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Thermo-Physiological Responses and Some Growth Parameters in Kids During the First 45 Days under Mediterranean Climate Conditions in Turkey

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Abstract: The aim of this study was to monitor thermo-physiological responses and growth parameters of kids during the first 45 days to obtain more information of the kid's homeostatic response and growth performance in this period. In total 20 male and female Saanen kids were used in the trial with a mean birth weight of 3.27±0.28 and 2.97±0.21 kg, respectively. Rectal Temperatures (RT), Hearth Rate (HR) and Respiration Rate (RR) were recorded two times a day; at 08:00 and 16:00, throughout the trial period. Also, Body Length (BL), Width Through Hip Joints (WTHJ) and Height at Withers (HW) were recorded. Significant effect of postnatal age has been revealed on thermo-physiological parameters. Statistically significant regressions were determined for respiration and heart rate in female kids, while only respiration rate and rectal temperature were revealed for male kids ($p<0.05$). Positive correlations between heart rate and respiration rate have been determined.

Key words: Growth parameters, heart rate, rectal temperature, respiratory rate, kids

INTRODUCTION

The most important alteration for the kid after birth is the adaptation to the new physical environment and free-living compulsion from the mother in the neonatal period. Kid mortality especially, in the neonatal period has been an important issue for the productivity of a farm and has been reported by many researchers between 16-100% and depending mostly on countries, breeds, husbandry methods, diseases and management systems (Awemu *et al*., 1999; Mohanty *et al*., 2002; Marai *et al*., 2002; Turkson, 2003). High mortality rate of kids associated with both pre-weaning and post-weaning period and low reproductive performance of dams are some of the major causes of low productivity in many livestock enterprises and farms.

The neonatal period care is very important for the kids. The adaptation and development of the organs to the new environment has a vital importance for the continuity of their life. It is of critical importance for the newborns to achieve gas exchange function through the respiratory system after the birth. These gas exchanges require a stable developed respiratory system which has a vital importance for the postnatal maturation of the lungs. Postnatal maturation of the ventilatory response to O_2 occurs within the first 10 days of life in newborn lambs and is largely due to an increase in sensivity of the O_2 chemoreceptors (Bureau and Begin, 1982). It is during this period that thermoregulatory, cardiovascular, respiratory and homeostatic mechanisms complete their maturation. The newborn is in a metabolically unstable state that makes the offspring particularly sensitive to perinatal diseases-resulting in high mortality rates (Piccone *et al*., 2006). Neonatal deaths are known to be highest (21%) during the first three days of life and represents an economic lose and welfare concern (Nowak *et al*., 2000). Mortality rate of kids are reported higher between the first 2-48 h of life and reflects mostly on respiratory and thermoregulatory disorders by Walser and Bolsted (1993). The metabolic responses that occur during the transition from fetal to neonate life present a change from a thermoregulatory quiescent state in which inhibitory stimuli dominate (Ball *et al*., 1995).

There is not sufficient studies related to thermo-regulatory responses in the neonatal period compared male and female kids under the Mediterranean climate conditions. The present study aims to reveal the thermo-regulatory responses and determine the progress and some growth parameters during the first 6 weeks of postpartum to obtain useful information for the neonatal

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care to avoid the kid mortality at some point related to the respiratory and thermoregulatory disorders of male and female kids under the Mediterranean conditions of Turkey.

MATERIALS AND METHODS

In this study (in total 20) ten male and female Saanen kids with a mean birth weight of 3.27±0.28 and 2.97±0.21 kg was used, respectively. Kids were fed with dam's milk, had free access to alfalfa hay after 2nd week and reared under semi-intensive system at the University of Cukurova Dairy Goat Research Farm Unit, located in the Mediterranean Region of Turkey, in which subtropical climate conditions is prevailed. It is 40 m in altitude (36°59'N, 35°18'E) and annual precipitation is 450 mm.

Daily thermo-physiological measurements; Rectal Temperature (RT), Hearth Rate (HR) and Respiration Rate (RR) were recorded 2 times a day; at 08:00 and 16:00, throughout the 45 days observation period. Body Length (BL), Width Through Hip Joints (WTHJ) and Height at Withers (HW) were recorded thrice (1st, 4th and 6th) during the experimental period. Animals were kept separated in semi open pens, fed concentrate diet and *ad-libitum* with alfalfa hay. The digestible crude protein and energy contents of concentrate were 16% and 2647 kcal ME kg^{-1}, respectively. RT was recorded by using a digital thermometer, while RR and HR were counted 15 sec and multiplied with 4 by using a stetho-scope from the jointing point of left-front leg and body.

All the results were expressed as the mean±SD. Factorial experiment for fully randomized design (2×2(10)) was used to determine statistical differences between months within sex factor for growth parameters. One-way repeated measures analysis of variance was used to determine statistical differences between mean values of the thermoregulatory response (RT, RR and HR) from the 1st-6th week during the study. Pearson correlation was evaluated to determine correlation coefficients between studied parameters. Regression lines between postnatal age (weeks) and RR, RT and HR of the kids (10 male and 10 female) were determined by using permutation of residuals (full model) due to existence of outliers.

RESULTS AND DISCUSSION

In Table 1 the mean values of the growth parameters are set out with the respective standard deviations for the kids. Significant differences for BL, WTHJ and HW were recorded among sex.

Results of ANOVA showed that male and female kids have similar values in the first four weeks in terms of HW, WTHJ and BL. HW, WTHJ and BL of male kids had higher values between 1st-4th weeks. HW, WTHJ and BL were found statistically significant for female kids after 4th week ($p<0.001$). Correlation coefficients of these characters within sex were given in Table 2. There were positively significant correlations between growth parameters (Table 2). Estimated correlation coefficients of female kids were determined higher than that of male kids except the correlation between HW and WTHJ.

Table 1: ANOVA results for BL, WTHJ and HW for sex within weeks

	Male kids		Female kids	
Parameters	1st-4th week	4th-6th week	1st-4th week	4th-6th week
HW	29.4±0.96^{c}	33.0±1,24^{a}	28.5±1.08^{c}	31.65±1.1^{b}
WTHJ	8.15±0.63^{c}	12.2±0.59^{a}	7.6±0.69^{c}	10.35±0.88^{b}
BL	29.4±2.17^{c}	33.3±2.14^{a}	28.8±1.29^{c}	31.7±1.16^{b}

^{a,b,c}Means within a column lacking a common superscript letter differ ($p<0.05$)

Table 2: Correlation coefficients of interested growth parameters of kids

	Male kids		Female kids	
Parameters	WTHJ	BL	WTHJ	BL
HW	0.865**	0.769**	0.837**	0.857**
WTHJ	-	0.783**	-	0.876**

$^{**}p<0.01$

Mean levels of thermo-physiological responses during 45 days are set on Table 3. Throughout the first 45 days of the experiment, significant differences were recorded on postnatal age for thermo-regulatory responses in male and female kids (Table 3). The mean values of the heart rate for male and female kids were determined 154.97±14.87 and 156.08±17.12, respectively. HR showed an increase with significant differences for 2nd and 3rd weeks versus 4th, 5th and 6th weeks, reaching the highest values during the 3rd week with 162.8 min^{-1} in female kids. Heart rate reflects primarily the homeostasis of circulation among with the general metabolic status. Piccone *et al.* (2006) reported that immediately after birth, heart must pump blood at a higher systolic rate into the vascular system that shows high elastic and peripheral resistances which cause a further increase of heart rate. Besides, according to Bushmann *et al.* (1993) suckling causes an increase in the heart rate of lambs. Significant effect of time ($p<0.001$) was recorded on heart rate and a linear decrease after the 2nd week in female kids. Furthermore, a positive correlation has been determined between HR and RR (Table 4) while, the relation between HR and RT has been found insignificant ($p>0.05$). A negative relation between RR and RT were determined for female versus for male kids. Obtained results related to correlation between HR and postnatal age is in consistent with the findings of Piccone *et al.* (2006). Results of analysis showed that postnatal age had not linear but quadratic effect on heart rate.

Table 3: Mean levels of thermo-physiological responses during 45 days recorded in kids

Parameters	1st week	2nd week	3rd week	4th week	5th week	6th week	Sig.
Male kids							
HR	148.8±9.5^{c}	160.5±13.8^{ab}	156.9±15.9^{abc}	162.6±8.3^{a}	152.4±17.3^{bc}	148.6±17.3^{c}	***
RR	71.0±5.52^{b}	83.9±14.9^{a}	69.4±12.15^{b}	56.8±8.1^{c}	51.8±7.94^{cd}	48.0±6.86^{d}	***
RT	39.21±0.2^{bc}	39.13±0,32^{c}	39.37±0.17^{a}	39.34±0.18^{ab}	39.44±0.17^{a}	39.49±0.29^{a}	***
Female kids							
HR	169.9±8.6^{a}	155.0±14.5^{bc}	162.8±7.8^{ab}	159.6±7.9^{b}	149.6±21.2^{c}	139.6±19.5^{d}	***
RR	81.7±4.5^{a}	82.3±6.93^{a}	71.3±10.24^{b}	64.0±8.23^{c}	56.4±7.210^{d}	49.6±5.25^{e}	***
RT	39.24±0.32^{b}	39.34±0.24^{ab}	39.36±0.18^{ab}	39.40±0.25^{ab}	39.40±0.27^{ab}	39.43±0.19^{a}	*
General							
HR	159.4±13.9^{a}	157.8±14.3^{a}	159.9±12.7^{a}	161.1±8.2^{a}	151.0±19.2^{b}	144.1±18.8^{b}	***
RR	76.33±7.33^{b}	83.1±11.5^{a}	70.33±11.2^{c}	60.38±8.86^{d}	54.1±7.84^{e}	48.8±6.09^{f}	***
RT	39.23±0.26^{a}	39.24±0.29^{a}	39.36±0.17^{b}	39.37±0.21^{bc}	39.42±0.22^{bc}	39.46±0.24^{c}	***

^{a,b,c}Means within a row lacking a common superscript letter differ ($p<0.05$), *$p<0.05$; ***$p<0.001$

Table 4: Correlation coefficients of RR, HR and RT of kids

	Male		Female		General	
Parameters	RR	RT	RR	RT	RR	RT
HR	0.208*	-0.084$^{\cdot}$	0.455**	0.065$^{\cdot}$	0.333**	-0.004$^{\cdot}$
RR	-	-0.284**	-	-0.155$^{\cdot}$	-	-0.213**

$^{*}p<0.05$; $^{**}p<0.01$; $^{\cdot}$ insignificant $p>0.05$

RR was found statistically significant both in male and female kids ($p<0.05$) for the postnatal age and a cubic effect has been observed. The mean values of respiration rate for male and female kids were found 63.47±15.75 and 67.54±14.17, respectively. The RR showed a constant increase from the 1st to the 2nd week of study. Started with the 3rd week, RR has been decreased for the rest of the experimental period. That increase in RR in the 1st week could be explained with the decrease in the RT in the same week to balance the body core temperature. Homoeothermic animals such as goats, maintain their body heat balance by increasing respiration rate or panting to balance their body core temperature.

Rectal temperature is generally used as a measurement of animal core temperature (Nielson, 1997). No statistical difference was recorded for rectal temperature ($p>0.05$) and the mean values of rectal temperature were determined for male and female kids 39.33±0.26 and 39.36±0.25°C, respectively. Postnatal age had linear effect on rectal temperature (Fig. 1). A linear increase was recorded in female kids in RT, while a significant decrease was determined 1st-2nd week in male kids; a constant increase has been continued for the rest of the experimental period ($p<0.001$). Piccone *et al.* (2006) has been reported that rectal temperature in the first 30 days of lambs vary between 39.8-40.3°C, which is a bit high than our findings however, the species difference may be effective on that result.

Regression for rectal temperature has been found significant for male ($p<0.05$) and insignificant for female kids ($p>0.05$) (Fig. 2). Correlation coefficients of physiological characters within sex are given in Table 4.

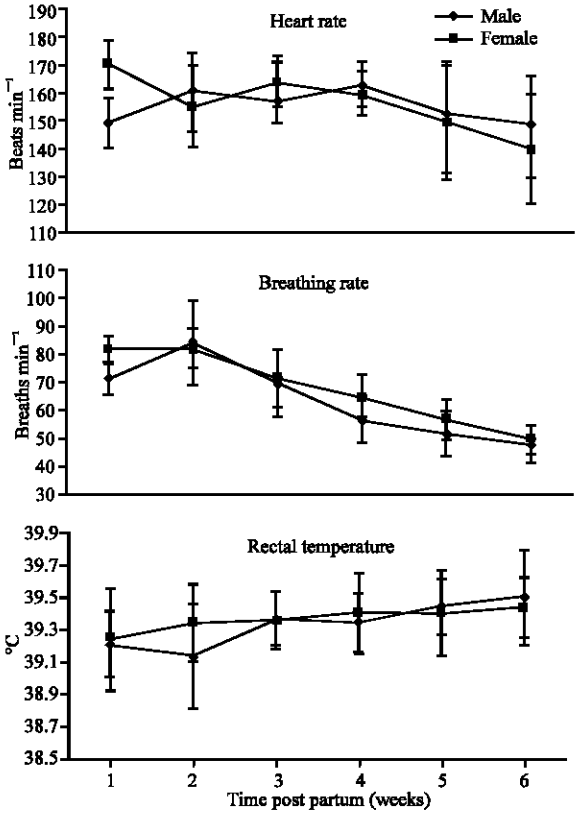

Fig. 1: Mean heart rate, breath rate and rectal temperature for the male and female kids during the first 45 days of postmartum. Effect of sex = $p>0.05$, effect of time = $p<0.001$

The mean values and the statistical differences of the interested physiological parameters (HR, RR and RT) for the kids are shown in Fig. 1. One-way repeated measures analysis of variance showed highly significant effects of time (postnatal age) on the physiological parameters both for male and female kids during the first 6 weeks of life ($p<0.001$).

Regression lines between postnatal age (weeks) and HR, RR and RT of the kids within sex plotted and R^2

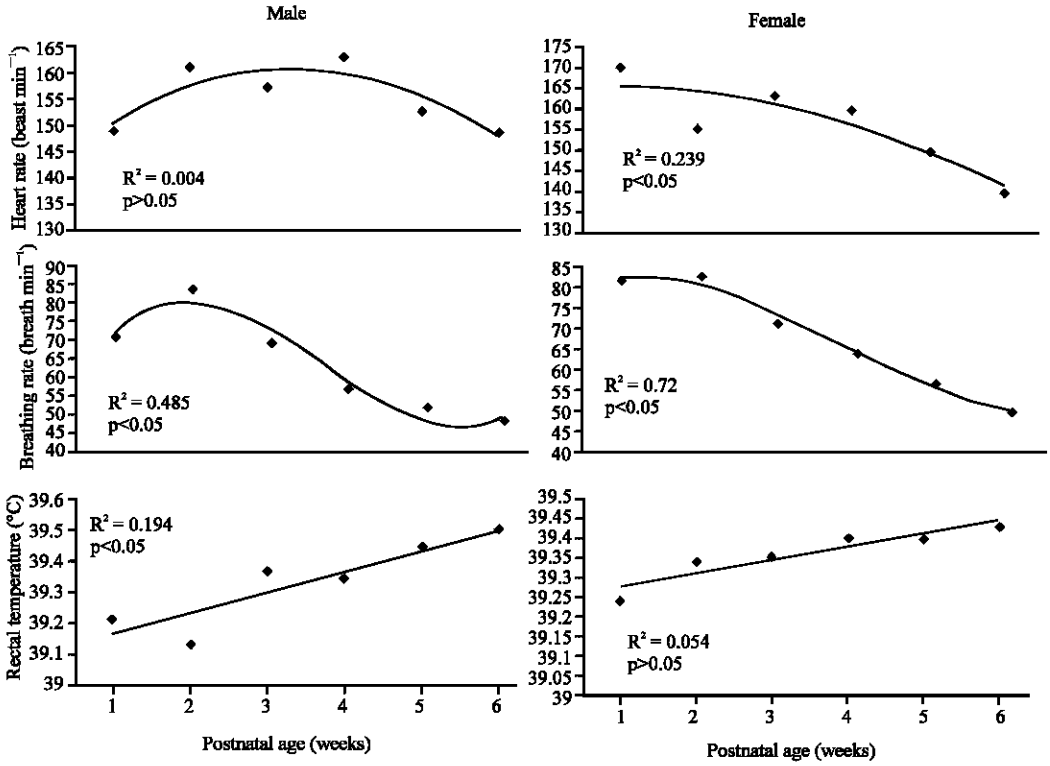

Fig. 2: Regressions between postnatal age (week) and HR, RR and RT of kids within sex

values were given in Fig. 2. Statistically significant regressions were determined for both sexes in RR ($p<0.05$). R^2 value of female kids has been found higher than that of male kids. In addition, no relation between growth and thermo-physiological parameters were determined.

CONCLUSION

An obvious fluctuation has been observed in heart rate, respiration rate and rectal temperature in the first 2 weeks after the birth. This fluctuation may due to the adaptation effort to the new life in the neonatal period. It has been revealed that 2 weeks after birth, the thermo-physiological parameters have been reached to a more smooth level.

Early period kid mortality is one of the main problem on goat breeding in all over the world, whereas with good monitoring whether during neonatal and/or postnatal period, more information can be obtained both from does and kids, which may very useful to make any kind of interference on that stage. Results showed a highly significant effect of postnatal age on some thermo-physiological parameters during the first 45 days of life in kids. Significant differences between male and female kids in heart rate and rectal temperature were determined while no correlation between growth and thermo-physiological parameters. In addition, this study will make a contribution to the knowledge of thermoregulatory, homeostatic and cardiorespiratory changes in kids during the first 45 days of life under the Mediterranean climate conditions and sheds some basic lights on the situation between male and female kids.

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