Placenta 31 (2010) 607–610

Contents lists available at ScienceDirect

Placenta

journal homepage: www.elsevier.com/locate/placenta

Changes in Placental Size during Ramadan

S.H. Alwasel [a,*], Z. Abotalib [b], J.S. Aljarallah [c], C. Osmond [d], S.M. Alkharaz [e], I.M. Alhazza [a], G. Badr [a], D.J.P. Barker [a,c,d,f]

[a] Fetal Programming of Diseases Research Chair, Zoology Department, College of Science, King Saud University, Saudi Arabia
[b] Obstetrics and Gynecology Department, King Saud University, Saudi Arabia
[c] Family and Community Medicine Department, King Saud University, Saudi Arabia
[d] MRC Epidemiology Resource Centre, Medical School, University of Southampton, UK
[e] King Saud Hospital, Unizah, Saudi Arabia
[f] Heart Research Center, Oregon Health & Science University, USA

ARTICLE INFO

Article history:
Accepted 21 April 2010

Keywords:
Placental weight
Placental ratio
Ramadan
Programming

ABSTRACT

Background: Placental growth responds to maternal influences. Ramadan is an annual period of day-time fasting during which people in Saudi Arabia, including pregnant women, change their diets and physical activity. Little is known about the effects of this altered lifestyle on placental development.
Methods: We studied the birth records of 7083 babies born over a four-year period to Saudi nationals in Unizah, a small city 350 km to the north of Riyadh, the capital city of Saudi Arabia. The records included birth weight, placental weight and gestational age.
Results: Mean birth weight was similar to European values but the mean placental weight and ratio of placental weight to birth weight were lower. Among babies who were in the second or third trimester of gestation during Ramadan the mean placental weight and ratio were below those of babies who were not in utero during Ramadan. Among boys the mean placental ratios were 14.4 percent (second trimester) and 14.5 percent (third trimester) compared with 14.9 percent ($p = <0.001$ and 0.002). The corresponding figures for girls were 14.8 and 14.6 percent compared with 15.1 percent ($p = 0.02$ and <0.001).
Conclusions: In Saudi Arabia placentas respond to mothers' limited ability to deliver nutrients to them. Placental growth slows but efficiency is increased so that fetal growth is sustained, albeit with a reduced reserve capacity. The lifestyle changes associated with Ramadan further slow placental growth. Ramadan may influence placental growth through dietary changes other than day-time fasting. Changes in placental growth during Ramadan could be associated with altered fetal programming, and may therefore have long-term implications for the health of the next generation.

1. Introduction

In humans, placental growth responds to maternal influences. Maternal anemia and high maternal body mass index are associated with a high placental ratio at birth (placental weight/birth weight) [1,2].Maternal smoking reduces both placental weight and birth weight. The diets of mothers during pregnancy, and their physical activity, are also known to be associated with altered placental size [2,3]. In sheep farming manipulation of placental size by moving pregnant ewes to different pastures is standard practice, because it leads to the production of larger lambs [4,5]. There is evidence for similar effects in humans [6].

In Islam, Ramadan is an annual period of day-time fasting. It lasts for one month and occurs at different seasons in different years because the Arabic calendar depends on the moon. Therefore the hours of daily fasting will depend on the season. During Ramadan people in Saudi Arabia change their lifestyle. They take no food or water from dawn to sunset, when they break their fast by eating sweet and fried meals. The next meal is "Sahoor" which is usually eaten before dawn and comprises fat-rich foods. People reduce their activities during the day, but are more active at night. Studies have shown that body weight and body mass index (weight/height^2) are reduced during Ramadan in both men and women [7,8]. This may reflect the changes in diet and pattern of eating rather than the

* Corresponding author. Zoology Department, College of Science, King Saud University, PO Box 2455, Riyadh 11451, Saudi Arabia. Tel.: +966 550880848; fax: +966 14678514.
E-mail address: sawasel10@hotmail.com (S.H. Alwasel).

0143-4004/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.placenta.2010.04.010

effects of fasting. Although pregnant women are allowed to defer fasting until after the pregnancy in Saudi Arabia they usually prefer to share the spiritual and social experiences of Ramadan with their families. Little is known about the effects of the altered lifestyle during Ramadan on placental development.

Fetal and placental size at birth are associated with the later risk of chronic diseases. People who were born at term but whose birth weights were towards the lower end of the normal range are at increased risk of a range of disorders including coronary heart disease, stroke, hypertension and type 2 diabetes [9,10]. Placental weight correlates with birth weight [11] and is also associated with later cardiovascular disease. Associations between both low placental weight and with high placental weight in relation to birth weight have been reported [2,12–14]. These associations between birth size and later chronic disease are thought to reflect "fetal programming", the process whereby nutrition and other influences during gestation permanently change the structure and function of the body in ways that affect long-term health [9]. If the altered lifestyle during Ramadan changes fetal or placental growth it could change fetal programming, and could therefore have long-term implications for the health of the next generation. There are sex differences in fetal and placental growth [15,16]. Boys grow more rapidly than girls [17]. At any placental weight at birth boys tend to be longer than girls [18]. This suggests that boy's placentas are more efficient, but they may have less reserve capacity. We present an analysis of body and placental size at birth in 7000 newborn babies who were in utero, at different stages of gestation, during Ramadan. Boys and girls are analysed separately.

2. Methods

We studied the birth records of 7083 babies born in King Saud Hospital, Unizah, Saudi Arabia. Unizah is a small city 350 km to the north of the capital city, Riyadh. It is an agricultural and administrative centre with a population 140,000. The King Saud Hospital is one of two maternity centres in the city. We restricted our data collection to singletons born to Saudi nationals. These were the only exclusion criteria. The data were abstracted from the maternity log books. During the four-year period of our study Ramadan occurred in three different calendar months, from October to December. We calculated whether each baby was in utero during Ramadan and, if so, during which trimester. The hospital records included date of birth, maternal age, birth weight, placental weight and gestational age, estimated from the date of the last menstrual period. Pregnant women are first seen around 40 days after their expected menstrual period did not occur. Women in Saudi Arabia are careful in knowing their menstrual cycles as menstrual bleeding affects religious practices. The majority of the mothers were born in Unizah.

2.1. Statistical methods

We studied births that occurred after 37 completed weeks of gestation. We defined four groups of exposure to Ramadan using the month of birth in the Arabic calendar. For example, births in months one to three (Muharram, Safar and Rabi'al-awwal) were treated as exposed to Ramadan in the second trimester. We analysed birth weight, placental weight and the ratio of placental to birth weight using multiple linear regression, adjusting for gender, time through the study and gestational age by including them as predictors. We included in the regression dummy variables for the trimester of exposure to Ramadan to assess trimester-specific effects, treating the group not exposed to Ramadan in pregnancy as the baseline group for comparison.

3. Results

There were 7083 birth records. Placental weight was correlated with birth weight ($r = 0.34$) and with gestational age ($r = 0.20$). The mean age of the mothers was 29.5 years. Table 1 shows the mean birth weight, placental weight and gestational age for boys and girls. Boys had higher mean birth weights and placental weights than girls but the ratio of placental to birth weight was lower. We found that while babies' mean birth weights remained constant throughout the four years of the study, their mean placental weights increased by 29 g per year, so that the ratio of placental weight to birth weight rose. We therefore adjusted for year of birth in our analyses.

In Table 2 the boys and girls are divided according to whether or not they were in utero during Ramadan and if so, whether it was during the first, second or third trimester of gestation. Among babies who were in the first trimester of gestation during Ramadan there was no difference in birth weight or placental size compared with babies who were not in utero during Ramadan. Among babies who were in the second or third trimester during Ramadan the mean birth weight was the same as that of babies who were not in utero during Ramadan, but mean placental weight and the ratio of placental weight to birth weight were lower. These differences were little changed by adjusting for the length of gestation.

Figure 1 shows that, while mean placental weights were higher in boys than girls, in both boys and girls those in the second or third trimester of gestation during Ramadan had reduced mean values. Similarly Figure 2 shows that, while the ratios of placental weight to birth weight were lower in boys than girls irrespective of whether or not they were in utero during Ramadan, in both boys and girls those in the second or third trimester of gestation during Ramadan had reduced mean ratios.

4. Discussion

We have examined the body and placental size of 7000 babies born over a four-year period in a small city in Saudi Arabia. When compared to babies who were not in utero during Ramadan those who were in the second or third trimester of gestation during Ramadan had reduced mean placental weight and a reduced ratio of placental weight to birth weight. The occurrence of Ramadan was not associated with changes in birth weight.

Placental weight was correlated with both birth weight and gestational age, as would be expected. In contrast to mean birth

Table 1
Mean birth size and gestational age in boys and girls.

Measurements	Boys		Girls		*p*-Value for difference
	Mean (SD)	*n*	Mean (SD)	*n*	
Birth weight (kg)	3.29 (0.50)	3542	3.19 (0.49)	3541	<0.001
Placental weight (g)	473 (87)	3498	467 (86)	3509	0.002
Placental/birth weight (%)	14.6 (3.1)	3498	14.9 (3.0)	3509	<0.001
Gestational age (weeks)	39.8 (1.1)	3542	39.8 (1.0)	3541	0.7