatan trigliserida ($p < 0.01$) and adiponektin ($p < 0.01$) adalah lebih tinggi tererti dalam anjing obes daripada yang tegap kurus. Kajian ini menunjukkan yang hasil analisis BCS dan BID ada korelasi dengan kepekatan adiponektin dan lemak plasma. Analisis BCS dan BID adalah kaedah yang baik dalam penentuan keobesan pada anjing.

Kata kunci: prevalens, anjing, keobesan, kolesterol, trigliserida, adiponektin.

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4901-Project.

**PREVALENCE, PLASMA LIPID AND ADIPONECTIN CONCENTRATIONS
OF OBESE DOGS IN KLANG VALLEY, MALAYSIA**

By

Riyouko Lim

2015

Supervisor: Professor. Dr. Rasedee Abdullah

With the improvement of living standards of the Malaysian society, obesity among pets, particularly dogs appears to become more prevalent. Currently, no study has been done on the characteristics of obesity in dogs in Malaysia. This study aims to determine the prevalence of obese dogs in Klang Valley, Malaysia. A portable Bioelectric Impedance Device (BID) was used to determine the body fat of lean and obese dogs for comparison. In addition, an obesity biomarker, plasma adiponectin, together with alanine aminotransferase (ALT), total cholesterol and triglyceride concentrations were also estimated to determine differences between lean and obese dogs. One hundred seventy-two apparently healthy dogs were selected for the study; of which 12 lean and 13 obese dogs were selected for estimation of plasma parameter concentrations. A 5-point scale body condition score (BCS) and fat percentage measurements were employed for all dogs. The study showed that the

prevalence of overweight and obese dogs based on BCS was 46.5% and based on BID was 56.0%. There was statistically significant correlation ($r = 0.70$, $N = 172$, $p < 0.01$) between BCS and fat percentage among dogs. Based on BCS and fat percentage, there were positive correlations between age and obesity (BCS: $r = 0.22$, $N = 172$, $p < 0.01$, fat percentage: $r = 0.38$, $N = 172$, $p < 0.01$), and between sex status ($p < 0.01$). Although there was no statistical significant difference in plasma ALT and total cholesterol concentrations among dogs, the fat percentage ($p < 0.01$) and triglyceride ($p < 0.01$) were significantly higher, and adiponectin concentrations ($p < 0.01$) was significantly lower in obese than lean dogs. This study shows that the results from BCS and the BID analyses correlate with plasma adiponectin and lipid concentrations. The BCS and BID analyses are good methods for the determination of obesity in dogs.

Keywords: prevalence, dog, obesity, cholesterol, triglyceride, adiponectin

1.0 INTRODUCTION

Obesity, defined as excessive adipose tissue and weight of 20% more than ideal weight (Stone *et al.*, 2009), is becoming common in dogs in Malaysia. This is partly due to the improvement in the Malaysian economy and income of its citizens in recent years, allowing them feed the pets under their care, well. Obesity in dogs, like in humans, poses a health risk, predisposing them to diseases like diabetes mellitus, cardiovascular disease, respiratory disorder, certain neoplasias, reproductive disorder, and early onset of degenerative disorders. Accumulation of fat has an association with important metabolic and hormonal changes in the body (Zoran, 2010).

Increase in body weight, which is measurable, could be due muscle mass gain instead of excessive adipose tissue. Currently, there is no really good standard for determining obesity in dogs. In veterinary practice, distinguishing obese from non-obese dogs is by body condition score (BCS), which is subjective. Since obesity is related to body fat, determination of blood and tissue fat content would be a more direct method for the determination. There is a portable and non-invasive device, Bioelectric Impedance Device (BID), which is used to estimate the body fat percentage in dogs. The data obtain from this machine can be correlated with the

lipid content in plasma of obese dogs. At present, there has been no report on the prevalence of obesity in dogs in Malaysia. The information from this study would be useful for owners in the management of their pets. Therefore, the objectives of this project are as follows;

1. To determine the prevalence of obesity in dogs in Klang Valley, Malaysia
2. To determine the association between 5-point body condition score and body fat percentage.
3. To determine the factors associated with obesity in dogs.
4. To estimate the concentration of plasma lipids and adiponectin in obese and lean dogs.

The hypotheses of this project are;

1. The Bioelectric Impedance Device is effective in determining obesity in dogs.
2. There are associations between age, sex status, and obesity in dogs.
3. There is correlation between plasma alanine aminotransferase, total cholesterol, triglyceride and adiponectin concentration with obesity in dogs.

REFERENCES

- Flynn, M.F., Hardie, E.M. and Armstrong, P.J. (1996). Effect of Ovariohysterectomy on Maintenance Energy Requirements in Cats. *Journal of the American Veterinary Medical Association*, 209: 1572-1581.
- Colliard, L., Ancel, J., Benet, J.J., Paragon, B.M., and Blanchard, G. (2006). Risk Factors for Obesity in Dogs in France. *J of Nutrition*, 136(7): 1951S-1954S.
- Cooke, P.S. and Naaz, A. (2004). Role of Estrogens in Adipocyte Development and Function. *Experimental Biology and Medicine*, 229(11): 1127-1135.
- Diez, M. and Nguyen, P. (2006). The Epidemiology of Canine and Feline Obesity. *Waltham Focus Dog and Cat Obesity*, 1.
- Fruebis, J., Tsao, T.S., Javorschi, S., Ebbets-Reed, D., Erickson, M.R., Yen, F.T., Bihain, B.E. and Lodish, H.F. (2001). Proteolytic Cleavage Product of 30-kDa Adipocyte Complement-Related Protein Increases Fatty Acid Oxidation in Muscle and Causes Weight Loss in Mice. *Proceedings of the National Academy of Science, USA*, 98(4): 2005-2010.
- Harper, E.J. (1998). Changing Perspectives on Aging and Energy Requirements: Aging, Body Weight and Body Composition in Humans, Dogs and Cats. *Journal of Nutrition*, 128(12 Suppl): 2627S-2631S.
- Harper, E.J., Stack, D.M., Watson, T.D.G. and Moxham, G. (2001). Effect of Feeding Regimens on Body Weight, Composition and Condition Score in Cats Following Ovariohysterectomy. *Journal of Small Animal Practice* 42: 433-438.
- Hoening, M. and Ferguson, D.C. (2002). Effects of Neutering on Hormonal Concentrations and Energy Requirements in Cats. *Journal of the American*

Veterinary Medical Research 63: 634-639.

Houpt, K.A. and Hintz, H.F. (1978). Obesity in Dogs. *Canine Practice*, 5: 54-58.

Hsiao, P.J., Kuo, K.K., Shin, S.j., Yang, Y.H., Lin, W.Y., Yang, J.F., Chiu, C.C., Chang, W.L., Tsai, T.R. and Yu, M.L. (2007). Significant Correlations Between Severe Fatty Liver and Risk Factors for Metabolic Syndrome. *Journal of Gastroenterology and Hepatology* 22: 2118-2123.

Ishioka, K., Okumura, M., Sagawa, M., Nakadomo, F., Kimura, K. and Saito, M. (2005). Computed Tomographic Assessment of Body Fat in Beagles. *Veterinary Radiology and Ultrasound*, 46(1): 49-53.

Jeusette, I, Lhoest E.T., Istasse. L. and Diez, M.O. (2005). Influence of Obesity on Plasma Lipid and Lipoprotein Concentrations in Dogs. *American Journal of Veterinary Research*, 66: 81-86.

Johnson, M. C. (2005). Hyperlipidemia Disorders in Dogs. *Compendium* May: 361-370.

Laflamme, D. (1997). Nutritional Management. *Veterinary Clinic of North America: Small Animal Practice*, 27(6):1561-1577.

Lund, E. M., Armstrong, P.J., Kirk, C. A., and Klausner, J. S. (2006). Prevalence and Risk Factors for Obesity in Adult Dogs from Private US Veterinary Practices. *International Journal of Applied Research Veterinary Medicine*, 4(2): 177-186.

McGreevy, P. D., Thomson, P. C., Pride, C., Fawcett, A., Grassi, T. and Jones, B. (2005). Prevalence of Obesity in Dogs Examined by Australian Veterinary Practices and the Risk Factors Involved. *Veterinary Record*, 156: 695-702.

Okawa, M., Ban, T. and Umeda, T. (2006). Investigation of Percent Body Fat in

Dogs Visiting Veterinary Practices in Japan [unpublished abstract]. Haga, Tochigi, Japan: Kao Corporation.

Radin, M. J., Sharkey, L.C. and Holycross, B. J. (2009). Adipokines: A Review of Biological and Analytical Principles and an Update in Dogs, Cats, and Horses. *Veterinary Clinical Pathology*, 38: 136-156.

Richey, J. M., Woolcott, O. O., Stefanovski, D., Harrison, L. N., Zheng, D., Lottati, M., Hsu, I. R., Kim, S. P., Kabir, M., Catalano, K. J., Chiu, J. D., Ionut, V., Kolka, C., Mooradin, V. and Bergman, R. N. (2009). Rimonabant Prevents Additional Accumulation of Visceral and Subcutaneous Fat During High-Fat Feeding in Dogs. *American Journal of Physiology-Endocrinology and Metabolism*, 296: E1311-E1318.

Robertson, I.D. (2003). The Association of Exercise, Diet and Other Factors with Owner Perceived Obesity in Privately Owned Dogs from Metropolitan Perth, WA. *Preventive Veterinary Medicine*, 58(1-2): 75-83.

Stone, R., Berghoff, N., Steiner, J. and Zoran, D. (2009). Use of a Bioelectric Impedance Device in Obese and Lean Healthy Dogs to Estimate Body Fat Percentage. *Veterinary Therapeutics*, 10(1-2): 59-70.

Yamauchi, T., Kamon, J., Waki, H., Terauchi, Y., Kubota, N., Hara, K., Mori, Y., Ide, T., Murakami, K., Tsuboyama-Kasaoka, N., Ezaki, O., Akanuma, Y., Gavrilova, O., Vinson, C., Reitman, M.L., Kagechika, H., Shudo, K., Yoda, M., Nakano, Y., Tobe, K., Nagai, R., Kimura, S., Tomita, M., Froguel, P. and Kadowaki, T. (2001). The Fat-derived Hormone Adiponectin Reverses Insulin Resistance Associated with Both Lipodystrophy and Obesity. *Nature Medicine*, 7: 941-946.

- Yamauchi, T., Kamon, J., Minokoshi, Y., Ito, Y., Waki, H., Uchida, S., Yamashita, S., Noda, M., Kita, S., Ueki, K., Eto, K., Akanuma, Y., Froguel, P., Foufelle, F., Ferre, P., Carling, D., Kimura, S., Nagai, R., Kahn, BB. and Kadowaki, T. (2002). Adiponectin Stimulates Glucose Utilization and Fatty-Acid Oxidation by Activating AMP-Activated Protein Kinase. *Nature Medicine*, 8: 1288-1295.
- Zoran, D. L. (2010). Obesity in Dogs and Cats: A Metabolic and Endocrine Disorder. *Veterinary Clinic of North America: Small Animal Practice*, 40: 221-239.