Effects of space allocation on finishing pig growth performance and carcass characteristics[1]

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ABSTRACT: A total of 405 pigs (PIC 327 × 1,050) were used in 2 experiments (Exp. 1, initially 66.1 ± 1.8 kg BW, Exp. 2 initially 60.8 ± 2.5 kg BW) to examine the effects of space allocation on finishing pig growth performance and carcass characteristics. Pigs were randomly allotted to pens on entry into the finishing facility. Pens of pigs were balanced by initial BW and randomly allotted to 1 of 3 treatments with either 7 or 8 replications per treatment (Exp.1 and 2, respectively). There were 9 pigs per pen and gates were adjusted to provide 0.84, 0.74, or 0.65 m^2 per pig. Each pen was equipped with a dry single-sided feeder with two 35.6 cm × 11.4 cm (length × width) feeder spaces and a cup waterer. In both experiments, as space allocation decreased, overall ADG and ADFI decreased (linear, $P < 0.019$) with no evidence for differences in G:F. In Exp. 2, there was marginal evidence for a linear improvement ($P = 0.061$) in G:F as space allocation decreased from d 42 to 56. Final BW was 3.8 and 5.3 kg greater (linear, $P \leq 0.005$) in Exp. 1 and 2, respectively, when comparing the 0.65 to the 0.84 m^2 per pig space allocation treatments. Using a predicted *k*-value of 0.0336, ADFI and, subsequently, ADG should have begun to decrease when pigs reached 121.2, 101.7, and 83.3 kg at 0.84, 0.74, or 0.65 m^2 per pig, respectively. In Exp. 1, we found marginal evidence for a reduction in ADFI as space allocation decreased starting at a mean BW of 80.3 kg (d 14; linear, $P = 0.072$). In Exp. 2, ADFI and consequently ADG decreased linearly ($P < 0.029$) starting at a mean BW of 74 kg, as space allocation decreased, before pigs reached the *k*-value that should have influenced performance. It is unknown if growth performance was impacted for the 0.84 m^2 treatment group as this was the greatest space allocation treatment. Overall, these studies indicate that decreasing space allocation resulted in poorer ADG driven by a reduction in ADFI. The data suggests that the accepted *k*-value of 0.0336 might underestimate the impact of space restriction on finishing pig ADG and ADFI.

Key words: finishing pigs, growth, *k*-value, space allocation

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INTRODUCTION

Pork producers are faced with a trade-off between allowing sufficient space to maximize performance yet minimize facility cost per pig. Previous research has demonstrated when grow-finish pigs are housed with decreasing amounts of space per pig, feed intake decreases, resulting in a reduction in ADG, with variable effects on feed efficiency (Brumm and Miller, 1996; Gonyou and Stricklin, 1998). Flohr et al. (2016) evaluated the impact of initial floor space allowance and removing pigs from pens as they were approached market weight. The authors observed that removing pigs from the pen and providing additional floor space can be useful in recapturing ADG and ADFI back to rates similar to those pigs maintained with adequate floor space. However, the specific source of the improvements in ADG and ADFI could not only be attributed to floor space but to other additional resources that become available after removals, such as feeder space and water availability.

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Petherick and Baxter (1981) first expressed space allowance as an allometric relationship between BW and body dimensions by which the 3-dimensional term of BW was converted to a 2-dimensional measure of area in the expression of floor space: $A = k \times BW^{0.67}$, where A represents floor space allowance in m^2, k represents an empirical coefficient, and $BW^{0.67}$ in kg represents the geometric conversion of weight to area. Prediction equations from Gonyou et al. (2006) used nonlinear statistical modeling to capture a broken line allometric based space requirement for ADFI and ADG.

In commercial swine production, average final market weights have increased steadily for the past twenty years. From 1994 to 2014, the average market weight increased from 116 to 129 kg, approximately a 0.65 kg increase in market weight per year (USDA, 2015). Yet, many of the pig space allowances have remained constant for the past 20 yr. Therefore, the objective of this experiment was to evaluate the effects of space allocation on growth performance and carcass characteristics of finishing pigs marketed at approximately 130 kg BW.

MATERIALS AND METHODS

These experiments were conducted at the Kansas State University Swine Teaching and Research Center in Manhattan, KS and were approved by and conducted in accordance with the guidelines of the Kansas State University Institutional Animal Care and Use Committee.

General

The facility was totally enclosed, and environmentally regulated containing 36 pens. The experiments were designed with 3 treatments providing 0.84, 0.74, or 0.65 m^2 per pig and 9 pigs per pen (5 barrows and 4 gilts). The pens were equipped with adjustable gating to provide the different space allowances. In case of a pig removal due to illness or death, pen gates were adjusted to maintain the desired floor space allowance. Each pen was equipped with a dry single-sided feeder (Farmweld, Teutopolis, IL) with two 35.6 cm × 11.4 cm (length × width) feeder spaces and a cup waterer. All pens contained 9 pigs yielding 7.9 linear cm of trough space per pig. Pens were located over a completely slatted concrete floor with a 1.2 m pit underneath for manure storage. A robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN) was used to deliver and record daily feed additions to each individual pen.

Animals and Diets

A total of 405 pigs (327 × 1,050, PIC North America, Hendersonville, TN) from 2 consecutive finishing groups (Exp. 1 initially 66.1 ± 1.8 kg BW, Exp. 2 initially 60.8 ± 2.5 kg BW) were used. Pigs were allotted randomly to pens on entry into the finisher and the experiments lasted 66 and 77 d for Exp. 1 and 2, respectively. Pens of pigs were balanced by initial BW and randomly allotted to 1 of the 3 treatments with 7 and 8 replications per treatment for Exp. 1 and 2, respectively. Pigs were given ad libitum access to feed and water throughout the study. Feed was manufactured at the Kansas State University O.H. Kruse Feed Technology Innovation Center. Pigs were fed a common 3 phase corn-soybean meal-based diet in meal form (Table 1). Diets were formulated to meet or exceed NRC (2012) requirement estimates for of finishing pigs. The diets were formulated to contain 0.85, 0.72, and 0.65% standardized ileal digestible Lys in phases 1 through 3, respectively.

Sample Collection

Samples of the complete feed were taken from the feeder at the beginning and end of each phase. Samples were then subsampled and submitted (Ward Laboratories, Inc., Kearney, NE) for analysis of CP (AOAC, 2006) , Ca, and P (method 968.08 b; AOAC, 2012; for preparation using ICAP 6500, ThermoElectron Corp., Waltham, MA; Table 1).

Pigs and feeders were weighed approximately every 2 wk to calculate ADG, ADFI, and G:F. Prior to marketing, all pigs were individually weighed and tattooed for carcass data collection and transported approximately 213 km to a commercial packing plant (Triumph Foods LLC, St. Joseph, MO) for processing and carcass data collection. All the pigs were marketed on the same day at the end of each study. Carcass measurements taken at the plant included HCW, backfat, 10th rib loin depth, percentage lean, and iodine value. Carcass yield was calculated by dividing the HCW at the plant by the pig's live weight at the farm before transport to the plant. Percentage lean was determined using the NPPC (2000) equation incorporating HCW as one of the variables. Fat depth and loin depth were measured with an optical probe inserted between the 3rd and 4th last rib (counting from the ham end of the carcass) at a distance approximately 7 cm from the dorsal midline. Jowl fat samples were also collected and analyzed by near infrared spectroscopy (Bruker MPA, Breman, Germany) for fat IV using the equation of Cocciardi et al. (2009).

Statistical Analysis

The experimental data were analyzed as a randomized complete block design using the MIXED procedure of SAS (Version 9.4, SAS Inst. Inc., Cary, NC) with pen as the experimental unit and initial BW as a blocking fac-

Table 1. Composition of experimental diets (as-fed basis)

	Phase[1]		
Item	1	2	3
Ingredient, %			
Corn	78.45	82.85	85.25
Soybean meal, 46.5% CP	19.20	14.95	12.70
Monocalcium P, 21% P	0.33	0.30	0.30
Limestone	1.10	1.08	1.00
Salt	0.35	0.35	0.35
L-Lys HCl	0.25	0.22	0.20
DL- Met	0.02	-	-
L-Thr	0.05	0.05	0.05
Vitamin and trace mineral premix[2]	0.26	0.20	0.15
Phytase[3]	0.015	0.015	0.015
Total	100.0	100.0	100.0
Calculated analysis			
SID[4] amino acids, %			
Lys	0.85	0.72	0.65
Ile:lys	64	66	67
Leu:lys	149	162	172
Met:lys	29	30	31
Thr:lys	61	64	67
Trp:lys	18	18	18
Val:lys	73	76	79
SID lys NE, g/Mcal	2.57	2.17	1.96
ME, kcal/kg	3,309	3,316	3,322
NE, kcal/kg	2,474	2,502	2,520
Total lys, %	0.96	0.82	0.75
Available P, %	0.27	0.26	0.26
Analyzed composition,[5] %			
CP, %	17.1	14.8	14.1
Ca, %	0.50	0.46	0.41
P, %	0.40	0.38	0.39

[1]Phase 1, 2, and 3 diets were fed from d 0 to 28, d 28 to 56, and d 56 to slaughter, respectively.

[2]Provided per kg of diet = 4,409,200 IU vitamin A, 551,150 IU vitamin D, 17,637 IU vitamin E, 1,764 mg vitamin K, 15 mg vitamin B12, 19,841 mg niacin, 11,023 mg pantothenic acid, 3307 mg riboflavin, 1,100 mg Zn, 1,100 mg Fe, 300 mg Mn, 110 mg Cu, 2 mg I, and 2 mg Se.

[3]HiPhos (DSM Inc, Parsippany, NJ) provided phytase units 102,853 FYT/kg of product and released 0.10% available P.

[4]SID = Standard ileal digestible.

[5]Values represent the mean of 2 composite samples of each diet.

tor. Backfat, loin depth, and lean percentage were adjusted to a common carcass weight. The final models used for inference were fitted using restricted maximum likelihood estimation. Degrees of freedom were estimated using the Kenward-Rogers approach. Estimated means and corresponding standard errors (SEM) are reported for all cell means. Results were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

RESULTS

In Exp. 1, from d 0 to 14 and 14 to 28, we found marginal evidence for a decrease (linear, $P < 0.081$ and 0.072, respectively) in ADFI as space allocation decreased up to a mean BW of 94.7 kg (Table 2). Space allocation had no effect on ADG, or G:F until after d 42 of the study, up to a mean BW of 108 kg. Thereafter, from d 42 to 55, decreasing space allocation decreased ADFI (linear, $P = 0.017$) leading to marginal evidence for a decrease (linear; $P = 0.064$) in ADG. From d 55 to 66, decreasing space allocation decreased (linear, $P = 0.001$) ADFI and subsequently ADG (linear, $P = 0.035$). Space allocation did not affect G:F. Overall, (d 0 to 66) as space allocation decreased, ADG and ADFI decreased (linear; $P < 0.019$) and G:F was not affected (linear; $P = 0.738$). Final BW decreased (linear; $P = 0.005$) as space allocation decreased, which resulted in a 3.8 kg difference in pig BW between the 0.65 and 0.84 m^2 per pig treatments.

There was a trend (quadratic, $P < 0.060$) for carcass yield to decrease then increase with decreasing space allocation. In addition, there was a marginally significant tendency (linear, $P = 0.101$) for decreasing backfat depth as space allocation decreased. As for loin depth, percentage lean and iodine value, there were no effects due to space allocation.

In Exp. 2, space allocation had no effect on ADG, ADFI, or G:F from d 0 to 14 or up to a mean BW of 74 kg (Table 3). In all subsequent periods, ADFI decreased (linear, $P < 0.028$) as space allocation decreased, which led to a decrease (linear; $P < 0.029$) in ADG in all periods except d 27 to 42 which showed only marginal evidence for a decrease (linear; $P < 0.062$) in ADG. There was marginal evidence that as space allocation decreased (linear, $P = 0.061$) G:F improved from d 42 to 56; however, G:F was not affected in any other periods. Overall, as space allocation decreased, ADG and ADFI decreased (linear; $P < 0.003$) and G:F was not affected (linear; $P = 0.414$). Final BW decreased ($P = 0.004$) as space allocation decreased, which resulted in a 5.3 kg difference in pig BW between the 0.65 and 0.84 m^2 per pig treatments.

Hot carcass weight decreased (linear; $P < 0.001$) and percentage-lean increased (linear; $P = 0.034$) as space allocation decreased. However, neither other carcass traits nor iodine value were affects be space allocation.

DISCUSSION

Floor space allowances for finishing pigs has been previously researched to predict optimum floor space based on BW. The use of allometry can be used to convert the 3-dimensional term of weight to a 2-dimensional measure of area, generating an expression in the form of $A = k \times BW^{0.67}$, where A represents floor space allowance in m^2, k represents a space allowance coefficient, and $BW^{0.67}$ in kg represents the geometric conversion of weight to area (Whittemore, 1998). Gonyou et al. (2006) developed floor

Table 2. Effects of space allocation on finishing pig performance (Exp. 1)[1]

	Space allocation per pig, m^2			Probability, $P <$	
Item	0.84	0.74	0.65	Linear	Quadratic
No. of pens	7	7	6	---	---
d 0 to 14					
d 0 weight, kg	66.1 ± 0.723	66.1 ± 0.723	66.1 ± 0.728	0.953	0.944
ADG, kg	1.05 ± 0.028	1.00 ± 0.028	1.00 ± 0.031	0.238	0.538
ADFI, kg	2.67 ± 0.042	2.63 ± 0.042	2.57 ± 0.044	0.081	0.780
G:F	0.392 ± 0.008	0.381 ± 0.008	0.388 ± 0.009	0.656	0.300
d 14 to 28					
d 14 weight, kg	80.8 ± 0.715	80.1 ± 0.715	80.1 ± 0.743	0.318	0.543
ADG, kg	1.07 ± 0.027	0.98 ± 0.027	1.02 ± 0.029	0.180	0.057
ADFI, kg	2.87 ± 0.050	2.78 ± 0.050	2.75 ± 0.053	0.072	0.533
G:F	0.375 ± 0.009	0.353 ± 0.009	0.371 ± 0.010	0.790	0.096
d 28 to 42					
d 28 weight, kg	95.9 ± 0.828	93.8 ± 0.828	94.4 ± 0.864	0.078	0.071
ADG, kg	0.92 ± 0.037	0.97 ± 0.037	0.91 ± 0.041	0.875	0.293
ADFI, kg	2.85 ± 0.066	2.80 ± 0.066	2.81 ± 0.070	0.598	0.578
G:F	0.323 ± 0.009	0.345 ± 0.009	0.325 ± 0.010	0.850	0.102
d 42 to 55					
d 42 weight, kg	108.8 ± 1.059	107.3 ± 1.059	107.2 ± 1.111	0.164	0.486
ADG, kg	0.96 ± 0.021	0.91 ± 0.021	0.91 ± 0.023	0.064	0.415
ADFI, kg	3.05 ± 0.069	2.99 ± 0.069	2.80 ± 0.074	0.017	0.454
G:F	0.316 ± 0.008	0.308 ± 0.008	0.324 ± 0.009	0.467	0.235
d 55 to 66					
d 55 weight, kg	121.3 ± 1.186	119.2 ± 1.186	119.0 ± 1.237	0.064	0.347
ADG, kg	1.06 ± 0.030	1.03 ± 0.030	0.96 ± 0.032	0.035	0.633
ADFI, kg	3.16 ± 0.043	3.11 ± 0.043	2.96 ± 0.046	0.001	0.216
G:F	0.336 ± 0.009	0.331 ± 0.009	0.326 ± 0.010	0.452	0.980
d 0 to 66					
d 66 weight, kg	133.4 ± 1.109	130.6 ± 1.109	129.6 ± 1.168	0.005	0.323
ADG, kg	1.01 ± 0.015	0.98 ± 0.015	0.96 ± 0.016	0.019	0.568
ADFI, kg	2.90 ± 0.042	2.84 ± 0.042	2.77 ± 0.045	0.009	0.805
G:F	0.348 ± 0.003	0.343 ± 0.003	0.347 ± 0.003	0.738	0.282
Carcass traits					
HCW, kg	98.6 ± 1.546	94.2 ± 1.504	95.3 ± 1.746	0.116	0.111
Yield,[3] %	73.4 ± 0.234	73.1 ± 0.227	73.8 ± 0.267	0.228	0.060
BF,[3] mm	18.4 ± 0.558	17.8 ± 0.535	17.0 ± 0.646	0.101	0.821
Loin depth,[3] cm	6.3 ± 0.140	6.5 ± 0.136	6.4 ± 0.158	0.641	0.471
Lean,[3] %	53.6 ± 0.329	54.1 ± 0.316	54.3 ± 0.385	0.188	0.718
Iodine value, mg/100g	69.1 ± 0.311	68.9 ± 0.299	69.7 ± 0.350	0.204	0.246

[1]A total of 189 finishing pigs (PIC 327 × 1,050, initially 66 kg BW) were used in a 66-d study.

[2]Each pen contained 9 pigs and space allocation was manipulated by utilizing adjustable gates.

[3]Values were adjusted using HCW as a covariate.

space prediction equations for ADG and ADFI based on the same allometric principle ($A = k \times BW^{0.67}$) and reported a critical k-value of 0.0336 m^2 per $BW^{0.67}$ below which ADFI was reduced for finisher pigs on fully slated flooring with equal group sizes. Thus, the critical k-value of 0.0336 m^2 per $BW^{0.67}$ acts as a threshold below which feed intake and growth performance is expected to be reduced due to inadequate space allowance.

Body weight corresponding to a k-value of 0.0336 was calculated (Tables 4 and 5), using the formula reported by Whittemore (1998), for each of the 3 space allocation treatments used in the present study. Based on this critical k-value, the negative effects on feed intake should have been observed as pigs reached the projected average BW of 121.2, 101.7, and 83.3 kg for 0.84, 0.74, or 0.65 m^2 per pig, respectively. We found marginal evidence for negative effects of decreased space allocation on ADFI starting at an average BW of 80.3 kg (d 14) which suggests that the commonly accepted k-value threshold of 0.0336 might be under-

Table 3. Effects of space allocation on finishing pig performance (Exp. 2)[1]

Item	Space allocation per pig, m^2			Probability, $P <$	
	0.84	0.74	0.65	Linear	Quadratic
Pens, no.	8	8	8	---	---
d 0 to 14					
d 0 weight, kg	60.8 ± 0.939	60.8 ± 0.939	60.7 ± 0.939	0.956	0.899
ADG, kg	0.97 ± 0.026	0.95 ± 0.026	0.93 ± 0.026	0.322	0.817
ADFI, kg	2.30 ± 0.032	2.26 ± 0.032	2.28 ± 0.032	0.621	0.412
G:F	0.422 ± 0.011	0.419 ± 0.011	0.410 ± 0.011	0.401	0.806
d 14 to 27					
d 14 weight, kg	74.3 ± 0.927	74.0 ± 0.927	73.8 ± 0.927	0.513	0.941
ADG, kg	1.02 ± 0.027	0.95 ± 0.027	0.94 ± 0.027	0.029	0.428
ADFI, kg	2.90 ± 0.052	2.79 ± 0.052	2.73 ± 0.052	0.028	0.694
G:F	0.352 ± 0.006	0.341 ± 0.006	0.343 ± 0.006	0.175	0.300
d 27 to 42					
d 27 weight, kg	87.6 ± 1.035	86.4 ± 1.035	86.0 ± 1.035	0.142	0.638
ADG, kg	1.03 ± 0.018	0.99 ± 0.018	0.98 ± 0.018	0.062	0.612
ADFI, kg	2.93 ± 0.038	2.80 ± 0.038	2.75 ± 0.038	0.003	0.421
G:F	0.351 ± 0.006	0.354 ± 0.006	0.356 ± 0.006	0.557	0.928
d 42 to 56					
d 42 weight, kg	103.6 ± 0.974	101.8 ± 0.974	100.7 ± 0.974	0.015	0.707
ADG, kg	0.97 ± 0.013	0.95 ± 0.013	0.91 ± 0.013	0.002	0.797
ADFI, kg	3.10 ± 0.039	2.92 ± 0.039	2.80 ± 0.039	<0.001	0.626
G:F	0.314 ± 0.005	0.324 ± 0.005	0.326 ± 0.005	0.061	0.460
d 56 to 77					
d 56 weight, kg	117.4 ± 0.992	115.0 ± 0.992	113.5 ± 0.992	0.005	0.688
ADG, kg	0.98 ± 0.015	0.97 ± 0.015	0.90 ± 0.015	0.001	0.098
ADFI, kg	3.20 ± 0.046	3.09 ± 0.046	2.86 ± 0.046	<0.001	0.312
G:F	0.306 ± 0.005	0.314 ± 0.005	0.315 ± 0.005	0.203	0.565
d 0 to 77					
d 77 weight, kg	138.0 ± 1.160	135.5 ± 1.160	132.7 ± 1.160	0.004	0.902
ADG, kg	0.99 ± 0.013	0.96 ± 0.013	0.93 ± 0.013	0.003	0.949
ADFI, kg	2.91 ± 0.032	2.80 ± 0.032	2.70 ± 0.032	<0.001	0.899
G:F	0.341 ± 0.003	0.344 ± 0.003	0.345 ± 0.003	0.414	0.833
Carcass traits					
HCW, kg	103.0 ± 1.057	100.0 ± 1.047	96.7 ± 1.111	<0.001	0.878
Yield,[3] %	77.6 ± 1.152	77.9 ± 1.150	77.3 ± 1.155	0.631	0.475
BF,[3] mm	20.1 ± 0.601	19.8 ± 0.586	18.6 ± 0.643	0.127	0.557
Loin depth,[3] cm	6.41 ± 0.129	6.42 ± 0.126	6.62 ± 0.137	0.292	0.571
Lean,[3] %	52.9 ± 0.268	53.0 ± 0.262	53.7 ± 0.288	0.034	0.296
Iodine value, mg/100g	68.8 ± 0.304	69.3 ± 0.294	69.0 ± 0.319	0.764	0.282

[1]A total of 215 finishing pigs (PIC 327 × 1,050, initially 61 kg BW) were used in a 77-d study.

[2]Each pen contained 9 pigs and space allocation was manipulated by utilizing adjustable gates.

[3]Values were adjusted using HCW as a covariate.

estimating the impact of decreased space allocation on ADFI. In Exp. 2, feed consumption and consequently ADG decreased linearly starting at an average BW of 74 kg (d 14) as space allocation decreased, before pigs reached the k value that should have influenced performance. It is unknown if performance of the 0.84 m^2 treatment group was impacted by space allowance during this study or if performance was impacted before reaching the threshold of 0.0336. This treatment group offered the greatest space allocation and therefore, we are unable to know if growth performance was impacted by space allowance simply due to the lack of comparison to a greater space allocation treatment group.

The present study is in agreement with previous research where ADFI and ADG decreased, and G:F was unchanged (Brumm and Miller, 1996; Gonyou and Stricklin 1998; Jensen et al., 2012). However, there is literature to support changes in G:F as space allocation decreases (Brumm, 1996; Street and Gonyou, 2008, Flohr et al., 2016). After compiling data from 17

Table 4. Determination of *k*-values for different space allocations and pig weights (Exp. 1)[1]

Item	Space allocation per pig, m^2			*k*-value[3,4]		
	0.84	0.74	0.65	0.84 sq m	0.74 sq m	0.65 sq m
BW when $k = 0.0336$, kg[5]	121.2	101.7	83.3	---	---	---
Weight, kg						
d 0	66.1	66.1	66.1	0.0504	0.0448	0.0392
d 14	80.8	80.1	80.1	0.0441	0.0394	0.0345
d 28	95.9	93.8	94.4	0.0393	0.0354	**0.0309**
d 42	108.8	107.3	107.2	0.0361	**0.0324**	**0.0284**
d 55	121.3	119.2	119.0	0.0336	**0.0302**	**0.0265**
d 66	133.4	130.6	129.6	**0.0315**	**0.0284**	**0.0250**

[1]Average pig weight reported for each space allocation and weigh day.

[2]Each pen contained 9 pigs and space allocation was manipulated by utilizing adjustable gates.

[3]*k*-values calculated using a formula reported by Whittemore (1998): Space per pig (m^2) $= k \times$ BW (kg)$^{0.67}$.

[4]Bold type indicate *k*-values below 0.0336, the critical *k*-value for adequate feed intake as defined by Gonyou et al. (2006).

[5]Calculated body weight for each space allocation when $k = 0.0336$, the critical *k*-value for adequate feed intake for grow-finish, fully slatted flooring and equal group sizes (Gonyou et al., 2006).

Table 5. Determination of *k*-values for different space allocations and pig weights (Exp. 2)[1]

Item	Space allocation per pig, m^2			*k*-value[3,4]		
	0.84	0.74	0.65	0.84 sq m	0.74 sq m	0.65 sq m
BW when $k = 0.0336$, kg[5]	121.2	101.7	83.3	---	---	---
Weight, kg						
d 0	60.8	60.8	60.7	0.0534	0.0474	0.0415
d 14	74.3	74.0	73.8	0.0466	0.0416	0.0364
d 27	87.6	86.4	86.0	0.0418	0.0375	**0.0329**
d 42	103.6	101.8	100.7	0.0373	0.0336	**0.0296**
d 56	117.4	115.0	113.5	0.0343	**0.0309**	**0.0273**
d 77	138.0	135.5	132.7	**0.0308**	**0.0277**	**0.0246**

[1]Average pig weight reported for each space allocation and weigh day.

[2]Each pen contained 9 pigs and space allocation was manipulated by utilizing adjustable gates.

[3]*k*-values calculated using a formula reported by Whittemore (1998): Space per pig (m^2) $= k \times$ BW (kg)$^{0.67}$.

[4]Bold type indicate *k*-values below 0.0336, the critical *k*-value for adequate feed intake as described by Gonyou et al. (2006).

[5]Calculated body weight for each space allocation when $k = 0.0336$, the critical *k*-value for adequate feed intake for grow-finish, fully slatted flooring and equal group sizes (Gonyou et al., 2006).

studies during a meta-analysis, Flohr (2015) observed small but significant relationships between G:F.

Flohr (2015) recently developed equations to predict the influence of floor space on finishing pig growth performance and found an increase in the precision of estimates compared to those of Gonyou et al. (2006). Flohr (2015) used improvements in modeling techniques to account of known random errors and included a larger database to develop the equations. The authors also concluded on different critical *k* thresholds based on the BW range of finishing pigs. Thus, the regression equations proposed by Flohr (2015) provide good alternative estimates of predict finishing pig growth performance when provided different floor space allowances.

One concern expressed in published reviews evaluating space allocation is the maintaining of adequate feeder space per pig when space allocation is decreased. Previous research indicates that the 7.9 cm per pig of feeder space provided in our study is considered unrestrictive and should not have negatively affected performance (Wolter et al., 2003; Myers et al., 2012). Furthermore, our ability to manipulate space allocation by utilizing adjustable gates allowed us to change the space allocation without impacting the feeder space per pig, which is typically observed when additional pigs are added to pens to decrease space allowance.

In conclusion, our trial was successful in determining the effects of space allocation on pig performance without affecting the results by restricting feeder space per pig. The differences in trial performance compared with expected outcomes from published reviews may have been attributable to group size, behavior, or other physiological variables. It is unknown whether these variables contributed to the negative effects on performance as space allocation decreased.

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