Effects of Catch-up Growth at Early Age on Body Composition

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Introduction:

Epidemiological studies have demonstrated a correlation between low-birth-weight in mammals and detrimental health in later life [1]. The occurrence of slow growth during foetal and early life is often followed by accelerated weight gain in infancy and later years (catch-up growth). Catch-up growth and environmental stress in early life are linked to different insults such as obesity and heart diseases [1, 2]. In this preliminary study, the effects of catch-up growth on adiposity and intrahepatocellular (IHCL) content is investigated in low (LBW) and high birth weight (HBW) female and male mice.

Methods:

Animals and treatment

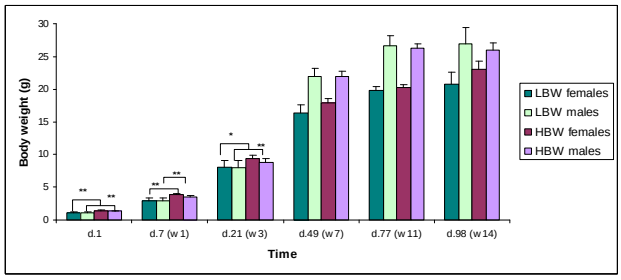
Virgin female C567Bl/6 mice were paired with males from the same strain. From the day mating was confirmed pregnant females were maintained on a normal control diet (20% protein) and remained on this diet during the gestation period (approx. 19 days) and the lactation period (21 days). At 21 days of age, the offspring were divided into four groups, low and high birth weight (males and females). These groups were weaned onto a standard chow diet (fat content 3%) for a period of 12 weeks. Body weights and length were recorded daily.

MR experiments

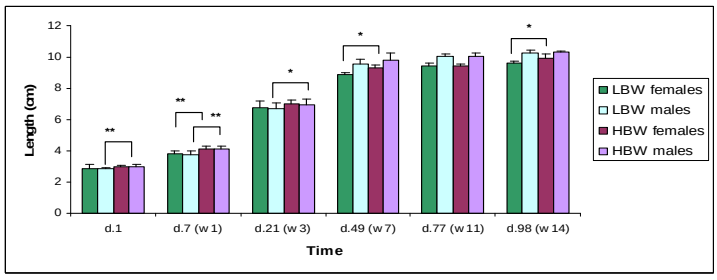
Whole body and liver ^{1}H MRS were performed on offspring at 11 and 14 weeks of age at 4.7T using a VMRIS scanner. Localised ^{1}H MRS of the liver was performed using a PRESS sequence with TR 10s, TE 9 ms and 64 averages following voxel (2x2x2mm) placement by MRI. The spectra were analysed using MestRe-C (Santiago de Compostela, Spain) where an exponential of 1.5 Hz was applied, prior to baseline correction and peak integration of the water and lipid peak.

Results and discussion:

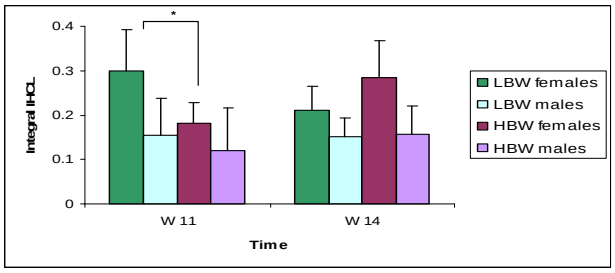
a)



b)



c)



	Body Weight (g)			Length (cm)		
Groups	Day 1	Week1	Week3	Day 1	Week1	Week3
LBW males	1.16 0.07**	2.87±0.5**	8.00± 1.02**	2.84 ±0.09**	3.76±0.22**	6.67±0.40
HBW males	1.41 ±0.03**	3.54±0.21**	8.80±0.56**	3.0 ±0.10**	4.10±0.18**	6.95±0.32
LBW females	1.17± 0.03**	3.00±0.38**	8.14 ±0.92*	2.9±0.21	3.83±0.19**	6.74±0.43
HBW females	1.44 ±0.07**	3.88±0.24 **	9.38±0.52*	3.0±0.10	4.15±0.14**	7.0±0.25

Figures: The effects of catch-up growth on (a) body weights, (b) lengths, (c) and Intrahepatocellular lipid (IHCL)by MRS* p<0.05, **p<0.001.

Table1: Body weights and lengths in males and females at day 1, week1 and week3, *p<0.05, **p<0.001.

LBW male and female mice showed significantly reduced body weight compared to HBW males and females, during the first 3 weeks of life (Fig. a, Table1.). It was evident that the body weight of both LBW males and LBW females started to catch-up by week 7. Body lengths were significantly increased at day 1 (day of birth) in LBW vs. HBW, but only in male animals. The differences were significant at week 1 in both LBW vs. HBW male and female mice. The catch-up phenomenon was observed by week 7 in LBW males and by week 3 in females. Total percentage of adiposity content was not significantly different between groups (data not shown). Despite similar body weight, length and adiposity in LBW and HBW male and female mice at week 11, LBW female mice had significant increased levels of IHCL compared with HBW females (0.30±0.10 vs. 0.18±0.04, p<0.05 in LBW and HBW females respectively). Although there was no significant difference in IHCL content between LBW and HBW males, there was a discrete increment in adiposity and IHCL in the LBW males at week 11. These results suggest that pattern and rate of lipid deposition during catch-up growth tends to be relatively unbalanced [3]; not occurring in a linear manner in relation to changes in weight, length and age. There appears to be different requirements for catch-up growth within this single diet group that could influence early programming of appetite regulation, hormonal levels and body composition [1, 3].

Conclusion:

Catch-up growth greatly influences body lipid content in mice born small for their gestational age, being more susceptible to fat deposition in a time-dependant rate. Although adaptations in body composition at an early age may aid short-term survival, such modifications could lead to detrimental consequences in the long-term.

References:

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