

The Welfare of Sows in Gestation Crates: A Summary of the Scientific Evidence

Introduction

The intensification of livestock farming has led to an increase in stocking densities and less space per animal (Marchant & Broom, 1996), which has led to the development of intensive confinement housing systems for farm animals (Marchant & Broom, 1996). Breeding sows in the US are typically kept in gestation stalls (also known as sow stalls or gestation crates) for most of their productive lives, typically three to five years (Rollin, 1995, p.76). Just before parturition (i.e. giving birth), the sow is moved into a farrowing crate, where she spends about a month (until her piglets are weaned), and then she is re-impregnated and returned to the gestation crate (Rollin, 1995, p.91). This type of housing system was developed to allow for economically efficient pork production, requiring less labor and feed than other housing arrangements (Rollin, 1995, p.76).

The sow stall is intended to allow the animal only enough movement necessary to stand up and lie down (Baxter & Schwaller, 1983). The recommended size is 9.2 to 14 square feet, or approximately 2x7 feet and 3.3 feet high, dimensions which do not permit the sow to turn around (National Pork Producer's Council). This is a welfare issue that has attracted much concern (Baxter & Schwaller, 1983).

Scientific evidence suggests that intensive confinement causes both physical and psychological disorders in sows.

Physical Disorders

Pigs, like other animals, need to exercise and use their muscles in order to remain physically healthy. Among the physical problems which result when breeding sows are confined in gestation crates are: joint damage, leg weakness, impaired mobility, and urinary tract infections.

Joint Damage

Fredeen and Sather (1978) found that the degree of joint damage in pigs was directly related to the duration of confinement. In addition, damage was greater in pigs confined individually compared to group-housed pigs. The researchers hypothesized that this difference was associated with the difference in degree of activity and exercise in the two populations since the pigs housed in groups were generally more active than individually-housed pigs (Fredeen & Sather, 1978). Petersen et al. (1998) found that activity in large

pens resulted in less thickening in the joint cartilage than in confined animals, indicating healthier joints in non-confined pigs.

Leg Weakness

There is much evidence showing that confined sows are prone to leg weakness due to a lack of exercise. In a study by Marchant and Broom (1996), stall-housed sows had shorter bodies than group-housed sows, indicating that the stall-housed sows' lack of exercise hindered growth and development of their muscle and bone. This is consistent with the research of Petersen et al. (1998) who found that pigs reared in large pens had an increased total bone mass, most significantly for the leg, compared to that of confined pigs.

Petersen et al. (1998) showed that locomotion problems were significantly less in pigs allowed spontaneous activity (afforded by a group-housing situation) than in confined pigs. Confined pigs who were exercised on a treadmill for a set time each day also had lower total bone mass than did pigs reared in large pens. This indicated that pigs reared in large pens performed activity patterns that resulted in improved skeletal development and health over pigs in more restricted conditions (Petersen et al., 1998). This is consistent with a finding of a 1976 study by McPhee and Laws of boars kept temporarily in small individual pens on concrete floors at a performance testing station. In this study, leg faults increased during testing, and virtually all weak-legged boars recovered on return to less confining conditions (McPhee & Laws, 1976). This shows "the rigors imposed by the confined housing conditions of the station in contrast to the less restricted farm environment" (McPhee & Laws, 1976). According to the European Commission's Scientific Veterinary Committee, the leg bones of stall-housed sows are two-thirds the strength of those of sows housed in groups (Stevenson, 1999).

The hard flooring in sow stalls is another condition thought to cause the development of leg weakness in pigs (McPhee et al., 1976). Marchant and Broom (1996) mentioned flooring as a possible contributing factor affecting the stall-housed sow's difficulty to stand up and lie down. In particular, they point to the possibility of a sow slipping when attempting to lie down on the bare concrete floor of a gestation stall as compared to lying down on straw.

Impaired mobility

Marchant and Broom (1996) found that sows housed long-term in stalls took significantly more time to lie down than group-housed sows, indicating that stall-housed sows experience difficulty of movement when standing up and lying down.

According to the European Commission's Scientific Veterinary Committee, the lack of exercise in stalls leads to a reduction in muscle mass which affects the

sow's ability to lie down (Stevenson, 1999). Marchant and Broom (1996) noted lack of exercise as a possible contributing factor affecting the difficulty to stand up and lie down in stall-housed sows. In their study, stall-housed sows had smaller locomotor muscles in proportion to total body weight than did group-housed sows. Sows with lower muscle weights may have less muscular control over their lying down movements (Marchant & Broom, 1996).

Grondalen (1974) found that exercised pigs developed an "easier action" than unexercised pigs. When exercised pigs slipped, they were usually able to transfer weight to other legs and resist falling, whereas unexercised animals usually slipped further and fell down (Grondalen, 1974).

Urinary Tract Infections

A French study by Madec showed that confined sows have increased levels of urinary tract infections. This is due to the accumulation of bacteria from less frequent urination than unconfined animals (probably because confined sows are less active and drink less than unconfined sows). Further, it is thought that confined sows are more susceptible to infections of the urinary tract because they often have no other choice but to lie or sit in their feces (O'Brien, 1997). Broom, Mendl, and Zanella's (1995) study of three housing systems also provided evidence suggesting that stall-housed sows are particularly susceptible to urino-genital infections.

Psychological Problems

A study of pigs outdoors in a natural environment shows the importance of a complex environment and relationships with other animals in the life of a pig. Much of their time was spent rooting, or exploring the soil with their noses (Rollin, 1995, p.74). Pigs are social animals who normally live in groups (Van Putten, 1988). Pigs studied in a natural environment cooperatively built a series of communal nests, and they formed complex social bonds.

When confined to a very small area, pigs are essentially deprived of nearly all possibilities of expressing themselves (Van Putten, 1988). The range of behavioral possibilities is "very limited" in confinement (Stolba et al., 1983). According to Kilgour and Dalton (1984), since pigs are "easily bored," housing should provide for their "inquisitive nature" to prevent "most vices which are the result of boredom." Sow stalls do the opposite, imposing monotony on the animals. Stall-housed pigs are generally prevented from performing many behaviors that pigs perform in less restricted environments, such as rooting (Broom, Mendl, & Zanella, 1995).

The lack of environmental stimulation in the stall environment and the sows' inability to perform normal behaviors leads to psychological disorders

including: chronic stress, depression and frustration, aggression, and abnormal and neurotic coping behaviors called stereotypies.

Chronic Stress

Neurophysiological indicators of chronic stress have been found in sows housed in stalls. For example, sows in stalls were found to have elevated levels of the hormone cortisol compared to those who were group-housed (Barnett et al., 1991). Bergeron et al. (1996) observed that pigs housed in bigger stalls that allowed them to turn around utilized the greater freedom of movement by turning frequently (an average of 75 times per day). Housing pigs in these "turn-around" stalls reduced their **cortisol level (Bergeron et al., 1996)**.

Depression and Frustration

Pigs are intelligent animals who have actually "told" us what their preferences are. A study by Spinka et al. (1998) showed that pregnant pigs preferred short-term confinement crates over long-term confinement crates. Further, the animals learned to associate external cues with two different periods of confinement, and were able to anticipate the long-term consequences of their choices (Spinka et al., 1998).

It has been suggested that sows housed in stalls with no hope of escape may develop an emotional state similar to depression (Mendl, Zanella, & Broom, 1992). In a study by Stolba et al. (1983), a major problem for stall-housed sows appeared to be the maintenance of a satisfying level of arousal. It can be concluded that stall-housed sows encounter frustrating situations more often than those housed in groups, possibly due to their inability to satisfy motivation to move, forage and express other behaviors (Broom et al., 1995).

In an observational study of sows housed in different systems (but under the same diet and stockmanship), it was evidenced that stall-housed sows found the conditions "more difficult" than those housed in groups (Broom, Mendl, & Zanella, 1995). Sows in small groups with individual feeders spent more time rooting or chewing at straw or at the floor than did stall-housed sows. It was suggested that the stall-housed sows encountered frustrating situations more often than those housed in groups- frustration likely caused by the sows' inability to move and express other behaviors. The sows' intense frustration often results in abnormal and neurotic coping behaviors which are discussed further below.

Aggression

Stall housing prevents socialization with other animals. Barnett, Hemsworth, and Winfield (1987) showed that individual housing affected pigs' level of motivation to interact socially. Pigs in cage stalls showed behavioral responses

to other female pigs at a higher level than did pigs housed in groups (Barnett, Hemsworth, and Winfield, 1987).

Another result of stress specifically applicable to the stall-housed sows was the high levels of hostile behavior (e.g., biting through bars) and aggression seen in sows housed in stalls- interaction that sows are unable to resolve (Broom, Mendl, & Zanella, 1995).

Abnormal and Neurotic Behaviors (including Stereotypies)

Striking evidence of welfare problems in stall-housed sows is the fact that animals in this housing system perform more stereotypic or abnormal behavior than those in other systems. Stereotypic behavior has been viewed as abnormal because it does not occur in the range of situations that could normally be encountered in nature (Stolba et al., 1983). According to Stolba et al. (1983), "the available evidence on stereotypies in higher mammals shows beyond doubt, that these patterns are sure signs of severely disturbed welfare." According to work by Mason; Broom and Johnson, a "considerable body of evidence" suggests that stereotypies often develop in situations where the animal is frustrated because its needs cannot be fulfilled (Broom et al., 1995). Thus many researchers believe that since stereotypies are more obvious in confinement, confinement housing systems cause poor welfare (Vieuille-Thomas et al., 1995). Stereotypies can be also viewed as a "normal" response to an abnormal environment which lacks adequate space and stimulation (Vieuille-Thomas et al., 1995).

Causal explanations for this type of stereotypic or abnormal behavior have included boredom resulting from lack of environmental stimulation (Terlouw, Larence, & Illius, 1991). Maier, Duncan & Wood-Gush have shown that stereotypies occur when animals are confronted with unsolvable or nearly unsolvable problems or with situations having unpredictable outcomes (Stolba et al., 1983). Fraser, Stolba et al., and Terlouw et al. have found stereotypies in sows to include vacuum chewing (chewing nothing), head waving, chewing of bars, licking, and chewing or nosing of objects (Vieuille-Thomas et al., 1995). Cronin has suggested that these repetitive actions promote the production of endorphins (Van Putten, 1988), chemicals that comfort the animal. Thus, as Cronin and Wiepkema stated, an animal unable to cope with its environment may drug itself via the performance of continued stereotyped behavior for a long period of time (Van Putten, 1989). Stereotypies observed by Stolba et al. (1983) likely originated in thwarted explorative behavior in the stall environment.

In a study of the effects of four housing treatments on the behavior of pregnant pigs, pigs in stalls showed greater amounts of oral-nasal behaviors (i.e., manipulation of drinkers and licking or biting pen components) compared to other housing treatments (Barnett et al., 1985). These behaviors were observed

an average of at least 46% more often than in other housing systems (Barnett et al., 1985). Mendl, Zanella, and Broom (1992) found that stall-housed sows spent 8.2% of observed time sham (vacuum) chewing, compared to 0% of sows housed in a group with an electronic feeder and 0.68% of sows grouped with individual feeders.

Vieuille-Thomas et al. (1995) found that a smaller proportion of group-housed sows presented stereotypies than did stall-housed females. Sows in stalls bit bar and trough substrates and showed tongue movements and chewing (Vieuille-Thomas et al., 1995). Mendl, Broom, and Zanella (1993) observed pigs kept in stalls, group-housed pigs with individual feeders, and those with an electronic sow feeder system. They found that during the first pregnancy, sows housed in groups spent less time performing stereotypic sham chewing and bar biting behavior than did stall-housed sows. At the fourth pregnancy, stall-housed sows showed "substantially higher" levels of activity and stereotypic behavior, indicating that prolonged confinement has a cumulative negative effect on pigs (Mendl, Broom, & Zanella, 1993).

A study by Broom, Mendl, and Zanella (1995) compared three housing systems--housing in small groups with individual feeders, housing in larger groups with an electronic sow feeder, and the stall system. Of all housing systems, sows in stalls spent the most time sham (vacuum) chewing and performing maintenance behavior, such as drinking and drinker related behavior, much of which was repetitive. Stall-housed sows also performed the most bar-biting of sows in the three systems, and spent the most time trough biting overall. The duration of stereotypies increased substantially with time spent in the stalls between the first and fourth parity-- a change that was much less pronounced in the group-housed animals. Since the stall-housed sows were never given access to straw, an observed increase in the performance of stereotypic behavior between the first three weeks of the first and fourth parity was not likely influenced by changes in the ratio of food availability to food requirement. Rather, the stall-housing environment itself appeared to promote the development of stereotypic behavior much more strongly than did group-housing environments (Broom, Mendl, & Zanella, 1995).

In a study of the nature of stereotypic behavior in stall-housed sows, it was found that stereotyped behavior increased substantially in high parities (parities 4 and more) (Stolba et al., 1983). The main behavioral changes were due to the cumulative duration of stay in the stall over the parities. This is in contrast to pigs in a pig park (a "natural" environment), who did not perform stereotyped sequences of behavior at all and showed "a much larger range of elements of variable behavior" (Stolba et al., 1983).

Some point to factors in addition to confinement as causes of the observed stereotypies in sows. Terlouw and Lawrence (1993) showed that food restriction plays a role in the development of stereotypies. According to

Whittemore et al., feed is restricted to prevent reproductive problems and to reduce feed costs (Lawrence & Terlouw, 1993). Thus, breeding pigs are typically fed less than their ad libitum food intake, and "commercial levels of food restriction have been shown to result in sustained feeding motivation" (Young et al., 1994). Vestergaard, Hughes and Duncan showed that restricted movement interacts with food level in affecting the incidence of stereotypies (Vieuille-Thomas et al., 1995).

Conclusion

The scientific evidence is clear: gestation stalls cause physical and mental suffering to sows. Stall-housed sows cannot exercise and are deprived of the basic necessity of living space. As a result, they are weak, suffer leg and joint problems, and experience difficulty carrying out simple movements. The barren sow stall does not meet the sow's social and cognitive needs and fails to allow for behaviors important to her species' way of life, and makes the animal depressed and frustrated to the point that she must perform repetitive actions in a pitiful appeal for mental stimulation. In scientific studies, sows have let us know themselves that they prefer environments that offer more space and complexity.

References

- Barnett JL, Hemsworth GM, Cronin EA, et al. Effects of design of individual cage-stalls on the behavioural and physiological responses related to the welfare of pregnant pigs. *Appl Anim Behav Sci* 1991;32:23-33.
- Barnett JL, Hemsworth PH, Winfield CG. The effects of design of individual stalls on the social behaviour and physiological responses related to the welfare of pregnant pigs. *Appl Anim Behav Sci* 1987;18:133-142.
- Barnett JL, Winfield CG, Cronin GM, et al. The effect of individual and group housing on behavioural and physiological responses related to the welfare of pregnant pigs. *Appl Anim Behav Sci* 1985;14:149-161.
- Baxter MR, Schwaller CE. Space requirements for sows in confinement. In: SH Baxter, MR Baxter, JAC MacCormack (Eds.), *Farm Animal Housing and Welfare* (pp. 181-195). Boston: Martinus Nijhoff Publishers, 1983.
- Bergeron R, Gonyou HW. Effects of increasing energy intake and foraging behaviours on the development of stereotypies in pregnant sows. *Appl Anim Behav Sci* 1997;53:259-270.
- Bergeron R, Gonyou HW, Eurell TE. Behavioral and physiological responses of Meishan, Yorkshire and crossbred gilts to conventional and turn-around gestation stalls. *Can J Anim Sci* 1996;76:289-297.

- Broom DM, Mendl MT, Zanella AJ. A comparison of the welfare of sows in different housing conditions. *Anim Sci* 1995;61:369-385.
- Fredeen HT, Sather AP. Joint damage in pigs reared under confinement. *Can J Anim Sci* 1978;58:759-773.
- Grondalen T. Leg weakness in pigs. *Acta Vet Scand* 1974;15:555-573.
- Kilgour R, Dalton C. *Livestock Behaviour: A Practical Guide*. Boulder: Westview Press, 1984.
- Lawrence AB, Terlouw EMC. A review of behavioral factors involved in the development and continued performance of stereotypic behaviors in pigs. *J Anim Sci* 1993;71:2815-2825.
- Marchant JN, Broom DM. Factors affecting posture-changing in loose-housed and confined gestating sows. *Anim Sci* 1996;63:477-485.
- McPhee CP, Laws L. An analysis of leg abnormalities of boars in the Queensland Performance Testing Station. *Austr Vet J* 1976;52:123-125.
- McGlone JJ, Salak-Johnson JL, Nicholson RI, et al. Evaluation of crates and girth tethers for sows: reproductive performance, immunity, behavior and ergonomic measures. *Appl Anim Behav Sci* 1994;39:197-311.
- Mendl M, Broom DM, Zanella AJ. A long-term study of the effects of housing conditions on the welfare of domestic pigs. *Anim Prod* 1993;56:440 (abstr.).
- Mendl M, Zanella AJ, Broom DM. The dexamethasone suppression test: an indicator of depression and poor welfare in sows? *J Anim Sci* 1992;70:suppl.1, p.155.
- National Pork Producers Council. *Swine Care Handbook*, p.12.
- O'Brien T. The Close Confinement of Irish Sows. *Compassion in World Farming*, April 1997.
- Petersen JS, Oksbjerg N, Jorgensen B, et al. Growth performance, carcass composition and leg weakness in pigs exposed to different levels of physical activity. *Anim Sci* 1998;66:725-732.
- Rollin BE. *Farm Animal Welfare: Social, Bioethical, and Research Issues*. Ames: Iowa State University Press, 1995.
- Spinka M, Duncan IJH, Widowski TM. Do domestic pigs prefer short-term to medium-term confinement? *Appl Anim Behav Sci* 1998;58:221-232.

Stevenson P. The factory farming of pigs [briefing]. *Compassion in World Farming*, June 1999.

Stolba A, Baker N, Wood-Gush DGM. The characterisation of stereotyped behaviour in stalled sows by informational redundancy. *Behaviour* 1983;87:157-181.

Terlouw EMC, Lawrence AB. Long-term effects of food allowance and housing on development of stereotypies in pigs. *Appl Anim Behav Sci* 1993;38:103-126.

Van Putten G. The pig: a model for discussing animal behaviour and welfare. *Appl Anim Behav Sci* 1989;22:115-128.

Van Putten G. Farming beyond the ability for pigs to adapt. *Appl Anim Behav Sci* 1988;20:63-71.

Vieuille-Thomas C, Le Pape G, Signoret JP. Stereotypies in pregnant sows: indications of influence of the housing system on the patterns expressed by the animals. *Appl Anim Behav Sci* 1995;44:19-27.

Young RJ, Carruthers J, Lawrence AB. The effect of a foraging device (The 'Edinburgh Football') on the behaviour of pigs. *Appl Anim Behav Sci* 1994;39:237-247.