

ASSESSMENT OF THERMOMETRY PRACTICES IN DOGS UNDERGOING GENERAL HEALTH EXAMINATIONS

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ABSTRACT

Dogs' temperature is measured through the rectum, which can be difficult to obtain in animals with aggressive nature, or those with ano-rectal conditions. Alternative instruments and routes have also been developed. These alternative methods may yield different results. This study aimed to compare different methods in measuring the internal temperature of dogs. Cases referred to the small animal clinic (n=20) for a general health check were included in this study upon confirming their health status. Axillary, tympanic membrane and rectal temperature were measured 30 minutes post-arrival. Rectal temperature (RT) was measured first using a mercury thermometer and a digital thermometer. Axillary temperature (AT) was measured using a digital thermometer. The tympanic membrane temperature (TMT) was measured last using an infrared thermometer. Complete blood count (CBC) profiles, heart rates and respiratory rates of animals were within normal range. The difference between RT and AT ranged from 0.1°C to 1.1°C, whereas that between RT and TMT ranged from 0.03°C to 2.1°C. 40% of temperatures measured by AT and 90% of those measured with TMT differed by more than 0.5°C from those measured by RT. AT and TMT were positively correlated with RT ($r = 0.833$, $P < 0.0001$) and ($r = 0.475$, $P = 0.035$) respectively. AT and TMT were weakly correlated ($r = 0.542$, $P = 0.014$). The present study showed that RT shouldn't be substituted for AT or TMT in dogs. AT and TMT cannot be used interchangeably with rectal temperature in dogs.

Key words: Rectal mercury temperature, Rectal digital temperature (RT), Axillary temperature (AT), tympanic membrane temperature (TMT) Auricular infrared (IR).

INTRODUCTION

Temperature measurement acts as an early indicator of a change in the Animal's condition that may be caused by infection, systemic inflammatory response syndrome,

immune-mediated diseases, neoplasia or shock (Battersby *et al.*, 2006). The most common method of taking a dog's temperature is through the rectal mucosa, as it is considered to be the least invasive method that accurately reflects the core temperature (Kreissl and Neiger, 2015). Rectal thermometers remain the gold standard for less-invasive body temperature measurement in veterinary practice (Hall and Carter, 2017a). Good agreement has been previously reported between rectal temperatures (RTs) and core body

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temperature in dogs (Greer *et al.*, 2007, Southward *et al.*, 2006). Rectal temperature has also been reported to be the most accurate method for measuring the core temperature (Lefrant *et al.*, 2003). However, measuring temperature through the rectal route has its limitations as it can be difficult to use on aggressive dogs or those with an infection or rupture of the anal mucosa (Kreissl and Neiger, 2015). In order to overcome the limitations of the rectal route, studies have been developed to evaluate non-contact infrared thermometers on alternative locations of the canine body such as the axilla, auricular canal, and ocular regions (Zanghi, 2016, Gomart *et al.*, 2014).

Auricular infrared (IR) thermometers are increasingly being used as an alternative to rectal thermometers. These IR devices measure the heat generated at the tympanic membrane in the ear (Kreissl and Neiger, 2015). The tympanic membrane's ability to reflect internal body temperature makes it a more convenient site for temperature measurement (Lamb and McBrearty, 2013, Smith *et al.*, 2015). The infrared auricular thermometer offers several other benefits, it provides rapid readings, typically taking only one second, and is known for its accuracy when used with both dogs and cats. Additionally, it is often well-tolerated by animals, causing little or no distress (Sousa *et al.*, 2011). It should be noted, however, that there can be significant differences between readings obtained using the infrared auricular thermometer and rectal temperature thermometers (Greer *et al.*, 2007).

Axillary temperature measurement has been also described in several veterinary texts and has become a popular method for its relative convenience and ease of application (Harvey *et al.*, 2009, Donohoe, 2012), (Gomart *et al.*, 2014). It is considered less invasive, easy to measure and only requires digital thermometers (Lamb and McBrearty, 2013). However, in a recent study, it was reported to be poorly correlated with rectal temperature (Cichocki *et al.*, 2017).

AT and TMT measurement has been the concern of many investigators, some concluded that TMT may be used instead of RT to measure internal body temperature (Smith *et al.*, 2015) while others concluded that TMT and AT should not be used as alternatives (Lamb and McBrearty, 2013, Cichocki *et al.*, 2017, Sousa *et al.*, 2011).

The aim of this study was to determine if differences existed between rectal temperature (RT) and axillary temperature (AT), and tympanic membrane temperature (TMT) in a group of healthy dogs referred to the Small Animal Clinic, Assiut University for a general health check or routine vaccination.

MATERIALS AND METHODS

Animals

Animals referred to the Small Animal Clinic, Assiut University were enrolled in the study. All animals that were referred for a general health check or routine vaccination were considered. Dogs were included in the study if they proved to be clinically healthy dogs with no history of recent disease upon examination. Dogs were excluded if they showed symptoms of any illness. In order to confirm the health status and eligibility of the animals for inclusion in the study, a complete blood count (CBC) was performed on blood samples collected from all dogs entering the study.

Methods

All animals were left in the examination room for at least 30 minutes before the commencement of temperature measurement to avoid the effects of exercise-related elevated body temperature. During this period, a full case history was recorded including (name, sex, age, breed, vaccination, diet composition and last meal timing before examination). Body weight was also recorded.

Temperature measurement

During the measurement process, a mercury thermometer was used to take the first RT reading via the rectal method followed by using a digital thermometer to measure RT, as well as AT and TMT. The measurement

order of the left or right axilla and tympanic membrane was randomized to reduce any potential bias.

To measure temperature using a mercury thermometer, the thermometer was first agitated to lower the mercury column, after which the probe was sterilized using an alcohol-saturated cotton ball and coated with a lubricant before each use. The probe tip was inserted into the rectum, ensuring a minimum depth of 1.5 cm and careful placement in proximity to the mucosal lining. Rectal temperature measurements were taken using the standard 90-second methodology (Wiedemann *et al.*, 2006).

Measurement of rectal temperature using the digital thermometer was done by first sterilizing the probe using an alcohol-saturated cotton ball. Probe was then coated with a lubricant before each use. The probe tip was then inserted into the rectum, ensuring a minimum depth of 1.5 cm and careful placement in proximity to the mucosal lining until a beeping sound is heard as an indication of an endpoint reading.

A digital thermometer was used to measure AT, with the tip being located as close as possible to the axilla and in direct contact with the skin. The foreleg was then gently held against the chest wall, and the thermometer was left in the axilla until an audible beep indicated the endpoint reading.

The TMT was measured using a commercially available veterinary infrared ear thermometer (Pet-Temp Model PT 300; Advanced Monitors). According to the manufacturer's guidelines, the device measures TMT between 34.0°C and 43.0°C, with a reported accuracy of $\pm 0.2^\circ\text{C}$. Prior to use, the lens was cleaned with an alcohol swab if required. A disposable, single-use protective cover was placed on the thermometer tip. The dog's ear was gently pulled caudolaterally to align the vertical and horizontal canals, and the thermometer was inserted into the ear canal directing it towards the angle of the opposite jaw. When the activation button was pressed, an audible

beep indicated the completion of the temperature measurement.

Blood Samples

Whole blood samples were collected from each dog by cephalic venipuncture using a standard procedure (An *et al.*, 2019). Dogs were appropriately restrained for blood collection. The dog's left or right arm was prepared for venipuncture by clipping hair and disinfection with alcohol. Blood samples were collected by introducing a sterile syringe for each dog in the cephalic vein and 1 cm of blood was collected. Samples of blood were then transferred into EDTA blood tubes and refrigerated until they were sent to the Central Lab of the Animal Pathology Department in the Faculty of Veterinary Medicine at Assiut University for a complete blood count that was measured automatically using an automatic cell counter (Exigo, Boule Medical AB, Sweden).

Statistical analysis:

The normality of data distribution was assessed using the Shapiro-Wilk test. One-way ANOVA was used to determine whether any significant differences existed between the various temperature measurement methods. The Pearson linear correlation coefficient was calculated to evaluate the presence of any linear correlation between the different temperature measurement techniques. Additionally, a Bland-Altman Limits of Agreement analysis was carried out to determine whether the axillary or auricular temperature measurements represented an overestimation or underestimation of rectal temperature.

RESULTS

Signalment

A total of 20 dogs were enrolled in this study; their age ranged from 2 to 60 months (Mean \pm SD, 13.35 ± 14.10 , Median= 8 months). Body weight ranged from 3.5 to 40 kg (Mean \pm SD; 23.9 ± 10.009 ; Median=25.5 kg) (table 1). Breeds enrolled in the study included Balady breeds (n=3), Golden Retrievers (n=3), German shepherd (n=6), Black Wood (n=2), Cane Corso (n=2), Griffon terrier

(n=1), Pit bull (n=1), Great Dane (n=1), Husky (1). Both males (M) and females (F)

Table 1: Characteristics of Study Population: Age and Body Weight of Enrolled Dogs.

	Mean ± SD	Median	Range
Age (months)	13.35 ± 14.10	8	2 – 60
Body weight (kg)	23.9 ± 10.0009	25.5	3.5 – 40

Data expressed as mean ± SD, median and range of study population (n=20).

Health Indicators

The heart rate of the whole group ranged from 102 to 146 beats/minute (Mean ± SD, 126.70± 14.165; Median=126). Respiration rate ranged from 23 to 35 breaths/minute

were included in the study (M, n=10; F, n=10).

(Mean ± SD, 27.85 ± 3.183; Median=28) (table 2).

Table 2: Physiological Parameters of Enrolled Dogs: Heart Rate, Respiratory Rate, and Body Weight

Parameter	Mean ± SD	Median
Heart rate (beats /minute)	126.70 ± 14.165	126
Respiratory rate (breaths /minute)	27.85 ± 3.183	28

Data expressed as mean ± standard deviation and median.

Hematological examination

All animals enrolled in the study had a normal complete blood count (table 3)

Table 3: Complete Blood Count (CBC) Results of the Study Group: Hematological Parameters and Differential White Blood Cell Counts.

Parameter	Mean ± SD	Median	Reference range*
WBC ($10^9/l$)	11.195 ± 3.5806	11.05	6 - 17
LYM ($10^9/l$)	3.065 ± 0.8171	3.1	0.9 - 5
MONO ($10^9/l$)	1.115 ± 0.3345	1.15	0.3 - 1.5
NEUT ($10^9/l$)	6.860 ± 3.0362	6.5	3.5 – 12
EOS ($10^9/l$)	0.195 ± 0.1538	0.2	0.1 - 1.5
HGB (g/dl)	13.100 ± 2.2431	13.2	12 - 18
HCT (%)	36.620 ± 6.4046	36.45	37 – 55
RBC ($10^{12}/l$)	5.556 ± 0.98805	5.486	5.5 - 8.5
MCV (fl)	66.290 ± 5.3048	67.2	60 -72
MCH (pg)	23.780 ± 1.8637	23.9	19.5 – 25
MCHC (g/dl)	35.895 ± 0.7884	36.1	32 - 38.5
PLT ($10^9/l$)	258.70 ± 66.648	263.5	200 – 500
MPV	9.725 ± 0.7447	9.9	5.5 - 10.5

WBC, white blood cell; LYM, lymphocyte count; MONO, monocyte count; NEUT, neutrophil count; EOS, eosinophil count; HGB, hemoglobin; HCT, hematocrit; RBC, red blood cell; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; PLT, platelet count; MPV, mean platelet volume. * Central Lab of Animal Pathology Department in the Faculty of Veterinary Medicine Assiut University's

Body Temperature

The recorded rectal mercury temperature ranged from 38.6 to 40.4 °C (Mean ± SD,

39.48 ± 0.5357 °C) while rectal digital ranged from 38.5 to 40.4 °C (Mean ± SD, 39.39 ± 0.5524 °C) (table 4). Among the animals

examined, 45% or 9 animals had the same rectal digital temperature as their rectal mercury temperature. However, 55% or 11 animals had a slightly lower rectal digital temperature than their rectal mercury

temperature, but this difference was not statistically significant ($P=0.623$), as illustrated in Figure 1. The difference between rectal mercury and rectal digital temperatures ranged from 0.1 to 0.4 °C.

Table 4: Assessment of Body Temperature in Study Group: Comparison of Rectal Mercury Temperature, Rectal Digital Temperature, Axillary Temperature (AT), and Tympanic Membrane Temperature (TMT).

Method	Mean \pm SD	Median	Range
Rectal mercury T (°C)	39.480 \pm 0.5357 ^a	39.55	38.6 - 40.4
Rectal digital T (°C)	39.390 \pm 0.5524 ^a	39.3	38.5 - 40.4
AT (°C)	38.965 \pm 0.5678 ^b	39	37.6 - 39.9
TMT (°C)	38.470 \pm 0.6449 ^c	38.6	37.1 - 39.5

Values followed by different superscript letters ^{a, b, c} differ significantly ($P < 0.05$).

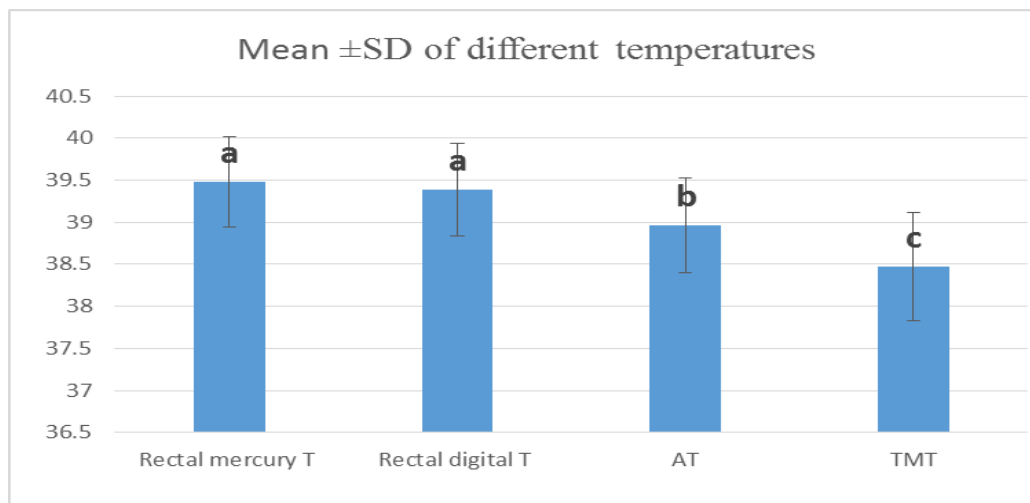


Figure 1: Comparison of Body Temperature Measurements in the Study Group: Rectal Mercury T, Rectal Digital T, Axillary Temperature (AT), and Tympanic Membrane Temperature (TMT)

Temperatures are measured in Celsius (°C) and columns represent the mean \pm SD of different temperatures. Letters above columns (a, b, c) indicate significant differences between different temperatures ($P < 0.05$)

AT ranged from 37.6 to 39.9 °C (Mean \pm SD; 38.965 \pm 0.5678 °C) (table 4). The difference between RTs and AT ranged from 0.1°C to 1.1°C, with the greatest difference being 1.1°C for mercury thermometers and 1°C for

digital thermometers. Additionally, the mean AT was found to be significantly different from that of RTs ($P=0.000$) (Fig. 1).

The Bland-Altman analysis indicated that, on the whole, AT underestimated RTs (see Fig. 2). Despite this under-estimation, a positive correlation was observed between AT and RTs obtained using either a mercury thermometer ($r = 0.833$, $P < 0.0001$) or a digital thermometer ($r = 0.823$, $P < 0.0001$) (refer to Table 5).

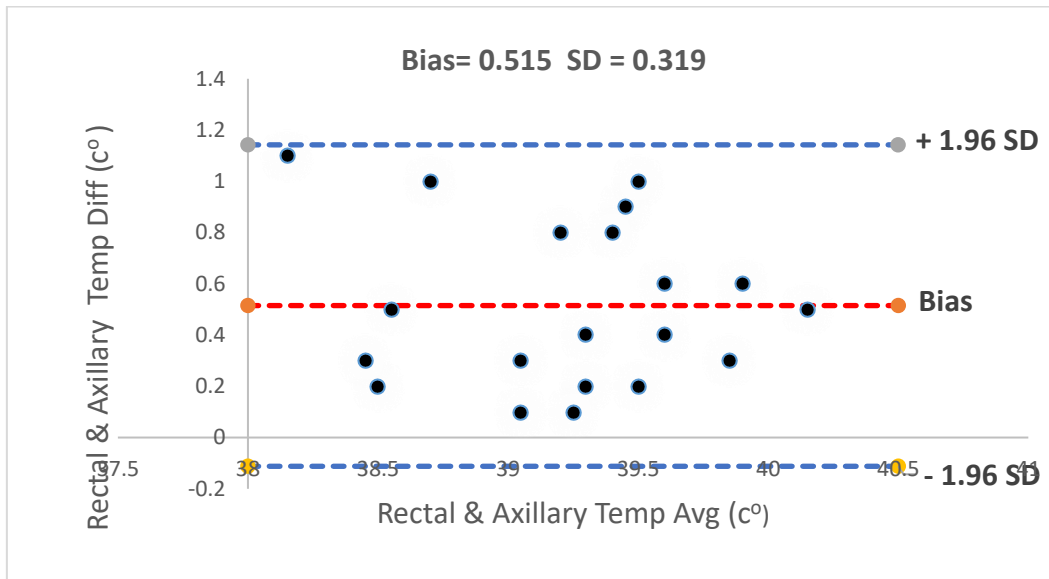


Figure 2: Bland-Altman Plot of Agreement between Rectal Mercury Temperature and Axillary Temperature Measurements in the Study Group

The y-axis represents the difference between rectal mercury temperature and axillary temperature measurements. The x-axis represents the average of rectal mercury temperature and axillary temperature. The red dashed line represents the bias, and the blue dashed lines represent the 95% limits of agreement (mean ± 1.96 standard deviation).

TMT had a mean value of 38.470 ± 0.6449 °C (ranging from 37.1 to 39.5 °C). Only two animals (10%) had TMT values higher than

RTs, whereas the remaining animals (90%; n=18) had TMT values below RTs. The RT–TMT difference ranged from 0.2°C to 2.1°C, with the highest difference observed being 2.1°C. The difference between TMT and both RTs was significant (P=0.000) (Fig. 1). The Bland Altman plot showed that TMT underestimated RTs (Fig. 3). A positive correlation was observed between TMT and RTs obtained using a mercury thermometer (r= 0.474, P = 0.035) (Table 5).

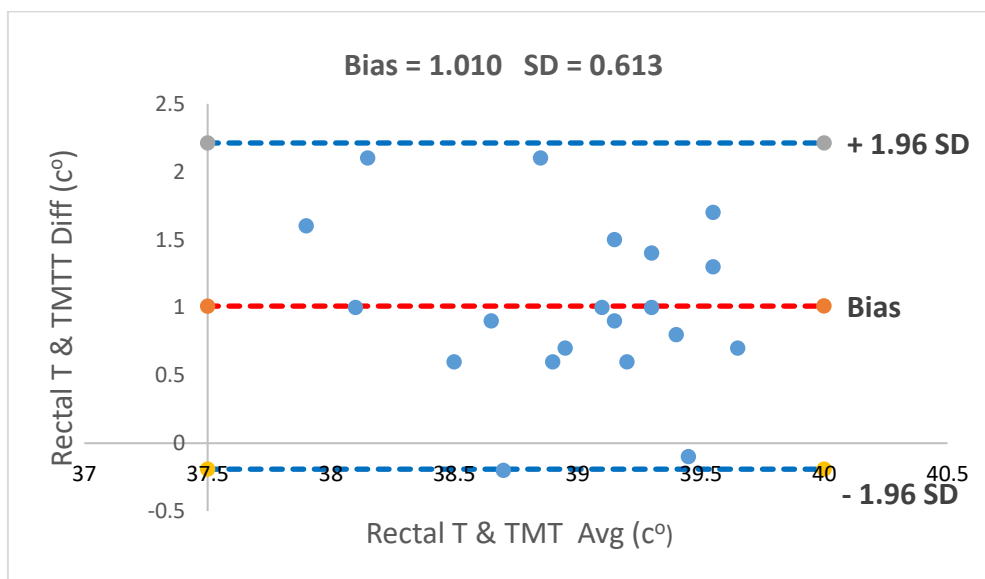


Figure 3: Bland Altman plot of the agreement between rectal mercury temperature and TMT.

The y-axis represents the difference between rectal mercury temperature and tympanic membrane temperature measurements. The x-axis represents the average of rectal mercury temperature and tympanic membrane temperature. The red dashed line represents the bias, and the blue dashed lines represent the 95% limits of agreement (mean ± 1.96 standard deviation).

A positive correlation was observed between AT and TMT ($r = 0.542$, $P = 0.014$). Bland Altman revealed that TMT underestimated AT (fig 4). TMT mean was significantly different from AT mean (fig 1). 90% of cases had a TMT temperature lower than AT (18/20), two animals had a TMT that was higher than AT. The highest difference between AT and TMT was 1.8°C .

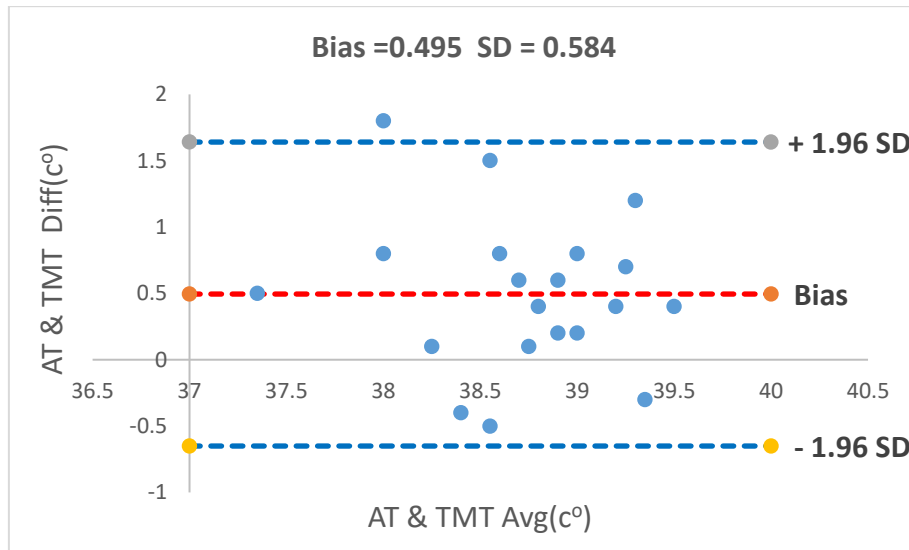


Figure 4: Bland-Altman Plot of Agreement between Axillary Temperature and Tympanic Membrane Temperature Measurements in the Study Group.

The y-axis represents the difference between axillary temperature and tympanic membrane temperature measurements. The x-axis represents the average axillary temperature and tympanic

membrane temperature. The red dashed line represents the bias, and the blue dashed lines represent the 95% limits of agreement (mean ± 1.96 standard deviation).

Table 5: Pearson's Correlation Coefficients for Body Temperature Measurements in the Study Group: Rectal Mercury Temperature, Rectal Digital Temperature, Axillary Temperature (AT), and Tympanic Membrane Temperature (TMT).

Methods	Pearson's correlation analysis results	
	Correlation coefficient (r)	P value
Rectal mercury temperature – AT	0.883**	0.000
Rectal mercury temperature – TMT	0.474*	0.035
Rectal digital temperature – AT	0.823**	0.000
Rectal digital temperature – TMT	0.450*	0.047
AT – TMT	0.542*	0.014

P value was significant < 0.05. Superscript stars indicate the presence of a correlation between different temperatures. * $P < 0.05$, ** $P < 0.01$

DISCUSSION

Accurate monitoring of body temperature is an essential part of physical examination in dogs, as it can help assess the patient's condition and

track their response to treatment during illness. Since rectal temperature may not be always accessible, it is important to compare multiple temperature measurement methods and verify

their accuracy, so as to provide useful alternatives for body temperature monitoring.

In this study, 20 healthy dogs were enrolled to determine if there was a difference between TRs, AT and TMT. A complete case history, physical examination and a CBC were carried out to ensure animals were healthy for inclusion into the study. Monitoring of heart and respiratory rates served as an additional means of confirming the health status of the dogs that were included in the study.

In our study, the mean heart rate of dogs was consistent with previous reports. A previous study (Hezzell *et al.*, 2013) reported a mean heart rate of 127.2 ± 19.8 bpm in a large group of healthy dogs referred for vaccination, while Boddy *et al.* (2004) found a mean heart rate of 128.70 ± 14.165 bpm in healthy dogs.

We recorded respiratory rates within the normal range, which is consistent with previous research (Rishniw *et al.*, 2012) and (WO, 2004).

The CBC profiles of the recruited dogs were unremarkable. This parameter was also taken to ensure that all dogs included in the study were healthy and not suffering from any illnesses. The various components of the blood were within the normal reference range of the local laboratory (Central Lab of Animal Pathology Department in the Faculty of Veterinary Medicine Assiut University's). Similar findings were also reported in a previous study where the researchers compromised CBC in healthy canine blood samples (An *et al.*, 2019).

There were no significant differences between rectal mercury and rectal digital temperature readings. This result was not unexpected since the recorded temperatures were for the same organ using different devices; both of which were established to give accurate measures of temperatures previously (Higazi, 2016). The upper and lower limits of rectal temperature in a previous study were higher than the reference values in healthy dogs that ranged from 37.2°C to 39.2°C (Konietschke *et al.*, 2014). This increase in upper and lower limits may be attributed to different geographical locations,

environmental living circumstances and breed size (Piccione *et al.*, 2009).

When measuring AT, we found that assistance was significantly less likely to be needed in comparison to RT and TMT, which is consistent with other studies (Lamb and McBrearty, 2013). However, we found that measuring ATs requires more time than measuring RT or TMT. This should be taken into consideration when measuring the temperature of active puppies, as they may be less likely to tolerate this method.

Additionally, stress behavior scores assessments revealed that measuring AT induced less stress compared to RT route (Gomart *et al.*, 2014). Although AT has its advantages, the results of our study indicated that there was a large variation between AT and RT. AT also underestimates RTs which was similar to previous studies where the authors reported the same observation (Cichocki *et al.*, 2017, Mathis and Campbell, 2015). The difference between RT and AT was defined in healthy beagles in a temperature and humidity controlled environment and ranged from 0.7 to 2.1°C (Mathis and Campbell, 2015) but in our present study, the difference ranged from 0.1 to 1.1°C . The smaller observed difference may be explained by the fact that axillary temperatures can be influenced by the animal's environmental conditions, which can result in greater variations in axillary temperature readings. (Mathis and Campbell, 2015). In a previous study (Goic *et al.*, 2014), a positive correlation was found between AT and RT. We also found similar results in our study, with a correlation coefficient of $r=0.833$ ($P < 0.0001$). However, other studies (Cichocki *et al.*, 2017, Mathis and Campbell, 2015) reported a poor correlation between the two methods.

It has been proposed that any deviation greater than $\pm 0.5^{\circ}\text{C}$ from RT in other temperature measurement methods is clinically unacceptable (Sousa *et al.*, 2011, Southward *et al.*, 2006). In this study, it was found that 40% of the dogs had ATs that differed from RT by more than $\pm 0.5^{\circ}\text{C}$, which is consistent with the findings of previous studies that reported rectal-axillary temperature differences of more than $\pm 0.5^{\circ}\text{C}$ from RT (Smith *et al.*, 2015, Lamb and

McBrearty, 2013). These findings suggest that the two techniques cannot be used interchangeably.

We found that TMT measured in this study had an average that was significantly lower than that measured through the rectum. We also found that TMT underestimates RTs. These findings are similar to multiple previous studies (Garner, 2011, Goodwin, 1998, Greer *et al.*, 2007, Kunkle *et al.*, 2004, Piccione *et al.*, 2011, Hall and Carter, 2017a, Cichocki *et al.*, 2017, Giannetto *et al.*, 2022). However, one previous study showed that TMT mean was higher than RT in healthy dogs but by an infrared auricular thermometer designed for use in humans (Sousa *et al.*, 2011). In cats, the mean TMT was found to be higher than the mean RT, but this was observed when TMT was measured using an infrared auricular thermometer designed for use in humans (Sousa *et al.*, 2013). The difference in results between studies may be due to the use of different devices to measure TMT.

We found that 90% of TMT results fell outside the acceptable clinical difference from RT, which is consistent with the findings of previous studies (Lamb and McBrearty, 2013, Hall and Carter, 2017a). This suggests that these techniques cannot be used interchangeably. Despite TMT underestimating RT, Pearson's correlation between RT and TMT showed a positive correlation, which is similar to the findings of other researchers (Sousa *et al.*, 2011). Others also reported a strong correlation between the two methods (Konietschke *et al.*, 2014, Cichocki *et al.*, 2017).

A recent study established the normal canine TMT reference interval to be between 36.6 - 38.8 °C (Hall and Carter, 2017b). In our investigation, we found that 75% of TMT readings fell within this reference range, while the remaining 25% were higher than the established reference range. These results suggest that TMT can replace RT, but it's essential to use veterinary auricular devices and the established TMT reference interval instead of the RT reference interval.

CONCLUSIONS

Based on the results of this study, it is not recommended to use AT or TMT as a substitute for RT in dogs. This is because a large proportion of dogs showed clinically unacceptable differences when the AT and TMT values were compared to normal canine RT values. However, TMT can be a viable option for measuring internal body temperature if a veterinary infrared ear thermometer is used, and normal canine TMT reference intervals are followed instead of RT reference intervals.

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تقييم قياسات الحرارة في ذوات الأنبيات التي خضعت لفحوصات الصحة العامة

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تقاس درجة حرارة الكلاب من خلال المستقيم ، والتي قد يصعب الحصول عليها في الحيوانات ذات الطبيعة العدوانية، أو تلك التي تعاني من امراض الشرج. لذا تم تطوير أدوات وطرق بديلة. قد تؤدي هذه الطرق البديلة إلى نتائج مختلفة. لذلك هدفت هذه الدراسة إلى مقارنة الطرق المختلفة في قياس درجة الحرارة الداخلية للكلاب. حيث تضم هذه الدراسة الحالات الواردة إلى عيادة الحيوانات الصغيرة (ن = 20) لفحص الصحة العامة بعد التأكد من حالتهم الصحية. تم قياس درجة حرارة المستقيم و الإبط والغشاء الطبلي بعد 30 دقيقة من استقبال الحالات. أولاً تم قياس درجة حرارة المستقيم باستخدام ميزان حرارة زئبقي ثم ميزان حرارة رقمي ثم بعد ذلك تم قياس درجة الحرارة الإبطية باستخدام ميزان حرارة رقمي واخيراً قياس حرارة الغشاء الطبلي باستخدام الأشعة تحت الحمراء. وأظهرت النتائج أن صورة الدم الكاملة ومعدل ضربات القلب ومعدل التنفس للحيوانات كانت ضمن المعدلات الطبيعية. وكانت الفروق بين درجة حرارة المستقيم و الإبط تتراوح من 0.1 الى 1.1 درجة مئوية بينما تراوحت الفروق بين درجة حرارة المستقيم والغشاء الطبلي من 0.2 الى 2.1 درجة مئوية. وكان 90% من درجات حرارة الغشاء الطبلي و40% من درجات حرارة الإبط تختلف بأكثر من 0.5 درجة مئوية عن درجات حرارة المستقيم. كما ترابطت درجة حرارة الإبط والغشاء الطبلي ترابطاً إيجابياً مع درجة حرارة المستقيم بينما ترابطت درجة حرارة الإبط مع درجة حرارة الغشاء الطبلي ترابطاً إيجابياً ضعيفاً. ومن تلك النتائج تبين أنه لا ينبغي استبدال درجة حرارة المستقيم بدرجة حرارة الإبط أو الغشاء الطبلي أو استخدامهما بالتبادل مع درجة حرارة المستقيم في الكلاب.