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### WORKLOAD IN MODERN DAIRY FARMS – ASSESSMENT FROM THE USER'S PERSPECTIVE

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**ABSTRACT** Disorders of the musculoskeletal system are very widespread in dairy farmers, despite increased mechanization and automation. To date, however, little is known about the distribution of work-related musculoskeletal disorders among dairy farmers, or about the workload situation on modern family dairy farms. The workload situation on modern Swiss dairy farms was surveyed by means of questionnaires sent to 2000 farms where the livestock was kept in cubicle housing systems. Addresses were randomly selected from a basic population of approximately 15,000 farms. The response rate was 53 %. The core questions related to the respondents' state of health, and to activities perceived as physically strenuous in dairy farming in general and in milking in particular. 68.7 % of the dairy farmers who responded to the survey stated that they regularly suffered from musculoskeletal disorders. Feed distribution (32 %), cubicle maintenance (20 %) and claw care (9 %) were perceived as especially physically strenuous in dairy farming in general. Milking was frequently rated as not very strenuous; 32 % of respondents did not state which task they found most of a strain. 18 % cited milking into separate churns or the manual transport of said churns as strenuous, 14 % applied this description to attaching the teat-cup clusters. Over 80 % of farmers enjoyed working in the milking parlour.

**Keywords:** workload, dairy farming, musculoskeletal disorders, physically strenuous activities, questionnaire.

**INTRODUCTION** Although the increasing mechanization and automation of modern livestock husbandry systems result in an easing of the farmer's workload, at the same time they frequently render the work monotonous. Studies show that despite the technical advances in dairy farming, disorders of the musculoskeletal system (MSS) are on the increase (Pinzke, 2003). Whereas in 1988 82 % (men) and 86 % (women) of the dairy farmers surveyed complained of symptoms in the previous 12 months, in 2002 the figures were 83 % and 90 % respectively. Over the same period the proportion of loose housing increased from roughly 0 % to 25 %. It was impossible to ascertain which task(s) ultimately caused the MSS symptoms. Various authors identified milking in modern milking parlours as being one significant cause, with the strain affecting the upper extremities in particular (Pinzke, 1999; Stål, 1999; Lundqvist et al., 1997). In general musculoskeletal disorders can be caused by repetitive activity, static loads, strenuous

effort, awkward posture and movement as well as an absence of regeneration (e.g. Hagberg et al., 1997; Hoehne - Hückstädt et al., 2007). The farmers surveyed by Pinzke (2003) felt that silage feeding and milking were particularly physically strenuous.

In Switzerland the proportion of farms where animals are kept in modern loose housing is rising steadily. Although this was only around 3 % in 1990, a figure of 40 % is already being assumed for 2010 (Federal Office of Agriculture, 2003). To date little is known about the distribution of work-related musculoskeletal disorders among Swiss dairy farmers, or about the workload situation on modern dairy farms. There is also virtually no evidence available on the situation of dairy farmers in other countries with comparable farm structures.

The aim of this study was therefore to survey the situation on modern dairy farms from the farmer's perspective. Special emphasis was placed on the distribution of musculoskeletal disorders as well as on the identification of physically strenuous activities.

**MATERIAL AND METHOD** Data was collected using a standardised questionnaire. This was sent to 2000 family farm managers, randomly selected from a basic population of 15,000 farms where the cattle was kept in cubicle housing systems. 1056 questionnaires were returned, equalling a 53 % response rate. All the information given below relates to these completed questionnaires, which represent a basic population of 100 %.

The key content of the questionnaire was as follows:

- The occurrence of symptoms in the musculoskeletal system based on the so-called Nordic Questionnaire (Kuorinka et al., 1987), as well as supplementary details on each of the activities where the symptoms were presented.
- The three activities (ranked 1, 2 and 3) in dairy farming perceived by the dairy farmer as the most physically strenuous.
- The milking parlour task assessed by the farmer as the most physically strenuous.
- An assessment of workplace comfort in the milking parlour.

The information provided on activities causing pain as well as on strenuous tasks while milking and in dairy farming in general needed to be handwritten on the questionnaire. The other questions could be answered by ticking various possible answers.

**RESULTS AND DISCUSSION** The average age of respondents was 45 (minimum 19, maximum 81, median 45 years of age). 96 % of the questionnaires were completed by men, attributable to the fact that the survey was addressed to the individual responsible for doing the bulk of the milking work on the farm. In Switzerland this is generally the man. 84 % of respondents favoured working with their right hand, 10 % were left-handed and 2 % worked with both the right and left hand.

**Distribution of musculoskeletal disorders** 68.7 % of respondents stated that in the previous twelve months they had suffered from symptoms in at least one area of the MSS. The commonest were pains in the area of the lumbar spine (LS) and cervical spine, as well as hip and knee disorders (Figure 1). In the upper extremities the right side was more severely affected than the left, attributable to the higher proportion of right-handers among the respondents.

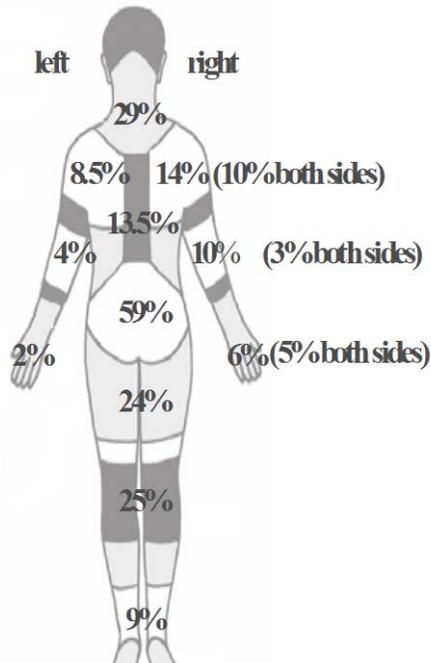


Figure 1. Distribution of symptoms in different areas of the musculoskeletal system.

Figure 2 shows the activities which caused farmers pain in the MSS. For all the regions of the body at least one third of respondents stated that they could not limit these to one or more activities, as the problems occurred non-specifically. Tasks carried out when walking and standing caused 32 % of respondents pain in the feet/ankle region, knee and thigh/hip problems occurred in 14 % and 12 % respectively. Milking together with forking and shovelling were cited by an average of approximately 10 % of respondents as the cause of disorders in the lower extremities. Although these activities were also predominantly carried out while walking or standing, the fact that they were expressly mentioned and not included under a “catch-all” term indicates that the symptoms were more intensely perceived in these jobs. Tractor driving damaged thighs and hips in 18 % of the respondents. In addition to non-specific activities, tractor driving and shovelling/forking also produced symptoms in the LS and thoracic spine (TS) area as well as in the neck. In approximately 25-30 % of respondents the upper extremities were painful during milking. This activity also caused neck symptoms in 18 %.

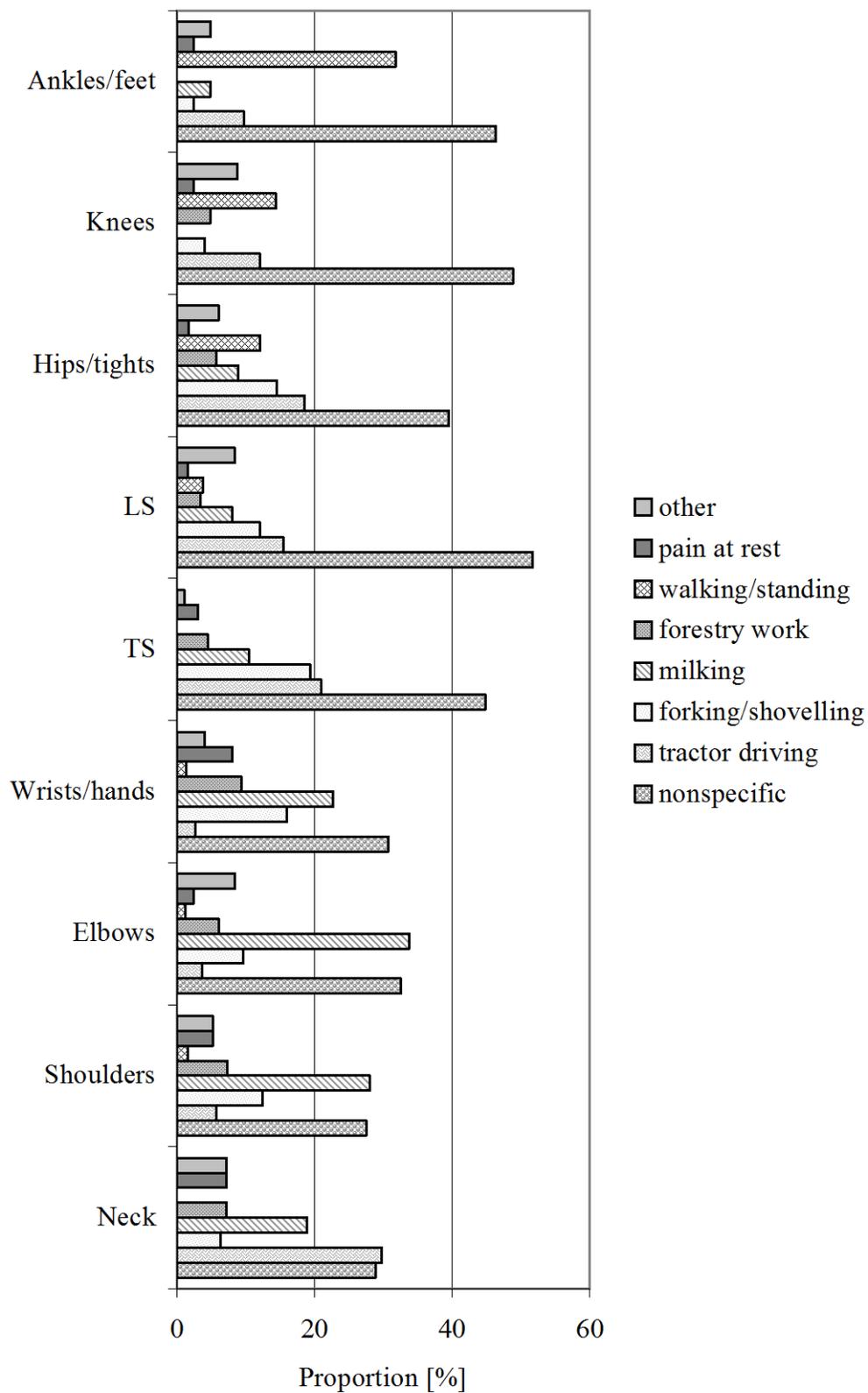


Figure 2. Relative proportion [%] of activities, the performance of which produced symptoms in the MSS.

The causes of the MSS symptoms could not be identified on the basis of this survey. They could also, for example, be associated with previous work in tethered housing. However, the fact that disorders occur despite increasing technisation and automation underlines the assumption that physically strenuous activities are performed in modern farming systems as well.

**Physically strenuous activities in dairy farming** For 32 % of the farmers surveyed feed distribution was the most physically strenuous task in dairy farming, followed by cubicle maintenance and mucking out (20 %) (Figure 3). The supposition here is that particularly the manual jobs with fork and shovel are perceived as physically strenuous. For 9 % claw care was the most strenuous, a further 8 % cited tending or dealing with livestock in general (habituation to attachment of and leading by halter, treating sick animals, obstetrics etc.). Only 2 % cited milking.

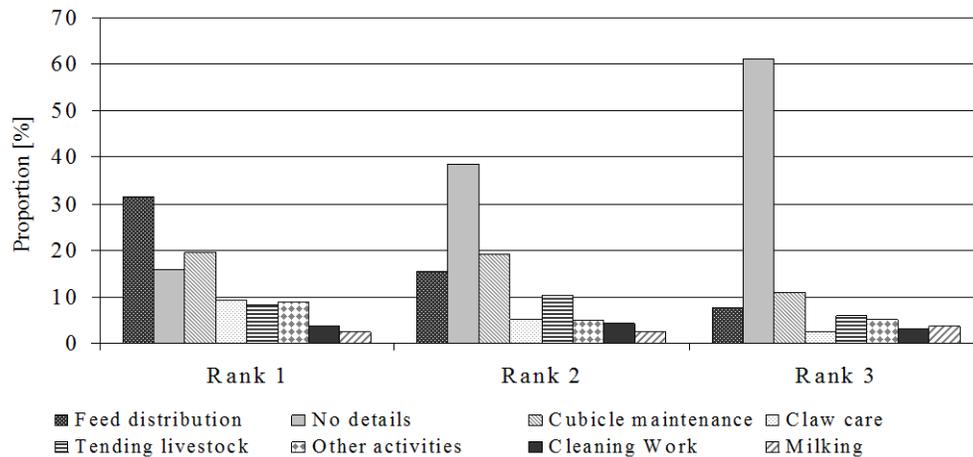


Figure 3. Dairy farming activities experienced by respondents as most physically strenuous (citing most strenuous activity = Rank 1, followed by Ranks 2 and 3)

Cubicle maintenance/mucking out, feed distribution, claw care and tending livestock were also cited at places 2 and 3 of most strenuous activities. Here, however, the farmers who did not answer the question to the end predominated, something for which there could be various reasons. Possibly they felt that the section had been covered sufficiently by naming the most physically strenuous work (Rank 1). Complete coverage of the question could actually have been facilitated by ticking multiple choice answers. This, however, can prevent the farmer from giving a spontaneous, intuitive answer, or can even suggest an answer by listing potentially strenuous activities. Another possible interpretation of the failure to answer the question about strenuous activities would be a high degree of mechanization which relieves the farmer from physical strain.

Both feed distribution and cubicle maintenance are jobs which have to be done day in, day out. Relatively long regeneration periods are almost impossible if health problems occur while they are being performed. The assumption is also that jobs which cause health disorders are perceived as physically strenuous. The most strenuous activities shown in Figure 3 correspond largely to those named in Figure 2 as the cause of disorders of the MSS.

The statement that feed distribution is the most strenuous activity is consistent with the information supplied by the Swedish dairy farmers surveyed by Pinzke (2003). There was, however, no agreement with the statement by the Swedish farmers that milking was one of the most strenuous activities. Only 2 % of the Swiss dairy farmers ranked milking in first place. A possible reason for this could be that farm structures in Switzerland are comparatively smaller. The farmers surveyed as part of this study kept an average of 40 dairy cattle, whereas in Sweden the average herd size was approximately 100 cattle at the time of the survey (Pinzke, 1999, p. 10). Milking took correspondingly more time, with the monotonous, repetitive tasks deemed harmful to health by Stål (1999) being carried out more often in conjunction with static postures. The assumption is therefore that, in view of growing herd sizes, the occupational health aspects of milking will gain importance in Switzerland as well.

**Physically strenuous activities while milking** To the question of which activity in the milking parlour was felt to be particularly strenuous, 32 % failed to respond or answered “no activity is particularly strenuous” (Figure 4). The reason for the failure to answer has already been discussed in general terms in the context of the survey of physically strenuous activities in dairy farming. In the context of milking work, which was classified as physically strenuous in various studies, ( e.g. Pinzke, 1999; Stål, 1999; Lundqvist et al., 1997) a further explanatory approach could be that the activity actually does strain the MSS, but that this is perceived only when health disorders are already present.

Handling buckets and milk churns in the milking parlour was cited as the most strenuous activity by 18 % of respondents. This can be attributed to the comparatively high weight transfer. The statement was also frequently supplemented by the remark that it was very hard work carrying the churn up or down milking parlour stairs, which are often narrow. 14 % of the respondents mentioned attaching the milking unit. Cleaning, habituating cattle, climbing stairs and herding animals were likewise perceived as strenuous. The “other activities” section contained, among other things, working at extreme temperatures, concentrating hard, dealing with technology or distributing fodder concentrate as an attractant.

In principle the activities cited can frequently be counteracted by optimised milking parlour design. Thus, for example, ground-level access to the milking parlour can do away with the need to climb stairs, and milk churns can be placed on handcarts and pushed/pulled out of the milking parlour. Strain when attaching milking units can be reduced by means of a service arm or support cable. By studying the effect of milking parlour design on the physical workload, physically strenuous elements can be identified and the milking parlour workplace optimised correspondingly.

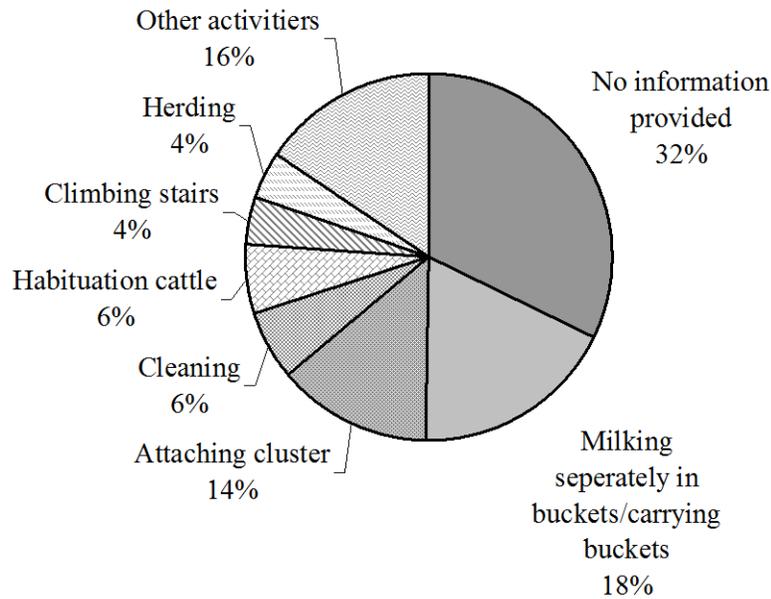


Figure 4. Milking parlour activities perceived by respondents as the most strenuous.

**Workplace comfort in the milking parlour** Workplace comfort in the milking parlour was surveyed indirectly, with respondents being able to rate various statements (grading: not at all correct, hardly correct, partly correct, for the most part correct, extremely correct; Figure 5). Over one third of the farmers assumed that their cows feel at ease in the milking parlour, 52 % agreed for the most part. The statement “milking is enjoyable” also met with great agreement, over half the farmers agreed for the most part, just under 30 % even found this extremely applicable. This assessment would indicate a pleasant environment for humans and animals. Only a limited amount can be said about the reasons for negating the statement that “milking is enjoyable”. In a few cases leakage current occurred in the milking parlours of owners who experienced hardly any or no pleasure at all in milking work. This can have a negative effect on the animals’ well-being and make the milking process correspondingly more difficult. Milking system functionality was rated good to very good by all the respondents, so no reason for the negative attitude to milking work can be found here. As a rule these farmers also did not respond to the question about the most strenuous activities in dairy farming with the activity of “milking”. The daily commitment 365 days a year may possibly play a role.

The necessity of having to concentrate hard on work in the milking parlour is assessed very differently. In each case approximately one third of respondents partly or hardly

agreed with the statement that “I have to concentrate constantly during milking”. 17 % did not agree with it at all, 18 % for the most part. These very contradictory statements can be attributed to different technical designs as well as to milking parlour size. Thus greater concentration is probably needed in a rotary parlour with 16 places with automatic premilking, automatic removal, milk meter etc. and a throughput of 80-100 cows/hour than in a tandem milking parlour with 2\*2 places and little technical equipment. Moreover, because of the routine in performing milking tasks, the milker may frequently not be aware of the fact that he is concentrating hard while working.

Almost half the respondents found that postures and movements when working in the milking parlour were not physically strenuous, another further 30 % found them hardly so. The proportion of farmers who agreed for the most part and extremely with the statement “I find the postures and movements physically strenuous” was under 10 %. This is consistent with the statements on the most strenuous activities in dairy farming, where milking was also cited by under 10 % of respondents in ranks 1 to 3.

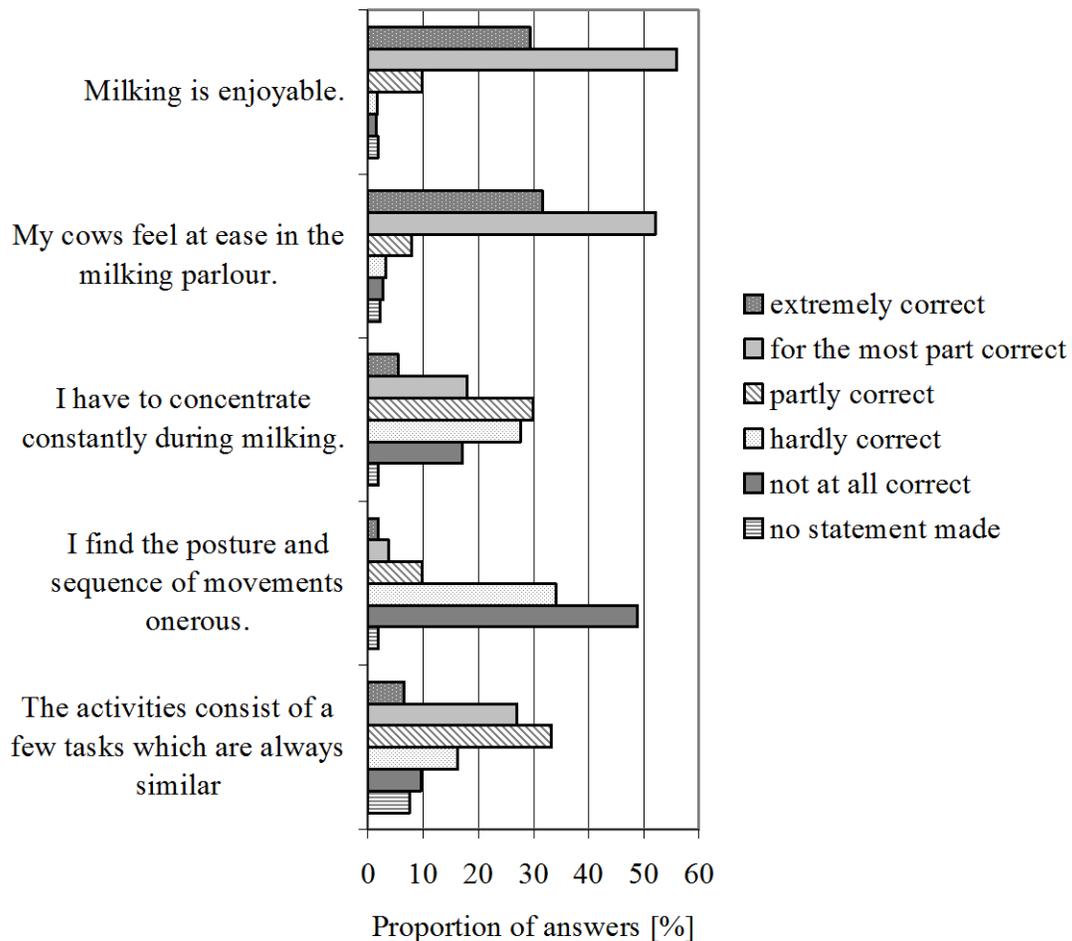


Figure 5. Assessment of statements on workplace comfort in the milking parlour.

**CONCLUSION** Two thirds of the dairy farmers questioned suffered regularly from disorders of the musculoskeletal system. Although the causes could not be identified on the basis of this survey, the farmers cited activities during which symptoms or pains occurred. This indicates that, despite technical progress and increasing automation on the farm, farmers are still exposed to physical strain at work, which it is essential to reduce. Feed distribution, cubicle maintenance and mucking out in particular are perceived by farmers as very strenuous, as well as dealing with and tending the animals. In this regard studies should be conducted on workplace design, and optimisation strategies formulated.

Although milking in the milking parlour was identified in various scientific studies as an physically strenuous activity, particularly for the upper extremities, it was not perceived as such by the majority of respondents. However, respondents who regularly suffered from disorders of the MSS stated that these occurred in the area of the upper extremities, particularly when milking. In view of growing herd sizes it can be assumed that the occupational health aspects of milking will in future gain importance on family farms as well. Milking parlour design can reduce basic physically strenuous tasks such as transporting milk churns or attaching milking clusters. The impact of milking parlour design on the posture of milkers is being studied in a current project at Agroscope Tänikon Research Station.

## REFERENCES

- Federal Office of Agriculture (FOAG). 2003. Agricultural Report, Bern.
- Hagberg, M.; B.A. Silverstein, R. Wells, M.J. Smith, H.W. Hendrick, P. Carayon and M. Pérusse. 1997. Work related musculoskeletal disorders (WMSDs): A reference book for prevention. London, United Kingdom: Taylor & Francis.
- Hoehne-Hückstädt, U., C. Herda, R. Ellegast, I. Hermanns, R. Hamburger und D. Ditchen. 2007. Muskel-Skelett-Erkrankungen der oberen Extremitäten. Entwicklung eines Systems zur Erfassung und arbeitswirtschaftlichen Bewertung von komplexen Bewegungen der oberen Extremitäten bei beruflichen Tätigkeiten, BGIA - Report 2/2007.
- Kuorinka, I., B. Jonsson, Å. Kilbom, H. Vinterberg, F. Biering-Sørensen, G. Andersson, and K. Jørgensen. 1987. Standardised Nordic Questionnaire for the analysis of musculoskeletal symptoms. *Applied Ergonomics* 18 (3): 233-237.
- Lundqvist P., M. Stål and S. Pinzke. 1997. Ergonomics of Cow Milking in Sweden. *Journal of Agromedicine* 4: 169-176.
- Pinzke S., 1999. Towards the Good Work. Methods for Studying Working Postures to Prevent Musculoskeletal Disorders with Farming as Reference Work. Doctoral Thesis, Swedish University of Agricultural Sciences, *Agraria 155*, Alnarp, Sweden.
- Pinzke S., 2003. Changes in working conditions and health among dairy farmers in southern Sweden. A 14-year follow-up. *Ann Agric Environ Med* (10): 185-195.
- Stål, M., 1999: Upper Extremity Musculoskeletal Disorders in Female Machine Milkers. An epidemiological, clinical and ergonomic study. Dissertation Lund University, Sweden.