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The effect of a low-protein diet on physiological adaptations to pregnancy

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Research has shown that maternal nutrient restriction can impair the physiological adaptations to pregnancy[1], including a reduction in blood and plasma volume expansion in pregnant rats consuming a low-protein diet[2]. The expansion of blood volume during pregnancy is vital to placental development and ensures an adequate nutrient supply to the fetus[3]. The present study aimed to investigate the mechanisms by which maternal diet interacts with blood volume control during pregnancy, using a low-protein rat model.

Sixty-four virgin female Wistar rats were mated and assigned to a control (180 g casein/kg; *n* 32) or low-protein (90 g casein/kg; *n* 32) diet during pregnancy. Animals were terminally anaesthetised on days 5, 10, 15 and 20 of gestation (eight per group at each time-point), following 24 h urine collection for determination of creatinine clearance (a proxy measure of glomerular filtration rate). A cannula was inserted into the left iliac vein of each animal, through which an initial blood sample was taken before administration of 0.3 ml Evans blue dye (0.5 mg/ml). After 5 min a final blood sample was taken and blood volume estimated by calculating the dilution of the dye[4]. Organs were collected, weighed and stored at −80°C for future analysis.

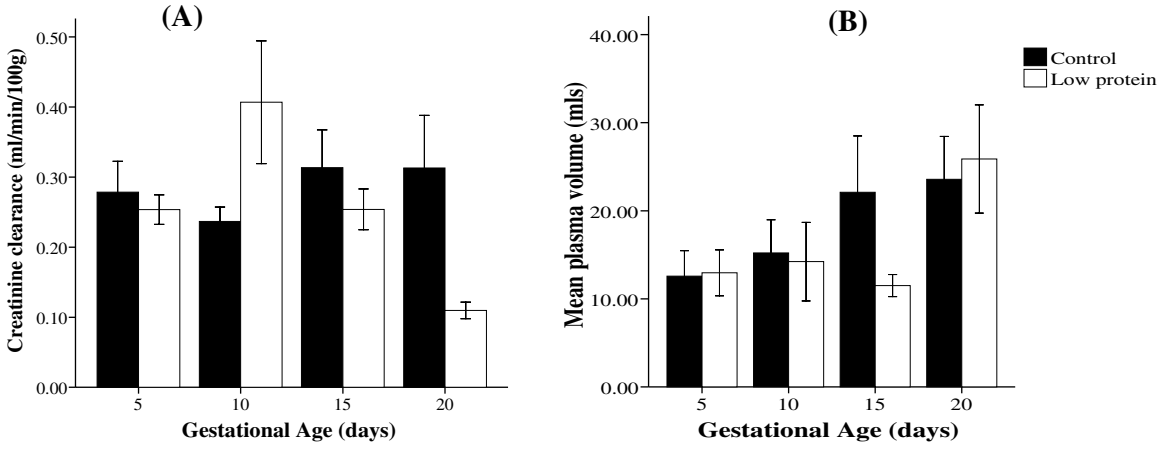

Figure. The effect of gestational age and maternal diet on plasma volume (A; effect of gestational age $P<0.05$) and creatinine clearance (B; interaction gestational age × diet $P<0.05$) during pregnancy. Data are means with their standard errors represented by vertical bars.

Blood volume (results not shown) and plasma volume (Figure; A) increased significantly with gestational age ($P<0.05$), but this outcome was unaffected by diet. There was a significant interaction between the effects of diet and gestational age on creatinine clearance (Figure; B), with low-protein animals exhibiting a decrease in clearance between days 10 and 20 of pregnancy in comparison with the relatively constant levels in controls.

The increase in plasma and blood volume observed during gestation agrees with previous investigations[2]. Although the data appeared to show a delay in the increase in plasma volume in low-protein animals, this effect was not significant. These data therefore suggest that plasma volume expansion is not sensitive to the level of maternal protein restriction used in the present study, despite the apparent effects of the low-protein diet on glomerular filtration rate. Further investigation of the impact of maternal diet on the molecular systems controlling maternal and fetal renal function during pregnancy is ongoing, as this effect may have implications for renal development and subsequent blood pressure control in the offspring.

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