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Milking parlour ergonomics

Milking parlour operatives are found to be overrepresented in statistics for suffering from musculoskeletal disorders. Despite the fact that the working environment considerably improves when changing from tie stall systems to loose housing barns the number of sick leaves does not decrease. The objective of the joint study carried out by Leibniz-Institut für Agrartechnik Potsdam-Bornim (ATB) and Bundesanstalt für Arbeitsschutz und Arbeitsmedizin Berlin (BAUA) is therefore to assess the effect of modern milking parlour workstation geometry regarding the working height and the weight of the milking unit. It was found that the experimental range of 30 cm in working height strongly influences the work load. The same was for an increase of 1 kg in weight of the milking cluster. The optimal working height is given, when shoulder and teat ends are on the same level.

Keywords
Work place design, milking parlour, musculoskeletal disorders

Abstract
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Within the last decades milk production was strongly affected by structural changes. Farm sizes and milk yields have continuously been increasing whereas the number of farms decreased. Those structural changes have influenced the work organisation and design in milking parlours. If possible tasks were mechanised and divided. A major cut was changing from tethering systems to loose housing barns with separate milking parlours. Auernhammer [1] showed that in a herringbone milking parlour the physical workload is considerably reduced in comparison to tethering systems with round-the-barn-pipelines or buckets. Similar results were published by Jürgens & Braemer [2] who compared the workload. As a matter of fact it can be stated that 20 years later despite the achieved reduction of physical load milking parlour operatives are still suffering from musculoskeletal disorders [3]. Pain is mainly located in the upper extremities. This seems to be a trend all over Europe, regarding that every third Finnish milk producer for example is suffering from pain in the neck- and shoulder-region [4].

Industrialized milking parlours are associated with highly repetitive, specialized large-herd opterations. According to the Finnish working group (4) the utilization rate of a milker is over 90% in herringbone or auto tandem parlours when there are eight or more milking units, one milker and more than 40 cows. The muscles have little time for recovery. The highest throughput of cows is achieved in rotary systems, where the working environment is similar to assembly lines.

The reasons for musculoskeletal disorders are multifaceted and difficult to precisely allocate. They might purely be physical or a result of work organisational factors. Some of the major risk factors in modern milking parlours are repetitive work tasks, static postures sometimes in combination with unfavourable body postures and a high work pace. A detailed analysis of the actual work situation was carried out to improve the work environment and find out the system with the lowest impact on the worker.

In cooperation with the national institute for occupational safety and health the influence of different working heights and weights of milking units was measured to be able to give advice for reconstruction or the positioning of adjustable floors.

Study design

The project was designed and performed as an experimental study in a laboratory setting. Three working heights were adjusted according to the individual shoulder height of the worker, 15 cm above, at and 15 cm below shoulder height respectively. In addition to that three milking clusters, a light (1.4 kg) and a heavy (2.4 kg) one and a single tube system (Multilactor, Siliconform, Germany) with a tube weight of 300 g each were compared. For each layout 15 repetitions were conducted measuring the body posture, the duration of and the muscular activity and the subjective strain while attaching the milking unit. The body posture was recorded with a 3-D-video based motion analysis system. Data was interpreted based on DIN EN 1005-4 and ISO 11226. The work routine was restricted to attaching the cluster and repeated once per minute.

Results

The weight of a milking unit had a significant influence on the perceived exertion as well as on the muscular activity determined by electromyography.

The rate of perceived exertion on the 6-20 Borg scale (6 = no exertion, 13 = somewhat hard, 20 = maximal exertion) was 12 on average when comparing the conventional milking clusters disregard less the working height. In a second experimental cycle the perceived exertion was lower (9 on average) when using the multilactor system in comparison to the light milking cluster (borg average of 11). While attaching the multilactor the working height had no influence on the perceived exertion. In contrast to that working with the conventional cluster above or below shoulder level was rated 12 and only 9 if the teat ends were at shoulder level.

Therefore a good opportunity to reduce the work load is to adjust the working height. The total range of variation (30 cm) already significantly influenced the body posture. Working above shoulder level induced an average upper arm elevation of 40° and when working below shoulder level an angle of 30° (**figure 1**). The upper body inclination turned out to be antagonistic. When working above shoulder level the upper body inclination was below 10° and when working below shoulder level the average angle of inclination was 16°. For approximately a quarter of the whole process the upper body inclination was exceeding 20° which is associated with a high load on the lower back (**figure 2**). For all working heights the upper body inclination was below 20° when attaching the multilactor.

The duration of muscular activity was 14 seconds on average for attaching the heavy cluster and one second shorter when attaching the light one. A further reduction of two seconds was noticed when the multilactor was in use.

The highest muscular load was measured for all muscle groups when the heavy cluster had to be attached above shoulder height. The use of the multilactor significantly reduced the muscular load. It also changed the load from static components to more dynamic work routines.

Conclusions

Based on the presented results dairy farmers are advised to adjust the working height if possible so that teat ends and shoulder of the worker are on the same level. This should be kept in mind if adjustable floors are available or new parlours are constructed. An optimal pit depth is calculated by subtracting the average distance between teat and floor from the average shoulder height of the working group on the farm.

The weight of the milking unit has a significant influence on the workload. The multilactor further lightened the load in comparison to the lightest cluster available on the market, proofed by EMG measurements and the rated perceived exertion.

The significant impact of the experimental variance on the parameters describing the workload, such as 1 kg in weight or 30 cm vertical height difference, might be the first explanation for the existing health problems among dairy farmers.

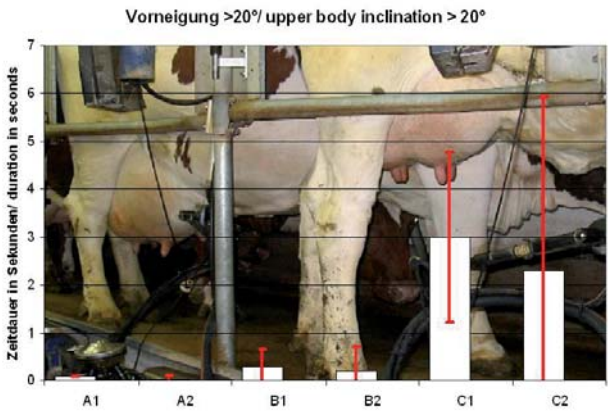
Furthermore small persons experience problems due to their shorter reach and have in consequence to lift their arms higher (**figure 1**); problems in the neck and shoulder region are more likely. At the same time tall persons are more likely to find a situation where they have to work below shoulder level. This results in a higher upper body inclination often coupled with twisting and side bending. The impact on the lower back is higher.

Concluding it has to be mentioned that in practice variation in working height is much bigger. Depending on age and race of the cow the individual distance between teat ends and floor can easily vary in a range of 40 cm. The variation in body height of the worker adds to that.

Fig. 1

Persons with short reach have to lift their arms when working slightly above shoulder level

Fig. 2



Variations in bovimetrics influence the body posture (A =working above shoulder level, B = at shoulder level, C = below shoulder level, 1 = light milking unit, 2 = heavy milking unit)

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