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REPRODUCTIVE PERFORMANCE OF DAIRY COWS IN RELATION TO GENOTYPE, AGE, PARITY, BODY WEIGHT AND BODY CONDITION SCORE AT RAJSHAHI DISTRICT OF BANGLADESH

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The present study was carried out from selected areas at Rajshahi district to evaluate the reproductive performance of dairy cows in relation to breed/genotype, age, parity, body weight and body condition. A total of 500 cows selected and data were collected directly from the dairy farms owner by using pre-tested questionnaires during the period from September 2013 to December 2014. The average reproductive performance (RP) were recorded as age at puberty (AP) 26.42±0.22 m, age at first calving (AFC) 35.48±0.22 m, post-partum heat period **(**PPHP**)** 121.85±3.48 days, service per conception (S/C) 1.93±0.04, days open (DO) 136.80±3.57 days and calving interval (CI) 401.04±3.94 days. Genotype had significant effect (P<0.05) on all the reproductive traits except on S/C. Local (L) × Holstein Friesian (HF) genotype showed earlier AP and AFC than L× Sahiwal (SL) and L. Age group had significant (P<0.05) effect on AP, AFC and other parameters were not significant (P>0.05). Middle age groups of cows had shown better RP than others groups. Parities of cows had significant effect (P<0.05) on PPHP, S/C, DO except on AP, AFC and CI. Third parity had better RP than others. The best RP was found in >300 kg BW groups. Body condition score had significant effect (P<0.05) on all RP. Good body condition score (BCS) had excellent RP.

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INTRODUCTION

Bangladesh is an agro-based country. Livestock, an integral part of agriculture, plays an important role to keep the rural economy of Bangladesh viable (Sarma and Ahmed, 2011). About 80% of Bangladesh is directly or indirectly involved in agriculture and livestock farming. The contribution of livestock in gross domestic product (GDP) is about 2.51 % in Bangladesh (DLS, 2016). The importance of livestock production has increased in Bangladesh as witnessed by the growth of the sub-sector over the last few decades and the contribution to employment in the country (FAO, 2005). Among the livestock, cattle are most available and versatile component providing a significant contribution to gross domestic, export products and raw materials for industries in relation to existing integrated agricultural farming system in Bangladesh. So, Livestock of Bangladesh is back bone of rural economy. The main goal of dairy farmers is one calf/cow per year. It plays an important role to promote human health and wealth by supplying animal protein in the form of milk and meat. The cattle population in Bangladesh is currently estimated 25.7 million cattle (http://en.banglapedia.org/ index.php? title=Livestock) and among them in Rajshahi district is approximately 5.35 lakh (personal contact with DLS, Rajshahi; 2015). The urban and peri-urban/rural dairy production system has tremendous potential for development and could play a significant role in minimizing the acute shortage of dairy products in urban centers of any country (Mureda and Zeleke, 2008). Reproduction, health and production i.e. calf and milk production are the principal factors affecting the profitability of a dairy herd. Productive performance is determined to a great extent by the milk yield at first lactation and the farm, followed by the age at first calving (Ilieva and Peeva, 2007). In recent years, the dairy industry agenda in many countries has been dominated by health-related problems (Vacek *et al.,* 2007). One prerequisite for effective health management is the accurate knowledge of factors that affect the health status of a cow, such as age, parity, body weight or health history, and of the relationship between health problems and other economically important traits, such as calf, milk production, reproduction, and length of productive life.

The lifetime productivity of cows largely depends on their individual reproductive performance such as age at puberty, age at first calving and calving interval (Ensminger, 1969). The most important measures of reproductive performance of cows are age at first calving, length of calving interval, and length of cow productive life. The current level of reproductive performance in dairy herds is well below the optimum in most countries (Morton, 2003). Reproductive inefficiency in turn, however, affects dairy herd profitability by decreasing milk yield, the number of replacement heifers produced and by increasing culling rate. Healthy pregnant cows are seldom culled from a dairy management control of reproduction and profitability in dairy herd (Grohn and Rajwala, 2000; Santos, 2007). The differences in management (production) systems and environmental conditions under which cattle are maintained could greatly affect the occurrence of reproductive health problems. To ensure food security of our people we need to improve our livestock production first. Low birth rates and reproductive problems are main problems for growth of this sector. Even an apparently healthy animal may not necessarily be in a state of good reproductive health. Very little work has been done to identify the extent of productive and reproductive performance of dairy cows in Rajshahi district, especially situated in low land and hilly areas. Hence, in order to design relevant dairy development strategies and implement context specific interventions for future development of the dairying at study areas, performance evaluation of existing dairying is important. The scientific information regarding the aforementioned parameters helps as a starting point for further development endeavors in dairy enterprise in the nation. Therefore, the present study was undertaken and designed with the objectives of identification of reproductive performance of cows in relation to breed/genotype, age, parity, body weight and body condition available in selected areas of Rajshahi district of Bangladesh.

MATERIALS AND METHODS

Study areas and population

The study areas were selected at the Rajshahi district of Bangladesh. A total of 500 cows selected and data were collected directly from the dairy farms owners/farmers/attendant by using questionnaires during the period from September 2013 to December 2014.

Method of data collection

The data were collected from the selected farms by the researcher every three (3) months interval in year. After collecting the questionnaire, preliminary sorting and checking, data were prepared for analysis.

Description of animals

Cross-bred cattle are mainly Holstein Friesian and Sahiwal. Approximately 20% animals are crossed in Bangladesh. Indigenous cattle are found everywhere of the country has no definite characteristics and constitute about 80% of indigenous cattle population of the country. Their coat color varies from red, grey, white, black or a mixture of them in different proportion.

Grouping of experimental animals

To achieve the goal, animals were grouped according to following considering factors:

Breed/genotype: The cow was classified broadly in Indigenous or Local and Cross-bred. Selected cows were further group into their genetic composition. These were

Group I : Local (n = 100)
Group II : Local × Friesian (n = 324)
Group III : Local × Sahiwal (n = 76)

Age group: Ages of the cows were measured by examination of teeth and counting number of horn ring and birth record kept by the farmers/register book. After confirmation of age of these cows and then divided in the following groups:

Group I : <3 years (n = 75)
Group II : 3 to <5 years (n = 214)
Group III : 5 to <9 years (n = 133)
Group IV : >9 years (n = 78)

Parity: The cows those did not give any calf considered as heifer (P_0), those gave 1st calf considered as parity 1 (P_1), those gave 2nd calf consider as parity 2 (P_2), 3rd calf as parity 3 (P_3) and so on and up to 5 parities cows were considered for the study. The cows were divided in the following groups considering parity:

Group I : Heifer (n = 26)
Group II : 1st calving (n = 138)
Group III : 2nd calving (n = 116)
Group IV : 3rd calving (n = 89)
Group V : 4th calving (n = 58)
Group VI : 5th calving and above (n = 73)

Body Weight: The body weights of dairy cow were recorded in kg and the body weight was measured by means of a measuring tape applying the formula of Rahman *et al.* (2004).

$$\text{Live body weight} = \frac{L \times G2}{300} \text{ pounds}$$

Where, L = Length from the point of shoulder to pin bone in inches
G = Chest girth in inches
Then, the body weights were converted from pound to kg, dividing by 2.2

The selected cows were classified according to their body weight such as:

Group I : <200 kg (n = 116)
Group II : 200 to <300 kg (n = 259) and
Group III : >300 kg (n = 125)

Body condition score (BCS)

Effect of body condition on the reproductive performance and disorders were studied. Cows of different body condition were considered for the study and BCS were determined by Nicholson and Butterworth (1986) with some modified technique. The cows were divided in the following groups considering body conditions:

Group I : Poor (n = 108)
Group II : Medium (n = 120) and
Group III : Good (n = 272)
Where,

Poor: Heads of vertebral process (HVP) were visible, the pad on tuber coxae and ischiatic tuberosity was thicker than that of the under conditioned animal.
Medium: Flank and covering well balanced. The gap between thighs was filled up by fat apparently looks lat not round.
Good: The gap between thighs was filled up by fat apparently looks fatty and well-muscled.
Reproductive traits of cows studied: The following reproductive traits of dairy cows were studied in this study-
Age at puberty: The age at which a heifer first shows the estrous signs and behaviors may be defined as age at puberty. It was measured in month (m).
Age at first calving: It is defined as the age when a heifer first calving a newborn calf. It was measured in month (m).
Post-partum heat period: It is considered as the interval between date of calving and the date of first insemination or first heat show after parturition. It was calculated in days (d).
Service per conception: The average number of services or inseminations required for each successful conception in case of heifer and cows.
Days open: Days open was measured in days. Day's open is referred as interval from parturition to date of conception of cows.
Calving interval: The number of days between two successful calving of the same cows or the period from one calving to the next was termed as calving interval. It was measured in days.

Data management and analysis

The data obtained from the questionnaire was entered into the Microsoft Excel 2007 and transferred to SPSS version, 17.0. Data were statistically analyzed to calculate the effect of reproductive and productive traits of dairy cows. Various standard statistical procedures ((percentages, mean and chi-square test etc.) had been adopted in this study. The mean and standard error of mean for the reproductive traits were calculated with help of a computer package programme (SPSS) version 17.0. Mean of different traits were then tested by using analysis of Variance (ANOVA) by Duncan Multiple Range Test (DMRT). Data were presented as Mean±SE. $P<0.05$ was considered as significant. Simple ANOVA was performed considering the age of dairy cows and to observe the significant differences among the mean values, Duncan's multiple range test (DMRT) was performed to observer significant differences of reproductive traits in different breed, genotype, age, parity, body weight etc. of dairy cows.

RESULTS AND DISCUSSION

Effects of breeds/genotypes on reproductive performance of dairy cows

The effects of breeds on reproductive performance of dairy cows are summarized in Table 1 and Figure 1. The higher value of age at puberty, age at first calving, post-partum heat period, days open and calving interval (27.88 ± 0.47 m, 36.76 ± 0.47 m, 147.84 ± 7.83 d, 155.96 ± 7.17 d and 414.31 ± 8.76 d) were observed in local breed cows and the lower value of (26.05 ± 0.25 m, 35.16 ± 0.25 m, 115.67 ± 3.82 d, 132.24 ± 4.04 d and 398.42 ± 4.38 d) were observed in cross-bred cows. The higher value of service per conception (1.95 ± 0.05) was observed in crossbred cows and the lower value (1.84 ± 0.08) was observed in local breed cows. There was only significant effect ($P<0.05$) of breed on post-partum heat period of dairy cows, other reproductive traits were not significant.

Table 1. Effect of breeds on reproductive performances of dairy cows of Rajshahi district

Reproductive performances	Breed		Grand Total	Chi-Square	C.V	T.V	D.F	Significance
	Local	Cross breed						
Age at puberty (m)	27.88±0.47 (n=100)	26.05±0.25 (n=400)	26.42 ± .22 (n=500)	χ^2	33.85	41.33	28	NS
Age at 1st calving (m)	36.76±0.47 (n=97)	35.16±0.25 (n=385)	35.48 ± .22 (n=482)		36.50	38.89	26	NS
Post-partum heat period (d)	147.84±7.83 (n=83)	115.67±3.82 (n=349)	121.85±3.48 (n=432)		54.100	52.19	37	*
Service per conception	1.84 ± 0.08 (n=100)	1.95 ± 0.05 (n=400)	1.93 ± 0.04 (n=500)		5.13	11.07	5	NS
Days open (d)	155.96±7.17 (n=81)	132.24±4.04 (n=340)	136.80±3.57 (n=421)		97.01	108.64	86	NS
Calving interval (d)	414.31±8.76 (n=57)	398.42±4.38 (n=288)	401.04±3.94 (n=345)		71.72	88.25	68	NS

χ^2 =Chi-Square, m=months, d=days, n=no. of observation, C.V= Calculated value, T.V= Tabulated value, D.F= Degree of freedom, NS=Non-significant, * (P<0.05).

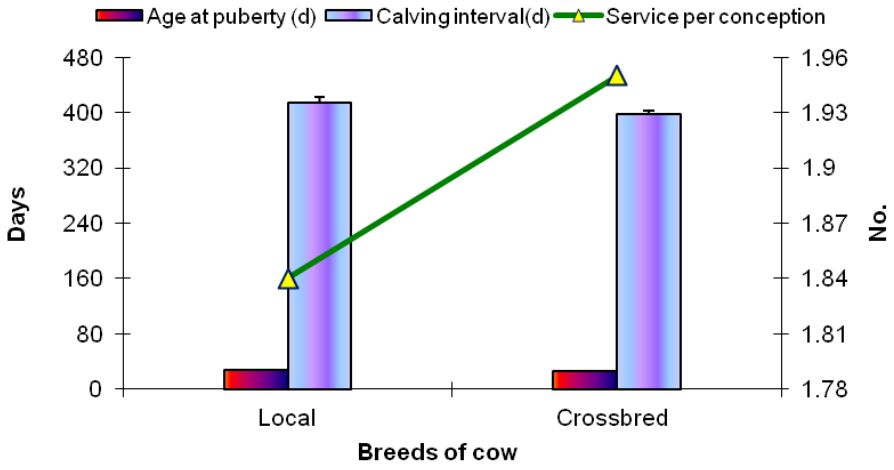

Figure 1. Graphical representation of post-partum heat period, days open and service per conception in different breeds of dairy cows in Rajshahi district

When compared with genetic composition the lower value of age at puberty and age at first calving (25.84 ± 0.27 m and 34.94 ± 0.27 m) were observed in Local × Friesian cows and (26.93 ± 0.61 m and 36.09 ± 0.62 m) and (27.88 ± 0.47 m and 36.76 ± 0.47 m) were in Local × Sahiwal and Local type, respectively (Table 2 and Figure 2 & 3). The higher value of post-partum heat period, days open and calving interval (147.84 ± 7.83 d), (155.96 ± 7.17 d and 414.31 ± 8.76 d) were observed in local type of cows and the lower value (112.43 ± 8.55 d), (128.28 ± 9.37 d) and (396.89 ± 10.96 d) were in Local × Sahiwal. Genotype had significant (P<0.05) effect on age at puberty, age at first calving, post partum heat period, days open and calving interval and had no significant (P>0.05) effect on service per conception.

Table 2. The influence of genotypes on reproductive performances of dairy cows of Rajshahi district

Reproductive performances	Genotype			Grand Total
	Local	Local × Friesian	Local × Sahiwal	
Age at puberty (m)	27.88 ± 0.47^{a} (n=100)	25.84 ± 0.27^{b} (n=324)	26.93 ± 0.61^{ab} (n=76)	26.42 ± 0.22 (n=500)
Age at 1st calving (m)	36.76 ± 0.47^{a} (n=97)	34.94 ± 0.27^{b} (n=314)	36.09 ± 0.62^{ab} (n=71)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	147.84 ± 7.83^{a} (n=83)	116.37 ± 4.27^{b} (n=287)	112.43 ± 8.55^{b} (n=62)	121.85 ± 3.48 (n=432)
Service per conception	1.84 ± 0.08 (n=100)	1.96 ± 0.05 (n=324)	1.90 ± 0.10 (n=76)	1.93 ± 0.04 (n=500)
Days open (d)	155.96 ± 7.17^{a} (n=81)	133.08 ± 4.48^{b} (n=280)	128.28 ± 9.37^{b} (n=60)	136.80 ± 3.57 (n=421)
Calving interval (d)	414.31 ± 8.76 (n=57)	398.73 ± 4.79 (n=239)	396.89 ± 10.96 (n=49)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each other's (P<0.05).

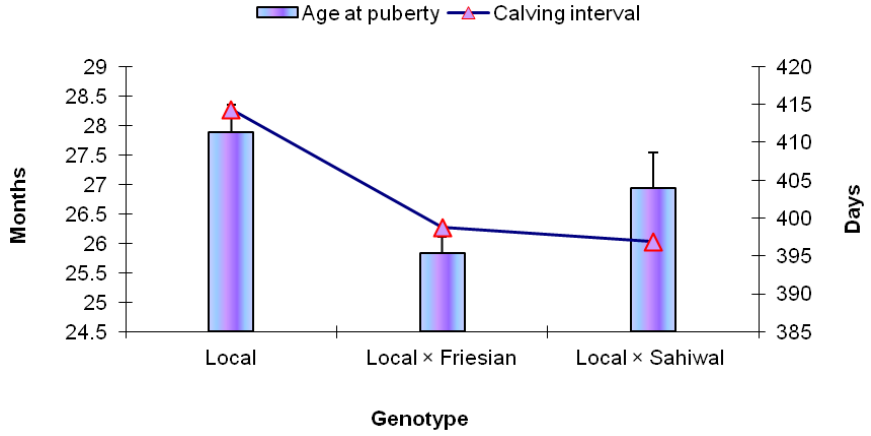

Figure 2. Graphical representation of age at puberty and calving interval of dairy cows in different genotypes

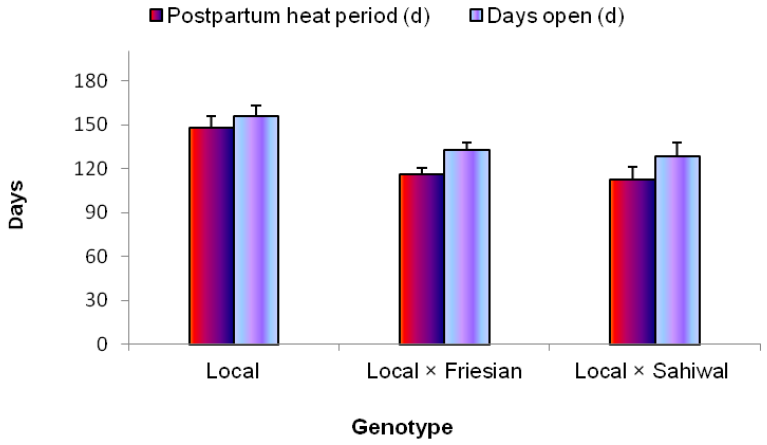

Figure 3. Graphical representation of postpartum heat period and days open of dairy cows in different genotypes

The effects of age group on reproductive performance of dairy cows

The effects of age group on reproductive performance of dairy cows are presented in Table 3 and Figure 4 and 5. The lower value of age at puberty and age at first calving (24.46 ± 0.53 m and 33.62 ± 0.56 m) were observed in 3 to <5 years of age and the higher (27.13 ± 0.41 m and 36.24 ± 0.39 m) were in >9 years. The shorter post-partum heat period (114.79 ± 7.78 d), minimum number of service per conception (1.81 ± 0.7) and days open (124.44 ± 8.18 d) were found in 5 to <9 years of age and the longest post-partum heat period (141.60 ± 9.35 d) was in <3 years, maximum number of service per conception (1.96 ± 0.12) was in 3 to <5 years and days open (148.40 ± 9.47 d) was in <3 years. The higher calving interval (409.59 ± 7.64 d) was found in >9 years of age and the lower (372.00 ± 19.84 d) was in 3 to <5 years.

Age group had significant (P<0.05) effect on age at puberty, age at first calving and had no significant (P>0.05) effect on post partum heat period, service per conception days open and calving interval.

Table 3. Effect of age groups on reproductive performances of dairy cows of Rajshahi district

Reproductive performances	Age group				Grand Total
	< 3 years	3 to <5 years	5 to <9 years	>9 years	
Age at puberty (m)	26.68 ± 0.35^{a} (n=75)	24.46 ± 0.53^{b} (n=214)	26.35 ± 0.54^{a} (n=133)	27.13 ± 0.41^{a} (n=78)	26.42 ± .22 (n=500)
Age at 1st calving (m)	35.62 ± 0.35^{a} (n=64)	33.62 ± 0.56^{b} (n=208)	35.35 ± 0.54^{a} (n=132)	36.24 ± 0.39^{a} (n=78)	35.48 ± .22 (n=482)
Post-partum heat period (d)	141.60 ± 9.35 (n=28)	119.97 ± 4.82 (n=196)	114.79 ± 7.78 (n=130)	124.67 ± 7.42 (n=78)	121.85 ± 3.48 (n=432)
Service per conception	1.90 ± .11 (n=75)	1.96 ± .12 (n=214)	1.81 ± .07 (n=133)	2.00 ± .07 (n=78)	1.93 ± .04 (n=500)
Days open (d)	148.40 ± 9.47 (n=27)	134.83 ± 4.98 (n=187)	124.44 ± 8.18 (n=129)	144.69 ± 7.39 (n=78)	136.80 ± 3.57 (n=421)
Calving interval (d)	396.48 ± 5.31 (n=5)	372.00±19.84 (n=135)	396.91 ± 7.90 (n=127)	409.59 ± 7.64 (n=78)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each other's (P<0.05)

Fig. 4

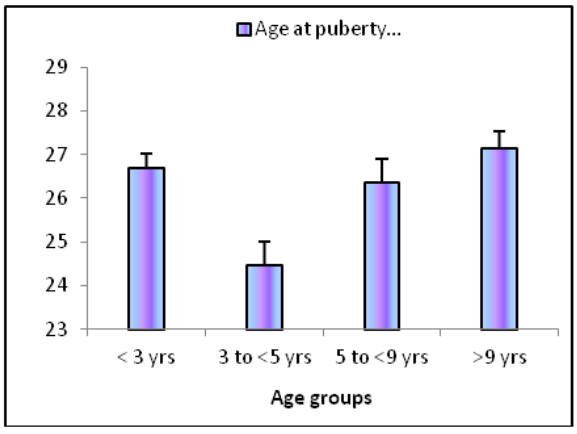

Fig. 5

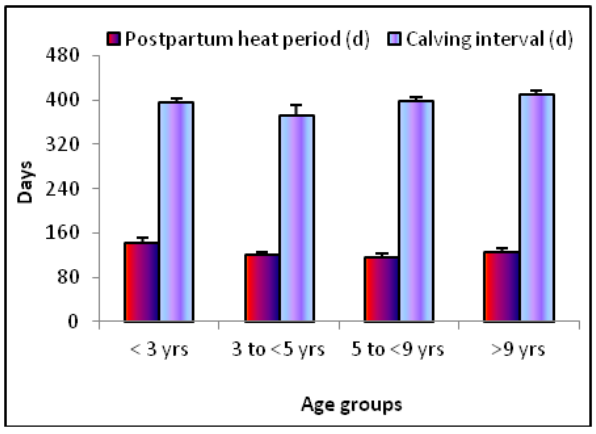

Figure 4. Reproductive performance of age at puberty of dairy cows among age groups; **Figure 5.** Reproductive performance of post-partum heat period and calving interval of dairy cows among age groups

The effects of parity on reproductive performance of dairy cows

To determine the variation of reproductive parameters of dairy cows due to parity effect are presented in Table 4 and Figure 6. The lower value of almost reproductive traits of age at puberty (25.57 ± 0.91 m), age at first calving (34.97 ± 0.46 m), post-partum heat period (109.16 ± 7.11 d), service per conception (1.77 ± 0.09) and calving interval (392.67 ± 7.60 d) were found in 3rd calving except days open (125.98 ± 9.23 d) which was in 4th calving. The higher value of age at puberty (27.25 ± 0.62 m) and age at first calving (36.27 ± 0.62 m) were found in 4th calving, post-partum heat period (181.25 ± 50.01 d), service per conception (2.30 ± 0.25) and days open (190.00 ± 48.47 d) were found in heifer and calving interval (413.96 ± 7.81 d) was found in 2nd calving. Parity had significant (P<0.05) effect on post-partum heat period, service per conception days open and had no significant (P>0.05) effect on age at poverty, age at first calving and calving interval.

Table 4. Reproductive parameters of dairy cows of Rajshahi district in different parities

Reproductive Parameters	Parity						Grand Total
	P_0	P_1	P_2	P_3	P_4	$>P_5$	
Age at puberty (m)	25.83±0.48 (n=26)	26.52±0.43 (n=138)	26.75±0.47 (n=116)	25.57±0.91 (n=89)	27.25±0.62 (n=58)	26.05±0.63 (n=73)	26.42±0.22 (n=500)
Age at 1st calving (m)	35.44±1.35 (n=9)	35.44±0.43 (n=137)	35.75±0.47 (n=116)	34.97±0.46 (n=89)	36.27±0.62 (n=58)	35.12±0.61 (n=73)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	181.25±50.01^{a} (n=4)	145.43±6.93^{ab} (n=92)	121.00±7.71^{b} (n=116)	109.16±7.11^{b} (n=89)	109.98±8.82^{b} (n=58)	115.15±7.44^{b} (n=73)	121.85±3.48 (n=432)
Service per conception	2.30 ± 0.25^{a} (n=26)	1.94 ± 0.08^{ab} (n=138)	1.97 ±.09^{ab} (n=116)	1.77 ± .09^{b} (n=89)	2.00 ±.14^{ab} (n=58)	1.84 ± .10^{b} (n=73)	1.93 ± .04 (n=500)
Days open (d)	190.00±48.47^{a} (n=4)	156.62±6.99^{ab} (n=82)	140.02±7.96^{b} (n=115)	127.22±7.33^{b} (n=89)	125.98±9.23^{b} (n=58)	126.83±7.53^{b} (n=73)	136.80±3.57 (n=421)
Calving interval (d)		393.45±16.52 (n=11)	413.96 ±7.81 (n=114)	392.67 ±7.60 (n=89)	399.39 ±8.96 (n=58)	393.54±7.31 (n=73)	401.04±3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days, P_0=heifer, P_1=1st calving, P_2=2nd calving, P_3=3rd calving, P_4= 4th calving and P_5=5th calving and above; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each other's (P<0.05)

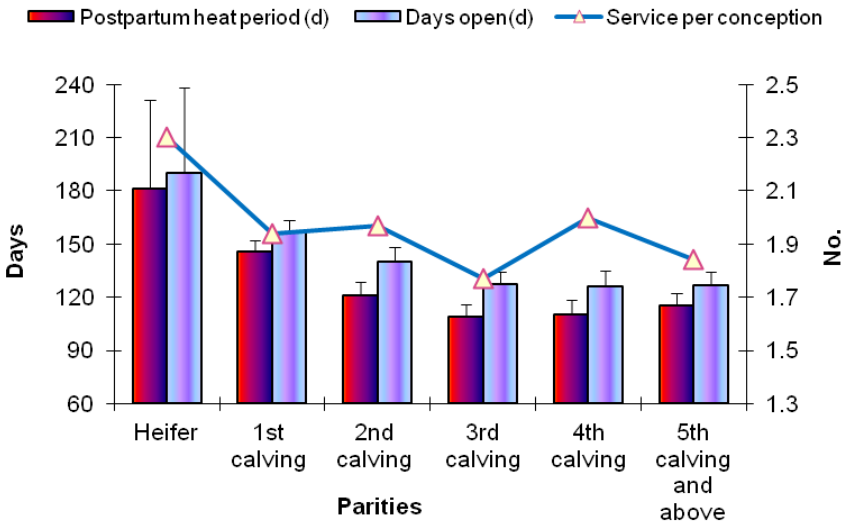

Figure 6. Reproductive performance of post-partum heat period, days open and service per conception in different parities of dairy cows in Rajshahi district

The effects of body weight on reproductive performance of dairy cows

The effects of body weight on reproductive performance of dairy cows are presented in Table 5 and Figure 7 & 8. The lower value of all reproductive traits of age at puberty (25.43 ± 0.44 m), age at first calving (34.53 ± 0.42 m), post-partum heat period (101.44 ± 5.44 d), service per conception (1.88 ± 0.09), days open (115.80 ± 5.38 d) and calving interval (382.78 ± 5.79 d) were found in >300 kg body weight of cows and the higher value of almost reproductive traits of age at puberty (27.37 ± 0.39 m), age at first calving (36.45 ± 0.40 m), post-partum heat period (136.14 ± 8.05 d), service per conception (1.99 ± 0.07), days open (150.15 ± 8.04 d) were found in <200 kg body weight of cows except calving interval (409.57 ± 5.83 d) which was found in 200 to <300 kg. Body weight had significant (P<0.05) effect on age at puberty, age at first calving, post-partum heat period, days open and calving interval and had no significant (P>0.05) effect on service per conception.

Table 5. Reproductive parameters of dairy cows of Rajshahi district by the different body weight groups.

Reproductive Parameters	Body weight			Grand Total
	<200 kg	200 to <300 kg	>300 kg	
Age at puberty (m)	27.37 ± 0.39^{a} (n=116)	26.47 ± 0.32^{ab} (n=259)	25.43 ± 0.44^{b} (n=125)	26.42 ± .22 (n=500)
Age at 1st calving (m)	36.45 ± .40^{a} (n=107)	35.53 ± 0.32^{ab} (n=251)	34.53 ± 0.42^{b} (n=124)	35.48 ± .22 (n=482)
Post-partum heat period (d)	136.14 ± 8.05^{a} (n=88)	127.29 ± 5.04^{a} (n=223)	101.44 ± 5.44^{b} (n=121)	121.85 ± 3.48 (n=432)
Service per conception	1.99 ± .07 (n=116)	1.93 ± .06 (n=259)	1.88 ± .09 (n=125)	1.93 ± .04 (n=500)
Days open (d)	150.15 ± 8.04^{a} (n=86)	142.56 ± 5.25^{a} (n=220)	115.80 ± 5.38^{b} (n=115)	136.80 ± 3.57 (n=421)
Calving interval (d)	409.20 ± 9.97^{a} (n=58)	409.57 ± 5.83^{a} (n=178)	382.78 ± 5.79^{b} (n=109)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each other's (P<0.05)

Fig. 7

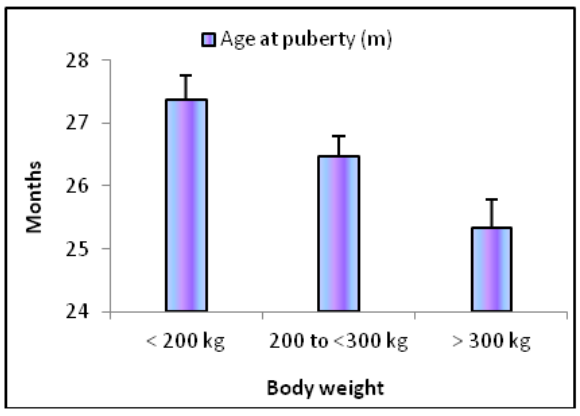

Fig. 8

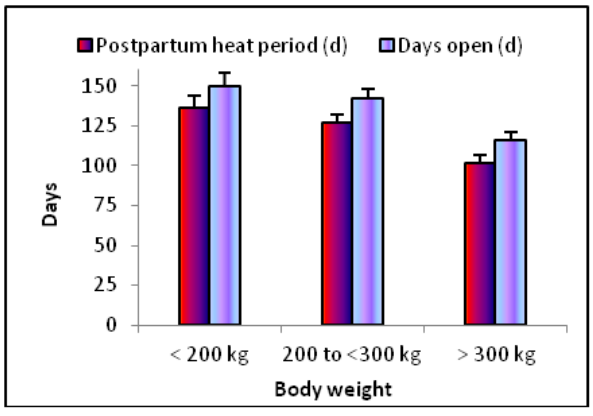

Figure 7. Reproductive performance of age at puberty of dairy cows among body weight groups; **Figure 8.** Graphical representation of post-partum heat period and days open of dairy cows in different body weight groups

The effects of body condition score on reproductive performance of dairy cows

The effects of body condition score on reproductive performance of dairy cows are presented in Table 6 and Figure 9 & 10. Effect of good type of body condition resulted the lower value of all reproductive traits of age at puberty (25.54 ± 0.31 m), age at first calving (34.64 ± 0.31 m), post-partum heat period (108.76 ± 3.71 d), service per conception (1.76 ± 0.06), days open (124.58 ± 3.88 d) and calving interval (392.18 ± 4.18 d) were found in good body condition of cows and the higher value of almost reproductive traits of age at puberty (28.77 ± 0.33 m), age at first calving (37.70 ± 0.35 m), post-partum heat period (143.62 ± 8.52 d), days open (154.96 ± 8.68 d) and calving interval (415.73 ± 10.25 d) were found in poor body condition of cows except service per conception (2.15 ± 0.09) which was found in medium body condition of cows. Body condition score had significant (P<0.05) effect on age at puberty, age at first calving, post-partum heat period, service per conception, days open and calving interval.

Table 6. Effect of body condition score (BCS) on reproductive parameters of dairy cows of Rajshahi district.

Reproductive Parameters	Body condition score (BCS)			Grand Total
	Poor	Medium	Good	
Age at puberty (m)	28.77 ± 0.33^{a} (n=108)	26.29 ± 0.47^{b} (n=120)	25.54 ± 0.31^{b} (n=272)	26.42 ± .22 (n=500)
Age at 1st calving (m)	37.70 ± .35^{a} (n=105)	35.36 ± 0.48^{b} (n=114)	34.64 ± 0.31^{b} (n=263)	35.48 ± .22 (n=482)
Post-partum heat period (d)	143.62 ± 8.52^{a} (n=93)	132.19 ± 8.61^{a} (n=103)	108.76 ± 3.71^{b} (n=236)	121.85 ± 3.48 (n=432)
Service per conception	2.11 ± .09^{a} (n=108)	2.15 ± .09^{a} (n=120)	1.76 ± .06^{b} (n=272)	1.93 ± .04 (n=500)
Days open (d)	154.96 ± 8.68^{a} (n=91)	147.69 ± 8.65^{a} (n=103)	124.58 ± 3.88^{b} (n=227)	136.80 ± 3.57 (n=421)
Calving interval (d)	415.73 ± 10.25^{a} (n=68)	410.40 ± 10.17^{ab} (n=80)	392.18 ± 4.18^{b} (n=197)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each other's (P<0.05)

Fig. 9

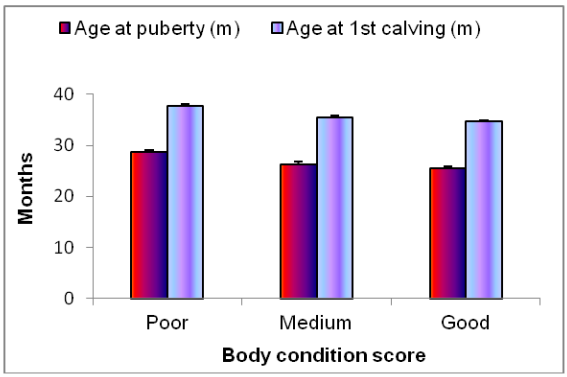

Fig. 10

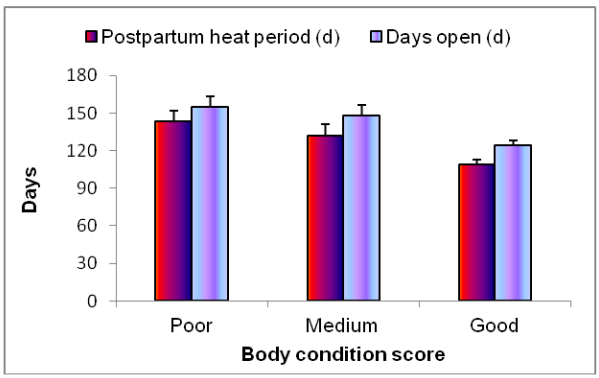

Figure 9. Reproductive performances of age at puberty and age at 1st calving of dairy cows among body condition score; **Figure 10** Graphical representation of post-partum heat period and days open of dairy cows between body condition score

The reproductive performance of dairy cows in Rajshahi district of Bangladesh

Infertility problems are usually overlooked by the farmers and reproductive health management is not ensured. These lead to delayed first calving, long calving interval and poor conception rate, imbalance feed management of dairy cows and calves, unavailability of pasture land, inadequate veterinary services,

excessive cost of concentrate and unawareness of farmers in herd health management (Shamsuddin *et al.,* 2001) are burning issues, which seriously affects the farm economy. The breeds of animal is genetically determined that affects production and reproduction. In this study, the higher value of all reproductive parameters was observed in local than cross-bred cows except service per conception. There was only significant effect (P<0.05) of breed on post-partum heat period of dairy cows. In local cows, the present value is lower than that of observed by Rahman and Kalita (2015) which were average age at puberty (31.45± 0.87) months, age at first calving (43.60±0.96) months, calving interval (533.63± 0.87) days, post-partum heat period (210.1±0.19) days and service per conception 2.47±0.11. Jabber and Green (1983) stated an extended age at first calving in Bangladesh similar to the present study which was 36 months. Tesfu Kasa (1996) observed post-partum intervals and days open were 110.4 ± 23.5 and 148.8 ± 61.8 days for Zebu and 97.5 ± 25.1 and 157.8 + 55.5 days for cross-bred cow which were lower than the present study. In comparison, Sarder *et al.* (1997) reported the reverse the present study that Holstein-Friesian cross requiring the longest time (149 days) to onset of post-partum estrus compared with the local ones (119 days). The author also reported the local cows required fewer S/C (1.4) than the cross-bred (1.8), Khan (1990) found the S/C of local and cross-bred cows was 1.3 and 1.4, respectively which were lower than the present study. The findings of present calving interval were lower than the findings of Halim (1992) observed of local and cross-bred dairy cows was 445 and 425 days, respectively and (Butt and Deshpande, 1986) observed 430.20 ± 3.75 days in Friesian x Local crosses.

Genotype had significant (P<0.05) effect on almost reproductive traits except S/C. The present findings were more or less similar with the findings of others Asimwe and Kifaro (2007) **observed t**he AFC 35.1 ± 9.7 months, S/C 1.66 ± 0.0, DO 162.2 ± 2.6 days, CI 450.4 ± 2.4 days and Kollalpitiya *et al.* (2012) revealed that the age at puberty and age at 1st calving 26 and 35 months, respectively. On the other hand, the lowest post-partum heat period and calving interval of 75 and 403 days was recorded from Sahiwal. Tsegaye *et al.* (2014) observed the age at first calving, calving interval and S/C of Arsi zebu, cross less than 50%, greater than or equal 50%, boran and Jersey were 36.39, 24.78, 24.29, 12.88 and 24.54 months, 420.2, 360.4, 330.3, 330.8 and 360.4 days, and 1.18, 1.50, 1.72, 2.17 and 2.29, respectively in Hawassa city which are agree with the present study. Sultana (1995) observed that S/C of local (L)), similar to the present study but S/C of Local x Sahiwal and Local x Friesian were lower than the present study. Ghosh (1995) observed the S/C were 1.6 ± 0.2 and 1.7 ± 0.2, for F x L and SL x L, respectively which were also lower than the present findings. Shamsuddin *et al*. (2001) reported shorter days open in cross-bred Sahiwal cows than that in cross-bred Friesian and local cows which are almost similar to the present findings. Mondal (1998) observed the average calving interval of Jersey cross, Sahiwal cross, Sindhi cross, Holstein cross and Red-Chittagong cows were as 501.4 ± 86.4, 446.0 ± 95.3, 414.1 ± 51.6 and 469.3 ± 123.8 days, respectively. Hoque *et al*. (1999) obtained the average calving interval of Pabna, Sahiwal × Pabna and Friesian × Pabna were 480.3±4.3, 450.5±4.1 and 390.7±3.6 days, respectively, in Baghabari milk producing area that are higher than the present study. This difference of reproductive traits among the breeds could be due to effects of the differences in management practice, environmental conditions, little rainfall, malnutrition and inappropriate semen handling and insemination techniques (Arthur *et al.,* 1989).

In the present study, we found age group had significant (P<0.05) effect on age at puberty, age at first calving and had no significant (P>0.05) effect on post-partum heat period, service per conception days open and calving interval. Rahman *et al.* (1995) found the highest age at puberty in heifers 47.3 ± 0.6 months, age at puberty, age at first calving, post-partum heat period and days open in cows were as 43 to 48 months, 56.3 ± 0.5 months, 360.1 ± 0.5 and 360.6 ± 0.4 days, respectively than the present study. **T**his study was more or less similar to the result of Sarder (2001) where he observed age at puberty, age at first calving, service per conception in heifer, onset of post-partum estrous, service per conception in cows, days open and caving intervals were 27.9 months, 38.7 months, 1.68, 139 days, 1.6, 160 days and 438 days, respectively. Spalding *et al.* (1975) reported slight increase in the fertility of cows up to 3 to 4 years of age and a decline after 4 years of age. They found a marked decline in fertility in the cow over 7 years of age that are agree with the present study. Shamsuddin (1988) observed lower result of the present study of S/C in cows and heifers which were 1.69 and 1.86, respectively. Coleman *et al.* (1985) reported that reproductive performance had become poor with the advancement of age. Plasse *et al.* (1972) reported higher value of calving interval 496 days in old cows and 424 days in young cows than the present study. Environmental condition, nutrition, care and management, suckling and post calving infection on female reproductive tracts may also affect this trait.

Parity had highly significant effect (P<0.01) on post-partum heat period, days open and calving interval and had insignificant effect on S/C. The lower value of almost reproductive traits was found in 3rd calving except days open which was found in 4th calving. Parity influenced the onset of post-partum ovarian cyclicity and calving to conception interval in dairy cattle (Alam and Ghosh, 1988). This study observed the potential effect of parity on reproduction. Similar findings recorded by McDougall *et al.* (1995) that first parity cows had longer post-partum heat period and days open than cows of > 3rd parity. They reported that the cows of 2nd and 3rd parity shown the best performance. Similarly, cows in their 2nd and 3rd lactation had best performance with regard to onset of ovarian cyclicity recorded by (Pereira *et al*., 1995). In contrast, Darwash *et al.* (1996) found that the interval from calving to onset of ovarian activity become progressively longer as the number of parities increased. The present findings in line with the findings recorded by Zewdu *et al.* (2015). He observed the first parity cows had longer post-partum heat period, days open and calving interval. The findings of present study were more or less similar to the findings of Sarder *et al.* (1997), he studied that days open of different parities such as 1st, 2nd, 3rd, 4th, and 5th were 147 ± 90, 128 ± 76, 134 ± 117, 121 ± 107 and 149 ± 143 days, respectively. However, Haider (2007) observed the younger cows showed the better performance than the older cows that are disagree with the findings of present study. Than *et al*. (2001) reported as increased conception rate with advancing parity from parity 2 upto 6 and then declined at parties 7 and 8. Zu and Zun (1997) reported a higher first service conception rate in cows at their first 3rd parity than that in later parities that are agree with the present study. Lemma1 *et al.* (2010) revealed that calving interval and days open were decreasing significantly with parity number that are similar to the present study. Motlagh *et al*. (2013) observed the reproductive performance decreased from parity ≥6 and Sattar *et al.* (2005) recorded the average number of services per conception was 3.07 ± 0.10 which were disagree with the present study. The findings of present study were similar to the findings of Hammoud *et al*. (2010), he observed the values of post-partum heat period, days open, calving interval, number of services per conception and age at first calving were 88.4 ± 1.1, 130.7 ± 1.9, 403.1 ± 1.9 days, 2.1 ± 0.1 services and 30.7 ± 0.1 months, respectively.

Body size is an important genetic factor in cattle production. Body condition scores are an excellent indicator of reproductive performance. It is an arbitrary scale for estimating the amount of body fat in cows (Wildman *et al.,* 1982). BCS had a good reflection on the reproduction. Good BCS better reproductive performance. This study observed the potential effect of body weight and body condition score on reproduction. In the present study, >300 kg body weight had better reproductive performance compared to other body weight groups and good body condition cows showed the excellent performance than others groups of cows. Haider (2007) observed that cows having a BCS >3.25 were superior in early insemination (82.4±72 days), days open (105.8±72 days), calving interval (397±62.3 days) and S/C (2.1±2.3) than their counterparts. For conception within 115 days BCS 3.25 (55%) and BCS >3.25 (54%) shown better performance than BCS 1.5-<3 (49%), BCS 3 (52%). The author also revealed that the higher the body condition score, the better were the reproductive performance. The present study also in line with (Haider, 2007), Riberior *et al.* (1997) and (Wright *et al.,* 1992). A local study by Shamsuddin *et al.* (2001) stated that body condition score 3.5 or more at AI had shorter interval between calving and conception than with cows having ≤2.5 body condition score that are agree with the present study. The higher reproductive performance of good BCS might be due to better hygienic managemental practice of the farm that reduces the incidence of mastitis and other diseases.

CONCLUSIONS

The current investigation showed a relatively lower productive and reproductive performance of dairy cows at compared with different parameters in Rajshahi district of Bangladesh. The situation demands for further study to determine causes, economic impact and appropriate control strategies under different management systems. This study also clearly indicates that lack of awareness about performance of dairy cow farmers and their importance in the economic viability of their farms. Hence more efforts should be extended towards training, increasing awareness of the animal owners/attendant available veterinary services about these problems and their proper management.

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CONFLICT OF INTERESTS

There is no conflict of interest in this study.

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