Optimum nutrition of the pregnant ewe:

A meta-analytic approach

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Abstract

Formal systematic review guidelines and meta-analytic methods were used in the present study to achieve three main objectives. Firstly, literature on the effect of ewe nutrition during pregnancy on fetal and postnatal lamb growth was reviewed and effect sizes estimated for fetuses/lambs at three stages of their life: 1) late gestation fetal weight (LGFW), 2) lamb birth weight (BW) and 3) weaning weight (WW). Secondly, the contribution of experimental factors responsible for variation in study results was determined. Thirdly, a field trial was conducted to increase understanding in an area identified by the meta-analyses as requiring further experimentation. Overall, early- and mid-pregnancy undernutrition had no significant effect on LGFW ($\beta[_{\text{Early-pregnancy}}]$ = -0.0007, 95% Highest posterior density (HPD) = -0.26 to 0.28; $\beta[_{\text{Mid-pregnancy}}]$ = -0.07, 95% HPD = -0.27 to 0.16), BW ($\beta[_{\text{Early-pregnancy}}]$ = 0.01, 95% HPD = -0.36 to 0.34; $\beta[_{\text{Mid-pregnancy}}]$ = -0.02, 95% HPD = -0.36 to 0.33) and WW ($\beta[_{\text{first 100 days of pregnancy}}]$ = -0.008, 95% HPD = -0.42 to 0.18), suggesting that short to moderate periods of undernutrition in these stages are tolerated by ewes with limited impact on their offspring, when nutrition is re-established to pregnancy maintenance (PM) or above levels during late-pregnancy. Late-pregnancy undernutrition can significantly decrease LGFW and BW by up to 1.15 kg at birth, with residual effects at weaning resulting in weaned lambs that are up to 18% lighter than their control counterparts and thus, should be avoided. The present study also considered the effect of maternal above PM feeding on LGFW, BW and WW. The combined effects across these studies were variable, as few experiments investigated above PM feeding at each stage of pregnancy, and thus it was not possible to draw definitive conclusions. A field experiment was undertaken to determine the effects of *ad-libitum* (AL) feeding at various stages of pregnancy and for differing lengths of time on twin lamb BW and WW. Results showed that providing ewes with AL feeding significantly ($p<0.05$) increased their live weight and BCS, but did not increase ($p>0.05$) the BW or WW of their lambs relative to their control counterparts. This study also suggested that AL feeding during late-pregnancy may have negative consequences to the survival of twin lambs and requires further examination. Thus, AL feeding is not justified as a management tool to increase twin lamb BW and WW, when nutrition is adequate during lactation. The present study represents the first meta-analytic approach examining the effect of changes in the ewe nutrition during pregnancy on the growth of offspring at various developmental stages. Given the complex interrelationship between nutrition of the pregnant ewe, her reproductive success, fetal growth and development, and offspring post-natal performance, no single study can provide a definitive understanding of responses to a particular treatment and there is value in combining available experimental evidence to elucidate a more global picture. A meta-analytic approach can find trends in combined data that would otherwise be overlooked using traditional review methods and can also identify gaps in current knowledge.

Key words: meta-analysis, sheep, pregnancy, undernutrition, *ad-libitum*.

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