

Dynamic Space Requirements of Lame and Non-lame Sows as they Lie and Stand

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Summary and Implications

Therefore, the objective of this study was to calculate the dynamic space requirements to lie down and stand up of lame and non-lame sows using two separate measurement methods. Eighty-five multiparous sows were moved from their home stall to a testing pen where they were video recorded for one lying-standing sequence at 30, 60, and 90 days of gestation. The digital video camera was affixed onto the ceiling immediately above the testing pen and the sow was filmed until she laid down and stood up one time, or if 2.5 hours elapsed from the start of recording. Sows were lameness scored using a 3-point scale on the same gestation days. Multiple images were extracted from the video and combined into a single image. Images were measured by two different procedures, i) by counting the number of pixels on the contour of the sows' body and ii) by overlaying a grid on the image of the sow. On average, sows used $1.16 \pm 0.4 \text{ m}^2$ to lie down and to stand up. There were no differences observed between lameness scores or measurement method in the dynamic space required to lie down or stand. In conclusion, under the conditions of this study, lameness did not affect the dynamic space needed to lie-down and stand-up.

Introduction

An animal's dynamic space requirement is a summation of its static space- and animal movement space requirements. Studies using a sow model have attempted to calculate the dynamic space required to lie-down and stand up. However, the authors were unable to derive minimum dynamic space requirements due to (1) large space variation during the rising up and lying-down movements and (2) the technology available 30 years ago. Knowing a sows' dynamic space requirement is critical because gestation housing is moving away from stalls to groups. This information will provide needed data to assist producers

when building new- or retrofitting existing facilities. To compound this housing shift, there has been rapid genetic improvements within the U.S. swine industry and the modern sow is longer, and taller. Therefore, the objective of this study was to calculate lame and non-lame sows dynamic space requirements.

Materials and Methods

The protocol for this work was approved by the ISU-IACUC committee. This work was conducted between August 2015 to June 2016.

Animals and Housing: Eighty-five multiparous crossbred and Yorkshire sows (parity range 1 to 4), were moved from their home stall (2.38 x 0.69 meters) into a testing pen (2.17 x 2.42 meters) for video recording on 30, 60 and 90 days of gestation.

Walking Lameness Scoring: Sows were lameness scored when moving from her home stall to the testing pen using a 3-point scale (Table 1).

Video Equipment: A video camera (GoPro Hero, GoPro Inc., San Mateo, CA, USA) was fixed to the ceiling directly above the sow in one of two testing pens at 2.9 or 2.2 meters to capture a dorsal view. Difference in camera height was accounted for using pixels. The sow was filmed continuously (30 frames per second) until she laid down and stood up one time, or an elapsed time of 2.5 hours.

Video Methodology: From the video, still frames of sows moving through the lying and standing process were identified and these video clips were cut out using AVcutty v3 (Andreas von Damaros, Krefeld, Germany). Still frames were layered in Adobe Photoshop Elements 14 and were measured using two methods; i) the sow was outlined or ii) a grid was superimposed on the image and squares that were at least half covered by the sow were counted. In both methods, the number of pixels were compared to the standard measurement of a clipboard measuring 0.072 m^2 (1796 pixels), using the following equations:

$$\left(\frac{\text{Sow pixels}}{\text{Clip board pixels}} \right) \times 0.072 \text{ m}^2$$

for the outline method and

$$\left(\left(\frac{\text{Square pixels}}{\text{Clipboard pixels}} \right) \times 0.072 \text{ m}^2 \right) \times \text{counted squares}$$

for the grid method.

Statistical Analysis: Data were analyzed using mixed model equations in SAS. Models included; walking lameness score (1, and ≥ 2), measurement method (outline vs. grid) and gestation day (30, 60 and 90 days). Significance levels were set at $P \leq 0.05$, and tendencies were noted at $P \leq 0.10$. Each sow was considered the experimental unit.

Results and Discussion

The average dynamic sow space requirement calculated using both methods, regardless of lameness status was $1.16 \pm 0.4 \text{ m}^2$ to lie down and to stand up.

Walking lameness score: There were no observed differences in the dynamic space required to perform the lying-down or standing-up sequence between lame and non-lame sows ($P \geq 0.05$) table 2.

Measurement methods: There were no observed differences in the dynamic space required to perform the lying-down or standing-up sequence between the two measuring methods (outline vs. grid; $P \geq 0.05$) table 3.

Gestation day: There were no observed differences in the dynamic space used to rise up between sows at 30 and 60 days of gestation. However, sows at 90 days gestation took more space to rise up than both 30 and 60 day animals ($P < 0.05$) table 4. In regards to lying down, sows at 30 days gestation were not different in their dynamic space used

than 60 day sows, but used a smaller dynamic space envelope than 90 day sows. Sows at 60 days gestation did not differ in the space they used from sows at either 30 or 90 days gestation table 4.

The dynamic space requirements found in this study are smaller than those reported elsewhere (1.90 m^2). Differences might be due to calculation methods (i.e. allometric equations based on metabolic BW were previously used), sow breed and measuring time (i.e. gestation stage or post-partum period). Under the conditions of this study, lameness did not affect the dynamic space needed to lie-down and stand-up. However, lameness observed was mild and only one sow received a severe lameness score. Nonetheless, results from this study are a useful resource for stakeholders involved in decisions regarding new policies and/or decisions regarding the dynamic space needs for gestation sow housing in the U.S.

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Table 1. Walking lameness scoring system

Score	Description	Definition
1	Normal	Sow moves with unaltered gait on all limbs
2	Moderately lame	General stiffness, altered gait on affected limb(s)
3	Severely lame	Non-weight bearing on affected limb

Table adapted from Calderon Diaz et. al 2015

Table 2. Effect of lameness on space to rise-up and lie down (meters²)

Lameness	Rise-up	Lie down
Sound	1.22 ^a	1.17 ^a
Lame	1.23 ^a	1.16 ^a

^{a, b} signifies differences within column at $P < 0.05$

Table 3. Effect of Measurement Method (meters²)

Method	Lying-down	Standing-up
Contour	1.19 ^a	1.25 ^a
Grid	1.14 ^a	1.21 ^a

^{a, b} signifies differences within column at $P < 0.05$

Table 4. Effect of Gestation Day on space to rise-up and lie down (meters²)

Gestation Day	Rise-up	Lie down
30	1.18 ^a	1.09 ^a
60	1.19 ^a	1.17 ^{a, b}
90	1.32 ^b	1.23 ^b

^{a, b} signifies differences within column at $P < 0.05$