The Back Pains of Pet Grooming
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Pet grooming is a task that involves risk of developing musculoskeletal disorders as it involves physical activities that expose pet groomers to several awkward postures, forceful exertions, and repetitive motions. An initial investigation through Nordic Musculoskeletal Questionnaire (NMQ) suggests that majority of those engaged in this job experience MSDCs in the lower back. The study aims to develop a causal model of lower back MSDC taking into consideration tasks, tools and workplace related factors and determine those that are significant in predicting the likelihood of experiencing MSDC through logistic regression (LR). Causes of MSDC were identified through review of related literature as well as interview and observation of pet grooming tasks. A model that explains the causes of MSDC was proposed in order to determine factors that will be included in the predictive model of MSDC occurrence. Based on the causation model, the following variables were included in the LR model: (1) number of dogs groomed, (2) percentage of ill tempered dogs, (3) percentage of long hair dogs groomed, (4,5) back twisted during blow drying and cutting, as well as (6) deviation from sink bottom to reach (7) working with back bent at least 30 deg during blow drying (8) deviation of elbow height to table height (9) percentage of large breed dogs. The LR model depicted several variables that significantly contribute to MSDC experience by pet groomers. Results indicate that the following variables namely, (1) number of dogs groomed, (2) percentage of ill tempered dogs, (3) percentage of long hair dogs groomed, (4,5) back twisted during blow drying and cutting, as well as (6) deviation from sink bottom to reach significantly contribute to MSDC in the lower back. The model was assessed for goodness-of-fit tests and was found to be adequate.

Practitioner Summary: Pet grooming is a physically demanding task. Principles of ergonomics may be used to design workstations that alleviate the poor working conditions of people involved in this growing industry in the Philippines. This paper presents how significant factors in MSDC incidence may be identified so that designers can focus on them when designing pet groomer's workstation.

Keywords: Pet Groomers; Work Related Musculoskeletal Discomfort (MSDC); Logistic Regression; Lower back MSDC

1. Introduction
The increasing prevalence of work related musculoskeletal disorders amongst workers in different industries has been a cause for major concern, such that consideration for the health and well being of laborers is taken as an important issue in the field of ergonomics. Musculoskeletal discomfort (MSDC) is an antecedent to clinically defined health events associated with the risk of musculoskeletal disorders (Dul, Douwes, & Smitt, 1994; Jacewicz, 2006; Punnet & Wegman, 2004). MSDC, as defined by Scuffham et al. (2010) pertains to “musculoskeletal aches and pain trouble, specifically, aches, pain, discomfort or numbness affecting an identified body site”.

Pet grooming is a task where there is a risk of developing musculoskeletal disorders as it involves different physical activities that exposes pet groomers to several risk factors. A pet groomer can be defined as “a person in business or employed to attend to the grooming health, hygiene and grooming needs of pet owners’ pet animals” (Richard & Neely, 2010). Ergonomic risk factors that pet groomers experience include awkward postures such as reaching, lifting, bending as well as forceful exertions, and repetitive motions. An initial investigation using the Nordic Musculoskeletal Questionnaire revealed that majority pet groomers (n=30) experience MSDC in the lower back.

To the knowledge of the proponents, MSDC incidence in the pet grooming industry had not been thoroughly studied despite the presence of ergonomic risk factors on the job. The incidence of MSDC in hairdressing which may be considered to some tasks in pet grooming had been investigated by Wahlstrom et al. (2010) and Mussi and Gouveia (2008), however, despite the similarities between the two professions,
there are distinct characteristics in terms on the nature of the task, techniques, scope of work, workstation design and tool usage in pet grooming which may influence the discomfort experienced.

As such, the current study aims to understand the causes of MSDC in relation to lower back and determine which of these factors significantly predict occurrence.

2. Method

2.1 Causal model

In order to identify variables that may be included in a predictive model of MSDC occurrence in the lower back, a causal model was constructed to better understand the nature of causes. There is sufficient evidence from literature that exposure to ergonomic risks factors including repetitive motion patterns, forceful exertions, non-neutral body postures and vibration causes musculoskeletal disorders in one or more body regions. As such, the different tasks accomplished by pet groomers along with the tools and workstations utilized are examined in relation to exposure to ergonomic risk factors. The root causes were analyzed based on interviews with pet groomers, observations and findings from literature.

2.2 Logistic regression

Several independent variables were considered as predictors of MSDC based on the causal model developed. A survey was done to determine the occurrence of MSDC of pet groomers. The survey also included current working conditions including tools, techniques, postures and characteristics of dogs groomed. Data gathered were utilized to build a logistic regression model that will identify significant variables that influence the likelihood of MSDC.

The questionnaire developed included demographic questions, personal information including anthropometric measurements, work type and duration, posture and movement during work activities, relevant measurements of equipment and tools utilized. Work type and duration included determining the number of dogs groomed during peak and non peak days, taking into consideration which days the pet groomers consider peak. In addition to this, pet groomers were asked to estimate the type of work in reference to percentage of large breed, ill tempered, long hair, and shaved dogs which was adapted from the work of Scuffman et al. (2010), contextualizing it to the pet grooming industry.

The interviewer also gathered relevant information with regards to workstation, tools and equipment utilized. For the workstations, dimensions including height (table; sink) and depth (sink) were measured. In addition to this, individual factors specifically, elbow height and hand length, were also taken. These were obtained with the objective of assessing working height, which is an important consideration in workstation design (Lehto & Buck, 2008). For tools, measurements taken include grip span (open and closed), handle diameter, handle length, type of scissor grip and cushion. These measurements, using inches as the unit of measure, were obtained with the objective of determining whether tools conform to acceptable tool standards and guidelines as per literature (Radwin R. G., 1998).

The pet groomer assessed work activities using a Likert scale (1-Never; 5-Always). These were segregated as to specific grooming tasks, listing possible postures and techniques adapted in reference to the lower back during specific tasks. To assess lifting technique, the pet groomer was tasked to demonstrate the way he lifts an animal, assessing whether he bends his knees to lower his body and lifts with his knees or merely relies on his lower back to lift the animal. Assessment of work activities using a Likert scale was based on the work of Scuffman et. al (2010).

In this study, the dependent variable is the occurrence of MSDC, which is a binary variable. The value of the variable is 1 if the pet groomer experienced an MSDC at the back and 0 otherwise. Logistic regression was used because it is the type of regression that is appropriate for the dependent variable selected which is the incidence of MSDC. The specific form of the logistic regression model is

\[
\pi(x) = \frac{e^{\beta_0 + \beta_1x}}{1 + e^{\beta_0 + \beta_1x}}
\]

Pet groomers assessed for MSDC in the lower back experienced enough discomfort as to prevent them from doing normal work (1) versus not experiencing such MSDC (0). The regression model predicts the likelihood that the pet groomer will experience MSDC given certain characteristics including techniques.
utilized in the tasks, tool quality and usage, workstation dimensions and pet related attributes, which were derived from the causal model.

The data set used in this study was derived from a sample of 144 persons from different pet grooming facilities. Respondents of the survey were chosen based on the following criteria:

1. At least one year of job experience in order to assure credibility and accuracy in responses.
2. Should work full time to reduce the influence of job related discomfort not caused or related to pet grooming.

3.0 Results

3.1 Causal model

The model divided the major causes of MSDC of the back into three major factors that are known to contribute to MSDC such as exposure, lifting, and awkward posture (Lanfranch & Duveau, 2008; Colombini, Occhipinti, Delleman, Fallentin, Kilbom, & Grieco, 2001; Buckle & Devereux, 2002).

Frequency and duration of the task contribute to incidence of MSDC. The number of dogs being groomed varies between pet grooming facilities between peak and non-peak days. The larger the quantity of dogs being groomed, the more likely the pet groomer would experience discomfort in different areas as exposure to ergonomic risk factors. On the other hand, duration of the task may be affected by the type of dog being groomed which is also affected the physical and behavioral condition of the dog. The physical aspects include the size of the animal, the length of hair and type of cut desired. Shaving task entails lesser time and effort for the pet groomer in comparison to cutting/shaping the animal’s coat. The length of hair also affects duration, as it would take longer length of time to blow dry a dog with longer tresses. Furthermore, the size of the animal also affects duration of grooming with the size of the dog. Large sized dogs with long hair take more time to groom. In terms behavior, a dog who is ill tempered may also affect the duration of the task as more effort and time is required to control the movement of the animal.

Aside from exposure, MSDC of the lower back discomfort experienced by pet groomers may also be attributed to lifting of animals to different workstations, specifically bathing and grooming workstations. In these stations, pet groomers manually lift animals. Such effort resulted to an average back compression force of 528.74 pounds from analysis done through 2-D Biomechanical Prediction software. Although this is lower than the allowable limit of 770 pounds the size and temperament of the animal contributes to the difficulty of lifting to different workstations.

Pet groomers were also observed to bend their back instead of lowering their legs in order to lift the animal to the workstations. They also reach for the animal especially when the dog is not leashed. Ill-tempered dogs may also contribute to the difficulty of pet groomer to properly lift the animal as greater effort is exerted in controlling the dog during lifting. Moreover, when the dog is unruly, the pet groomer may not be able to adequately position his hands and force him to reach for the animal or put more pressure in his back.

Several awkward postures were found to contribute to MSDC of pet groomers. Workstation dimensions in relation to the size of the animal being groomed and pet groomer’s anthropometric measures are crucial determinants of posture. Specifically, elbow height and hand length in relation to workstation dimension may result to awkward postures especially in bending forward.

Figure 1 shows the causal model developed for MSDC of the lower back. Final causes identified from this cause diagram were incorporated in the logistic regression model developed.
3.2 Logistic regression

3.2.1 Variables and measurements

In this study the dependent variable is the occurrence of MSDC, which is a binary variable. The value of the variable is 1 if the participant surveyed experienced MSDC of the back and 0 otherwise. Several independent variables were considered as predictors of MSDC as enumerated in Table 1. The values of these variables were obtained from a survey conducted among pet groomers. The participant estimated the number and percentages while postures assumed were rated using a Likert scale. The proponents measured deviations of body parts to workstation in inches.

Ages of respondents vary from age of 17 to 39 with an average of 25.94±5.59. Years of experience, on the other hand, ranges from a single year to 12 years (average of 4.20±2.09) working in the grooming profession which is indicative of the relatively new and growing pet grooming industry in the Philippines. Eighty one percent (81%) are male as it is a relatively male-dominated industry. Some of the variables from Figure 1 were removed from the model due to significant correlations between factors.
### Independent variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Code</th>
<th>Variable setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of dogs groomed</td>
<td>Weighted average number of dogs groomed on peak and non-peak day</td>
<td>#DG</td>
<td>Number</td>
</tr>
<tr>
<td>Percent large breed</td>
<td>Number of large breed dogs groomed</td>
<td>%LB</td>
<td>Percentage</td>
</tr>
<tr>
<td>Percent ill tempered</td>
<td>Number of ill-tempered dogs groomed</td>
<td>%ITD</td>
<td>Percentage</td>
</tr>
<tr>
<td>Percent long hair</td>
<td>Number of long hair dogs groomed</td>
<td>%LHD</td>
<td>Percentage</td>
</tr>
<tr>
<td>Back bent at least 30 deg blowdry</td>
<td>Frequency that back is bent at least 30 deg during blow drying</td>
<td>BBBD</td>
<td>1- never up to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-always</td>
</tr>
<tr>
<td>Back twisted/bent sideways blowdry</td>
<td>Frequency that back is twisted/bent sideways during blow drying</td>
<td>BTBD</td>
<td>1- never up to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-always</td>
</tr>
<tr>
<td>Back twisted/bent sideways cutting</td>
<td>Frequency that back is twisted/bent sideways during cutting</td>
<td>BTC</td>
<td>1- never up to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-always</td>
</tr>
<tr>
<td>Deviation of reach to sink bottom</td>
<td>Deviation from effective reach to sink bottom</td>
<td>DEVERSB</td>
<td>inches</td>
</tr>
<tr>
<td>Deviation of elbow ht to table ht</td>
<td>Deviation from elbow height to table height</td>
<td>DEVEHTH</td>
<td>inches</td>
</tr>
</tbody>
</table>

#### 3.2.2 Logit Model

Eight variables were found to be significant to the likelihood of experiencing MSDC by pet groomers in the lower back area region.

\[
g(x) = \exp(x) = -6.4159 \#DG + 25.4565 \%LHD + 6.8489 BTBD - 5.8234 BTC + 0.3312 DEVERSB + 2.0469 \#DG BTC - 11.3309 (\%LHD)(BTBD)
\]

As such, the logit model for MSDC experienced by pet groomers in the lower back area with variables found to be significant is as follows:

\[
g(x) = \frac{e^{\exp(x)}}{1 + e^{\exp(x)}}
\]

\[
\pi(x) = \frac{-6.4159 (\#DG) + 25.4565 (\%LHD) + 6.8489 (BTBD) - 5.8234 (BTC) + 0.3312 (DEVERSB)}{1 + e^{\exp(x)}}
\]

\[
= \frac{-6.4159 (\#DG) + 25.4565 (\%LHD) + 6.8489 (BTBD) - 5.8234 (BTC) + 0.3312 (DEVERSB) + 2.0469 (\#DG) (BTC) - 11.3309 (\%LHD)(BTBD)}{1 + e^{\exp(x)}}
\]
4. Discussion

Back forward bending at the bathing workstation, which is the result of the deviation of effective reach to sink bottom, was found to significantly contribute to MSDC in the lower back area. The larger the deviation between the pet groomers effective reach as well the sink bottom, the greater the angle by which pet groomers bend. An increasing trend can be observed where a larger deviation (forward bending during bathing task) increases the likelihood of experiencing MSDC in the lower back. The regression coefficient of deviation of effective reach to sink is positive therefore increasing odds ratio and the likelihood of lower back MSDC as can be seen in Figure 2. Literature supports the significance of this variable where there is positive association between awkward postures of the back, specifically, forward bending, with work related musculoskeletal disorders (Bernard, 1997). The body’s center of gravity is located anterior to the second sacral vertebra; however, when the trunk is inclined forward, the location of the new center of gravity lies outside the body, adding stress to the muscles of the body to counteract forces to maintain its balance (Norkin & Levangie, 1992). This added stress to the muscles of the lower back area results to MSDC.

![Odds Ratio (Deviation of effective reach to sink bottom-MSDC Lower back)](image)

Awkward posture specifically, back bending during cutting task with interaction effect with number of dogs groomed were found to be significant factors that contribute to lower back MSDC. As such, analysis entails taking into consideration both individual as well as interaction effects of the variables. It can be seen from Figure 3 that more frequent back twisting during cutting task, the higher the probability of experiencing MSDC based on the increasing odds ratio. Pet groomers may opt to bent/twist their back during cutting in order to reach certain areas of dog without shifting their position. Bernard (1997) asserted that there is evidence that work related awkward postures are associated with lower back disorders; as manifested by MSDC in the earlier stages. The lower back, in particular the lumbar area of the vertebrae column, is highly movable and source of major movement, where muscles take the stress/brunt of force during bending/twisting. The body’s objective is to always maintain the line of gravity and counteract the forces that displace such. During awkward postures, muscles in the lower back area work to counteract the forces, allowing one to avoid falling or be out balance. As such, this additional and repeated stress to the muscles of the lower body leads to MSDC in the lower back area.
Uncontrollable variable, percentage of long hair dogs groomed along with the rate by which back is twisted/bent sideways during blow drying were found to significantly contribute to MSDC of the lower back. An increasing trend in odds ratio can be observed as back twisted during grooming increases with high percentage of long hair dogs groomed indicating that when majority of the pet groomers’ clientele are of long hair dogs, the likelihood of experiencing lower back MSDC becomes greater. According to Bernard (1997), there is evidence that work related awkward postures are associated with lower back disorders and MSDC. This can be attributable to longer time spent in grooming long hair dogs in comparison to short hair breeds where it negates the effect of back twisting during blow-drying task. The duration it takes to blow-drying the animal’s coat is also greater. It should be noted that most of the clientele of grooming facilities are long hair dogs both of small breed (ex. Shih Tzu, Pomeranian, Poodles) and large breed sizes (ex. Chow-chow), as pet owners may not have the skill nor the time to groom their dogs.

5. Conclusion
The existence of several ergonomic risk factors including, repetition and awkward posture, were identified in several grooming tasks which contribute to MSDC experienced. A causal model was generated depicting probable factors that can contribute to pet groomer MSDC of the lower back. This includes specific features of the workstation, including deviation of working height, techniques utilized, tool design and usage, as well as dog related factors such as the number of dogs groomed, long hair dogs, size and even temperament. Logistic regression provided meaningful interpretations with regards to MSDC experienced.

Workstations of pet groomers need to consider the body dimensions of the users and the convenience of the majority of the population. Ergonomics researchers can design workstations with dimensions taken from anthropometric data of Filipinos. The effect of uncontrollable variables in the model can be minimized by allowing groomers to rest before succeeding grooming tasks or rotating the tasks so that exposure will be limited.

6. References