ROSHAN RIAZ DEPARTMENT OF ANIMAL SCIENCE, MASTER THESIS 2021

T.C.
BURSA ULUDAG UNIVERISTY
INSTITUTE OF HEALTH SCIENCES
DEPARTMENT OF ANIMAL SCIENCE

EFFECT OF MATERNAL PARITY ON OFFSPRING'S MILK AND REPRODUCTIVE PERFORMANCE, DISEASE INCIDENCE OF CALF PERIOD, AND LONGEVITY IN HOSLSTEIN COWS

ROSHAN RIAZ

(MASTER THESIS)

BURSA-2021

T.C.
BURSA ULUDAG UNIVERSITY
INSTUTE OF HEALTH SCIENCES
DEPARTMENT OF ANIMAL SCIENCE

EFFECT OF MATERNAL PARITY ON OFFSPRING'S MILK AND REPRODUCTIVE PERFORMANCE, DISEASE INCIDENCE OF CALF PERIOD, AND LONGEVITY IN HOSLSTEIN COWS

ROSHAN RIAZ

(MASTER THESIS)

SUPERVISOR:
Prof. Dr. Abdülkadir ORMAN

BURSA-2021

T.C.
BURSA ULUDAĞ ÜNİVERSİTESİ
SAĞLIK BİLİMLERİ ENSTİTÜSÜ

ETİK BEYANI

Yüksek Lisans tezi olarak sunduğum **"Holstein İneklerde Anne Laktasyon Sırasının, Yavrularda; Süt ve Döl verimi Performansları, Buzağılık Dönemi Hastalık İnsidensi ve Sürüde Kalma Süresine Etkisi”** adlı çalışmanın, proje safhasından sonuçlanmasına kadar geçen bütün süreçlerde bilimsel etik kurallarına uygun bir şekilde hazırlandığını ve yararlandığım eserlerin kaynaklar bölümünde gösterilenlerden oluştuğunu belirtir ve beyan ederim.

Roshan RIAZ

TEZ KONTROL ve BEYAN FORMU

17/09/2021

Adı Soyadı: Roshan RIAZ
Anabilim Dalı: Zootekni Anabilim Dalı
Tez Konusu: Holstein İneklerde Anne Laktasyon Sırasının, Yavrularda; Süt ve Döl verimi Performansları, Buzağılık Dönemi Hastalık İnsidensi ve Sürüde Kalma Süresine Etkisi

ÖZELLİKLER	UYGUNDUR	UYGUN DEĞİLDİR	AÇIKLAMA
Tezin Boyutları	■	❑	
Dış Kapak Sayfası	■	❑	
İç Kapak Sayfası	■	❑	
Kabul Onay Sayfası	■	❑	
Sayfa Düzeni	■	❑	
İçindekiler Sayfası	■	❑	
Yazı Karakteri	■	❑	
Satır Aralıkları	■	❑	
Başlıklar	■	❑	
Sayfa Numaraları	■	❑	
Eklerin Yerleştirilmesi	■	❑	
Tabloların Yerleştirilmesi	■	❑	
Kaynaklar	■	❑	

DANIŞMAN ONAYI

Unvanı Adı Soyadı: Prof.Dr. Abdülkadir ORMAN

İmza:

TABLE OF CONTENTS

ABSTRACT

Present information on the maternal parity influences on reproductive and milk production parameters is ambiguous and less information is available on maternal parity effects on the calf duration disease incidence and longevity. The present study aimed to investigate the influence of parity on the calf duration diseases incidence, milk yield and reproductive parameters, and longevity of offspring in Holstein dairy cows. Data were retrieved from a commercial dairy farm present at Karacabey-Bursa state in Turkey. All the data was organized and subjected to statistical analysis, and correlations were established between all first lactation production parameters (peak yield, days to peak yield, 100-d yield, and 305-d yield), reproduction (age at first insemination, number of inseminations), and longevity of the dams and their heifers. In all parity calves, the incidence of calf duration diseases averaged 16.8%, and the rate reduced as mother parity increased ($p<0.01$). Age at first insemination, number of inseminations gestation length as a heifer, and peak milk yield, time to peak yield, 100-d milk yield, 305-d milk yield during the first lactation of all parity heifers averaged 481-d, 1.67, 274-d, 46.06 L, 67.50-d, 3611.93 L and 9588.47 L respectively. Non-significant ($p>0.05$) effect of the parity was found on all these heifer's reproduction and first lactation milk production parameters. A non-significant correlation established for reproduction and milk production studied parameters of the dams and heifers. Longevity averaged 32.43, 27.93, and 26.57 months for first, second and third parity dams offspring respectively, but results remained non-significant ($p>0.05$) for all parity. Non-significant ($p>0.05$) correlation was found between maternal longevity and the longevity of offspring. Among culling reasons investigated, reproductive diseases were the primary culling reason (28.9%), followed by low production (8.4%), mastitis and udder problems (4.8%), foot problems (6.0%), and abomasum displacement (3.6%), and we found a significant ($p<0.01$) positive correlation between culling reasons of dams and heifers. It can be concluded that maternal parity influences the calf duration health diseases, longevity, and extra care should be paid to the first two parity calves, but for better reproductive and production performance during the first lactation, higher emphasis on growth and breeding decisions is suggestive.

Key Words: Maternal age, parity, longevity, health, milk yield, fertility, calf

ÖZET

Anne paritenin üreme ve süt üretimi parametreleri üzerindeki etkilerine ilişkin mevcut bilgiler belirsizdir ve anne paritenin buzağı süresi hastalık insidansı ve ömrü üzerindeki etkileri hakkında daha az bilgi mevcuttur. Bu çalışma, Holştayn süt ineklerinde buzağı süresi hastalıkları insidansı, süt verimi ve üreme parametreleri ve yavruların ömrü üzerindeki anne paritenin etkisini araştırmayı amaçlamıştır. Veriler, Türkiye'nin Karacabey-Bursa ilçesinde bulunan bir süt çiftliğinden elde edilmiştir. Tüm veriler organize edildi ve istatistiksel analize tabi tutuldu ve tüm ilk laktasyon sütü üretimi (pik verimi, pike kadar geçen gün sayısı, 100 günlük verimi ve 305 günlük verimi), üreme (ilk tohumlama yaşı, tohumlamalar sayı) ve düvelerinin sürüde kalma süresi arasında korelasyonlar kuruldu. Tüm parite buzağılarda, buzağı süresi hastalıklarının insidansı ortalama %16,8 idi ve anne paritesi arttıkça oranı azaldı ($p<0,01$). İlk tohumlama yaşı, tohumlama sayısı bir düve olarak gebelik süresi ve pik süt verimi, pik verime kadar geçen süresi, 100 günlük süt verimi, 305 günlük süt verimi tüm parite düvelerin ilk laktasyonunda ortalama sırasıyla 481-gün, 1,67; 274-d; 46,06 L; 67,50-d; 3611,93 L ve 9588,47 L idi. Tüm bu düvelerin üreme ve ilk laktasyon sütü üretim parametreleri üzerinde paritelerinin anlamlı olmayan ($p>0.05$) etkisi bulunmuştur. Sürüde kalma süresi ve düvelerin incelenen parametreleri ile üreme ve süt üretimi için önemli olmayan bir ilişki kurulmuştur. Uzun ömür, birinci, ikinci ve üçüncü parite sürüde kalma süresi yavruları için sırasıyla ortalama 32,43; 27,93 ve 26,57 aydı, ancak parite içindeki tüm pariteler için sonuçlar anlamlı değildi ($p>0,05$). Annenin sürüde kalma süresi ile yavrunun sürüde kalma süresi arasında anlamlı olmayan ($p>0,05$) bir ilişki bulundu. Araştırılan sürüden çıkarma nedenleri arasında üreme hastalıkları birincil sürüden çıkarma nedeni (%28,9) olurken, bunu düşük üretim (%8,4), mastitis ve meme sorunları (%4,8), ayak sorunları (%6,0) ve abomazum displasman (%3,6) izlendi. Annenin sürüden çıkarma nedenleri ve düvelerin sürüden çıkarma nedenleri arasında anlamlı ($p<0,01$) pozitif bir ilişki bulduk. Anne paritenin buzağı süresindeki hastalıkları ve uzun ömür etkilediği sonucuna varılabilir, hemde ilk iki parite buzağıya ekstra bakım ödenmesi gerekir. Ancak ilk laktasyon sırasında daha iyi üreme ve üretim performansı için büyüme ve üreme kararlarına daha fazla önem verilmesi anlamlıdır.

Anahtar Sözcükler: Anne yaşı, parite, uzun ömür, sağlık, süt verimi, döl verimi, buzağı

1. INTRODUCTION

In the 1970s, Ravelli, Stein, & Susser (1976) studied the offspring of Dutch women who suffered from food insufficiency during the pregnancy at the end of World war II. The researcher found differences in the body patterns in the offspring and reported that the mother who suffered from food insufficiency during the early month and the last trimester of pregnancy gave birth to the babies, which showed less occurrence of obesity. On the other hand, the babies born to the mother suffered from food insufficiency during mid of pregnancy, the occurrence of obesity increased. This study opened new research horizons, and later scientists started to focus on the carry-over non-genetic effects of the mother on the offspring. In livestock, nutritional supply in pigs and sheep at the time of gestation influenced the body patterns and the physiological response of next progeny (Braunschweig, Jagannathan, Gutzwiller, & Bee, 2012; Osgerby, Gadd, & Wathes, 2003). Furthermore, the heat stress exposure to the dam during the last trimester reduced the milk production of the heifers (Tao et al., 2019). This change in the functioning of the offspring is due to intra-uterine programing of the fetus as a result of maternal influences. Maternal influences can be stated as maternal environmental, health, nutrition and its partitioning, maternal age, and hormonal and metabolic changes (González-Recio, Ugarte, & Bach, 2012).

Maternal age influences on the intra-uterine programming and postnatal health of the calves in Holstein dairy cows is not well documented. Generally, dairy cows are first inseminated when they attain 60% of their mature weight, and they become pregnant when their body is still growing. Therefore, primiparous cows partition the nutrition to meet the demand of the growing fetus and for its own body growth (González-Recio et al., 2012). Furthermore, after parturition, pregnancy occurs while the cow is milking, and milk production is the primary competing factor for energy and nutrients. The pregnant cow partitions the nutritional resources with its own growth, maintenance, and milk production and provides care for the fetus's development. At the early stage of lactation, there is less nutritional demand by the fetus, but high lactating cows may influence the development of the fetus through hormonal changes (Banos, Brotherstone, & Coffey, 2007). However, after the peak of lactation, where the cow loses its energy reserve, there is excessive fetal growth which requires nutrients. Lee, & Kim (2006) also reported that advanced parity is commonly linked with increased milk output while sacrificing some body conditions and creating a higher incidence of peri-partural disease. After calving, more than 50% of cows also show uterine problems (Balendran et al., 2008). These inflammatory diseases, higher milk yield, and environmental, nutritional, and metabolic stresses with the increase in maternal age and parity not just determine the production and but also have the long term effect on uterine organs, the hormonal and metabolic profile of the cows (Evans et al., 2012; Meikle et al., 2004; Ribeiro, & Carvalho, 2018; Van Eetvelde, Kamal, Vandaele, & Opsomer, 2017). Thus change in maternal uterine environment as a result of a change in hormones, metabolic profile, nutrition, disease, and production can also change the offspring's health status, growth, and future production performance through intra-uterine programming.

In dairy production, birth weight is the main indicator of understanding intra-uterine growth, subsequent development, and survival. It is well accepted that younger (1^{st} and 2^{nd} parity) cows give birth to lighter calves (Cushman et al., 2020). Low-quality colostrum is also produced by younger cows (Morin, Constable, Maunsell, & McCoy, 2001; Shivley et al., 2018), and claves receiving this colostrum have a higher incidence of respiratory and digestive problems (Svensson, Lundborg, Emanuelson, & Olsson, 2003). With increasing maternal age and parity, they encounter several diseases and environmental stresses which change their physiological functioning and productivity, but these changes can help the growing uterine fetus in their postnatal health (Collier, Dahl, & VanBaale, 2006; Gao et al., 2012; Ling, Hernandez-Jover, Sordillo, & Abuelo, 2018; Evans et al., 2012). Calves' health was found to have a considerable impact on the early growth rate, particularly within the first six months of life (Heinrichs, & Heinrichs, 2011). However, Hoseyni, Mahjoubi, Zahmatkesh, & Yazdi (2016) research commination showed a similar average daily gain (ADG) in primiparous and multiparous cow calves, and Van Eetvelde et al. (2017) reported compensation in the growth of weaning calves from all parity cows and no effect in their production performances if well managed.

To date, little literature has been published on maternal age carryover effects over offspring milk production, fertility, and longevity. Among the published studies, some researchers (Astiz et al., 2014; Fuerst-Waltl, Reichl, Fuerst, Baumung, & Sölkner, 2004; Storli, Heringstad, & Salte, 2014) reported a decrease in milk yield (MY), 305-d MY, and ECM (Energy Corrected Milk) with an increase in maternal parity and age within the parity in Holstein, Norwegian and Simmental dairy cows respectively. Banos et al. (2007) found a significant negative effect of maternal MY on the heifers 305-d MY, but this effect was too small to be considered practically. Similarly, Hoseyni et al. (2016) and Van Eetvelde et al. (2017) reported a non-significant effect of maternal parity and production on the offspring's milk yield. Fuerst-Waltl et al. (2004) and da Silva, Musgrave, Nollette Nollette, Applegarth, & Funston (2016) found the maternal age influence on prolonging the maturity age of offspring but no impact on fertility. Carvalho et al. (2020) reported acquiring early mature body weight, early conception, and higher fertility and pregnancies in heifer from the primiparous compared to multiparous Holstein cows. Banos et al. (2007) reported worse fertility in the heifers from the cows who conceived earlier during their first parity. The published studies on maternal age effects on the MY and reproductive parameters of the Holstein dairy cows are unclear. Although, few studies reported the increase in culling rate with an increase in maternal age (Beard, Musgrave, Hanford, Funston, & Mulliniks, 2019; Carvalho et al., 2020; Fuerst-Waltl et al., 2004). However, no clear association between the maternal age and its culling reasons effect on the offspring's longevity and removal causes is reported. Furthermore, in many previous studies, data were collected from the national database or from different farms, or the effects of maternal influences were analyzed based on the parity. It is well known that herd size, region, milk yield, the breeding decision for culling, and environmental factors vary from farm to farm. Therefore, a study was required to quantify maternal age effects on the calves' health, their milk and reproductive performance, and longevity in Holstein dairy cows at a well-managed commercial dairy farm.

The present research was aimed to study maternal age effects on morbidity and health of the calves, milk production and reproduction significant parameters, culling reasons, and longevity in the offspring of Holstein dairy cows.

2. GENERAL INFORMATION

2.1. Developmental Origin of Health and Diseases

The new branch of the science, Developmental origin of health and diseases (DOHaD), that has drained the attention of the medical community, was emerged in the early 1990s. This area of research aggregates the information from various disciplines and studies the conceptus intrauterine altered development and programming due to the maternal and environmental factors and their short or long term effects on next-generation (Silveira, Portella, Goldani, & Barbieri, 2007).

Over a period of time, with the popularity of this research area in biomedical sciences, there are increasing studies supporting the theory of the DOHaD in livestock animals. There are several pieces of evidence that correlate the maternal and environmental influences on their offspring in farm animals. Milking cows have more fertility issues than heifers, and there is a prominent difference among the nutritional requirement as well as the metabolic profile, biology of reproductive organs, and pregnancy (Ahmed, Riaz, & Inal 2020; Bisinotto et al., 2018; Leroy 2008; Sartori, Haughian, Shaver, Rosa, & Wiltbank, 2004; Wiltbank, Lopez, Sartori, Sangsritavong, & Gümen, 2006). Furthermore, after parturition, animals suffer from many health problems, and these inflammatory diseases not just determine the production but also have a long-term effect on uterine organs, reproduction, and pregnancy. As a result, this intrauterine change and change in maternal physiological functioning have long-term influences on the offspring's performance (Bromfield, Santos, Block, Williams, & Sheldon, 2015; Ribeiro et al., 2016).

In-utero or maternal environment affects offspring mainly through the placenta in many animal species and disrupts potential growth and survivability. For example, heat exposure in the late gestation in dairy cows results in the impaired proliferation and development of the mammary cells and results in reduced production. In addition to the poor productivity in cows, heat exposure also results in reduced secretion of placental hormone and impairs the development and birth weight of the in-utero developing calf. These calves possess metabolic alteration and continue under development over the first lactation. In-utero heat stress exposed calves' bear impaired immunity, high disease risk, undergoes programmed anatomy of mammary glands due to mammary cells' DNA methylation in postnatal life, more inseminations for the first conception, up to 20% more chances to leave the herd till first lactation and reduced milk production (Monteiro, Tao, Thompson, & Dahl, 2016; Skibiel et al.,2018; Tao et al., 2019). Predictive physiological changes lead to long-term alterations, most probably via epigenetic processes, which are often transmitted from adults to offspring. Nutrition, development, fertility, and stress responses are all important for an individual's survival, and then it is only natural that they'd be the most receptive to programming and transmittable through epigenetics (Silveiria et al., 2007).

Epigenetics is the inherent modification in the gene expression and phenotype of the next generation without any modification in the DNA sequence, which results in different cellular gene expressions and is a predictive physiological response to the environment (Bird, 2007). Some researchers think these epigenetic effects should be erased in the new individuals during the fetal developmental phase (Kelly, & Trasler, 2004). However, recent studies have evidence that many epigenetic modifications are inheritable (Chong, & Whitelaw, 2004). There are different processes through which non-mendelian inheritances occur, like DNA methylation, non-coding RNA, associated protein modification, or through chromatin structure (Gapp et al., 2014; Lees-Murdock, & Walsh, 2008). These modification processes mainly occur through the environmental influences at the vital growth period of offspring (Jirtle, & Skinner, 2007).

Therefore, many studies have been done focusing on the environmental exposure of toxic substances or nutrients on the exposed one or their offspring's performance. Offspring who are prone to obese mothers and a high-fat intake during pregnancy are more likely to experience mental health and behavioral problems including agitation, depression, attention-deficit hyperactivity disorder, and autism disorders (Sullivan, Nousen, & Chamlou, 2014), and cardio-metabolic health (Chantel et al., 2019). Mothers smoking through epigenetic effect has an adverse effect on the child's growth, behavior, food selection, and hyperactivity which results in several deadly heart diseases and low life duration (Ayres et al., 2011; Bernstein, Plociennik, Stahle, Badger, & Secker-Walker, 2011; Melchior et al., 2015). Mass starvation exposure in utero, on the other hand, through epigenetics was linked to higher neonatal and adult period health issues (Painter et al., 2018). Similarly, the study on the boar offered an increased amount of methylation micronutrients and a standard diet in the group to investigate the epigenetic effect of nutrition on muscles and DNA methylation. The second generation of boars offered with experimental diets showed lean and well-developed shoulder muscles compared to the control group. Furthermore, a noticeable change was seen in DNA methylation, especially in the liver, which has been shown to epigenetically affect fat metabolic processes. (Braunschweig et al., 2012). In sheep, over nutrition during peri-conception and late gestation resulted in an increase in whole-body fat mass and subcutaneous fat, respectively. In contrarily, the under-nutrition to the over-nutrition sheep during the peri-conception period triggers a rise in the weight of the lamb adrenals and the response to cortisol stress (Zhang, Rattanatray, McMillen, Suter, & Morrison, 2010). These results indicate nutritional programming during the peri-conception period cannot remove all the adverse effects in the over-nutrient sheep in the long term. Epigenetic influence on the development of diseases is not well addressed in dairy cattle. Large-Offspring Syndrome (LOS) is considered the epigenetically developed syndrome which results in higher fetal deaths (Kruip, & Den Daas, 1997; Young, Sinclair, & Wilmut, 1998). Dean et al. (2001) reported methylation differences among the embryos developed through advanced reproductive technologies and proposed the reason for LOS. Fang et al. (2019) study revealed that the gestation length could also be impacted through genomic and epigenetic programing effects through regulation of embryonic development.

Based on the above-mentioned evidence, at conception, a new individual acquires both genetic and extra-genetic inputs and also an epigenetic program dependent upon the environment that the developing fetus encounters during gestation. Many natural developmental conditions are affected by epigenetic changes, which can sometimes contribute to disease progression. With increasing age and parity, the cows experience critical management, vital environment, different feeding strategies, and diseases conditions which alter the reproductive system biology and intrauterine environment; as a result, the programs the developing calf during the gestation. However, little is known about maternal age experiences, and this intrauterine programming affects future production, disease development, and survivability of the offspring's in the dairy cattle and needs to address.

2.2. Calf Health Index and Maternal Influences

2.2.1. Morbidity, Mortality and Maternal Influences

Production of the more weaning calves with minimum morbidity, less mortality, and lower medical costs are the priority for the commercial dairy production systems. Several managements, nutritional, calf, and maternal factors are responsible for raising healthy dairy calves. However, after a constant advancement in technologies, progress in the management, and expansion in the prevention of diseases and medicinal treatments, still, morbidity and mortality of the calves are more than acceptable level even in the advanced dairy farming countries. Furthermore, calves' morbidity is directly linked to their survival. The calves which do not suffer from any disease and are not treated have 2.3 times more chances to survive than the calves which are treated once. In addition, the chances of survival also decrease to an extent as the treatment numbers rise (McCorquodale et al., 2013).

Asmare, & Kiro (2016) collected the 30 calves' data from 8 different small farms and reported 67% and 20 % calf morbidity and mortality, respectively. The higher mortality was reasoned due to less care and management of the newborn, more susceptibility to infection and treatments. Windeyer, Leslie, Godden, Hodgins, Lissemore, & LeBlanc (2014) studied the NCD (Neonatal Calf Diarrhea) and BRD (Bovine Respiratory Disease) in 3 month old calves and found NCD and BRD morbidity 23% and 22% respectively and mortality 3.5%. The researchers stated season, housing, dipping of naval, FPT (Failure in Passive Transfer) of immunity, and occurrence of other diseases before two weeks as key risk factors for NCD and BRD. Demir, Aydin, & Ayvazoğlu (2019) reported 25% morbidity and up to 6% mortality of dairy calves in

Turkey. Furman-Fratczak, Rzasa, & Stefaniak (2011) observed the incidence of gastrointestinal and respiratory illness in 37% and 14% of the calves, respectively. Erdogan et al., (2009) reported morbidity in the dairy calves ranging from 36% to 51% in a two-year analysis and found diarrhea (24%), omphalitis (13%), and pneumonia (3%) as the major illness in the newborns. Walker et al. (2012) reported the overall calf mortality, diarrhea morbidity and mortality, and respiratory morbidity and mortality 3.6%, 20%, 1.2%, 5.3%, 0.7%, respectively. Furthermore, they also studied male and female calf morbidity and death rates and reported 3%, 22%, 1%, 5.7%, 0.3% and 4.5%, 19%, 1.4%, 5%, .84% overall mortality, diarrhea morbidity, diarrhea mortality, respiratory morbidity and respiratory mortality for female and male calves respectively. Thus, higher morbidity and mortality affect the farm's economics, the welfare of the calves, reduced weaning calf numbers mean less replacement heifer supply and ultimately a hindrance to the progressiveness of dairy farms.

After birth, the calves do not have a developed immune system to fight against environmental pathogens and resist the early day's illness. Therefore, a passive immunoglobulin transfer from the dam to the calves through colostrum is essential to protect the newborns from diseases and mortality (Weaver, Tyler, Van Metre, Hostetler, & Barrington, 2000). In addition to this passive transfer of immunity, several non-immunological stressors also impact the calves' health status.

2.2.2. Immunological Factors

Colostrum is a mammary secretion right after birth that contains an extra amount of nutrients, antibodies, hormones, maternal cells as immunological factors and growth promoters (Godden et al., 2019). Immunoglobulins, especially IgG1, are the dominant immunoglobin in the colostrum, which is produced from the dam serum IgG1 and protects the calves in the early days (Lin et al., 2020). In addition to the immunoglobulins, colostrum also possesses lactoferrin as a soluble media and immunologically active cells, which enhance the competencies of the calves for the production of immunity (Lakritz et al., 2000). In the early hours after birth, for the calves to protect against the diseases, there must be a sufficient amount of immunoglobulins transfer to the calves. In order to develop sufficient immunity in the calves and to resist infections again, colostrum volume and quality are two important indicators that never be taken lightly. There are several risk factors such as breed, age, calving season, dry period (Godden et al., 2019), which affect the colostrum quality and may cause FPT and cause increased susceptibility of calves for diseases and less vitality (Todd et al., 2018).

Langel et al. (2015) fed newborns with the whole and cell-free colostrum and examined that either immunological state of dairy newborns can be influenced by the adoptive shift of entire immune cells through colostrum at birth and disease resistance. Furthermore, the whole colostrum feeding not just enhances the immunity at the early days after birth but also enhances the long-term immune response and resistance to diseases. Novo et al. (2017) compared the incidence of the diseases in the two groups, one fed with colostrum from their own dams and other group calves fed with preserved colostrum of foster dams, and observed that the calves fed with their own dam colostrum had the higher immunity and disease resistance compared to the foster dams' preserved colostrum fed calves.

It is also long been accepted that cows in their first lactation produce low-quality colostrum than the cows in their higher lactations. Shivley et al. (2018) reported the 25% colostrum samples had the lower (<50 g/L) IgG content, and colostrum quality was high in third and higher lactations compared to the first and second. Morin et al. (2001) also reported breed, season, and lactation impacting the colostrum quality and founded the higher quality of the colostrum in third and higher parities compared to the first and second parity. On the contrary, Kehoe, Heinrichs, Moody, Jones, & Long (2011) studied parity effects on IgG colostrum concentration and examined that IgG concentration in the colostrum rises with the increase in lactation number, and for all parity, the IgG concentration was double compared to the previous reports and higher than the accepted level of IgG 50 mg/ml. Heifer calves consuming colostrum from primiparous cows, on the other hand, had a greater incidence of diarrhea and respiratory illnesses, according to a research by Svensson et al. (2003). According to Gulliksen, Lie, Løken, & Østerås (2009) 58% of Norwegian dairy cows produce colostrum with fewer than the required immunoglobulins (50g IgG/L), and the lowest amount of the colostrum was found in the first and second parity as compared to the higher parities. The authors also reported the higher SCC (Somatic Cell Count) also results in the inferior quality colostrum. Similarly, Ferdowsi Nia et al. (2010) also found that calves offered colostrum with higher SCC possess low serum IgG levels, higher chances of getting infected with diarrhea and other health problems. Calves produced from the dams vaccinated against diarrhea gain a sufficient passive immunity and less suffer from infections than the unvaccinated cows (Alkan, Burgu, Şahna, & Çokçalişkan 2004).

The health status of the calves is also affected by the birth score of the calves. Asmare, & Kiro (2016) found that dystocia-stressed calves were unable to adjust to life in the outside conditions. The calves' immunoglobulin absorption efficiency was likely lowered as a result of the stress, as was colostrum intake, which was likely delayed or lowered. As a result, the longer calves go without enough colostrum immunity, the more opportunities microorganisms causing diarrhea have to infiltrate the intestine. Lower serum Ig level is linked to calf morbidity and death, according to Arthington, Cattell, & Quigley (2000). Thus, dystocia-stressed calves have the increased chances to get and higher. Furman-Fratczak et al. (2011) also found that the FPT and higher morbidity were associated with less colostrum ingestion and dystocia. Primiparous cows' calves were more susceptible due to a higher incidence of dystocia than multiparous cows' calves. Calves with serum Ig concentrations surpassing 10 g/L had the lowest incidence and severity of illness course (Furman-Fratczak et al., 2011). Moreover, they observed that the serum level of Ig over 15g/L protects the calves from respiratory and digestive diseases illnesses and allows the body weight gain to gain the first insemination earlier.

2.2.3. Non-Immunological Factors

The basics to protect the calves against the diseases is to increase immunity, prevent the FPT, and early detect and prevent infections. In addition to immunological protection, the farmers should also give a concentrate on other environmental and management stressors, which enhance the probability of the calves being prone to infections (Uetake, 2013).

Many housing, management, nutritional, calf, and dam-associated factors, which are key risk factors for infections and death in calves, have been reported (Lombard et al., 2007; Svensson et al., 2003; Wilde, 2009). Megersa et al. (2009) also found the newborn's morbidity and mortality up to 30% and 10%, respectively, and reported the calve's bedding condition, animal numbers, housing, and calf gender as critical risk factors impacting the calf morbidity and mortality. Gulliksen et al. (2009) reported calves in large herds are more prone to infections and mortality. At small herds, the owners give extra care to the calve, and management is easy compared to the large herd.

When calf livability is estimated as a direct or maternal trait, male calves die more frequently than female calves (Martinez, Freeman, & Berge, 1983). This is because calving ease is affected by calf gender and dam parity. When compared to calves delivered to multiparous dams, more than half of primiparous dams' calves require help during calving. When compared to heifer calves, a higher percentage of bull calves require help. Calves born to the primiparous dams suffering from severe dystocia had a higher risk of respiratory and digestive illness and total calf mortality (Lombard et al., 2007). Similarly, Johanson, & Berger (2003) observed that cows in their first parity are 4.7 times more liker to have dystocia compared with cows in later parities. Azizzadeh (2011) also reported that in comparison to calves delivered from a healthy calving, dystocia-affected calves had a two-fold risk of infections and mortality. However, Asmare, & Kiro (2016) in their study reported that multiparous and poor body conditions in dairy cows result in higher morbidity and increased mortality in calves compared to the impact caused by the prim-parity cows. This is due fact that the highly producing cows with poor BCS (Body Condition Score) give birth to low BW (Birth Weight) calves which are less resistant to diseases.

Carvalho et al. (2020) studied the dam's health status influence on their calves and reported that the female calves from multiparous cows which suffered from clinical diseases compared to the multiparous cows with no previous clinical illness, have been less prone to digestive illness and other clinical problem during their first lactation. However, Maternal genetic effects for the BRD are high but negative means the dam's resistant to BRD give birth to the calves which are more susceptible to BRD (Snowder, Van Vleck, Cundiff, & Bennett, 2005).

Karslıoğlu Kara (2020) studied the non-infectious causes of calf viability and observed the digestive and respiratory problems as primary reasons of mortality in dairy calves. The author reported calving season, birth weight, dam BCS, and dam parity as vital factors which influence the viability of the calves. Later the author also explained that the calves born to multiparous cows have the highest health status. Furthermore, calves born in autumn or spring have a higher heath status compared to the calves born in summer and winter. Thermal stress lowers the Average Daily Gain (ADG) and impairs the immunity of calves resulting in an increased risk of infections and mortality. Similarly, calves given birth in the winter season have low BW and fat reserves and less ability to compete with environmental conditions. Thus, they have increased risks of morbidity and mortality (Azizzadeh, 2011). The significant variations in the environment across seasons contribute to variations in feeding regimen, and indoor environment, all of which may alter disease incidence (Gulliksen et al., 2009).

Another critical factor that may affect the calves' health status is the feeding plan (Lombard et al., 2007). Calves born to the dams which suffered from peri-parturient metabolic stress possess higher basal inflammatory response but compromised immune response to the lipopolysaccharides compared to the calves from fewer stress biomarkers, indicating that the peri-parturient nutrition and metabolic stress can alter the metabolic and inflammatory response of the calves and may results in increased susceptibility to infections (Ling et al., 2018). Wilde (2009) also studies that the peri-parturient feed regime of the cow is important for neonate's early production of immunity. Furthermore, highly producing animals also modulate the immunological response of the calves because the immunological components of the colostrum from highly producing cows rapidly fall after subsequent milking (Wąsowska, & Puppel, 2018). Dairy calf morbidity is also substantially linked to milk feeding management. Diseases are more prevalent in calves that get less than four liters of milk each day (Asmare, & Kiro, 2016). In addition, the Calves group fed through a single teat controlled system are more susceptible to diarrhea and respiratory problems compared to the single pen bucket fed calves (Curtis, Argo, Jones, & Grove-White, 2016). Godden, Fetrow, Feirtag, Green, & Wells (2005) examined that the weaning periods calved given pasteurized milk are less susceptible to diseases and death and show more weight gain than the calves nourished with milk replacer.

In conclusion, the dam’s parity, production, previous health condition, and vaccination affect the colostrum quality. Low-quality colostrum and FPT of immunity result in increased disease incidence in calves. Therefore, dairy farmers should test the quality of colostrum before discarding it or giving it to newborns. In addition to colostrum quality, several other housing, management nutrition, maternal, and calf associated risk factors also influence the diseases incidence and mortality of the calves. Therefore, more attention should also be paid to these key factors to reduce the post-parturient calf stress and infection rate. Controlling morbidity and mortality in dairy calves can enhance the dairy industry's bottom line, as well as its health and welfare.

2.3. Raising Dairy Replacement Heifers for Sustainable Production

Producers of cow-calf operations have one of the costly choices to make management for replacing heifers, and it is a major concern for developing commercial dairy operations (Tahir, Riaz, Bilal, & Nouman, 2019). Several research has looked into ways to cut heifer development expenses without compromising reproductive performance. Because of the number of calf harvests necessary to cover development expenditures, it's essential for profitability to reduce heifer investment costs while preserving reproductive performance. (Clark et al., 2005). Replacement heifer raising operation starts right after the birth of the calf, its weight, and dam factors. Further, calves and heifers should grow weight at a rate that allows for the first insemination at about 15 months. Weight increase that is appropriate leads to earlier calving and lowers the expense of raising heifers (Furman-Fratczak et al., 2011). Selecting the replacement heifer and its development have an impact on the production and profitability of dairy farms over time (Beard et al., 2019).

2.3.1. Birth Weight, Growth Performance and Puberty

Accurate birth weight estimation and ADG are important for several farm operations (Riaz, Tahir, Waseem, Asif, & Khan, 2018). The fetus's intrauterine growth is shown by birth weight, and this intra-uterine growth of the fetus depends upon the uterine environment and nutritional supply to the calf. The calves' nutritional supply bases on maternal age, parity, it's nutrition, and body condition (Osgerby et al., 2003). In utero, less nutritional supply results in a structural and physiological modification which results in effects on the later stage production. Wathes, Pollott, Johnson, Richardson, & Cooke (2014) described that major periods of nutritious deficit, as well as severe calf hood illness, jeopardize growth, resulting in prolonged negative implications. BW is also an essential characteristic since it is a potential cause both for calf surviving and dystocia. The heavier or lower BW reduces the calve ability to compete for environmental conditions, infection, and mortality. The dams giving birth to the heavier calves also have a higher incidence of dystocia (Johanson, & Berger, 2003).

Many studies demonstrated that diet, management, and housing influence calves' BW and development and have long-term consequences. Hoseyni et al. (2016) evaluated parity impact in Holstein's calves and reported higher weight at birth and ADG in multiparous cow calves. Cushman et al. (2020) study also showed the lighter birth and weaning weight of primiparous calves compared to the multiparous cow calves. Carvalho et al. (2020) also found a lighter BW of the calve born to primiparous cows compared to the multiparous cows. On the contrary, lower BW calves are also produced from older mothers. Later the authors described that after the first calving, highly producing cows lose their condition, and during pregnancy, calves compete for nutrients supply from the dam's growth and lactation nutrient needs, resulting in decreased insulin and IGF-I levels and birth weight (Swali, & Wathes, 2006).

Swali, & Wathes, (2007) found the BW of claves born to multiparous cows higher compared to the primiparous cows. However, no difference in body weight was found later than three months. Van Eetvelde et al. (2017) described that poor growth rate at before six months of age can be compensated through extensive management and nutrition. Handock et al. (2019) study revealed that the lighter weight calves show higher weight gain and highlighting the positive aspects of nourishing lightweight heifers to achieve a higher BW. Da Silva et al. (2016) studied beef cattle, and results revealed higher BW and weaning weight in multiparous cows' heifer calves compared to primiparous cows' heifer calves. The authors also reported the early gain in puberty weight in multiparous cow calves. However, the pregnancy rate remains the same among all cow heifer calves. Similarly, Beard et al. (2019) study shows that female calves from younger dams showed a low birth weight than those delivered to medium or older cows. Further, maternal age has a significant positive effect on the weaning weight and calves' growth to reach puberty. However, the author did not observe any difference in all groups for breeding and pregnancy. In a study, with an increase in maternal age, the weaning percentage of the calves also decreased (Freetly, Cushman, & Bennett, 2021). Cooke, Cheng, Bourne, & Wathes (2013) reported heifers with ADG of 0.75 kg show good fertility, conceive at 15 months and show optimal AFC (Age at First Calving).

Heinrichs, & Heinrichs (2010) reported low birth weight negative effect on AFC (Age at First Calving), first lactation MY, and longevity in Holsteins. Cooke et al. (2013) found that at age of 8 to 15 months, the lighter calves show less growth and reach an AFC of more than 30 months. On the contrary, healthy calves show better growth at this time give birth to calves less than 26 months. Early insemination without altering management to guarantee adequate growth results in less first lactation milk yield. Because there is a financial balance among raising expenses, AFC, and first lactation yield, therefore young stock management decisions should be carefully considered (Nor, Steeneveld, Van Werven, Mourits, & Hogeveen, 2013). Khaton (2020), reported that dairy cow age significantly influences the breeding age and AFC; however, parity influences services per conception and fertility.

In conclusion, birth weight and pre-weaning weight increase with the increase in maternal age and parity. Calves from the multiparous cows also reach puberty earlier compared to primiparous cow calves, but their lightweight at birth can be compensated through extensive management and nutrition. BW and growth in heifer calves is the key parameter to attain the early breeding age and AFC of replacement dairy heifers.

2.3.2. Breeding Age and AFC

Replacement dairy heifers are the farm's future cash generators. They are, nonetheless, a considerable cost component and the 2nd biggest contributor to yearly dairy operations costs during their pre-productive time (Heinrichs et al., 2013). Actual AFC is based on the breeding age and the fertility of the cows. Gaining breeding weight at an earlier age but poor fertility results in delayed calving age and increases the cost of raising. Breeding age and AFC are the key factors for the subsequent production of the heifers. Before breeding, the heifers have to attain a puberty weight. The heifers with slow growth show delay in attaining the breeding weight, delayed insemination, and extended AFC, as reported by Costa, Boselli, & De Marchi (2021). On the opposite, heavier weight gain after the weaning age can result in poor development and higher fat in the mammary gland. A less developed mammary gland gives poor milk in first and higher lactation. In addition, heavyweight gains at an earlier age also result in poor fertility and higher insemination numbers, which further delays the AFC and also adds to the financial cost.

Eastham et al. (2018) studied the AFC in Holsteins and reported that only 12% of the studied heifers give birth at 24 months, and up to 40% of heifers are calved at the age of 30 months or higher. For milking and customized heifer businesses, the average cost of raising a replacement heifer was 1124.06 $ and 1019.20 $, respectively. For milking and customized heifer, businesses feed expenditures accounted for 60.3 and 64% percent of the overall cost for raising a heifer (Gabler, Tozer, & Heinrichs, 2000). The overall average replacement heifer raising expenses was 1,808 ±338 $, according to Heinrichs et al. (2013), with greater raising expenses before the weaning period. Feed accounts for approximately 73% of the total cost of rearing heifers from birth through calving. This cost can be decreased by lowering AFC, and with a one-month reduction in the AFC lowers replacement heifers raising expenses up to 4.3% (Tozer, & Heinrichs, 2001). These cost analyses lead us to think about when to breed and maximize fertility to achieve the optimum AFC.

Increased delivery score, treatment of illness, increased liquid feeding prior to weaning, low-quality roughages feeding to weaned calves, poor housing conditions in calf housing areas were all linked to increased AFC (Heinrichs, A., Heinrichs, B., Harel, Rogers, & Place, 2005). Reproduction, course of parturition, milk production and production lifespan, genetic advancement, and farm economics are all also affected by the AFC (Cooke et al., 2013). The optimal age to breed the cow is a critical decision because it depends upon the health condition of the heifer at the time of conception. Underfeeding and illness during the raising phase have been linked to delayed breeding age and AFC. Heifer calves from multiparous and older cows reach puberty earlier than the calves from the younger cows. However, dam age did not influence the progeny reproductive performance. Mean the post-weaning growth performance influence puberty and reproductive performance. However, breeding age and AFC affect future production and longevity (Beard et al., 2019)

The primiparous calves conceive earlier compared to the multiparous cow. Reproductive performance among the primiparous and multiparous cows remains similar. However, after calving, the BCS loss in the calves from the primiparous cows was higher compared to the multiparous cow (Swali, & Wathes, 2007). Primiparous dam calves reach puberty and calve earlier (Carvalho et al., 2019). On the contrary, Swali, & Wathes (2006) hypothesized that the calves from multiparous higher lactating dairy cows suffered from nutrient competition and reported that the highest producing older dams give birth to 10 kg lighter calves compared to the healthy heavier calves, and this difference in the weight continues up to the nine-month. The calves born with heavier weight showed poor fertility after their first calving. However, they did not found a significant negative effect of the lower birth weight over fertility and reproduction. Milk production remained similar among all weight groups. In addition, they found that not the dam but sir affect the gestation length, metabolism after birth, and fertility. Meier et al. (2020) reported that the heifers having higher genetic merit for fertility traits attain their puberty prior and show higher fertility compared to the negative genetic merit heifer for fertility. Henrichs, & Henrichs (2011) reported that the treatments and sickness prior to 4 months and rising AFC would have a deleterious impact on Holstein cows' first-lactation yield. Further, they reported that the Holstein cows' first-lactation productivity is influenced by their body weight at calving.

Sawa., Siatka, & Krężel-Czopek (2019) suggested that Holstein-Fresian should give birth between 22 to 26 months of their age. They observed that the cows giving birth at this AFC in this range show higher first lactation MY, life span MY, and less probably leave the herd. On the other hand, cows giving birth at AFC more than 26 months produce less first and lifespan lactation yield and left the herd earlier to culling as a result of less production and other udder health problems.

Kučević et al. (2019) said that when the AFC was art 23 months, then the overall milk yield and overall production life were observed higher. When the AFC was raised, especially more than 29 m, the overall production length decreased. Cooke et al. (2013) also found, heifers having 23-25 months AFC have higher fertility compared to the heifers calving at AFC at older ages. Milk production in the first two lactations remained similar among all the groups, but the heifers which gave birth before 26 months of age calved higher. Thus, heifer calving at the age of 23-25 months has a higher lifespan of production and fertility, more calves, and good profit. Higher BW and IGF-I concentrations at early six months of age promote skeletal development and are linked to lower first breeding age and AFC. Although, better management of replacement heifers during the raising phase might relieve suboptimal growth linked with an increased AFC (Brickel et al., 2009).

In order to maintain a low AFC, effective heifer care and proper development are required to provide an optimal body weight and frame size during calving. In animals, in order to go through estrous cycles before mating, at least six weeks before the optimum breeding age, puberty should occur. If calves attain an acceptable size by calving at various ages, there is some flexibility in ADG. After acquiring breeding weight and age, the most important factor in fertility and AFC success can be harmed by infertility or substantial deviations in calves' development patterns (Wathes et al., 2014). However, Heinrichs et al. (2005) stated that AFC did not show any influence from dam parity.

Optimal AFC in Holsteins is indicated to be around 24 months with BW higher than 560 kg at calving to enhance lactation performance and decrease raising expenditures

(Tozer, & Heinrichs, 2001). Similarly, Handock et al. (2018) also described heifer at 21 month AFC with body weight ranging 450-475 yield more first lactation and an average of three lactation milk. In the form of hidden costs and missed productivity, daily management decisions linked to heifer's operation can impact present and future farm profitability (Heinrichs et al., 2005). Curran et al., (2013) described that reducing AFC lower to 23 months reduces the milk production, overall MY, and total milk protein and fat. In addition, they also found that in higher milking cows and three-time milking farms, AFC can be reduced less than 23 months but at average two-time milking average yielding cow farms AFC reduction results in poor milk yield at first lactation and overall milk production. This study results indicate that AFC and breeding decisions should be made depending upon the farm production condition and management. Many studies have been conducted by collecting nation data or from multiple farms. Although, management and animal production across farms remains different, which can influence the results. However, it can generally be accepted that at commercial well-managed farms the AFC can be maintained around 23 to 26 month without affecting the overall production and longevity and it should not accede 30 months which result in poor overall milk yield, fertility and days in production. Therefore, it is a critical, decisive matter and should be taken carefully.

2.4. Fertility and Maternal Influences

Proper reproduction requires the coordination of many physiological functions and AI techniques, many of which are artificially controlled. Improved fertility and reduction in the calving period are two ways to enhance the genetics of dairy animals. However, poor fertility is the significant determinant of the genetic improvement in dairy herds. As a result of lower calf crop, the supply of prospective replacement heifers becomes limited, while the reduction in fertility increases the need for many more (Wathes, Brickell, Bourne, Swali, & Cheng, 2008). Therefore, according to scientists, genetic enhancement of the dairy production system can be done by decreasing pregnancy losses and improving fertility (Bamber, Shook, Wiltbank, Santo, & Fricke, 2009).

Boujenane, & Draga (2021) reported that parity influences the first insemination age, gestation period, calving to insemination duration, open days, first insemination to fruitful conception duration, and calving interval. The reproduction performance of the heifers was higher than the cows. Generally, heifers having more follicles have a relatively higher pregnancy percentage than those with few numbers. Later, the authors explained that the cows with more antral follicles on the ovaries also have higher pregnancy rates, a short interval for conception, and improved reproductive performance. Therefore, they found a dramatic decrease of 67.9% to 11.9% in the pregnancy rates from heifers to 4^{th} parity cow, respectively. However, the authors did not found the difference in progesterone hormone among all the parity cows (Sartori et al., 2004). Although, under the influence of the parity, the different follicular growth and hormonal concentration premature meiosis occurs in dominant follicles, and other abnormalities as well as an increase in mitochondria numbers and lipid droplets (Mihm et al., 1999). Iwata et al. (2011) research found that during oocyte development, both mitochondrial DNA number and ATP (Adenosine Triphosphate) amount increased. With increasing dam age beyond 90 months, the mitochondrial DNA number of mature oocytes dropped, and no apparent connection between the mitochondrial number and ATP content was seen. The nature of fertilization among the above and below 90-month age group was significantly different. According to the researchers, mitochondrial number, ATP concentration, and fertilization result of bovine oocytes are all influenced by maternal age. Furthermore, estradiol concentration at the time of estrus and luteinizing hormones surge are higher in heifers compared to cows (Sartori et al., 2004).

Lactating cows have a greater likelihood of reproductive issues than heifers (Sartori et al., 2004). After parturition due to higher production and increased demand for energy for growth and maintenance, primiparous cows undergo poor energy balance, BCS loss, and delayed fertility. Meikle et al. (2004) found that after parturition, primiparous cows exhibited a more unbalanced hormonal and metabolic profile suggesting a difficulty in returning from the post-parturient poor energy balance phase, and the duration from calving to conception and insemination remains more in these animals. This delay in the conception was directly linked to the more BCS loss in first parity cows and existed for a long duration. During the last trimesters of pregnancy, it is vital to prevent losing the dam BCS as possible. The calf's future performance is affected by the dam's BCS change (Banos et al., 2007). According to the authors, after parturition, first parity cows have significantly more postpartum follicular waves, which leads resulting in a postponement of first ovulation and, as a result, a postponement of the start of the initial period of estrus (Wiltbank et al., 2016). However, due to high metabolic performance and endocrine signaling, multiparous cows start reproductive cyclic periodicity earlier than the primiparous cows (Meikle et al., 2004).

Lucy (2001) studied the effect of MY on fertility and reported that cows with higher production in milk have the greatest incidence of infertility. These higher incidences of infertility are due to poor energy balance after parturition and hormonal changes. Dominguez-Castaño, Ospina, El Faro, & de Vasconcelos Silva (2021) observed that the cows with higher MY require a prolonged duration from parturition to conception. The observed fertility differential between heifers and milking cows is caused variably linked to the uterine environment. After the first calving, the uterine environment seems to alter because more than 50% of cows experience uterine illness (Balendran et al., 2008). This alteration in hormones, metabolic profile, and uterine environment can have a programming effect on the fetus during gestation and may alter the future performance.

In a review, Moussa, Shu, Zhang, & Zeng (2015) described that increase in maternal age influence the follicular size, circulating hormones and impairs the functioning of mitochondrial RNA. Fuerst-Waltl et al. (2004) results showed no difference in the antral follicle of the offspring from heifers and cows, and dam age has no effect on the fertility of the offspring. Although heifer's claves show lightweight and poor growth performance until weaning, they show catchup growth after the weaning period and conceive earlier during service as a nulliparous. However, they undergo a major BCS loss and show lower metabolic performance after parturition (Swali, & Wathes, 2007). Although, in Simmental dairy cows, dam age did not impact the differences in pubertal growth in heifer and breeding animals. The age of the dam, on the other hand, has an effect on the proportion of heifers that enter puberty prior to commencement of breeding, with no change in the number of pregnancies (Beard, Musgrave, Hanford, Funston, & Mulliniks, 2020). When compared to heifers born from multiparous dams, a smaller proportion of heifers born from primiparous mothers were pubertal prior to the breeding season. Heifers from the multiparous cows show higher cyclic activity than the heifers from the heifers, but pregnancy rates during the first reproductive season were similar among both age groups. In addition, the heifers from the multi-parity cows showed better BCS and body weight during parturition as well as at the time of weaning of their calves (da Silva et al., 2016).

Carvalho et al. (2020) divide the offspring into three groups; claves from the primiparous cow with no lactation, claves from multiparous cow calves with no previous clinical disease history, and calves from multiparous cows suffered from clinical disease. They reported that breeding age, AFC, and gestation period were similar among all three groups. However, primiparous cow calves were conceived and calved earlier compared to multiparous cow caves. The pregnancy loss percentage was higher in the primiparous calves than the multiparous cow calves. But, at the breeding time, the breeding per conception and embryonic loss at 45 days of age were higher in multiparous cow claves with a history of clinical disease compared to primiparous ones. Similarly, successful pregnancies were lower in multiparous cow calves with a history of clinical disease compared to primiparous cow calves. Nonetheless, reproductive performance parameters remain the same among multiparous diseased and non-diseased cow calves. The AFC of the dam also influences the reproductive performance of the offspring. The heifers from the primiparous cows having AFC around 23 months acquire more inseminations and present a high return percentage compared to the cows breed and calved later, but compared to the cows having late AFC show improved fertility (Banos et al., 2007).

2.5. Milk Production and Maternal Influences

Similar to reproduction, milk production is an important trait for optimal profitability and farm sustainability. Given these conditions, it's really no surprise that the primary goal of dairy cow breeders for the previous decades has been focusing on milk output through genetic improvement. Therefore, the milk production of the European countries dairy cow has been raised two times in the last four decades, and Swedish dairy cows average milk production has risen from 4200 kg in 1957 to 9000 kg by 2003 (Oltenacu, & Algers, 2005).

At that time, understanding the genetic and environmental variables effect on milk production and components was needed, and many potential variables were discovered by the researchers which impact the production and the component of the milk. Several studies showed that herd, calving season, calving year, lactation number and stage, environmental conditions, nutrition, and many other potential variables all influence MY and composition (Bertocchi et al. 2014; Çardak, 2016; Yoon, Lee, Kim, Chung, & Kim, 2004). When the data are analyzed in relation to lactation number, it is observed that lactation number has an impact on 305-d MY (Milk Yield) and LMY (Lactation Milk Yield) and that the aforementioned values rose as the lactations progressed (Kara, & Koyuncu, 2018). Van Eetvelde et al. (2017) found the birth season as the main factor, not the calving season, which enhances the peripheral sensitivity to the insulin and increases the milk production during the first lactation. Later the author also reported that age at birth also significantly alters the 305-d milk production of the cows. Boujenane (2021) reported that except for milk urea nitrogen concentration, all milk production characteristics were shown to be statistically significant when parity was considered. Further, parity results in higher milk production, fat content, and protein level but a lowers amount of lactose. Similarly, Rajib, Patel, Rao, & Tissopi (2020) study results showed that parity increases the milk production and fat percentage but not the SNF (Solid Not Fat). According to Lee, & Kim (2006), increasing parity rises average 305-d MY. This increase in milk production also put the high producing animal at a higher loss in BCS and delayed recovery. During the first month of lactation, cows with parities higher than 3 lost greater BCS than cows with parity of first. Higher parity cows (4 or higher) recovered their BCS more slowly than 1-3 parity cows until 3-mo of lactation, and BCS recoveries of more than five parity cows were consistently delayed.

Astiz et al. (2014) findings indicate that maternal age is a significant predictor of progeny life performance under ideal nutrition, health, and environmental conditions. Later the author also described that younger cows give birth to high milk-producing offspring compared to the older multiparous dams, which gave birth to the low milk-producing offspring. Similarly, Lubritz, Forrest, & Robison (1989) also observed the highly producing offspring from younger dams in comparison to the offspring from higher parity cows. They also report that with low production, older dam calves also give birth to lighter-weight offspring. Fuerst-Waltl et al. (2004) also observed a reverse association of dam age on the milk production of the offspring in Simmental dairy cows. Lactation yield lowered as the parity increased, and results were significant for all the parties. However, researchers described that the higher milk production of the heifers could be biased because the younger cows have, the higher genetic merit compared to the older multiparous cows. Storli et al. (2014) research on the Norwegian dairy cows revealed that increasing dam's parity results in lower 305-d MY of the offspring. Calves from the seventh parity cows produced 149 kg less milk compared to the first parity cow. Researchers also studied the effect of the maternal age within the parity and reported that dams giving birth at an older age have offspring which produce less milk, while the claves from younger dams within the same parity giving birth at early age produce more milk. In the same, daughters of dams who calved early, around 23 months, gave 4.5 percent more daily milk in the first lactation, had a 7% higher BCS. However, second-lactation dam (36 to 41 months) heifers give about 6% more milk per day for the first lactation, as well as having 2% BCS (Banos et al., 2007). Carvalho et al. (2019) also demonstrated that primiparous dam calves have higher genetic value and milk output compared to multiparous cow calves. However, Milk, ECM, and protein yield remained the same among primiparous and multiparous cows except for the fat yield, which is lower in primiparous than in multiparous cows. In addition, researchers did not found any difference in the milk production or composition for the calves from non-diseased and at least once diseased multiparous cows.

However, Hoseyni et al. (2016) reported the non-significant influence of dam's parity, BW pre-weaning ADG on first lactation yield. Later the authors described that although the non-significant and low correlation was observed for ADG and 305-d milk production, milk yield tended to increase with high weight gain. Cow BCS at calving is significantly impacted by pre-weaning diet and delivery score in a favorable way that can be the reason for the increase in milk production (Heinrichs et al., 2005). Alike, Banos et al. (2007) result reported that the dam's milk production expressed as a significant environmental factor on the heifers and had a negative impact on the 305-d MY and composition. Despite the fact that the impact was significant, it was too (0.3%) small to consider. But, dam milk production affects the overall three lactation milk yield of the offspring, and the AFC of the dam also influences the first three lactation milk production of the offspring. In a nutshell, older cows give birth to daughters who have lower BCS, produce low milk per day and require additional days for the first service, and have less first three lactations MY (Banos et al., 2007). Contrary, no relation was observed between the dam's milk supply during gestation and her daughter's first-lactation yield (Van Eetvelde et al., 2017). Further, the researchers found that neither dam’s milk production and parity nor first-year heifer growth were related to the first lactation MY of the heifer.

2.6. Herd Life of Dairy Animals and Maternal Influences

Dairy producers' primary focus is to achieve healthier, fertile animals at the right age, with maximal genetic expression and a long productive lifespan. Therefore, longevity is also an important functional trait in dairy animals (Çavuşoğlu, Riaz, Omar, Demir, & Orman, 2021). Dairy cows with more herd life are more advantageous because they require fewer replacement heifers, and the raising expenses will be cut off; more superior genetic offspring from superior cows become available as a replacement, and higher selection pressure can be applied, as well as more milk yield can be obtained from available superior genetic cows (Pritchard, Coffey, Mrode, & Wall, 2013). Olechnowicz, Kneblewski, Jaśkowski, & Włodarek (2016) also reported longer lifespans lead to reduced production costs for replacing animals, reproducing, and medicinal costs, with higher milk output. On the contrary, early mortality and culling result in increased replacement heifer raising the cost and less selection of heifers for replacement (Compton et al., 2017). Tozer, & Heinrichs (2001) described that reduction in culling from 25 to 20% dairy cows decreases the replacement heifers raising cost up to 25%.

Generally, culling dairy animals is a critical management decision-taking balancing consideration for milk production, cow's parity, genetic advancement, availability of the replacements, and the economy of the farm. The average reported herd life and production span for Holstein dairy cows is 33.8 ± 1.08 and 36.8 ± 2.60 months, respectively (Kara, & Koyuncu, 2018; Kara, Koyuncu, & Tuncel, 2010), and the average culling rate is between 20 to 35% each year, which is further divided into voluntary and involuntary culling (Smith, Ely, & Chapa, 2000). There may be varying culling rates based on the calculating technique. Not all research accounted for the mortality losses when calculating the culling rate (Smith et al., 2000). Pritchard et al. (2013) described that heifer survival is affected by many management and environmental conditions, and genetic heritability for this trait is very low (~ 0.01).

Dairy animals only start generating revenue when they are more fertile and start producing milk. Genetic enhancement and betterment in nutrition, health, and management conditions improved the lactation milk yield of the dairy cows (Collier et al., 2006). However, this increased MY also raised the culling incidence of the dairy cows. Sewalem, Kistemaker, Ducrocq, & Van Doormaal (2005) reported the higher milk production as a major risk factor for the herd life of the dairy cows. This risk also increases as the fat amount of the milk increases comparatively to the normal milk-producing dairy cows. However, a large percentage of replacement heifers don't successfully cross the first lactation, as many are born dead, die during the raising process, or fail to conceive (Wathes et al., 2008). Later the authors also reported higher MY and excessive utilization of energy for MY during the first lactation results in lower herd life. However, depending on a herd production level, it is possible to get a greater lifespan of a herd from the perspective of herd milk production. There is a risk that the productive life of the first calving heifers will be reduced if the living conditions are insufficient to cope with the high milk production. However, as herd production increased, culling decisions decreases with increased herd production levels, from 16% at low herd production levels to around 6% at high herd production levels. The major reason for removing the cows from the herd was fertility problems (40%). But this culling due to fertility problems was associated with the production level of the cows and was high in first calvers with milk yield up to 11000 kg (Sawa, & Bogucki, 2017). Bach (2012) analysis also indicated that 8.4% of cows left the herd before completion of their lactation, and more than 31% left within two-month completion of days in milk.

While studying the genetic association between MY and the health condition, researchers observed the reverse relation among milk yield and mastitis, ketosis, ovarian cyst, and lameness, suggesting that the higher milk production opens the door to other health problems and reduces the longevity of the animals (Oltenacu, & Algers, 2005). Furthermore, with an increase in lactation stage, milk yield, age, and parity, the incidence of mastitis also increases (Assefa, 2021). Mirzaei, Ararooti, Ghavami, & Tamadon (2021) also observed a rise in sub-clinical mastitis in first to fourth-party dairy cows ranging from 18.8 to 35.4%, respectively. Furthermore, the conception rate was lower in the cows presenting sub-clinical mastitis compared to the healthy cows. With the increase in duration from birth to conception, the removal chances from the herd also raise. Abortion, increase in the number of inseminations, and delayed AFC is negatively linked to the survival of the first lactation cows, and the major reason for culling during the first lactation was the fertility problems (Bach, 2012).

Workie, Gibson, & van der Werf (2021) study over the past 21 years also showed fertility (17.0%) as the most often cited cause, followed by mastitis (12.9%), poor productivity (9.3%), and then being sold for dairy purposes (6.4%). About 37.4% of the other causes were not recorded. As cow age increased, the chance of culling due to infertility and poor production decreased, but the likelihood of culling due to mastitis increased. During the determination of the long-term trend of main culling reasons, it was discovered that the likelihood of Holstein being culled due to infertility has risen over time. Since the culling of cows for declined milk output drastically reduced over the course of 21 years (Workie et al., 2021). Atakan (2017) also described reproduction problems (38.4%) as the major reason for culling in the production life of the dairy cows, followed by selling (14.5%) and metabolic problems (7.5%). Boujenane (2017) also identified reproductive issues as the major reason for the culling (36%) in dairy cows. Chiumia, Chagunda, Macrae, & Roberts (2013) reported a per-year culling of 33.7%. Fertility problems (27.4%) were the premier reason for involuntary culling, followed by udder health (26.9%). Higher BCS during service increased milk production, and higher milk protein around two months of lactation period increased the involuntary culling risk. Yaylak (2003) reported estimated culling of 40.2% for sale for dairy purposes, 17.9% for infertility, 16.2% for udder issues, 3.5% for poor milk production, 3.5% for milk fever, 2.2% for calving difficulties, and 10.9% for foot and leg abnormalities, respectively.

Tutka (2019) reported a 16.04% culling rate in the Holstein cows raised in Turkish conditions. He found reproductive issues, mastitis, and foot problems as three major reasons for culling. In addition, in the cows producing milk more than 30 L and less than 30 L, the main culling reason was mastitis (19%) and reproductive problem (24%), respectively. For small herds, the proportion of cows reported as having left rose to 33.1%, while for big herds, the rate jumped to 37.9%. Production is 17.9%, injury is 17.9%, mortality is 14.8%, mastitis is 13.5%, and poor production is 12.7% as a reason for removal among the higher producing animals (Smith et al., 2000). Similarly, Azizzadeh (2011) also reported reproductive problems as the major (23.6%) in-voluntary reason for the removal from the herd, followed by udder problems (15.5%) and digestive tract problems (15.9%), respectively. Overall removal of the animals was 20.9%, the voluntary reason for the culling was very low (4%) in this study.

According to research by Karslıoğlu (2007), dairy cow's voluntary culling reasons such as sale and less milk yield of the animals was 37% and 4%, respectively. In-voluntary causes for culling was reproductive failure (21%), mastitis (20%), foot problem (5%), old-age (2%) and death (1%). Overall, culling for voluntary and involuntary reasons was 41% and 59%, respectively. In another study, (Tatar, Deniz, & Tutkun, 2017) stated 56% and 44% involuntary and voluntary removal reason of dairy cows from the herd. Reduced milk production (29-36 percent), reproductive issues (15-27 percent), mastitis (18-23 percent), and other factors (25%) were reported as grounds for culling.

Culling risk also increases with parity number. There were three times as many hazards to the third parity cows as there were to the first parity cows. In parity 1 to 6, the average productive life for cows after they calved decreased from 907 days to 399 days.

For pregnant cows, the risk of culling was 3–7 times less than that of cows that were not pregnant. It was more challenging for cows who had difficulty giving birth, who gave birth to heavier male calves or twins, or who had days for artificial insemination more compared to the rest herd (De Vries, Olson, & Pinedo, 2010). With each successive pregnancy, the chance of retained placenta, metabolic disease, and endo-metritis also rose. Reproductive failure was more common among older mothers, who suffered an elevated culling rate as a result (Lee, & Kim, 2006). However, little is known about maternal influences on the offspring's longevity and culling reasons in the Holstein cows.

Beard et al. (2019) research reported that production and longevity are adversely affected by the increase in maternal age. Furthermore, the calf crop of the calves also influences by maternal age. Heifers from the older dams give birth to fewer calves compared to the young dams, which give birth to more claves. Additionally, the calf crop is not just influenced by maternal age, but the heifers born to the older age dams also give less calf crop (Cushman et al., 2020). Fuerst-Waltl et al. (2004) study on the Simmental cows showed a higher risk of culling in the older dam calves, and this risk rises as the maternal age increase. Nevertheless, the culling hazard of calves started to decrease at the oldest age of the dams. The author described that this could be due to the acquired defensive mechanism of the oldest cows to the stressors causing mitochondrial damage. In addition, only breeding value determining traits was studied in the analysis. Furthermore, daughters of the primiparous dams are more prone to being culled and have reproductive problems compared to the multiparous cows. However, the authors also reported that the heifers from the multiparous cows with a history of any clinical disease experience fewer digestive problems, fewer clinical diseases during their first lactation, and a higher chance of being culled compared to the multiparous cow calves with no previous clinical disease (Carvalho et al., 2020).

3. MATERIAL AND METHOD

This study was conducted at a commercial dairy farm located in Karacabey-Bursa state in Turkey, and data of 280 calves and their dams (83 cows) was collected from the single farm to minimize the environmental influences such as management, nutrition, production, and breeding and culling decisions, etc.

3.1. Animals Care and Management

3.1.1. Calves Care and Management

The cows and the heifers at the farm gave birth to the calves in the maternity pen. After drying and naval treatment, the calves were removed from the cows and were paced in the calf pens and fed with good quality colostrum containing IgG more than 50 g/L within 2 hours of birth. Later the calves were transferred to the individual calf pens, where they were fed individually with the milk and had full access to the fresh water and concentrate. Milk supply was gradually reduced before the weaning age and fully cut off during the weaning. After weaning, the growing heifers were placed in the groups in the separate growing sheds. The calves were monitored daily for the illness by the trained supervisors and veterinarians. The clave's dam, sire, birth, and health records were listed in the system.

3.1.2. Reproduction of Heifers

After attaining the breeding weight according to the breeding management protocols of the farm, the heifers were sent to the breeding heifer sheds. The estrus was detected through a pedometer which shows hyperactivity in estrus heifers. Then heifers showing hyperactivity were made confirm for estrus, and AI was performed in the estrus heifers. The heifers were monitored for their next expected estrus. The heifers again returning to estrus were re-inseminated through AI, and heifers not showing any sign of estrus were checked for pregnancy at 45 days after insemination. The non-pregnant heifers were subjected to synchronization protocols and again were inseminated and were followed till their pregnancy. The pregnant heifers were followed till their calving. First insemination date, number of inseminations, calving date, sire, illness, and treatments for heifers were recorded in the system on a daily basis.

3.1.3. Milk Production During the First Lactation

The pregnant heifers near to the parturition were shifted to the maternity sheds. At the start of the lactation, the cows were shifted to the lactating cow sheds. The lactating animals were divided into highly producing, average producing, and low producing animals. The milking was performed three times for the high producing and two times for the average and low producing cows, and data were directly stored in the software program. The cows were fed and managed according to their production and requirement. All the animals had full access to fresh and clean water.

3.1.4. Reproduction in Cows

After the involution period, the cow’s estrus was detected through pedometer hyperactivity and then visual confirmation. When the cows were ready, the AI was performed by the trained technician and followed for their next estrus. The cows which did not conceive and came to estrus were inseminated again. The cows showing pregnancy were checked after 45 days of insemination. The non-pregnant cows were subjected to a synchronization program. The cows showing pregnancy were followed till their calving. Cow's reproductive and production details were saved in the system.

3.1.5. Culling of the Heifers and Cows and Longevity

Heifers and cows were always under surveillance, and any occurrence of the problem was monitored and recorded by the technicians. The main reason to left the herd for heifers was selling or death, and heifers were culled due to respiratory and digestive problems, fertility issues, injuries, or some other problems. The cows left the herd for sale, death, and low production. The involuntary culling was done for reproductive issues, metritis, infertility, digestive problems, abomasum displacement, ketosis, mastitis, foot problem, mastitis, and udder problems. The heifer and cows leaving the herd with culling reasons were enrolled in the system.

3.2. Collection of the Data

In this retro-prospective analysis, the data of the dams and their calves for the traits of interests was retrieved from the farm software (OSCR Data Flow™ II). The calves suffering from any illness (Diarrhea, respiratory problem, naval illness, etc.) were subjected to the treatment by the veterinarian and calf diseases with their medication, and days in treatments were registered daily and feed in the software on a daily basis. The data of calves' dam, dam's birth date, calf birth date, and dam's parity were recorded. The digestive problem, respiratory problem, and naval illness were considered as main issues, and eye problems and other illnesses were considered as "others." Males and calves born dead or died on the day of birth were not included in the analysis.

Reproductive parameters for the heifers and their dams were recorded. The data of age at first insemination, number of inseminations, gestation period, and AFC of the heifers and dams and dam's parity were retrieved for analysis. Heifers from first to third parity dams were only were studied, and the heifers from higher parity cows were removed from the analysis. For milk production, starting date, peak yield, days to reach the peak yield, 100-d MY, and 305-d MY of the first lactation of the heifers and their dams were analyzed in the study. The heifer-dam pairs which did not complete the 100 DIM were removed from the analysis. For the cows whose lactation length was less than 305-d, then their lactation milk yield for 305-d was calculated by the adjusted milk production table (McDaniel, Miller, & Corley, 1965).

The culling cows leaving the herd, the reason to leave the herd, and age at culling were recorded from the system. The cows left the herd for selling purposes, death, low production, and other involuntary reasons. Major culling reasons were grouped as low production, reproduction (metritis, anestrous, infertility, abortion), foot problem, abomasum displacement, mastitis, and udder problems, and others (Selling, slaughtering, injuries, death, acidosis, paralysis, etc.)

3.3. Statistical Analysis

Reproductive and milk production traits and culling reasons data were tested to determine normal distribution by F-test, and One-way ANOVA was used to compare data according to groups. Group was included to model as a factor and the other variables as the dependent variable. Variances were tested by the homogeneity of variances test, and variances were homogeny; therefore, the Tukey HSD test was chosen as post hoc multiple comparisons. Proportional data were analyzed by Chi-square Test. Pearson Chi-Square or Fisher's Exact Test were used for the significant level of the results. Correlation analysis was done by Pearson correlation.

Differences were considered significant at a probability level of $p<0.05$, and the confidence level was 95% in all analyses. All statistical analysis was performed with SPSS software (version 20.0, SPSS Inc, USA).

4. RESULTS

4.1. Calf Period Disease Incidence and Maternal Influences

The morbidity averaged 16.8% in all parity dam calves, and significant differences ($p<0.05$) were observed between parities. The lowest disease incidence was in the third parity dam's calves ($p<0.05$). Although diseases incidence was similar in first and second parity dam's calves ($p>0.05$), the disease case percentage was low in second parity than first parity dam's calves (Table 1).

Table 1. Effect of the maternal parity on the health status of the calves

			Health Status		Total	Significance Letter
			Healthy	Disease		
Parity	1	Count	99	30	129	a
		% within Parity	76.7%	23.3%	100%	
	2	Count	78	14	92	a
		% within Parity	84.8%	15.2%	100%	
	3	Count	56	3	59	b
		% within Parity	94.9%	5.1%	100%	
Total		Count	233	47	280	
		% within Parity	83.2%	16.8%	100%	
p						0.002

p: 1-3, p=0.002; 2-3, p=0.05

The occurrence of respiratory diseases was higher (55.3%) than all the other diseases. As expected, first parity dam's calves were more affected by respiratory infection compared to third parity calves. It is important to note here that the incidence of respiratory diseases was highest in the second parity (Table 2).

The digestive diseases percentage in all parity calves was 27.7%. Digestive diseases were the second major disease problem in the calves of the herd. The lowest incidence of digestive diseases was in the second parity dam's calves, and morbidity of digestive diseases remained the same (33.3%) in the first and third parity dam's calves (Table 3).

Table 2. Effect of the maternal parity on the incidence of respiratory diseases in the calves

			Diseases		Total
			Other Diseases	Respiratory Diseases	
Parity	1	Count	14	16	30
		% within Parity	46.7%	53.3%	100%
	2	Count	5	9	14
		% within Parity	35.7%	64.3%	100%
	3	Count	2	1	3
		% within Parity	66.7%	33.3%	100%
Total		Count	21	26	47
		% within Parity	44.7%	55.3%	100%

Table 3. Effect of the maternal parity on the incidence of digestive diseases in the calves

			Disease		Total
			Other Diseases	Gastrointestinal Diseases	
Parity	1	Count	20	10	30
		% within Parity	66.7%	33.3%	100%
	2	Count	12	2	14
		% within Parity	85.7%	14.3%	100%
	3	Count	2	1	3
		% within Parity	66.7%	33.3%	100%
Total		Count	34	13	47
		% within Parity	72.3%	27.7%	100%

Table 4. Effect of the maternal parity on the incidence of umbilical and other diseases in the calves

			Disease		Total
			Respiratory and Gastrointestinal Diseases	Umbilical and Other Diseases	
Parity	1	Count	26	4	30
		% within Parity	86.7%	13.3%	100%
	2	Count	11	3	14
		% within Parity	78.6%	21.4%	100%
	3	Count	2	1	3
		% within Parity	66.7%	33.3%	100%
Total		Count	39	8	47
		% within Parity	83.0%	17.0%	100%

The umbilical and other diseases were grouped together and averaged 17.0%. It is important to note here that the incidence of umbilical and other diseases increased with the increase in parity and the highest percentage (33.3%) was in the third parity dam's calves (Table 4).

4.2. Reproduction of Heifers

The descriptive statistics for reproductive traits of interest for heifers reached puberty and inseminated are presented in table 5. First insemination age in the heifers from all parity groups (days, month) were evaluated and averaged 481-d and 16-mo, respectively. The first insemination age in the heifers remained similar among the parities ($p>0.05$). Similarly, the number of inseminations also remained similar among the parity. The heifers which successfully calved were analyzed for the gestation period, and results showed a non-significant ($p>0.05$) effect of maternal age and parity (Table 6). We also studied the correlation of maternal age at first insemination (AFI), the number of inseminations (NI), milk yield parameters, and longevity on the offspring AFI and NI, and non-significant results were found ($p>0.05$) (Table 14).

4.3. First Lactation Milk Production

Regarding milk production, 100-d yield. 305-d yield, peak milk yield, and days to reach the peak were studied are shown in table 5. 100-d and 305-d milk yield averaged 3612 kg and 9688 kg respectively, and non-significant effect ($p>0.05$) of dam's parity were observed between the group. Similarly, peak milk yield and days to reach the peak also remained similar ($p>0.05$) among heifers from primiparous and multiparous dams. Except for NI in dams which showed a significant positive correlation ($p<0.05$) with 305-d first lactation yield of offspring, AFI, milk yield traits in the first lactation, and longevity of the dams showed non-significant correlations ($p>0.05$) with the milk yield studied parameters in the offspring (Table 14).

Table 5. Descriptive statistics for the reproductive traits, milk production, and culling reasons of the offspring

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Age at First Insemination (day)	1	111	479.01	57.479	5.456	468,20	489,82	392	721
	2	74	486.66	43.312	5.035	476,63	496,70	416	630
	3	41	476.46	39.478	6.165	464,00	488,92	417	577
	Total	226	481.05	50.171	3.337	474,48	487,63	392	721
Age at First Insemination (Month)	1	111	15.9674	1.91577	.18184	15,6070	16,3277	13,07	24,03
	2	74	16.2223	1.44366	.16782	15,8878	16,5568	13,87	21,00
	3	41	15.8827	1.31590	.20551	15,4673	16,2980	13,90	19,23
	Total	226	16.0355	1.67223	.11124	15,8163	16,2547	13,07	24,03
Number of Insemination	1	110	1.75	1.200	.114	1,52	1,97	1	9
	2	73	1.47	.899	.105	1,26	1,68	1	5
	3	41	1.83	1.160	.181	1,46	2,20	1	6
	Total	224	1.67	1.108	.074	1,52	1,82	1	9
Gestation Period	1	102	274.06	8.669	.858	272,36	275,76	210	294
	2	58	275.36	4.771	.626	274,11	276,62	267	289
	3	24	273.04	4.102	.837	271,31	274,77	267	286
	Total	184	274.34	7.161	.528	273,30	275,38	210	294
Milk Yield 305-d	1	91	9608.1868	1936.46348	202.99653	9204,8988	10011,4749	4102,00	18234,00
	2	49	9481.7551	1830.84508	261.54930	8955,8750	10007,6352	3349,00	12738,00
	3	20	9760.2000	1338.72094	299.34710	9133,6593	10386,7407	7808,00	11896,00
	Total	160	9588.4688	1831.96699	144.82971	9302,4306	9874,5069	3349,00	18234,00
Milk Yield 100-d	1	91	3448.4615	2810.54475	294.62514	2863,1373	4033,7858	1094,00	27555,00
	2	49	4075.4286	3477.19459	496.74208	3076,6617	5074,1955	2066,00	25050,00
	3	20	3220.1000	364.35334	81.47188	3049,5774	3390,6226	2678,00	3947,00
	Total	160	3611.9250	2870.18752	226.90825	3163,7821	4060,0679	1094,00	27555,00
Peak Milk Yield	1	84	46.2048	7.97680	.87034	44,4737	47,9358	32,30	68,70
	2	47	46.4617	6.58703	.96082	44,5277	48,3957	32,10	64,10
	3	20	44.5700	5.13298	1.14777	42,1677	46,9723	35,90	51,90
	Total	151	46.0682	7.22563	.58801	44,9064	47,2301	32,10	68,70
Days to Peak Milk Yield	1	84	69.2143	24.36325	2.65825	63,9271	74,5014	29,00	133,00
	2	47	64.4681	25.43949	3.71073	56,9988	71,9374	24,00	142,00
	3	20	67.5000	26.28087	5.87658	55,2002	79,7998	30,00	143,00
	Total	151	67.5099	24.87807	2.02455	63,5096	71,5102	24,00	143,00
Culling Age (Days)	1	40	972.83	497.247	78.622	813,80	1131,85	125	1929
	2	27	838.04	392.368	75.511	682,82	993,25	141	1591
	3	5	797.00	338.189	151.243	377,08	1216,92	280	1212
	Total	72	910.07	451.363	53.194	804,00	1016,13	125	1929
Culling Age (Month)	1	40	32.43	16.575	2.621	27,13	37,73	4	64
	2	27	27.93	13.079	2.517	22,76	33,11	5	53
	3	5	26.57	11.275	5.042	12,57	40,57	9	40
	Total	72	30.34	15.046	1.773	26,80	33,87	4	64

4.4. Culling Reasons and Herd Life of the Offspring

Generally, from studied offspring, 83 were removed from the herd based on different culling reasons. The culling reasons were grouped into reproduction problems, low production, foot problems, mastitis and udder problems, abomasum displacement, and all the other reasons such as the death of animals, sales for breeding purposes and slaughtering, injuries, metabolic problems, etc. were added to other reasons. Overall, up to 48% of the animals left the herd because of other reasons, and the prevalence of offspring for leaving the herd due to the other reasons were similar among the parities (50%) except second parity in which culling due to other reasons was 43% (Table 12).

Among the other groups except "other reasons" in all parities major reason for the culling was the reproductive problem (29%) and individually, the highest reason for culling in the second parity dam's offspring; however, it was the same among first and third parity dam's calves (Table 10). The second major culling reason was the low production (Table 8), and the remaining 15% from all the parties were culled due to foot problems, mastitis, and udder problem, and abomasum displacement (Table 7,9,11). Between the parity, culling prevalence was high in the primiparous dam's offspring, followed by second and third parity dam's offspring. We also found a significant ($p<0.05$) positive correlation between maternal and offspring culling reasons (Table 13). However, the herd lives (both days and months) were not different ($p>0.05$) among primiparous and multiparous dam calves (Table 5 and 6). Maternal AFI, NI, milk production parameters, and longevity did not show any correlation with the longevity of the offspring ($p>0.05$).

Table 6. Effect of the maternal age and parity on the reproductive and milk production traits and culling reasons on the offspring in Holstein dairy cows

		Sum of Squares	df	Mean Square	F	Sig.
Age at First Insemination (day)	Between Groups	3655.623	2	1827.811	.724	.486
	Within Groups	562699.740	223	2523.317		
	Total	566355.363	225			
Age at First Insemination (Month)	Between Groups	4.055	2	2.027	.723	.486
	Within Groups	625.128	223	2.803		
	Total	629.183	225			
Number of Inseminations	Between Groups	4.712	2	2.356	1.937	.147
	Within Groups	268.842	221	1.216		
	Total	273.554	223			
Gestation period	Between Groups	109.107	2	54.553	1.065	.347
	Within Groups	9274.002	181	51.238		
	Total	9383.109	183			
Milk Yield 305-d	Between Groups	1183215.758	2	591607.879	.174	.840
	Within Groups	532437170.085	157	3391319.555		
	Total	533620385.844	159			
Milk Yield 100-d	Between Groups	16029026.685	2	8014513.342	.973	.380
	Within Groups	1293809222.415	157	8240823.073		
	Total	1309838249.100	159			
Peak Milk Yield	Between Groups	53.736	2	26.868	.511	.601
	Within Groups	7777.731	148	52.552		
	Total	7831.467	150			
Days to Peak Milk Yield	Between Groups	678.890	2	339.445	.545	.581
	Within Groups	92158.845	148	622.695		
	Total	92837.735	150			
Culling age (Days)	Between Groups	361547.915	2	180773.957	.884	.418
	Within Groups	14103166.738	69	204393.721		
	Total	14464714.653	71			
Culling age (Month)	Between Groups	401.629	2	200,815	,884	,418
	Within Groups	15670.462	69	227,108		
	Total	16072.092	71			

Table 7. Offspring culling rates due to foot problems according to dam parity

			Culling Reason		Total
			Total Culling Animal	Foot Problem	
Parity	1	Count	43	4	47
		% within Parity	91.5%	8.5%	100%
	2	Count	27	1	28
		% within Parity	96.4%	3.6%	100%
	3	Count	8	0	8
		% within Parity	100.0%	0.0%	100%
Total		Count	78	5	83
		% within Parity	94.0%	6.0%	100%

Table 8. Offspring culling rates due to low production based on dam parity

			Culling Reason		Total
			Total Culling Animal	Low Production	
Parity	1	Count	43	4	47
		% within Parity	91.5%	8.5%	100%
	2	Count	25	3	28
		% within Parity	89.3%	10.7%	100%
	3	Count	8	0	8
		% within Parity	100%	0.0%	100%
	Total	Count	76	7	83
		% within Parity	91.6%	8.4%	100%

Table 9. Offspring culling rates based on mastitis and udder problems in accordance with dam parity

			Culling Reason		Total
			Total Culling Animal	Mastitis and Udder Problem	
Parity	1	Count	45	2	47
		% within Parity	95.7%	4.3%	100%
	2	Count	27	1	28
		% within Parity	96.4%	3.6%	100%
	3	Count	7	1	8
		% within Parity	87.5%	12.5%	100%
	Total	Count	79	4	83
		% within Parity	95.2%	4.8%	100%

Table 10. Offspring culling rates based on reproductive problems in accordance with dam parity

			Culling Reason		Total
			Total Culling Animal	Reproduction	
Parity	1	Count	35	12	47
		% within Parity	74.5%	25.5%	100%
	2	Count	18	10	28
		% within Parity	64.3%	35.7%	100%
	3	Count	6	2	8
		% within Parity	75.0%	25.0%	100%
Total		Count	59	24	83
		% within Parity	71.1%	28.9%	100%

Table 11. Offspring culling rates based on abomasum displacement in accordance with dam parity

			Culling Reason		Total
			Total Culling Animal	Displacement of Abomasum	
Parity	1	Count	46	1	47
		% within Parity	97.9%	2.1%	100%
	2	Count	27	1	28
		% within Parity	96.4%	3.6%	100%
	3	Count	7	1	8
		% within Parity	87.5%	12.5%	100%
	Total	Count	80	3	83
		% within Parity	96.4%	3.6%	100%

Table 12. Offspring culling rates based on other reasons in accordance with dam parity

			Culling Reason		Total
			Total Culling Animal	Other Reasons	
Parity	1	Count	23	24	47
		% within Parity	48.9%	51.1%	100%
	2	Count	16	12	28
		% within Parity	57.1%	42.9%	100%
	3	Count	4	4	8
		% within Parity	50.0%	50.0%	100%
Total		Count	43	40	83
		% within Parity	51.8%	48.2%	100%

5. DISCUSSION and CONCLUSION

5.1. Calf Period Disease Incidence and Maternal Influences

Morbidity and mortality are the major constrain in the development and economy of the dairy industry (Acha et al., 2004). In the present study, the calf period diseases incidence averaged 16.8%, lower than in the other studies (Erdoğan et al., 2009; Tokgöz et al., 2013). Further, the most common problem in the calves were respiratory diseases (55.3%), followed by gastrointestinal diseases (27.7 %), and umbilical and other issues such as arthritis, eye problems, etc. (17%). Demir et al. (2019) also reported respiratory diseases as a significant disease problem in the calves. However, the incidence of respiratory diseases was two times higher than reported by Demir, & Bozulkhan (2012). On the contrary, gastrointestinal diseases were the most common problem in calves, followed by respiratory diseases in some studies (Walker et al., 2012; Windeyer et al., 2014). Nevertheless, the gastrointestinal diseases were in the range of reported by these studies except Furman-Fratczak et al. (2011), who wrote a higher incidence rate of digestive diseases. Windeyer et al. (2014) reported several risk factors affecting the incidence of calf diseases, which can be the reasons for this difference in the results of our study and other studies noted.

In this study, calf period diseases incidence decreased with the increase in maternal parity. The highest incidence of diseases was in the first parity dam's calves and lowest in the third parity dam's calves. There are two possible reasons for the decreases in diseases incidence in calves with increases in maternal parity. First, after parturition, many cows suffer from inflammatory diseases (Ribeiro et al., 2013), nutritional change (Santos et al., 2011), and environmental stresses (Monteiro et al., 2016), which alter the reproductive organs biological functioning (Bromfield et al., 2015; Ribeiro et al., 2016). These changes in the uterine environment with increases in maternal parity, diseases, and other environmental stresses not just reduce the fertility in cows but also affect the developing fetus and can influence its survival and calf duration health and performance. Thus, uterine programming of the fetus improves the health and survival in the calves due to predictive adaptive response. However, half of the parturition cows suffer from inflammatory diseases after the first partition, but the disease incidence results in calves from first and second parity cows were non-significant. Therefore, maternal intrauterine immunological programming, uterine growth, and post-parturition passive transfer of the immunity can be the most probable second reason for the health and survival in the calves from the higher parities. The maternal harsh environmental, and disease experiences program the fetus for developing a strong immunological response to fight against the infections (Williams, Teeling, Perry, & Fleming, 2011). Furthermore, the birth weight indicates intra-uterine growth, and the first parity cows give birth to lighter calves than multiparous cows (Hoseyni et al., 2016). Additionally, higher parity cows also produce high-quality colostrum compared to younger cows (first and second parity), and the calves receiving colostrum from younger dams have less developed immune response and are more susceptible to diarrhea and respiratory diseases (Gulliksen et al., 2009; Svensson et al., 2003). Collectively, intrauterine programming and growth and passive transfer of the immunity through colostrum protect the higher parity dam's calves from diseases. Therefore, umbilical and other problems were higher in the higher parities than respiratory and gastrointestinal diseases.

Among all parity dam's calves, respiratory and gastrointestinal problems were highest in the first parity calves. It is also important to note here that in all three parities, the respiratory problem was highest in the second parity dam calves, but the digestive diseases were lower in multiparous dam's calves. This is because younger cows have a higher incidence of dystocia, and claves exposed to dystocia have two times more susceptibility to infections (Azizzadeh, 2011). Further, dystocia exposed calves are less able to absorb the immunoglobulins from the colostrum (Asmare, & Kiro, 2016). In addition, low-quality colostrum is also reported in second parity cows (Morin et al., 2001). Therefore, exposure to dystocia, FPT of immunoglobulins, and low-quality colostrum collectively increase respiratory diseases in second parity cows.

5.2. Reproduction of Heifers

As discussed above, the increase in maternal age and parity results in a change in reproductive organs biology, uterine environment, ovum quality, and such effect carries over to the next generation. An increase in the parity of cows results in a reduction of fertility (Balendran et al., 2008). This decrease in fertility with parity does not affect the reproductive performance of heifers from primiparous and multiparous dams. The reproductive performances of all heifer groups were similar. All parity heifers were first inseminated at an average age of 481.05-d and 16.05-mo, and the number of insemination per conception was averaged 1.67. These results are in the rage of Swali, & Wathes (2007), who reported services per conception 1.4-1.7 and first insemination age 444 – 448-d. The gestation length presented here is also in range with the results reported by (Swali, & Wathes, 2006) and gestation length similar as observed by Carvalho et al. (2020) but five days short, and inseminations were less than reported by (Eaglen, Coffey, Woolliams, & Wall, 2013).

Similar to our results, other studies also reported comparable pregnancy rates and fertility in heifer from primiparous and multiparous dams during the first reproductive season (da Silva et al., 2016ş Fuerst-Waltl et al., 2004). Carvalho et al. (2020) reported better reproduction in heifers which showed early reach to puberty and early calving from primiparous dams compared to multiparous dam's calves. However, fertility remained similar among all parity heifers. Similarly, Swali, & Wathes (2007) reported better reproduction in the primiparous dam's calves based on reaching the breeding age earlier, conceiving faster. Although researchers also reported similar fertility among the offspring from all the groups, and inseminations per conception were in the range of our study. In the line, Beard et al. (2020) study showed the early entry to puberty by the primiparous dam's heifers in Simmental dairy cows. However, no effect of maternal age was observed on pubertal growth and pregnancies. These slight differences in results can be due to birth weight and daily weight gain of the offspring, which, similar to our research, were not studied by Carvalho et al. (2020).

Nevertheless, other studies showing better reproduction based on prior entry to puberty studied and reported lighter birth weight and body size from primiparous cow calves. Swali, & Wathes (2007) also summarized that although primiparous dam's offspring were more lightweight and smaller, they showed a catchup growth after three months. No differences were observed among the all parity dam's calves. Hoseyni et al. (2016) also reported no effect of the maternal parity on the average daily gain of the offspring after weaning. Wathes et al. (2008) also reported better reproductive performance in the calves showing decent growth at the growing period.

Generally, heifers are bred at the age of 15 months when they attain up to 60% of mature body weight and give birth around 24 months (Coffey, Hickey, & Brotherstone, 2006). However, at the dairy farms raising and breeding heifers is a critical management task. Many studies reported several financial benefits of early breeding and calving but deciding the optimal age from breeding is crucial. Heifers from the dams giving birth around 23 months of age require 7% more insemination than heifers born from the dams around 26 months of age (Banos et al., 2007). Furthermore, early calving animals lose their BCS if they are high producing and give birth to lighter and smaller calves which have reproductive problems during the first reproductive season (Swali, & Wathes, 2006). Therefore, in the studied farm, the animals were deliberately bred at the age of 16 months so that they can give birth at the age of 25 months so that that uniformity can be obtained in the calves at the time of weaning and less management and nutrition should be employed for the catch-up growth of the calves and the recovery of the BCS in dams. Similarly, Banos et al. (2007) also concluded that the breeding decisions should be taken wisely and carefully and reported AFC between 24-29 months for optimal production and fertility. Likewise, Cooke et al. (2013) also reported better performance when the animals are bred and first give birth before 26 months but more than 23 months.

5.3. First Lactation Milk Production

For the nourishment of the growing fetus, milk production is the main adversary. Early lactation can affect the fetus indirectly via hormonal changes when the fetus requires fewer nutrients and directly when the fetus grows rapidly at the ending of the lactation (Schoonmaker, & Eastridge, 2013). It is also well accepted that milk production rises with the advancement of lactation and parity (Boujenane, 2021; Yoon et al., 2004). Thus, in higher parities, the higher milk production during gestation and changes in the reproductive biology of the reproductive organ can influence the first lactation milk yield of the offspring. In the present study, we did not observe any effect of maternal parity on the offspring's first lactation milk production studied parameters. These results are similar to the results reported by Van Eetvelde et al. (2017), with just a higher milk production in the heifers of the present study. Hoseyni et al. (2016) also reported no difference in heifers 305-d milk production produced from primiparous and multiparous Holstein cows.

Contrary to presented results, in Simmental dairy cows, Fuerst-Waltl et al. (2004) discovered a negative relationship between maternal age and offspring 305-d ECM yield. Banos et al. (2007) also reported less milk production in offspring from dams giving late birth in first and second parity. Carvalho et al. (2020) reported no difference in observed milk production from primiparous and multiparous dam calves. However, when the estimated breeding value was considered, offspring from primiparous dams had higher genetic merit for milk production. Storli et al. (2014) also reported the significant influence of the maternal age and parity on first and second lactation milk yield of the offspring, but they did not found any significant difference in progenies from second and higher parity dams.

In the present study, the average 305-d milk yield peak yield was higher than reported by Dominguez-Castaño et al. (2021), and days to reach the peak were higher than reported by the study of Boujenane (2021). 305-d MY was in the range reported by Hoseyni et al. (2016) but reported less than the present study by Kara, & Koyuncu (2018). These differences in production can be due to differences in feeding, management, and breeding practices. Similar to our study results, no relationship was found for the maternal milk yield parameters on the offspring's first lactational milk yield (Astiz et al., 2014). Though maternal milk negatively affects the 305-d milk production in offspring, this change was negligible for consideration practically (Banos et al., 2007). In the first and second lactation of offsprings Berry et al. (2008) reported adverse effects of the high maternal milk yield. However, except for NI in dams which showed a significant positive correlation with 305-d first lactation yield of offspring, AFI, milk yield traits, and longevity of dam in first lactation and longevity of the dams showed non-significant correlations all these studied parameters in the progenies. No association of maternal milk yield to the offsprings milk yield in the present and similar result reporting studies can be described on the fact of different energy states of the dams with high milk yield (Bach, 2012) but not the higher milk yield which affects the offsprings first lactation performance energy states of the dams at birth but not the milk yield management and nutrition of the dams because, heifers milk supply during the first lactation was not related with any of the maternal variables such as milk production, or with the growth of the heifer during the first year of life (Van Eetvelde et al., 2017). In the line, although the birth weight was significantly different in the calves from primiparous and multiparous cows, authors reported non-significant difference in ADG in all to calve groups, and AFC were observed similar in the offsprings, indicating parity did not influence the growth and first calving age and production during the first lactation in primiparous and multiparous dam's progeny (Hoseyni et al., 2016). Researchers also reported a loss in BCS at first calving and the metabolic profile of the dams and the offsprings after first calving (Meikle et al., 2004; Swali, & Wathes, 2006). Better maternal BCS during gestation positively affects the BCS in calves at the time of calving and fertility. Additionally, change in BCS at the time of pregnancy did not affect the offspring's performance (Banos et al., 2007). Thus it is a matter of critical management and nutrition to meet the requirements of the dairy calves to show better growth, attain the pubertal weight earlier, bred and calve at optimal age offer high production and to prevent negative energy balance and to lose their condition during the first lactation for getting higher fertility and production in higher lactations and the future performance of the offspring. Inline to present study results, other researchers highlighted the importance of the weight at calving, optimal breeding, and calving age importance for the first lactation production (Coffey et al., 2006; Van Eetvelde et al., 2017).

5.4. Culling Reasons and Herd Life of the Offspring

Culling risk increases with an increase in the parity of the animals, and the animals having difficulty in parturition, fertility problem, and higher lactation are at the higher risk of culling. In the present study, the average longevity was found higher in the first parity dam's offspring, and the observed longevity of offspring decreased with the increase in maternal parity. However, differences were non-significant, and the longevity of the offspring was not maternal parity. Similar to our results, Carvalho et al. (2020) found less culling and higher longevity in primiparous offspring than multiparous dams, but the results were significantly different. Contrary to the preset result, Beard et al. (2019) reported a significant difference in the longevity of offspring from primiparous young dams compared to multiparous dams. They found higher longevity and calf crop from offspring of younger dams. Similar results were also reported by Cushman et al. (2020). The risk of the culling also increased in offspring with maternal age in Simmental dual-purpose cows (Fuerst-Waltl et al., 2004).

The longevity of the Holstein cows in the present study averaged 30.34-mo and was slightly higher than Atakan (2007) and less than reported by other studies in Turkey (Yaylak, 2003; Kara et al., 2010; Kara, & Koyuncu, 2018). Usually, 50% of animals are culled on voluntary basis (Kara et al., 2010) by the breeder's preferences, which results in differences in the average longevity of the cows across different farms. Although no maternal age and parity effects were found in the offspring longevity, we found a significant positive correlation across the maternal and offspring culling reasons, indicating that it is not the maternal age or parity that influences the longevity in offspring but the maternal culling reasons. No such correlation has been reported in published literature. Calvalho et al. (2020) reported less clinical diseases incidence in primiparous dam's offspring compared to multiparous dam's offspring, and primiparous dam's offspring were less likely to leave the herd. Similarly, González-Recio et al. (2012) reported incidence of subclinical mastitis in the dams during offspring gestation reduces the longevity but does not influence the milk yield of the offspring. This can be the possible reason for the difference in the present and other studies' results because they did not evaluate the association between maternal and offspring culling reasons.

In the present study, we also tried to figure out and categorize the primary culling reasons in the mature cows across different parity dams. For a better understanding and evaluation, some culling factors such as selling for breeding purposes and slaughtering, injuries, death other minor culling factors were categorized as "other factors" and remained similar across the parities. Among the remaining culling reasons, reproductive problems were the primary issue across all the parity (28.9%) and were highest in second parity cows. Similar to previous researches, where the causes for culling were investigated, the findings indicate concordance (Workie et al., 2021; Chiumia et al., 2013). However, Udder health issues were higher in both studies, 12.9% and 26.9%, respectively. These differences can be due to the origin of the animals, the number of studied animals, and their milk yield and parity. Increasing age, parity, lactation stage, and milk production all contribute to increasing the incidence of mastitis (Assefa, 2021). An increase in sub-clinical mastitis was also seen in first to fourth-parity dairy cows by Mirzaei et al. (2021).

In the present study, reproductive issues, low production, foot problems, mastitis, and udder problems, and displacement of abomasum ate culling reason averages 28.9, 8.4, 6.0, 4.8, and 3.6%, respectively. Atakan (2017) reported fertility problems, metabolic problems, udder problems, and low production rate culling reasons of 26.97, 7.69, 7.69, and 0.00%, respectively in Holstein dairy cows. Yaylak (2003) reported fertility problems, low production, udder problems, and foot problems 40.2, 16.2, 17.9, and 2.2 %, respectively. Kara et al. (2010) reported a 24, 20, 5% rate of culling reason for udder problems, reproductive problems, and low production respectively in the Holstein cows. The rate of the culling reasons cows was 23, 15, 7, and 6% for metabolic diseases, mastitis, foot diseases, and reproduction diseases, respectively in Holstein dairy cows (Kara et al., 2010). Karslıoğlu (2007) reported a rate of culling reasons such as low milk output (4%), reproductive issues (21%), udder problems (20%), and foot problems (5%). Differences in the culling reasons of present and other studies can be due to herd size, region, milk yield, and preferences of the breeders for culling decisions (Kara et al., 2010; Smith et al., 2000).

In conclusion of the present study, maternal age influenced disease incidence during calf duration, and the highest incidence of calf duration diseases was observed in younger dams (first and second parity) compared to third parity cows. First insemination age, number of inseminations, peak milk yield, time to peak milk yield, 305-d milk yield found unaffected by the maternal parity. Longevity, although decreased with the increase in parity, however, results differences remained non-significant. No correlation was found in maternal first insemination age, the number of insemination, peak milk yield, time to peak milk yield, and 305-d milk yield parameters on all these parameters of their offspring except 305-d milk yield of the offspring's, which showed that their offspring's positive correlation with the number of inseminations in the dam. We also investigated the primary culling reasons of the progeny, and reproductive diseases were the major culling reason followed by low production, mastitis and udder problems, foot problems, and abomasum displacement. Interestingly we found a significant positive correlation between dam's culling reasons and the culling reasons of their heifers.

Maternal influences on the calf duration diseases incidence are less investigated, and it can be suggested from the present results that extra care should be paid to younger dam's calves. Birth weight, ADG, the health of the calves should form the younger dams should monitor consistently, and the colostrum quality of the dams also be analyzed before feeding to the calves. For better reproductive and milk production performance, lighter weight calves have to be managed separately for better catchup growth, and for replacement heifers, a significant emphasis should give on development and breeding age and inseminations and according to the study results breeding at 14-16 months with minimum possible inseminations and first calving at the age of 23-26 months is suggested. Longevity is a complex functional trait, and the breeder makes culling decisions based on several factors. However, for dams culling reasons should be evaluated critically because they not only affect the culling, replacement, and economics but also the rate of culling diseases in the offspring.

Maternal age and parity influences reproduction, first lactation milk yield parameters were unclear, and information effects over the calf duration diseases incidences and culling reasons and correlation among maternal and offspring's culling reason were not investigated in Holstein cows. Therefore, the present study results can be the guideway for the management and breeding decisions at the farms. In addition, this research serves as a beacon for future research in this field. Further studies are recommended to investigate the effect of maternal age and production on the intrauterine programming, growth, and molecular mechanisms behind these changes and their influence on the health and future performance of the calves.

6. REFERENCES

Acha, S., Kühn, I., Jonsson, P., Mbazima, G., Katouli, M., & Möllby, R. (2004). Studies on calf diarrhoea in Mozambique: prevalence of bacterial pathogens. *Acta Veterinaria Scandinavica*, 45(1), 1-10, doi: 10.1186/1751-0147-45-27

Ahmed, I., Roshan, R., & Fatıma, I. (2020). Effects of rumen protected choline supplementation on dairy cattle, Conference: II. AGBIOL. 1111-1114, cited from: https://agbiol.org/index/sayfa/1648/2020-abstract-book

Alkan, F., Burgu, İ., Şahna, K. C., & Çokçalişkan, C. (2004). Yeni doğan buzağı ishallerine karşı ticari aşı ile aşılanan sığırlardan doğan yavrularda pasif bağışıklık düzeyi. *Ankara Ünıversitesi Veteriner Fakültesi Dergesi*, 51, 47-53, doi: 10.1501/vetfak_0000002269

Arthington, J., Cattell, M., & Quigley III, J. (2000). Effect of dietary IgG source (colostrum, serum, or milk-derived supplement) on the efficiency of Ig absorption in newborn Holstein calves. *Journal of Dairy Science*, 83(7), 1463-1467, doi: 10.3168/jds.s0022-0302(00)75018-1

Asmare, A. A., & Kiros, W. A. (2016). Dairy calf morbidity and mortality and associated risk factors in Sodo town and its suburbs, Wolaita zone, Ethiopia. *Slovak Journal of Animal Science*, 49(1), 44-56, cited from: http://www.cvzv.sk/slju/16_1/6_Asmare.pdf

Assefa, B. (2021). Epidemiology of Bovine Mastitis in Selected Major Milk Shade Districts of Arsi Zone, Ethiopia, doi: 10.20944/preprints202101.0551.v1

Astiz, S., Gonzalez-Bulnes, A., Sebastian, F., Fargas, O., Cano, I., & Cuesta, P. (2014). Maternal aging affects life performance of progeny in a Holstein dairy cow model. Journal of Developmental Origins of Health and Disease, 5(5), 374-384, doi: 10.1017/S2040174414000361

Atakan, K. (2017). Siyah–Alaca, Kırmızı–Alaca ve Simmental Irkı Sığırların Sürü Ömrü Üzerine Bir Araştırma. *Adnan Menderes Üniversitesi Ziraat Fakültesi Dergisi*, 14(2), 63-68, doi: 10.25308/aduziraat.321914

Ayres, C., Silveira, P., Barbieri, M., Portella, A., Bettiol, H., Agranonik, M., ... Goldani, M. (2011). Exposure to maternal smoking during fetal life affects food preferences in adulthood independent of the effects of intrauterine growth restriction. *Journal of Developmental Origins of Health and Disease*, 2(3), 162-167, doi: 10.1017/s204017441100016x

Azizzadeh, M. (2011). Characterisation and pattern of culling in Holstein-Friesian dairy herds in Khorasan Razavi Province, Northeast of Iran, cited from: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=254390

Bach, A. (2012). Ruminant Nutrition Symposium: Optimizing performance of the offspring: Nourishing and managing the dam and postnatal calf for optimal lactation, reproduction, and immunity. *Journal of Animal Science*, 90(6), 1835-1845, doi: 10.2527/jas.2011-4516

Balendran, A., Gordon, M., Pretheeban, T., Singh, R., Perera, R., & Rajamahedran, R. (2008). Decreased fertility with increasing parity in lactating dairy cows. *Canadian Journal of Animal Science*, 88(3), 425-428, doi: 10.4141/cjas07127

Bamber, R., Shook, G., Wiltbank, M., Santos, J., & Fricke, P. (2009). Genetic parameters for anovulation and pregnancy loss in dairy cattle. *Journal of Dairy Science*, 92(11), 5739-5753, doi: 10.3168/jds.2009-2226

Banos, G., Brotherstone, S., & Coffey, M. (2007). Prenatal maternal effects on body condition score, female fertility, and milk yield of dairy cows. *Journal of Dairy Science*, 90(7), 3490-3499, doi: 10.3168/jds.2006-809

Beard, J. K., Musgrave, J. A., Hanford, K. J., Funston, R. N., & Mulliniks, J. T. (2019). The effect of dam age on heifer progeny performance and longevity. *Translational Animal Science*, 3(1), 1710-1713, doi: 10.1093/tas/txz063

Beard, J. K., Musgrave, J. A., Hanford, K., Funston, R. N., & Mulliniks, J. T. (2020). Effect of Age of Dam on Heifer Progeny Performance. *Nebraska Beef Cattle Reports*, 1062, doi: 10.1093/tas/txz063

Bernstein, I. M., Plociennik, K., Stahle, S., Badger, G. J., & Secker-Walker, R. (2000). Impact of maternal cigarette smoking on fetal growth and body composition. *American Journal of Obstetrics and Gynecology*, 183(4), 883-886, doi: 10.1067/mob.2000.109103

Berry, D. P., Lonergan, P., Butler, S. T., Cromie, A. R., Fair, T., Mossa, F., & Evans, A. C. O. (2008). Negative influence of high maternal milk production before and after conception on offspring survival and milk production in dairy cattle. *Journal of Dairy Science*, 91(1), 329-337, doi: /10.3168/jds.2007-0438

Bertocchi, L., Vitali, A., Lacetera, N., Nardone, A., Varisco, G., & Bernabucci, U. (2014). Seasonal variations in the composition of Holstein cow's milk and temperature–humidity index relationship. *Animal*, 8(4), 667-674, doi: 10.1017/s1751731114000032

Bird, A. (2007). Perceptions of epigenetics. *Nature*, 447(7143), 396, doi: 10.1038/nature05913

Bisinotto, R., Greco, L., Ribeiro, E., Martinez, N., Lima, F., Staples, C., Thatcher, W., & Santos, J. (2018). Influences of nutrition and metabolism on fertility of dairy cows. *Animal Reproduction*, 9(3), 260-272, doi: 10.5661/rdr-vii-387

Boujenane, I. (2017). Reasons and risk factors for culling Holstein dairy cows in Morocco. Journal of Livestock Science and Technologies, 5(1), 25-31

Boujenane, I. (2021). Non-genetic effects on daily milk yield and components of Holstein cows in Morocco. *Tropical Animal Health and Production*, 53(2), 1-9, doi: 10.1007/s11250-021-02663-w

Boujenane, I., & Draga, B (2021). Non-genetic factors affecting reproductive performance of Holstein dairy cows. *Livestock Research for Rural Development*. 33(10). Retrieved June 16, 2021, from http://www.lrrd.org/lrrd33/1/ismail3310.html, doi: 10.1007/s11250-021-02663-w

Braunschweig, M., Jagannathan, V., Gutzwiller, A., & Bee, G. (2012). Investigations on transgenerational epigenetic response down the male line in F2 pigs. *PloS One*, 7(2), e30583, doi: 10.1371/journal.pone.0030583

Bromfield, J., Santos, J. P., Block, J., Williams, R., & Sheldon, I. (2015). Physiology and Endocrinology Symposium: Uterine infection: linking infection and innate immunity with infertility in the high-producing dairy cow. *Journal of Animal Science*, 93(5), 2021-2033, doi: 10.1371/journal.pone.0030583

Çardak, A. (2016). Effects of somatic cell count, parity and lactation stage on yield and components of milk in Holstein-Friesian cows. *Harran Üniversity Veterinary Fakultesi Dergisi*, 5(1), 34-39, cited from inViewer=1&pdfJsDownload=1&origin=publication_detail&previewAsPdf=false

Carvalho, M., Aboujaoude, C., Peñagaricano, F., Santos, J., DeVries, T., McBride, B., & Ribeiro, E. (2020). Associations between maternal characteristics and health, survival, and performance of dairy heifers from birth through first lactation. *Journal of Dairy Science*, 103(1), 823-839, doi: 10.3168/jds.2019-17083

Çavuşoğlu, E., Riaz, R., Omar, M., Demir, M., Orman, A. (2021). Effect of parity and the production year on the longevity of the kids in saneen dairy goats. *Journal of Research in Veterinary Medicine*, 40 (1), 68-72, doi: 10.30782/jrvm.811826

Chiumia, D., Chagunda, M. G., Macrae, A. I., & Roberts, D. J. (2013). Predisposing factors for involuntary culling in Holstein–Friesian dairy cows. *Journal of Dairy Research*, 80(1), 45-50, doi: 10.1017/s002202991200060x

Chong, S., & Whitelaw, E. (2004). Epigenetic germline inheritance. *Current Opinion in Genetics & Development*, 14(6), 692-696, doi: 10.1016/j.gde.2004.09.001

Coffey, M., Hickey, J., & Brotherstone, S. (2006). Genetic aspects of growth of Holstein-Friesian dairy cows from birth to maturity. *Journal of Dairy Science*, 89(1), 322-329, doi: 10.3168/jds.s0022-0302(06)72097-5

Collier, R., Dahl, G., & VanBaale, M. (2006). Major advances associated with environmental effects on dairy cattle. *Journal of Dairy Science*, 89(4), 1244-1253, doi: 10.3168/jds.s0022-0302(06)72193-2

Compton, C., Heuer, C., Thomsen, P., Carpenter, T., Phyn, C., & McDougall, S. (2017). Invited review: A systematic literature review and meta-analysis of mortality and culling in dairy cattle. *Journal of Dairy Science*, 100(1), 1-16, doi: 10.3168/jds.2016-11302

Cooke, J. S., Cheng, Z., Bourne, N. E., & Wathes, D. C. (2013). Association between growth rates, age at first calving and subsequent fertility, milk production and survival in Holstein-Friesian heifers. *Open Journal of Animal Sciences*, 3(1), 27-35, doi: 10.4236/ojas.2013.31001

Costa, A., Boselli, C., & De Marchi, M. (2021). Effect of Body Weight and Growth in Early Life on the Reproductive Performances of Holstein Heifers. *Agriculture*, 11(2), 159, doi: 10.3390/agriculture11020159

Curtis, G., Argo, C. M., Jones, D., & Grove-White, D. (2016). Impact of feeding and housing systems on disease incidence in dairy calves. *Veterinary Record*, 179(20), 512-512, doi: 10.1136/vr.103895

Cushman, R., Spuri-Gomes, R., Tenley, S., Rosasco, S., Rich, J., Northrop, E., … Perry, G. (2020). 33 Influence of age of dam on daughter reproductive performance and follicle numbers in beef heifers. *Journal of Animal Science*, 98(3), 115-115, doi: 10.1093/jas/skaa054.195

da Silva, A. G., Musgrave, J. A., Nollette Nollette, J., Applegarth, A., & Funston, R. N. (2016). Effect of dam age on offspring productivity. *Nebraska Beef Cattle Reports*, 874, cited from: http://etd.repository.ugm.ac.id/penelitian/unduh/265407

De Vries, A., Olson, J., & Pinedo, P. (2010). Reproductive risk factors for culling and productive life in large dairy herds in the eastern United States between 2001 and 2006. *Journal of Dairy Science*, 93(2), 613-623, doi: 10.3168/jds.2009-2573

Dean, W., Santos, F., Stojkovic, M., Zakhartchenko, V., Walter, J., Wolf, E., & Reik, W. (2001). Conservation of methylation reprogramming in mammalian development: aberrant reprogramming in cloned embryos. *Proceedings of the National Academy of Sciences*, 98(24), 13734-13738, doi: 10.1073/pnas.241522698

Demir, P., & Bozukluhan, K. (2012). Economic losses resulting from respiratory diseases in cattle. *Journal of Animal and Veterinary Advances*, 11(4), 438-442, doi: 10.3923/javaa.2012.438.442

Demir, P. A., Aydin, E., & Ayvazoğlu, C. (2019). Estimation of the Economic Losses Related to Calf Mortalities Kars Province, in Turkey. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*, 25(3), doi: 10.5713/ajas.2013.13105

Dominguez-Castaño, P., Ospina, A. M. T., El Faro, L., & de Vasconcelos Silva, J. A. I. (2021). Genetic principal components for reproductive and productive traits in Holstein cows reared under tropical conditions. *Tropical Animal Health and Production*, 53(2), 1-8, doi: 10.1007/s11250-021-02639-w

Eaglen, S., Coffey, M., Woolliams, J., & Wall, E. (2013). Direct and maternal genetic relationships between calving ease, gestation length, milk production, fertility, type, and lifespan of Holstein-Friesian primiparous cows. *Journal of Dairy Science*, 96(6), 4015-4025, doi: 10.3168/jds.2012-6229

Eastham, N. T., Coates, A., Cripps, P., Richardson, H., Smith, R., & Oikonomou, G. (2018). Associations between age at first calving and subsequent lactation performance in UK Holstein and Holstein-Friesian dairy cows. *PloS One*, 13(6), e0197764, doi: 10.1371/journal.pone.0197764

Erdoğan, H. M., Ünver, A., Çitil, M., Güneş, V., Arslan, M. Ö., Tuzcu, M., & Gökce, H. I. (2009). Dairy farming in Kars district, Turkey: III. Neonatal calf health. *Turkish Journal of Veterinary and Animal Sciences*, 33(3), 185-192, doi: 10.3906/vet-0708-2

Evans, A. C. O., Mossa, F., Walsh, S., Scheetz, D., Jimenez-Krassel, F., Ireland, J., … Ireland, J. (2012). Effects of maternal environment during gestation on ovarian folliculogenesis and consequences for fertility in bovine offspring. *Reproduction in Domestic Animals*, 47, 31-37, doi: 10.1111/j.1439-0531.2012.02052.x

Fang, L., Jiang, J., Li, B., Zhou, Y., Freebern, E., Vanraden, P. M., … Ma, L. (2019). Genetic and epigenetic architecture of paternal origin contribute to gestation length in cattle. *Communications Biology*, 2(1), 1-11, doi: 10.1038/s42003-019-0341-6

Ferdowsi Nia, E., Nikkhah, A., Rahmani, H., Alikhani, M., Mohammad Alipour, M., & Ghorbani, G. (2010). Increased colostral somatic cell counts reduce pre-weaning calf immunity, health and growth. *Journal of Animal Physiology and Animal Nutrition*, 94(5), 628-634, doi: 10.1111/j.1439-0396.2009.00948.x

Freetly, H. C., Cushman, R. A., & Bennett, G. L. (2021). Production performance of cows raised with different post-weaning growth patterns. *Translational Animal Science*, 5(3), txab031, doi: 10.1093/tas/txab031

Fuerst-Waltl, B., Reichl, A., Fuerst, C., Baumung, R., & Sölkner, J. (2004). Effect of maternal age on milk production traits, fertility, and longevity in cattle. *Journal of Dairy Science*, 87(7), 2293-2298, doi: 10.3168/jds.s0022-0302(04)70050-8

Furman-Fratczak, K., Rzasa, A., & Stefaniak, T. (2011). The influence of colostral immunoglobulin concentration in heifer calves' serum on their health and growth. *Journal of Dairy Science*, 94(11), 5536-5543, doi: 10.3168/jds.2010-3253

Gabler, M., Tozer, P., & Heinrichs, A. (2000). Development of a cost analysis spreadsheet for calculating the costs to raise a replacement dairy heifer. *Journal of Dairy Science,* 83(5), 1104-1109.

Gao, F., Liu, Y.C., Zhang, Z.H., Zhang, C.Z., Su, H.W., & Li, S.L. (2012). Effect of prepartum maternal energy density on the growth performance, immunity, and antioxidation capability of neonatal calves. *Journal of Dairy Science*, 95(8), 4510-4518, doi: 10.3168/jds.2011-5087

Gapp, K., Jawaid, A., Sarkies, P., Bohacek, J., Pelczar, P., Prados, J., … Mansuy, I. M. (2014). Implication of sperm RNAs in transgenerational inheritance of the effects of early trauma in mice. *Nature Neuroscience*, 17(5), 667-669, doi: 10.1038/nn.3695

Godden, S. (2008). Colostrum management for dairy calves. *Veterinary Clinics of North America: Food Animal Practice*, 24(1), 19-39, doi: 10.1016/j.cvfa.2007.10.005

Godden, S. M., Fetrow, J. P., Feirtag, J. M., Green, L. R., & Wells, S. J. (2005). Economic analysis of feeding pasteurized nonsaleable milk versus conventional milk replacer to dairy calves. *Journal of the American Veterinary Medical Association*, 226(9), 1547-1554, doi: 10.2460/javma.2005.226.1547

González-Recio, O., Ugarte, E., & Bach, A. (2012). Trans-generational effect of maternal lactation during pregnancy: a Holstein cow model. *PloS one*, 7(12), e51816, doi: 10.1371/journal.pone.0051816

Gulliksen, S., Lie, K., Løken, T., & Østerås, O. (2009). Calf mortality in Norwegian dairy herds. *Journal of Dairy Science*, 92(6), 2782-2795, doi: 10.3168/jds.2008-1807

Handcock, R. C., Lopez-Villalobos, N., McNaughton, L. R., Back, P. J., Edwards, G. R., & Hickson, R. E. (2019). Positive relationships between body weight of dairy heifers and their first-lactation and accumulated three-parity lactation production. Journal of dairy science, 102(5), 4577-4589.

Heinrichs, A. J., & Heinrichs, B. S. (2011). A prospective study of calf factors affecting first-lactation and lifetime milk production and age of cows when removed from the herd. *Journal of dairy science*, 94(1), 336-341.

Heinrichs, A., Heinrichs, B., Harel, O., Rogers, G., & Place, N. (2005). A prospective study of calf factors affecting age, body size, and body condition score at first calving of Holstein dairy heifers. *Journal of Dairy Science*, 88(8), 2828-2835, doi: 10.3168/jds.s0022-0302(05)72963-5

Heinrichs, A., Jones, C., Gray, S., Heinrichs, P., Cornelisse, S., & Goodling, R. (2013). Identifying efficient dairy heifer producers using production costs and data envelopment analysis. *Journal of Dairy Science*, 96(11), 7355-7362, doi: 10.3168/jds.2012-6488

Hoseyni, F., Mahjoubi, E., Zahmatkesh, D., & Yazdi, M. H. (2016). Effects of dam parity and pre-weaning average daily gain of Holstein calves on future milk production. *Journal of Dairy Research*, 83(4), 453-455, doi: 10.1017/s0022029916000558

Iwata, H., Goto, H., Tanaka, H., Sakaguchi, Y., Kimura, K., Kuwayama, T., & Monji, Y. (2011). Effect of maternal age on mitochondrial DNA copy number, ATP content and IVF outcome of bovine oocytes. *Reproduction, Fertility and Development*, 23(3), 424-432, doi: 10.1071/rd10133

Jirtle, R. L., & Skinner, M. K. (2007). Environmental epigenomics and disease susceptibility. *Nature Reviews Genetics*, 8(4), 253-262, doi: 10.1038/nrg2045

Johanson, J., & Berger, P. (2003). Birth weight as a predictor of calving ease and perinatal mortality in Holstein cattle. *Journal of Dairy Science*, 86(11), 3745-3755, doi: 10.3168/jds.s0022-0302(03)73981-2

Kara, N. K., & Koyuncu, M. (2018). A research on longevity, culling reasons and milk yield traits in between Holstein and Simmental cows. *Mediterranean Agricultural Sciences*, 31(3), 325-329, doi: 10.29136/mediterranean.443409

Kara, N. K., Koyuncu, M., & Tuncel, E. (2010). Siyah Alaca irkı ineklerde damızlıkta kalma süresi ve sürüden çıkarma nedenleri. *Hayvansal Üretim*, 51(1), cited from: https://dergipark.org.tr/en/pub/hayuretim/issue/7613/99770

Karslıoğlu Kara, N. (2020). Relation between non-infectious factors and neonatal calf health status in dairy herd. *Animal Science Journal*, 91(1), e13471, doi: 10.1111/asj.13471

Karslıoğlu, N. (2007). Siyah alaca ırkı ineklerde damızlıkta kalma süresi ve sürüden çıkarma nedenleri. Yayınlanmamış yüksek lisans tezi. *Uludağ Üniversitesi Fen Bilimleri Enstitüsü*, cited from: http://hdl.handle.net/11452/3540

Kehoe, S., Heinrichs, A. J., Moody, M., Jones, C., & Long, M. (2011). Comparison of immunoglobulin G concentrations in primiparous and multiparous bovine colostrum. *The Professional Animal Scientist*, 27(3), 176-180, doi: 10.15232/s1080-7446(15)30471-x

Kelly, T., & Trasler, J. (2004). Reproductive epigenetics: *Clinical Genetics*, 65(4), 247-260, doi: 10.1111/j.0009-9163.2004.00236.x

Khaton, R. (2020). Reproductive Performance of Dairy Cows in Relation to Genotype, Age, Parity, Body Weight and Body Condition Score at Rajshahi District of Bangladesh. *Research in Agriculture Livestock and Fisheries*, 7(3), 481-495, doi: 10.3329/ralf.v7i3.51368

Kruip, T. A., & Den Daas, J. (1997). In vitro produced and cloned embryos: effects on pregnancy, parturition and offspring. *Theriogenology*, 47(1), 43-52, doi: 10.1016/s0093-691x(96)00338-x

Kučević, D., Dragin, S., Pihler, I., Čobanović, K., Papović, T., Gantner, V., & Mirkov, M. (2019). Effect of age at first calving and other non-genetic factors on longevity and production traits in Holstein cattle under Vojvodina Province condition, Serbia. *Indian Journal Animal Research*, 10, 1-4, doi: 10.18805/ijar.b-1063

Lakritz, J., Tyler, J. W., Hostetler, D. E., Marsh, A. E., Weaver, D. M., Holle, J. M., … Denbigh, J. L. (2000). Effects of pasteurization of colostrum on subsequent serum lactoferrin concentration and neutrophil superoxide production in calves. *American Journal of Veterinary Research*, 61(9), 1021-1025, doi: 10.2460/ajvr.2000.61.1021

Langel, S., Wark, W., Garst, S., James, R., McGilliard, M., Petersson-Wolfe, C., & Kanevsky-Mullarky, I. (2015). Effect of feeding whole compared with cell-free colostrum on calf immune status: The neonatal period. *Journal of Dairy Science*, 98(6), 3729-3740, doi: 10.3168/jds.2014-8422

Langel, S., Wark, W., Garst, S., James, R., McGilliard, M., Petersson-Wolfe, C., & Kanevsky-Mullarky, I. (2016). Effect of feeding whole compared with cell-free colostrum on calf immune status: Vaccination response. *Journal of Dairy Science*, 99(5), 3979-3994, doi: 10.3168/jds.2015-9892

Lee, J.-Y., & Kim, I.-H. (2006). Advancing parity is associated with high milk production at the cost of body condition and increased periparturient disorders in dairy herds. *Journal of Veterinary Science*, 7(2), 161-166, doi: 10.4142/jvs.2006.7.2.161

Lees-Murdock, D. J., & Walsh, C. P. (2008). DNA methylation reprogramming in the germ line. *Epigenetics*, 3(1), 5-13, doi: 10.4161/epi.3.1.5553

Leroy, J., & Vanholder, T. Van knegsel AT, Garcia-Ispierto I & Bols PE (2008). Nutrient prioritization in dairy cow early postpartum: mismatch between metabolism and fertility. *Reproduction in Domestic Animals*, 43, 96-103, doi: 10.1111/j.1439-0531.2008.01148.x

Lin, S., Ke, C., Liu, L., Gao, Y., Xu, L., Han, B., Zhao, Y., Zhang, S., & Sun, D. (2020). Genome-Wide Association Studies for Immunoglobulins in Colostrum and Serum in Chinese Holstein. *Research Square*, 1-25, doi: 10.21203/rs.3.rs-40831/v1

Ling, T., Hernandez-Jover, M., Sordillo, L. M., & Abuelo, A. (2018). Maternal late-gestation metabolic stress is associated with changes in immune and metabolic responses of dairy calves. *Journal of Dairy Science*, 101(7), 6568-6580, doi: 10.3168/jds.2017-14038

Lubritz, D., Forrest, K., & Robison, O. (1989). Age of cow and age of dam effects on milk production of Hereford cows. *Journal of Animal Science*, 67(10), 2544-2549, doi: 10.2527/jas1989.67102544x

Martinez, M. L., Freeman, A., & Berger, P. (1983). Age of dam and direct and maternal effects on calf livability. *Journal of Dairy Science*, 66(8), 1714-1720, doi: 10.3168/jds.s0022-0302(83)81996-1

McCorquodale, C., Sewalem, A., Miglior, F., Kelton, D., Robinson, A., Koeck, A., & Leslie, K. (2013). Analysis of health and survival in a population of Ontario Holstein heifer calves. *Journal of Dairy Science*, 96(3), 1880-1885, doi: 10.3168/jds.2012-5735

McDaniel, B. T., Miller, R. H., & Corley, E. L. (1965). DHIA factors for projecting incomplete records to 305 days. Dairy Herd Improvement Letter. *ARS*, 44, 164.

Megersa, B., Yacob, A., Regassa, A., Abuna, F., Asmare, K., & Amenu, K. (2009). Prevalence and incidence rates of calf morbidity and mortality and associated risk factors in smallholder dairy farms in Hawassa, Southern Ethiopia. *Ethiopian Veterinary Journal*, 13(2), 59-68, doi: 10.4314/evj.v23i2.4

Meier, S., McNaughton, L., Handcock, R., Amer, P., Beatson, P., Bryant, J., … Burke, C. (2021). Heifers with positive genetic merit for fertility traits reach puberty earlier and have a greater pregnancy rate than heifers with negative genetic merit for fertility traits. *Journal of Dairy Science*, 104(3), 3707-3721, doi: 10.3168/jds.2020-19155

Meikle, A., Kulcsar, M., Chilliard, Y., Febel, H., Delavaud, C., Cavestany, D., & Chilibroste, P. (2004). Effects of parity and body condition at parturition on endocrine and reproductive parameters of the cow. *Reproduction*, 127(6), 727-737, doi: 10.1530/rep.1.00080

Melchior, M., Hersi, R., Van Der Waerden, J., Larroque, B., Saurel-Cubizolles, M.-J., Chollet, A., & Galéra, C. (2015). Maternal tobacco smoking in pregnancy and children's socio-emotional development at age 5: The EDEN mother-child birth cohort study. *European Psychiatry*, 30(5), 562-568, doi: 10.1016/j.eurpsy.2015.03.005

Mihm, M., Curran, N., Hyttel, P., Knight, P., Boland, M., & Roche, J. (1999). Effect of dominant follicle persistence on follicular fluid oestradiol and inhibin and on oocyte maturation in heifers. *Reproduction*, 116(2), 293-304, doi: 10.1530/jrf.0.1160293

Mirzaei, A., Ararooti, T., Ghavami, M., & Tamadon, A. (2021). Sub-Clinical Mastitis and Reproduction: Season, Parity and Stage of Lactation Effects on Conception Rate and Milk Somatic Cell Count. *Research Square*, 1-11, doi: 10.21203/rs.3.rs-185675/v1

Monteiro, A., Tao, S., Thompson, I., & Dahl, G. (2016). In utero heat stress decreases calf survival and performance through the first lactation. *Journal of Dairy Science*, 99(10), 8443-8450, doi: 10.3168/jds.2016-11072

Morin, D., Constable, P., Maunsell, F., & McCoy, G. (2001). Factors associated with colostral specific gravity in dairy cows. *Journal of Dairy Science*, 84(4), 937-943, doi: 10.3168/jds.s0022-0302(01)74551-1

Moussa, M., Shu, J., Zhang, X., & Zeng, F. (2015). Maternal control of oocyte quality in cattle “a review”. *Animal Reproduction Science*, 155, 11-27, doi: 10.1016/j.anireprosci.2015.01.011

Nor, N. M., Steeneveld, W., Van Werven, T., Mourits, M., & Hogeveen, H. (2013). First-calving age and first-lactation milk production on Dutch dairy farms. *Journal of Dairy Science*, 96(2), 981-992, doi: 10.3168/jds.2012-5741

Novo, S. M. F., dos Reis Costa, J. F., Baccili, C. C., Sobreira, N. M., Silva, B. T., de Oliveira, P. L., … Gomes, V. (2017). Effect of maternal cells transferred with colostrum on the health of neonate calves. *Research in Veterinary Science*, 112, 97-104, doi: 10.1016/j.rvsc.2017.01.025

Olechnowicz, J., Kneblewski, P., Jaśkowski, J., & Włodarek, J. (2016). Effect of selected factors on longevity in cattle: A review. *Journal of Animal and Plant Science*, 26, 1533-1541, cited from: https://www.researchgate.net/publication/311718426_Effect_of_selected_factors_on_longevity_in_cattle_A_review/stats

Oltenacu, P. A., & Algers, B. (2005). Selection for increased production and the welfare of dairy cows: are new breeding goals needed? *AMBIO: A Journal of the Human Environment*, 34(4), 311-315, doi: 10.1579/0044-7447-34.4.311

Osgerby, J., Gadd, T., & Wathes, D. (2003). The effects of maternal nutrition and body condition on placental and foetal growth in the ewe. *Placenta*, 24(2-3), 236-247, doi: 10.1053/plac.2002.0902

Painter, R. C., Osmond, C., Gluckman, P., Hanson, M., Phillips, D., & Roseboom, T. J. (2008). Transgenerational effects of prenatal exposure to the Dutch famine on neonatal adiposity and health in later life. *BJOG: An International Journal of Obstetrics & Gynaecology*, 115(10), 1243-1249, doi: 10.1111/j.1471-0528.2008.01822.x

Pritchard, T., Coffey, M., Mrode, R., & Wall, E. (2013). Understanding the genetics of survival in dairy cows. *Journal of Dairy Science*, 96(5), 3296-3309, doi: 10.3168/jds.2012-6219

Rajib, K., Patel, N., Rao, T., & Tissopi, M. (2020). Effect of parity on the yield, fat and SNF content of milk in Holstein Friesian crossbred cows. *Haryana Veterinarian*, 59(2), 254-255, cited from: https://www.luvas.edu.in/.../26.pdf

Ravelli GP, S. (1976). Susser M W. Obesity in young men after famine exposure in utero and early infancy. *New England Journal of Medicine*, 1976, 295, 349-353, doi: 10.1056/nejm197608122950701

Riaz, R., Tahir, M., Waseem, M., Asif, M., & Khan, M. (2018). Accuracy of estimates for live body weight using schaeffer's formula in non-descript cattle (bos indicus), nili ravi buffaloes (bubalus bubalis) and their calves using linear body measurements. *Pakistan Journal of Science*, 70(3), 225, cited from: https://www.thefreelibrary.com/ACCURACY+OF+ESTIMATES+FOR+LIVE+BODY+WEIGHT+USING+SCHAEFFER%27S+FORMULA...-a0579553695

Ribeiro, E. S., & Carvalho, M. R. (2018). Impact and mechanisms of inflammatory diseases on embryonic development and fertility in cattle. *Animal Reproduction* (AR), 14(3), 589-600, doi: 10.21451/1984-3143-ar1002

Ribeiro, E., Gomes, G., Greco, L., Cerri, R., Vieira-Neto, A., Monteiro Jr, P., … Santos, J. (2016). Carryover effect of postpartum inflammatory diseases on developmental biology and fertility in lactating dairy cows. *Journal of Dairy Science*, 99(3), 2201-2220, doi: 10.3168/jds.2015-10337

Ribeiro, E., Lima, F., Greco, L., Bisinotto, R., Monteiro, A., Favoreto, M., … Thatcher, W. (2013). Prevalence of periparturient diseases and effects on fertility of seasonally calving grazing dairy cows supplemented with concentrates. *Journal of Dairy Science*, 96(9), 5682-5697, doi: 10.3168/jds.2012-6335

Santos, J., Bisinotto, R., Ribeiro, E., Lima, F., Greco, L., Staples, C., … Pate, J. (2011). Applying nutrition and physiology to improve reproduction in dairy cattle. *Reproduction in Domestic Ruminants VII*, 387-403, doi: 10.7313/upo9781907284991.030

Sartori, R., Haughian, J., Shaver, R., Rosa, G., & Wiltbank, M. (2004). Comparison of ovarian function and circulating steroids in estrous cycles of Holstein heifers and lactating cows. *Journal of Dairy Science*, 87(4), 905-920, doi: 10.3168/jds.s0022-0302(04)73235-x

Sawa, A., & Bogucki, M. (2017). Longevity of cows depending on their first lactation yield and herd production level. *Annals of Animal Science*, 17(4), 1171, doi: 10.1515/aoas-2016-0096

Sawa, A., Siatka, K., & Krężel-Czopek, S. (2019). Effect of age at first calving on first lactation milk yield, lifetime milk production and longevity of cows. *Annals of Animal Science*, 19(1), 189-200, doi: 10.2478/aoas-2018-0044

Schoonmaker, J., & Eastridge, M. (2013). Effect of maternal nutrition on calf health and growth. *The proceedings of tri-state dairy nutrition conference*, 63-80, cited from: https://www.researchgate.net/publication/281600551_Effect_of_maternal_nutrition_on_calf_health_and_growth

Sewalem, A., Kistemaker, G., Ducrocq, V., & Van Doormaal, B. (2005). Genetic analysis of herd life in Canadian dairy cattle on a lactation basis using a Weibull proportional hazards model. *Journal of Dairy Science*, 88(1), 368-375, doi: 10.3168/jds.s0022-0302(05)72696-5

Shivley, C., Lombard, J., Urie, N., Haines, D., Sargent, R., Kopral, C., … Garry, F. (2018). Preweaned heifer management on US dairy operations: Part II. Factors associated with colostrum quality and passive transfer status of dairy heifer calves. *Journal of Dairy Science*, 101(10), 9185-9198, doi: 10.3168/jds.2017-14008

Silveira, P. P., Portella, A. K., Goldani, M. Z., & Barbieri, M. A. (2007). Developmental origins of health and disease. *Journal De Pediatria*, 83(6), 494-504, doi: 10.2223/jped.1728

Skibiel, A., Peñagaricano, F., Amorín, R., Ahmed, B., Dahl, G., & Laporta, J. (2018). In utero heat stress alters the offspring epigenome. *Scientific Reports,* 8(1), 1-15, doi: 10.1038/s41598-018-32975-1

Smith, J., Ely, L., & Chapa, A. (2000). Effect of region, herd size, and milk production on reasons cows leave the herd. *Journal of Dairy Science*, 83(12), 2980-2987, doi: 10.3168/jds.s0022-0302(00)75198-8

Snowder, G., Van Vleck, L. D., Cundiff, L., & Bennett, G. (2005). Influence of breed, heterozygosity, and disease incidence on estimates of variance components of respiratory disease in pre-weaned beef calves. *Journal of Animal Science*, 83(6), 1247-1261, doi: 10.2527/2005.8361247x

Storli, K., Heringstad, B., & Salte, R. (2014). Effect of dams' parity and age on daughters' milk yield in Norwegian Red cows. *Journal of Dairy Science*, 97(10), 6242-6249, doi: 10.3168/jds.2014-8072

Sullivan, E. L., Nousen, E. K., & Chamlou, K. A. (2014). Maternal high fat diet consumption during the perinatal period programs offspring behavior. *Physiology & behavior,* 123, 236-242, doi: 10.1016/j.physbeh.2012.07.014

Svensson, C., Lundborg, K., Emanuelson, U., & Olsson, S.O. (2003). Morbidity in Swedish dairy calves from birth to 90 days of age and individual calf-level risk factors for infectious diseases. *Preventive Veterinary Medicine*, 58(3-4), 179-197, doi: 10.1016/s0167-5877(03)00046-1

Swali, A., & Wathes, D. (2006). Influence of the dam and sire on size at birth and subsequent growth, milk production and fertility in dairy heifers. *Theriogenology,* 66(5), 1173-1184, doi: 10.1016/j.theriogenology.2006.03.028

Swali, A., & Wathes, D. (2007). Influence of primiparity on size at birth, growth, the somatotrophic axis and fertility in dairy heifers. *Animal Reproduction Science,* 102(1-2), 122-136, doi: 10.1016/j.anireprosci.2006.10.012

Tahir, M. N., Riaz, R., Bilal, M., & Nouman, H. M. (2019). Current Standing and Future Challenges of Dairying in Pakistan: A Status Update. In Milk Production, Processing and Marketing. *Intech Open*, doi: 10.5772/intechopen.83494

Tao, S., Dahl, G. E., Laporta, J., Bernard, J. K., Orellana Rivas, R. M., & Marins, T. N. (2019). Physiology symposium: Effects of heat stress during late gestation on the dam and its calf. *Journal of Animal Science*, 97(5), 2245-2257, doi: 10.1093/jas/skz061

Tatar, A. M., Deniz, H., & Tutkun, M. (2017). Reasons for Culling and Replacement Rate in Dairy Cattle. *Animal Science,* 60(1), 49-51, cited from: http://animalsciencejournal.usamv.ro/pdf/2017/Art7.pdf

Todd, C., McGee, M., Tiernan, K., Crosson, P., O'Riordan, E., McClure, J., Lorenz, I., & Earley, B. (2018). An observational study on passive immunity in Irish suckler beef and dairy calves: tests for failure of passive transfer of immunity and associations with health and performance. *Preventive Veterinary Medicine,* 159, 182-195, doi: 10.1016/j.prevetmed.2018.07.014

Tokgöz, B., Özdemir, R., Turut, N., Mirioğlu, M., İnce, H., Mahanoğlu, B., Yoldaş, A., & Tuzcu, N. (2013). Adana Bölgesinde görülen neonatal buzağı enfeksiyonlarının morbidite ve mortaliteleri ve risk faktörlerinin belirlenmesi. *AVKAE Dergisi,* 3(1), 7-14, cited from: https://vetkontrol.tarimorman.gov.tr/adana/Belgeler/dergi%202013/2.pdf

Tozer, P., & Heinrichs, A. (2001). What affects the costs of raising replacement dairy heifers: A multiple-component analysis. *Journal of Dairy Science*, 84(8), 1836-1844, doi: 10.3168/jds.s0022-0302(01)74623-1

Tutka, B. (2019). *Investigation of Factors Affecting Culling Rates in Holstein and Simmental Cows*. Master of Science Thesis Department of Animal Science, May 2019.

Uetake, K. (2013). Newborn calf welfare: A review focusing on mortality rates. *Animal Science Journal*, 84(2), 101-105, doi: 10.1111/asj.12019

Van Eetvelde, M., Kamal, M., Vandaele, L., & Opsomer, G. (2017). Season of birth is associated with first-lactation milk yield in Holstein Friesian cattle. *Animal*, 11(12), 2252-2259, doi: 10.1017/s1751731117001021

Walker, W., Epperson, W., Wittum, T. E., Lord, L. K., Rajala-Schultz, P. J., & Lakritz, J. (2012). Characteristics of dairy calf ranches: Morbidity, mortality, antibiotic use practices, and biosecurity and biocontainment practices. *Journal of Dairy Science*, 95(4), 2204-2214, doi: 10.3168/jds.2011-4727

Wąsowska, E., & Puppel, K. (2018). Changes in the content of immunostimulating components of colostrum obtained from dairy cows at different levels of production. *Journal of the Science of Food and Agriculture*, 98(13), 5062-5068, doi: 10.1002/jsfa.9043

Wathes, D., Brickell, J., Bourne, N., Swali, A., & Cheng, Z. (2008). Factors influencing heifer survival and fertility on commercial dairy farms. *Animal*, 2(8), 1135-1143, doi: 10.1017/s1751731108002322

Wathes, D., Pollott, G., Johnson, K., Richardson, H., & Cooke, J. (2014). Heifer fertility and carry over consequences for life time production in dairy and beef cattle. *Animal*, 8(s1), 91-104, doi: 10.1017/s1751731114000755

Weaver, D. M., Tyler, J. W., VanMetre, D. C., Hostetler, D. E., & Barrington, G. M. (2000). Passive transfer of colostral immunoglobulins in calves. *Journal of Veterinary Internal Medicine*, 14(6), 569-577, doi: 10.1111/j.1939-1676.2000.tb02278.x

Wilde, D. (2009). Nutrition and immunity in the newborn calf: new advances from yeast-based technologies. *Revue de Medecine Veterinaire*, 160(8/9), 425-428, doi: 10.1111/j.1753-4887.1949.tb02172.x

Williams, C. L., Teeling, J. L., Perry, V. H., & Fleming, T. P. (2011). Mouse maternal systemic inflammation at the zygote stage causes blunted cytokine responsiveness in lipopolysaccharide-challenged adult offspring. *BMC biology*, 9(1), 1-12, doi: 10.1186/1741-7007-9-49

Wiltbank, M., Lopez, H., Sartori, R., Sangsritavong, S., & Gümen, A. (2006). Changes in reproductive physiology of lactating dairy cows due to elevated steroid metabolism. *Theriogenology*, 65(1), 17-29, doi: 10.1016/j.theriogenology.2005.10.003

Wiltbank, M. C., Baez, G. M., Garcia-Guerra, A., Toledo, M. Z., Monteiro, P. L., Melo, L. F., … Sartori, R. (2016). Pivotal periods for pregnancy loss during the first trimester of gestation in lactating dairy cows. *Theriogenology*, 86(1), 239-253, doi: 10.1016/j.theriogenology.2016.04.037

Windeyer, M., Leslie, K., Godden, S. M., Hodgins, D., Lissemore, K., & LeBlanc, S. (2014). Factors associated with morbidity, mortality, and growth of dairy heifer calves up to 3 months of age. *Preventive Veterinary Medicine*, 113(2), 231-240, doi: 10.1016/j.prevetmed.2013.10.019

Workie, Z. W., Gibson, J. P., & van der Werf, J. H. (2021). Analysis of culling reasons and age at culling in Australian dairy cattle. *Animal Production Science*, 61(7), 680-689, doi: 10.1071/an20195

Yaylak, E. (2003). Siyah Alaca ineklerde sürüden çıkarılma nedenleri, sürü ömrü ve damızlıkta yararlanma süresi. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi*, 16(2), 179-185, cited from: https://dergipark.org.tr/en/pub/akdenizfderg/issue/1584/19679

Yoon, J., Lee, J., Kim, C., Chung, Y., & Kim, C.H. (2004). Effects of milk production, season, parity and lactation period on variations of milk urea nitrogen concentration and milk components of Holstein dairy cows. *Asian-Australasian Journal of Animal Sciences*, 17(4), 479-484, doi: 10.5713/ajas.2004.479

Young, L. E., Sinclair, K. D., & Wilmut, I. (1998). Large offspring syndrome in cattle and sheep. *Reviews of Reproduction*, 3(3), 155-163, doi: 10.1530/revreprod/3.3.155

Zhang, S., Rattanatray, L., McMillen, I., Suter, C., & Morrison, J. (2011). Periconceptional nutrition and the early programming of a life of obesity or adversity. *Progress in Biophysics and Molecular Biology*, 106(1), 307-314, doi: 10.1016/j.pbiomolbio.2010.12.004

7. SYMBOLS and ABBREVIATIONS

ADG: Average Daily Gain
DNA: Deoxyribonucleic Acid
RNA: Ribonucleic Acid
LOS: Large-Offspring Syndrome
NCD: Neonatal Calf Diarrhea
BRD: Bovine Respiratory Disease
FPT: Failure in Passive Transfer
Ig: Immunoglobulin
IgG: Immunoglobulin G
IgG1: Immunoglobulin G1
SCC: Somatic Cell Count
BCS: Body Condition Score
BW: Birth Weight
ADG: Average Daily Gain
AFC: Age at First Calving
MY: Milk Yield
ATP: Adenosine Triphosphate
LMY: Lactation Milk Yield
SNF: Solid Not Fat
AFI: Age at First Insemination
NI: number of inseminations
-d: Days
-mo: Months
g: Gram
L: Liter
mg: Milligram
ml: Milliliter
$: Dollar
Kg: Kilogram
%: Percentage
~: Approximately

8. ANNEXURE

EK 1. Etik Kurul Onayı

GIDANI KORU
SOFRANA SAHİP ÇIK

T.C.
BURSA VALİLİĞİ
İl Tarım ve Orman Müdürlüğü

Sayı : E-61352012-325.04.02-3463707 10.12.2020

Konu : Proje Bazlı İzinler

Sayın Abdulkadir ORMAN
Uludağ Üniversitesi Veteriner Fakültesi A Blok Zootekni Anabilim Dalı Görükle Kampüsü 16059
Nilüfer BURSA

İlgi : Abdulkadir ORMAN'ın 04.12.2020 tarihli başvurusu.

İlgide kayıtlı yazınızda belirttiğiniz, Bursa Uludağ Üniversitesi Veteriner Fakültesi Zootekni Anabilim Dalında görevli Prof. Dr. Abdülkadir ORMAN'ın proje yürütücüsü olduğu "Holstein İneklerde Anne Yaşının Yavrularda Süt ve Döl Verimi Performanları Buzağılık Dönemi Hastalık İnsidensi ve Sürüde Kalma Süresine Etkisi" isimli projenin teknik olmayan proje özet içeriği, 13.12.2011 tarih ve 28141 sayılı Resmi Gazete'de yayımlanarak yürürlüğe giren "Deneysel ve Diğer Bilimsel Amaçlar İçin Kullanılan Hayvanların Refah ve Korunmasına Dair Yönetmelik" çerçevesinde incelenmiş olup yapılacak çalışmalar için, Yönetmeliğin 2. maddesi ikinci fıkrasında bahsedilen "Bu yönetmelik, deneysel olmayan tarımsal ve klinik veterinerlik uygulamalarını .... kapsamaz" hükmü gereğince, kapsam dışı olduğundan, 08.12.2020 tarihli ve 01 sayılı komisyon kararıyla Bakanlığımızdan izin alınmasına gerek bulunmamaktadır.

Bilgilerinize rica ederim

Mehmet Akif ŞENYÜREK
İl Müdürü V.

Bu belge, güvenli elektronik imza ile imzalanmıştır.
Belge Doğrulama Kodu : BRRTQLNL Belge Doğrulama Adresi: https://www.turkiye.gov.tr/tarim-ve-orman-bakanligi-ebys

Adalet Mah. 1.Hürriyet Cad No:98 Osmangazi Bursa
Tel: (0224) 246 42 30 Faks:(0224) 247 43 24
E-Posta: bursa@tarim.gov.tr Kep: tarimveormanbakanligi@hs01.kep.tr

Bilgi için:Gözde
COŞKUNSERÇE
Veteriner Hekim

83828794 - 83828794 - 83828794

9. ACKNOWLEDGMENT

This manuscript, despite bearing a single name as proprietor, was never possible without continuous teamwork and without the blessings of Allah Almighty, the creator. My two years of studentship, more like a bumpy ride, were made smoother by my supervisor Prof. Dr. Abdülkadir ORMAN. His support during hard times (during the COVID-19 pandemic), faith in my abilities, trust in me, openness to new ideas, thoughtful advice, and organization of necessities for this research work have played a central role in my masters. Graduating as your student gives me an immense pleasure. I am indeed humbly grateful to Dr. Can BAKLACI, who helped me in my research work at all levels and made all the arrangements to run my experiment smoothly. My gratitude to Suphan Batuk BAKLACI and his entire family for invaluable support and care. Mesud SÜNGER deserves special thanks for unwavering support during the data collection process. I gratefully acknowledge the jury members for their precious time to go through this manuscript.

I express my deep sense of obligation to Prof. Dr. Mustafa OĞAN, Prof. Dr. Serdal DİKMEN, Prof. Dr. Metin PETEK, Assitant prof. Dr. Hakan ÜSTÜNER, Dr. Enver ÇAVUŞOĞLU, Dr. Fazlı ALPAY for their keen interest throughout the course of my studentship. Heartful thanks are extended to Assistant Prof. Dr. Naeem Tahir, Assistant Prof. Dr. Umair Ahsan, Dr. Ibrar Ahmed, and Dr. Muhammad Furqan Asghar Chacher for lending their unconditional support and mentorship at every stage of my life. I am grateful to all the post-graduate students at the Department of Animal Science for their continuous support and assistance in executing the research work.

No acknowledgment could ever adequately express my obligation to my beloved parents, brothers, and sisters who supported me throughout the journey of my life.

I feel that my words cannot give appropriate shelter to my expressions for my friends who always motivated and supported me during the entire duration.

I feel my proud privilege to mention the award of a prestigious scholarship from Presidency for Turks Abroad and Related Communities (YTB).

10. RESUME

A. PERSONAL DETAILS

First Name, Last name: Roshan, Riaz
Nationality:
Place & Date of Birth:
Telephone:
E-mail:
Foreign Languages: English, Turkish

B. ACADEMIC DETAILS

Degree	Institution	Completion
Bachelors Doctor of Veterinary Medicine	The Islamia University of Bahawalpur	2018
M.Sc Animal Science	Bursa Uludağ University	2021

C. SCHOLARSHIPS AND AWARDS

- ✓ Position holder scholarship from Bahawalpur Islamia University during DVM tenure (2012-17)
- ✓ Laptop winner on merit base from Government of Punjab (2013)
- ✓ Higher Education Commission (HEC) Scholarship during Bachelors (2014-2017)
- ✓ Turkish Government Scholarship winner for pursuing masters in Turkey (2018-2021)

D. ACADEMIC PUBLICATIONS

Journal Articles

1. Çavuşoglu, E, Riaz, R. (2021). The Effect of Ambient Temperature on The Death Rate, Reject Rate, Dressing Percentage, and Economic Loss in Broilers During Transport to Slaughterhouse. *Journal of Research in Veterinary* Medicine, 40 (1), 19-2. DOI: 10.30782/jrvm.927286.
2. Putra, WPB, Riaz, R, Gunawan, A, Orman, A. (2021). Comparison of Growth Curve in Male Layer Chickens. *Journal of Research in Veterinary Medicine*, 40(1), 49-53. DOI: 10.30782/jrvm.779699
3. Çavuşoğlu, E, Riaz, R, Omar, M, Demir, M, Orman, A. (2021). Effect of parity and the production year on the longevity of the kids in saneen dairy goats.

Journal of Research in Veterinary Medicine, 40 (1), 68-72. DOI: 10.30782/jrvm.811826.

4. Riaz, R, Ahmed, I, Ahmad, M, Nouman, H, Sattar, M. (2020). Zoonotic Epidemics of Coronaviruses, Emergence of Covid-19, and Future Perspective for Zoonotic Diseases. *The Eurasia Proceedings of Science Technology Engineering and Mathematics*, 10, 44-55. Retrieved from https://dergipark.org.tr/tr/pub/epstem/issue/58035/836630
5. Riaz, R., Tahir, M. N., Waseem, M., Asif, M., & Khan, M. A. (2018). Accuracy of estimates for live body weight using Schaeffer's formula in non-descript cattle (Bos Indicus), Nili Ravi buffaloes (Bubalus Bubalis) and their calves using linear body measurements. *Pakistan Journal of Science*, *70*(3), 225.

Book Chapter

1. Tahir, M. N., Riaz, R., Bilal, M., & Nouman, H. M. (2019). Current Standing and Future Challenges of Dairying in Pakistan: A Status Update. In *Milk Production, Processing and Marketing*. IntechOpen.

Conference Proceedings

1. Putra, W. P. B., Riaz, R., & Ahmed, I. Bovine Arachnomelia Syndrome: A Study in the Genetical Aspect. International Conference on Environmentally Sustainable Animal Industry (ICRSAI) Indonesia, Nov 18-19, 2020.
2. Ahmed, I., Riaz, R., & Inal, F. Effects of rumen protected choline supplementation on dairy cattle. II. International Conference on Agricultural, Biological and Life Science (AGBIOL) at Edirne, Turkey, July 7-9, 2020.
3. Ahmed, I., Inal F., Kahraman, O., & Riaz, R. Insect fat: An alternative source of soybean oil in poultry feed. 3rd International Eurasian Conference on Biological and Chemical Sciences at Ankara, Turkey, March 19-20, 2020.
4. Putra, W. P. B., Riaz, R., Orman, A., & Ahmed, I. The association between live body weight and linear body measurements in Sumba Ongole (Bos indicus) and Bali (Bos javanicus) cows. 3rd International Eurasian Conference on Biological and Chemical Sciences at Ankara, Turkey, March 19-20, 2020.
5. Putra, W. P. B., Riaz, R., & Orman., A. The Methodology in Population Structure Analysis: A case study in Buffaloes of Indonesia. 1. International conference on agriculture, and animal husbandry at Şanliurfa, Turkey, November 29, 2019.