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Comparison of health and reproductive treatments over three seasons for once-a-day and twice-a-day milking herds

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Abstract

Once-a-day (OAD) milking has been increasing in popularity in New Zealand, while housing cows is being advocated as one means of minimising environmental impacts of dairying. The present study aimed to investigate health treatments under four different farming systems: OAD, and three twice-a-day (TAD) systems (housed, standard and commercial). There were health records from 377 cows milked OAD and 878 cows milked TAD, over the dairy seasons 2013-14, 2014-15 and 2015-16. Data were analysed assuming binomial distributions for the dependent variables with a generalised linear model that included the effects of season, system (OAD, TAD systems), breed and lactation number. In 2014-15, cows milked OAD were treated less often for mastitis than cows milked TAD (12% and 25% respectively; P<0.05). Cows milked OAD had fewer reproductive treatments compared to cows milked TAD (standard) in 2014-15 and 2015-16 (1% vs 39% and 2% vs 40% respectively; P<0.01). These results support the advice to farmers that milking OAD does not have a major impact on the risk of mastitis but may provide benefits in terms of reproductive performance. In addition, cows milked TAD (housed) had 13% of the cows treated for lameness compared to 7% of cows milked TAD (standard) (P<0.01).

Keywords: Mastitis; reproduction; once-a-day; twice-a-day

Introduction

Temporarily switching to once-a-day (OAD) milking has long been a valuable strategy in the pasture-based dairy-farming systems of New Zealand in times of drought, food shortage or to increase the body condition of the cows (Davis et al. 1999). Since the early 2000s, the percentage of farmers milking OAD throughout the entire lactation has increased from less than 1% to approximately 5% currently (Stachowicz et al. 2014). The switch to milking OAD for an entire lactation is mainly caused by a desire for different herd management or changing lifestyle expectations (Bewsell et al. 2008). Farmers starting to milk OAD may expect a loss in milk production of approximately 25% (Clark et al. 2006). On the other hand, health and reproductive performance of the cows is often claimed to improve, although research over longer time periods is limited to few studies (Lacy-Hulbert et al. 2005; Clark et al. 2006; Gleeson et al. 2007; O'Driscoll et al. 2010).

The impact of dairy farming on the environment increases as the dairy industry intensifies, for example, monitoring of water quality between 1990 and 2012 has shown that the amount of nitrogen that leached into water by agricultural activities increased 29% (Ministry for the Environment & Statistics New Zealand, 2015). This nitrogen leaching is mainly caused by both the increased use of nitrogen fertilizers and an increasing number of cows, and thus, more urine returned to the pasture. One method of lowering the nitrogen leaching is to keep cows on a stand-off area such as cow housing, to be able to collect the excreta. Many farmers are also interested in housing as a means of reducing pasture damage and improving feed utilisation (De Klein 2001). However, housing cows may also negatively impact on their health. For example, risk of disease spreading might be higher when cows are more concentrated, which is the case when housed in a shed compared to pasture-based (Laven & Holmes 2008).

The current study aimed to investigate the incidence of health treatments under four different farming systems: OAD, and three twice-a-day (TAD) systems (housed, standard and commercial) where cows per system per year were similar.

Materials and methods

Two datasets from Massey University research farms (Dairy 1 and Dairy 4; coordinates -40.393563, 175.614779) were analysed over the 2013-14, 2014-15 and 2015-16 dairy seasons. Health records from 728 and 1905 lactations from 377 cows milked OAD and 878 cows milked TAD, respectively, were analysed. The herd milked OAD was comprised of ⅓ Holstein-Friesian (HF) cows, ⅓ Jersey (J) cows, and ⅓ of HF×J crossbred cows. The breed composition of the herd milked TAD was mainly comprised of crossbred HF×J with a large range of proportion of HF and J breeds. Health and reproductive records were obtained from the InfoVet system records for both dairy 1 and 4, reproductive interventions mainly CIDRs were applied using the same criteria on both farms. In the 2013-14 dairy season, the OAD herd was formed at Dairy 1, and the housing of cows began at Dairy 4.

Cows in both systems were subject to the same health protocols, including pre-mating management. The cows milked TAD are divided into three different systems, from duration controlled grazing ('housed'), standard (managed to balance total feed intake with the housed cows), and a commercially managed herd (which aims to maximise profit as season and milk payout allowed) cows per system and year are presented in Table 1. The standard herd had a management comparable to the management of the OAD herd, except for the milking frequency, as both were low-input systems based predominantly on grazed pasture the standard TAD herd was used to compare TAD with OAD milking systems. When comparing housed cows and cows kept outdoors, the TAD housed and standard systems were used. The housed cows were managed using a methodology similar to that described by Christensen et al. (2014) with duration-controlled grazing during sensitive environmental periods. The commercial herd was managed as it would be on a commercial farm with strategic use of OAD milking during dry periods or feed shortages.

Statistical analysis

All data manipulation and statistical analyses were carried using the Statistical Analysis Software version 9.3 (SAS Institute Inc. Cary, NC, USA). Records from cows with a calving date before July 2013 were removed.

Lactations were divided into seasons based on the calving date of the cows, as cows calving after 1st June each season were assumed to lactate in that season. Percentages of J and HF breeds per cow were obtained from pedigree information. Cows with a percentage of 0.875 or higher of HF or J breeds were considered as purebred cows of the respective breed. Cows without breed information were removed from analyses. Jersey cows from the OAD milking herd were excluded from analyses, due to the absence of J cows in the TAD milking herd.

The veterinary treatments were categorized in five categories: mastitis, lameness, reproductive, metabolic and others, and formatted into a binary format for further calculations. Veterinary treatment records from cows which did not have complete lactation records were removed, due to veterinary treatments on dry cows. Variables with binomial distributions were analysed with a generalised linear model that included the effects of season, system (OAD, TAD systems), breed and lactation number. To analyse differences in health and reproduction treatments the GLIMMIX procedure was used with the logit transformation. Least-squares means were back-transformed into the binomial scale.

Results

Incidence of mastitis treatments were higher for cows in their 4th lactation compared with cows in their 1st, 2nd or 3rd lactation ($P<0.01$; Table 2). In season 2014-15, 11% of the herd milked OAD was treated at least once for mastitis, compared to 20% of the cows milked TAD (standard) ($P<0.01$;Table 3). The chance of a cow being treated for mastitis in season 2014-15 was 1.7 times higher compared to that in season 2015-16.

For lameness, in the 2014-15 season 11% of all cows were treated at least once, whereas in 2013-14 7% of cows were treated and in 2015-16 9% of cows were treated ($P<0.01$; Table 2). By milking system 13% of the housed cows had at least one treatment for lameness, whereas in the standard herd, 7% of cows had at least one treatment ($P<0.01$; Table 2). In 2014-15, 4% of the cows milked OAD received at least one treatment for lameness compared to 8% of the cows milked TAD (standard) ($P=0.03$; Table 3). Sixteen percent of cows in their 4th lactation received at least one treatment for lameness, whereas percentages of cows with at least one treatment in earlier lactations were 7% (1st and 2nd year) and 8% (3rd year; $P<0.01$; Table 2).

Treatments related to reproductive performance in season 2013-14 were much lower (7%) than in the consecutive seasons (24% in 2014-15 season and 27% in 2015-16 season; $P<0.01$; Table 2). Holstein-Friesian cows were 50% more likely to receive at least one reproductive treatment compared to HF×J cows ($P<0.01$; Table 2). A difference was visible with in a higher percentage of reproductive treatments for cows in earlier lactation years ($P<0.01$; Table 2). Also, 3% of the cows milked OAD received at least one treatment related to reproductive performance compared to 30% of the cows milked TAD (standard) ($P<0.01$; Table 2).

Table 1 Number of cows by system (OAD=once-a-day; TAD-H=twice-a-day housed; TAD-ST= standard; TAD-C = commerical) in each season included in the analysis

	System				
Season	OAD	TAD-H	TAD-ST	TAD-C	Total
2013-14	140	186	197	256	779
2014-15	220	192	199	268	879
2015-16	199	190	182	217	788

Discussion

The majority of treatments occurred in the categories mastitis, lameness and reproductive disorders. This is comparable with literature in which mastitis (10%) and lameness (20%) are known to be the most common health treatments in New Zealand (Clark et al. 2007). In the 2014-15 season, the herd milked OAD had a lower percentage of cows receiving at least one treatment for mastitis than the standard herd (11% versus 20%). It is often feared that milking OAD increases cases of mastitis. In a study performed by Lacy-Hulbert et al. (2005), somatic cell counts of cows milked OAD were double those of cows milked TAD, but number of treatments for mastitis were lower for cows milked OAD. This is in accordance with the present study, in which a lower percentage of cows milked OAD were treated at least once for mastitis in the 2014-15 season.

Bewsell et al. (2008) stated that one of the reasons for farmers to start milking OAD is because of fewer problems with lameness, and in support of this, O'Driscoll et al. (2010) found that milking OAD generally improves the hoof health and locomotion score. Also, the fact that cows are only moved once for milking each day means that they can spend extra time lying and resting, which may also be beneficial for their health (O'Driscoll et al. 2010).

Table 2 Odds ratio (OR) of likelihood that cows were treated at least once for mastitis, lameness, reproductive disorders, metabolic disorders and other diseases compared to 2015-16 dairy season. Proportions (P) of cows with standard errors are given. Comparisons were among seasons, systems (OAD=once-a-day; TAD_H= twice-a-day housed; TAD_ST=standard; TAD_C=commercial), breeds (HF= Holstein-Frisian; XB=Crossbred) and lactation number.

		Mastitis			Reproductive disorders			Lameness			Metabolic disorders			Other diseases		
Variables	n	P cows	OR	P-value	P cows	OR	P-value	P cows	OR	P-value	P cows	OR	P-value	P cows	OR	P-value
Season				0.0002			<0.0001			0.0010			0.0152			<0.0001
2013-14	779	0.15^{ab} (0.01)	1.4^{a}		0.07^{b} (0.01)	0.2^{c}		0.07^{b} (0.01)	0.7^{b}		0.01^{a} (0.01)	0.7^{b}		0.01^{b} (0.01)	0.2^{b}	
2014-15	879	0.18^{a} (0.01)	1.7^{a}		0.24^{a} (0.02)	0.8^{a}		0.11^{a} (0.01)	1.2^{ab}		0.02^{a} (0.01)	1.7^{a}		0.03^{b} (0.01)	0.5^{b}	
2015-16	788	0.11^{b} (0.01)	1.0^{b}		0.27^{a} (0.02)	1.0^{a}		0.09^{ab} (0.01)	1.0^{a}		0.01^{a} (0.01)	1.0^{a}		0.06^{a} (0.01)	1.0^{a}	
System				0.0056			<0.0001			<0.0001			0.3073			0.0123
OAD	559	0.11^{b} (0.01)	0.9^{b}		0.03^{c} (0.01)	0.1^{c}		0.05^{b} (0.01)	0.4^{b}		0.01^{a} (0.01)	0.5^{a}		0.01^{b} (0.01)	0.3^{b}	
TAD_H	568	0.18^{a} (0.02)	1.5^{a}		0.32^{a} (0.02)	1.8^{a}		0.13^{a} (0.01)	1.0^{a}		0.02^{a} (0.01)	0.9^{a}		0.04^{a} (0.01)	1.3^{ab}	
TAD_ST	578	0.16^{ab} (0.02)	1.2^{ab}		0.30^{a} (0.02)	1.6^{a}		0.07^{b} (0.01)	0.5^{b}		0.01^{a} (0.01)	0.7^{a}		0.03^{ab} (0.01)	0.8^{ab}	
TAD_C	741	0.13^{ab} (0.01)	1.0^{b}		0.21^{b} (0.02)	1.0^{b}		0.13^{a} (0.01)	1.0^{a}		0.02^{a} (0.01)	1.0^{a}		0.03^{ab} (0.01)	1.0^{a}	
Breed				0.1152			0.0020			0.1283			0.5946			0.1108
HF	802	0.16^{a} (0.01)	1.2^{a}		0.21^{a} (0.02)	1.5^{a}		0.10^{a} (0.01)	1.2^{a}		0.01^{a} (0.01)	1.2^{a}		0.03^{a} (0.01)	1.5^{a}	
XB	1644	0.13^{a} (0.01)	1.0^{a}		0.14^{b} (0.01)	1.0^{b}		0.08^{a} (0.01)	1.0^{a}		0.01^{a} (0.01)	1.0^{a}		0.02^{a} (0.01)	1.0^{a}	
Lactation				<0.0001			0.0044			<0.0001			<0.0001			0.0261
1	414	0.08^{c} (0.01)	0.2^{c}		0.21^{a} (0.02)	1.7^{a}		0.07^{b} (0.01)	0.4^{b}		0.02^{ab} (0.01)	0.4^{b}		0.03^{a} (0.01)	1.8^{ab}	
2	473	0.13^{bc} (0.02)	0.4^{bc}		0.18^{ab} (0.02)	1.4^{a}		0.07^{b} (0.01)	0.4^{b}		0.01^{b} (0.01)	0.1^{b}		0.04^{a} (0.01)	2.3^{a}	
3	405	0.15^{b} (0.02)	0.5^{b}		0.17^{ab} (0.02)	1.3^{ab}		0.08^{b} (0.01)	0.5^{b}		0.01^{b} (0.01)	0.2^{b}		0.02^{a} (0.01)	1.3^{ab}	
(>)4	1154	0.28^{a} (0.01)	1.0^{a}		0.13^{b} (0.01)	1.0^{b}		0.16^{a} (0.01)	1.0^{a}		0.04^{a} (0.01)	1.0^{a}		0.02^{a} (0.01)	1.0^{b}	

However, the present study found that only in the 2014-15 season did a lower percentage of the herd milked OAD receive at least one treatment for lameness compared to the standard herd (4% versus 11%). The low incidence of lameness treatments on the TAD farm could be explained by the location of the milking shed on the farm which is more centralised than the shed location in the OAD farm. The shed is located in the middle of the farm and the pastures are spread around it. Therefore, cows do not have to walk a very long distance to get to the milking shed, which is beneficial for those cows vulnerable to developing lameness (Ranjbar et al. 2016). Also, because of this short distance, walking one or two times per day to the milking shed does not significantly increase daily movement of the cow. Lameness problems are more likely to occur when the road to the milking shed is long or/and of bad quality (Ranjbar et al. 2016). Another interesting result was the difference in lameness treatments between the standard herd (7%) and the housed herd (13%). Previous research on lameness has reported that lame cows recover better when put on grass (Hernandez-Mendo et al. 2007). The floor of the house can have a negative impact on claw health and the development of lameness (Haufe et al. 2012).

Table 3 Proportion of cows in once-a-day (OAD) and twice-a-day (TAD standard herd) system, receiving at least one treatment for mastitis, lamenss or reproductive disorders (standard error of the mean)

		Mastitis		Reproductive disorders		Lameness	
		OAD	TAD	OAD	TAD	OAD	TAD
Season	2013	0.12^{a} (0.03)	0.16^{a} (0.03)	0.14^{a} (0.03)	0.07^{b} (0.02)	0.04^{a} (0.02)	0.04^{a} (0.01)
	2014	0.11^{b} (0.02)	0.20^{a} (0.03)	0.01^{b} (0.01)	0.42^{a} (0.04)	0.04^{b} (0.01)	0.08^{a} (0.02)
	2015	0.15^{a} (0.03)	0.11^{a} (0.02)	0.02^{b} (0.01)	0.51^{a} (0.05)	0.06^{a} (0.02)	0.05^{a} (0.03)
Breed	XB	0.11^{a} (0.02)	0.16^{a} (0.02)	0.02^{b} (0.01)	0.23^{a} (0.03)	0.04^{a} (0.01)	0.04^{a} (0.01)
	HF	0.14^{a} (0.03)	0.15^{a} (0.03)	0.04^{b} (0.02)	0.33^{a} (0.04)	0.05^{a} (0.01)	0.07^{a} (0.02)

^{ab} columns with different letters denote significant differences (P<0.05)

The higher chance of HF cows requiring at least one reproductive treatment compared to HFxJ cows is in accordance with a previous study (Xu & Burton 2003). From the 2013-14 season to 2014-15 and 2015-16 seasons, a large decline in the percentage of cows milked OAD and treated at least once for reproductive disorders was visible (13% in 2013-14 versus 1% and 2% in 2014-15 and 2015-16 seasons, respectively). The OAD herd started in 2013, and it is possible that this decline in cows treated at least once for a reproductive disorder is due to the fact that cows were adapting to the new system in their first year. Being milked OAD for a full year might have enabled them to restore their body condition, as less energy is required for milking, and extra energy could be used for body maintenance (Davis et al. 1999). The standard herd had a higher percentage of cows treated at least once for a reproductive disorder (39% and 40% in 2014-15 and 2015-16 seasons, respectively). Xu & Burton (2003) reported, that on average, 20% of cows in New Zealand were found to be anoestrous prior to the start of the mating season. In the present study, no distinction was made between different reproductive disorders, but anoestrous was the main disorder treated. Compared to the 24% reported by Xu & Burton (2003), the percentage of cows treated at least once for reproductive disorders was high for the standard herd. However, a possible reason influencing this high number is the higher milk production of the cows milked TAD compared to the average New Zealand milk production (19.5 kg versus 15.5 kg). A higher milk production is often related to decreased reproductive performance (Clark et al. 2007).

In summary, results from the present study indicate that number of cows receiving at a least one mastitis treatments were not significantly different between cows milked OAD and TAD (standard), although there was a trend for fewer mastitis treatments in cows milked OAD, however, the number of reproductive treatments were significantly lower under OAD than TAD after the first year of transition. These results support the advice to farmers that milking OAD does not have a major impact on the risk of mastitis but may provide benefits in terms of reproductive performance. Cows housed indoors had higher percentage of treatments for lameness compared to cows kept outdoors. Bedding and flooring are important contributors to lameness problems in dairy cows and should be carefully considered.

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References

Bewsell D, Clark DA, Dalley DE 2008. Understanding motivations to adopt once-a-day milking amongst New Zealand dairy farmers. The Journal of Agricultural Education and Extension 14: 69-80

Christensen CL, Horne DJ, Hedley MJ, Hanly JA 2014. Duration-controlled grazing on dairy farms: Decision support for slurry re-application. Fertiliser & Lime Research Centre 27th Workshop. http://www.massey.ac.nz/~flrc/workshops/14/Manuscripts/Paper_Christensen_2014.pdf [accessed 6 Feb 2017]

Clark DA, Phyn CVC, Tong MJ, Colllis SJ, Dalley DE 2006. A systems comparison of once- versus twice-daily milking of pastured dairy cows. Journal of Dairy Science 89: 1854-1862

Clark DA, Caradus JR, Monaghan RM, Sharp P, Thorrold BS 2007. Issues and options for future dairy farming in New Zealand. New Zealand Journal of Agricultural Research 50: 203-221

Davis SR, Farr VC, Stelwagen K 1999. Regulation of yield loss and milk composition once-daily milking: a review. Livestock Production Science 59: 77-94

De Klein CAM 2001. An analysis of environmental and economic implications of nil and restricted grazing systems designed to reduce nitrate leaching from New Zealand dairy farms. II. Pasture production and cost/benefit analysis. New Zealand Journal of Agricultural Research 44: 217-235

Gleeson DE, O'Brien B, Boyle L, Earley B 2007. Effect of milking frequency and nutritional level on aspects of the health and welfare of dairy cows. Animal 1: 125-132

Haufe HC, Gygax L, Wechsler B, Stauffacher M 2012. Influence of floor surface and access to pasture on claw health in dairy cows kept in cubicle housing systems. Preventive Veterinary Medicine 105: 85-92

Hernandez-Mendo O, Von Keyserlingk MAG, Veira DM, Weary DM 2007. Effects of pasture on lameness in dairy cows. Journal of Dairy Science 90: 1209-1214

Lacy-Hulbert SJ, Dalley DE, Clark DA 2005. The effects of once a day milking on mastitis and somatic cell count. Proceedings of the New Zealand Society of Animal Production 65: 137-142

Laven RA, Holmes CW 2008. A review of the potential impact of increased use of housing on the health and welfare of dairy cattle in New Zealand. New Zealand Veterinary Journal 56: 151-157

Ministry for the Environment, Statistics New Zealand 2015. New Zealand's Environmental Reporting. Series: Environment Aotearoa 2015. Pp 53-72

O'Driscoll K. Gleeson D, O'Brien B, Boyle L 2010. Effect of milking frequency and nutritional level on hoof health, locomotion score and lying behaviour of dairy cows. Livestock Science 127: 248-256

Ranjbar S, Rabiee AR, Gunn A, House JK 2016. Identifying risk factors associated with lameness in pasture-based dairy herds. Journal of Dairy Science 99: 7495-7505

Stachowicz K, Jenkins G, Amer P, Phyn CVC 2014. Genetic evaluation of milk traits under whole-season once-a-day milking. Proceedings, 10th World Congress of Genetics applied to Livestock Production, Vancouver, Canada.

Xu Z, Burton L 2003. Reproductive performance of dairy cows in New Zealand. Research and development group Livestock Improvement Corporation. Hamilton.