The relationship between head weight with total body weight during embryonic development in indigenous sheep

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Abstract

The study was carried out on (130) indigenous sheep fetuses with an estimated age ranged between (43 -147) days old (6 – 53 cm. crown– rump length), the total body weight of these fetuses ranged between (4.26– 3437 grams), while the weight of their heads ranged between (1.33 – 399.87 grams) for both sexes. The results revealed the followings:

1. High significant variance in the ratio between head weight and the total body weight of the 8^{th} and 10^{th} weeks of fetal age in both sexes.
2. Significant variance in the ratio between head weight and the total body weight in males higher than that in females of 10^{th} and 13^{th} weeks of fetal age, this variance decrease in both 8^{th}, 19^{th} weeks of fetal age,but it seems higher in females than in males in the 18^{th}, 20^{th} weeks of fetal age.
3. High significant correlation ($p < 0.001$) between the head weight and total body weight. The correlation coefficient were 0.938 in males and 0.984 in females.
4. The regression equation of the total body weight was (6.215 × head weight)– 52.22 for males.
5. The regression equation of the total body weight was (6.475 × head weight)-100.898 for females.

العلاقة بين وزن الرأس والوزن الكلي أثناء النمو الجنيني في الأغنام المحلية

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الخلاصة

أجريت الدراسة على130 جنين أغنام محلية التي تراوحت أعمارها التقديرية بين 43–147 يوم (بطول تاجي– منبتي 6–53 سم) وتراوح الوزن الكلي لهذه الأجنة بين 4.26–3437 غم، بينما تراوح وزن رؤوسها بين 1.33–399.87 غم ولكلا الجنسين. أظهر ت نتائج:

1. فرق معنوي عالي في النسبة بين وزن الرس والوزن الكلي في الاسبوعين الثامن والعاشر من عمر الجنين ولكلا الجنسين.
2. فر ق معنوي في النسبة بين وزن الراس والوزن الكلي في الذكور اعلى مما في الاناث في الاسبوعين العاشر والثالث عشر من عمر الجنين،و انخفض هذا الفرق في الاسبوعين الثامن والتاسع عشر من عمر الجنين لكنه يبدو متفوقا لصالح الاناث في الاسبوعين الثامن عشر والعشرين من عمر الجنين.

3. وجود ارتباط معنوي عالي ($p < 0.001$) بين وزن الرأس والوزن الكلي، بينما بلغ معامل الارتباط (0.938) في الذكور و(0.984) في الإناث.
4. كانت معادلة الانحدار للوزن الكلي= (6.215 × وزن الرأس) – 52.22 في للذكور.
5. كانت معادلة الانحدار للوزن الكلي= (6.475 ×وزن الرأس) – 100.898 في الإناث.

Introduction

The growth and development of fetuses depend on their weight, growth, and age increasing in the gestational stages (1). Determination of strength and consistency of the association between birth weight and subsequent ischemic heart disease in later life, revealed that the lower weight and smaller head circumference at birth indicate coronary heart diseases (2 and 3), so that the growth of fetuses has been the subject of numerous investigations, some of these studies focused on the relationship between low birth weight and risk of adult obesity and metabolic syndrome (4 and 5). There were many studies on fetal growth; this growth has often been quantified using measurements of weight or linear dimensions of the human body such as crown rump length, crown – heel length and head circumference (6, 7, and 8),the bioparietal diameter with the crown-rump length in relation to the gestational age (9), and using of the fetal weight and length to develop a standard of fetal growth (10).The relationships to weight and age jointly were significantly closer than to either of them alone, even after allowing for number of fetuses (11and 12). The aim of this study was to describe the development of the living sheep fetuses with the emphasis on the crown– rump length, shape and the total foetal weight and foetal head weight and compare those between males and females, and clearing the important of correlating between head weight and total body weight of fetuses during the embryonic development of Indigenous sheep fetuses and the effect of that in the health of individual in the future.

Materials and Methods

One hundred-thirty fetuses were collected from the uteri of indigenous ewes slaughtered routinely of Mosul City, Ninavha, Iraq. The crown-rump length of each of these fetuses was measured by using vernier and a measuring tape, this length used in Richardson formula to find the estimated age of these fetuses as follow:

Estimated age (day) = 2.1 x (CRL (cm) + 17) , (13).

The estimated age of the studied fetuses ranged between 49 and 147 days. After determining the sex of each fetus, the weight of each fetus had been measured by using a sensitive Sartorius scale, the head had been separated from the body at atlanto-occipital junction and the weight also gained by using the same sensitive scale (14).

The data of previous measurements were analyzed statistically using Sigma Stat (Jandel Scientific Software v. 3.1, 2006), then T-test using to find any significant variance related to sex using Minitab Stat (Publisher, v.13, 2001). The relative increases in weight gaining were compared between male and female fetuses (15).

Results

The results of study showed that the estimated age of the studied fetuses ranged between 49-147 days old (Crown-rump length ranged between 6-53 cm.), the total body weight of these fetuses ranged between (4.26-3437 grams), while the weights of their heads ranged between (1.33 – 399.87 grams). The results of analysis of variance have been done on the relative increase in the head weight and total body weight of the indigenous sheep foetuses showed presence of high significant variance in the ratio between relative increase of head weight and relative increase of total body weight at the 8^{th} and 10^{th}weeks in both sexes.

The variance in this ratio become less in the other weeks except in the 15^{th}, 16th, 18th and 20^{th} weeks in males and 13^{th}, 14th, 15th and 18^{th} weeks in females, while the variance in this ratio becomes insignificant among the previous weeks in each sex (Fig1 and 2). These figures have concluded a significant variance in the ratio between head weight and total body weight in males which was higher than that in females in the 10^{th} and 13^{th} weeks, this variance appeared less between males and females in 8^{th} and 19^{th} weeks, While the variance become higher in females than in males at 18^{th} and 20^{th} weeks of age, (Fig 1and 2). The results showed high significant correlation ($P<0.001$) between the head weight and total body weight. The correlation coefficient was (0.938) in males and (0.984) in females, while the regression equation were as followed:

Total body weight = (6.215 * head weight) – 52.22 for males.

Total body weight = (6.475 * head weight) -100.898 for females.

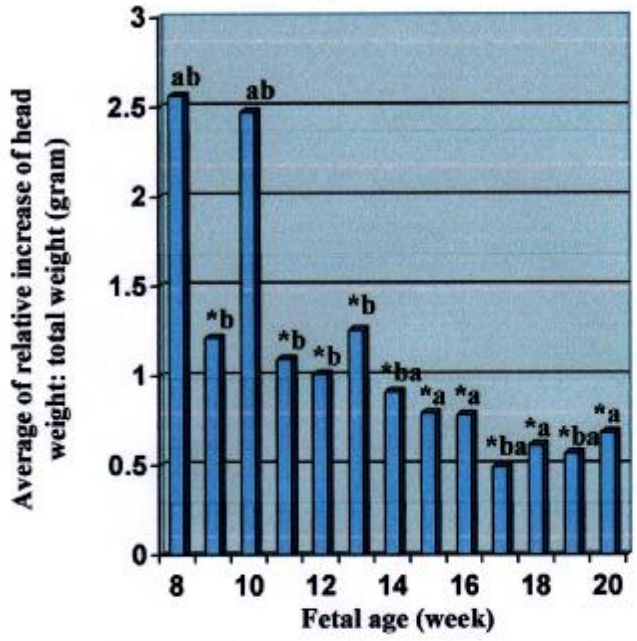

Fig 1: The relative increase in the head weight: total weight of male indigenous sheep fetuses

***: differ significantly in this week than in the 8^{th} and 10^{th} weeks at $p< 0.001$.**
a: differ significantly in this week than in the 9^{th} and 13^{th} weeks at $p< 0.001$.
b: differ significantly in this week than in the 15^{th} and 16^{th} weeks at $p< 0.001$

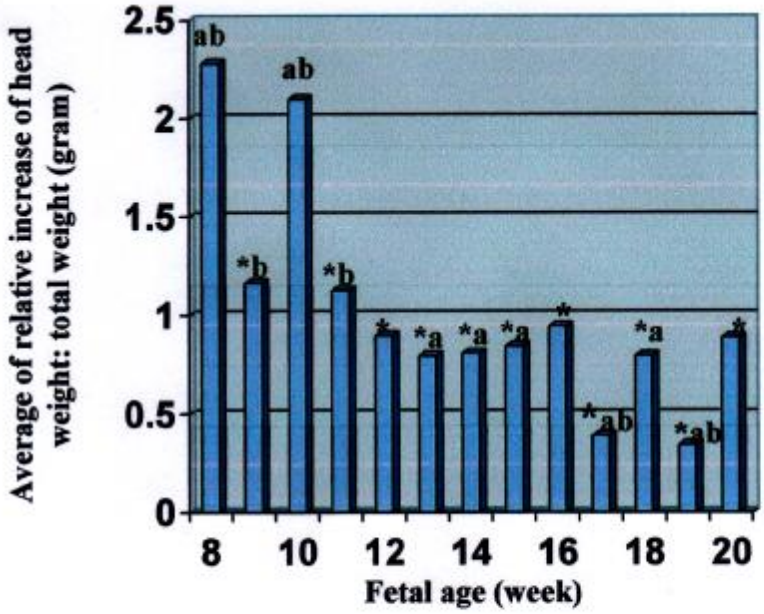

Fig 2: The relative increase in the head weight: total weight of female indigenous sheep fetuses.

***: differ significantly in this week than in the 8th and 10th weeks at p< 0.001.**
a: differ significantly in this week than in the 9th and 11h weeks at p< 0.001.
b: differ significantly in this week than in the 13 th ,14 th 15 th and 18 th weeks at p< 0.001.

Discussion

The results showed high significant variance in the ratio between the relative increase in head and total body weight at 8th and 10th weeks of fetal age in both sexes of indigenous sheep foetuses. This significant variance decreased in other weeks and become insignificant at 15th, 16th, 18th and 20th weeks in males and at 13th, 14th, 15th and 18th weeks in female, which can be explained by high increase in head size in comparison to the total body weight during the first period of pregnancy. These results agree with (16) which refer that the very fast development (or growth) occurs at the 12th week of human fetal age and complete to the end of pregnancy. Furthermore it is agree with the results of (11) which refer that the variation in the fetal weight at fixed age of course is not entirely due to differences in number of sheep foetuses. Also it matches with the work of (12) who refer that the rapid growth occurs at the first half peroid of pregnancy in human foetuses.

Significant variance in the ratio between head weight and total body weight in males is higher than that in females at the 10th and 13th weeks, and this variance appears less between males and females at 18th and 19th weeks, and then the variance become higher in females than in males at 18th and 20th weeks. These results agree with the results of (17) who stated that for the same little size, male sheep foetuses were on average over 6% heavier than females of the same age. The results also were ingredient with the results of (18) who shows that the occurrence of small birth weight for gestational age decreased with

age progress increasing in second trimester in human foetuses, also agree with (19) who referred that the human fetal weight increased dramatically with foot length, while these results disagree with the results of (3) who referred that the small heads are observed only in the first and second trimester and for the post ovulation of (0-7) weeks and (8-15) weeks in human foetuses that exposure to the Dutch famine. Nerveless it is disagreeing with (20) who refer that there was no significant difference in the total fetal weight, or weight of individual organs in sheep foetuses.

The results are showed high significant correlation ($p< 0.001$) between head weight and the total body weight. The correlation coefficient were (0.938) in males while it is (0.984) in females, this respecting that the fetal head and the total body weight estimate weight for both sexes and this agree with the results of (21) in human foetuses if the limbs included in the head and trunk volume of human foetuses. At the same time it's agree with (22) which based on a multiple regression analysis, the standardized partial regression coefficients of the affected foetus weight, the dam weight, and the little size on the maxillary size of the affected (Cl / Fr) mouse foetus were 0.71 ($p< 0.1$), 0.03, and -0.07. (22) also referred that the dam strain effects, as well as the effect of the affected foetus weight, both play an important role on the craniofacial morphogenesis of the (Cl/Fr strain) of the affected foetuses that developed in both strain dams.

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