Original Article

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High Altitude: An Independent Factor Causing Decline in Birth Weight

Shaily Sengar[1], Raman Ohary[2]

[1]Consultant Gynaecologist, Community Health Center, Khairna, Nainital, Uttarakhand, India, [2]Consultant Surgeon, Community Health Center, Khairna, Nainital, Uttarakhand, India

Abstract

Introduction: At high altitude, reduced uteroplacental blood flow is likely to be responsible for hypoxia-induced decline in birth weight.

Objective: The objective of this study was to determine whether high altitude is an independent factor causing decline in birth weight.

Materials and Methods: Maternal and infant characteristics were obtained from high altitude (Nainital, Uttarakhand) and low altitude (plain - Farrukhabad District, Uttar Pradesh) regions from February 2014 to April 2014. Finally, comparison was made between each 50 patients of high and low altitude.

Results: The results of the present study suggest that birth weight declines at high altitude in comparison to low altitude. Percentage of low birth weight at high altitude was 56% whereas at low attitude, it was 20%.

Conclusion: High altitude acts independently from other factors to reduce birth weight.

Key words: High altitude, Low altitude, Low birth weight

INTRODUCTION

According to the World Health Organization, any infant who weighs <2500 g is termed a low birth weight (LBW) infant irrespective of when the infant is born during pregnancy. In India, about 2 out of 10 full-term infants are born with LBW.[1]

There are several risk factors for LBW and high altitude is one of them. LBW is a concern because these infants are at an increased risk for complications.

Researchers have found that infants born at high altitude above 2500 m (8202 ft) are about 3 times as likely to be born small for their age as infants born at low altitude.[2]

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According to a study done in Colorado, birth weight declines at an average of 102 g/3300 ft of elevation when the other characteristics were taken into account.[3]

At high altitude, reduced uteroplacental blood flow is likely to be responsible for hypoxia-induced decline in birth weight. Ultrasound-based studies have shown that near-term uterine blood flow is lower by one-third, and calculated oxygen delivery to the pregnant uterus at high altitude is 30% less than that observed at low altitude[4] and consistent with the reduced birth weight.[5]

Krampl *et al.* have published the first systematic, longitudinal analysis of ultrasound-based fetal biometry at a high altitude (4300 m).[6]

MATERIALS AND METHODS

The study was conducted in the community health center (CHC), Garampani, Khairna, Nainital, Uttarakhand, India. Patients who came to this CHC are from high altitude ranging from 1940 m (6360 ft) to 2100 m (6890 ft) from the sea level; comparison was done with patients residing over

Corresponding Author: Dr. Shaily Sengar, Consultant Gynaecologist, Community Health Center, Khairna, Nainital, Uttarakhand, India. E-mail: shailysengar@gmail.com

low altitude of 151 m from the sea level (MSDS Medical College, Farrukhabad District, Uttar Pradesh) over the same time period from January 2014 to April 2014.

About 50 primipara patients from each place were taken and maternal and infant characteristics were noted. All the other risk factors of LBW were excluded such as ex-smoking, high blood pressure, previous bad obstetric history, and preterm delivery.

All patients were between the age of 20 and 30 years of single-term frequency with no other complications.

RESULTS

In this study, we have seen the following observations:

In this study, 28 infants out of 50 were having LBW at a high altitude whereas 10 out of 50 were LBW at a low altitude. Percentage of LBW infants at a high altitude – 56% and percentage of LBW infants at a low altitude – 20%. There was a significant difference with $P < 0.05$ (Table 1 and Figure 1).

At high altitude, only one out of 28 LBW infants born by instrumental delivery and one LBW infant born by lower segment cesarean section because of fetal distress. At low altitude, all LBW infants born by spontaneous vaginal delivery with $P > 0.05$ as not significant (Table 2).

At high altitude, out of 28 LBW infants, 13 were male and 15 were female children. At low altitude, out of 10 LBW infants, 6 were male and 4 were female children with no significant difference at $P > 0.05$ (Table 3).

Both at high and low altitude, the appearance, pulse, grimace, activity, respiration score was <7 at 1 min in 2 LBW infants. But, there was no cases of <7 at 5 min with $P > 0.05$ as not significant. None of the LBW infants needed more than normal resuscitation after birth (Table 4).

We followed the newborn after delivery for 3 months, no mortality was reported in each group, though 6 newborns out of 28 at high altitude came to pediatrics outpatient department with various complaints such as poor feeding, rashes, fever, and cough. They were managed conservatively.

DISCUSSION

At high altitude, patients were thin built, poorly nourished, heavy workers, and there is inadequate oxygenation in atmosphere.

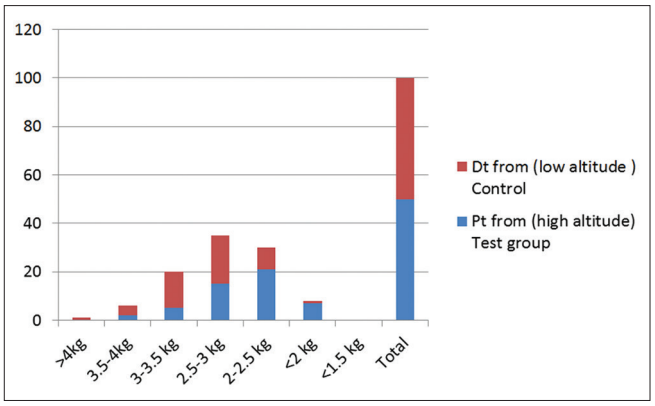

Figure 1: Graphical representation of incidence of low birth weight

Table 1: Incidence of low birth weight

Birth weight	Patient from (high altitude) test group	Patient from (low altitude) control
>4 kg	0	1
3.5-4 kg	2	4
3-3.5 kg	5	15
2.5-3 kg	15	20
2-2.5 kg	21	9
<2 kg	7	1
<1.5 kg	0	0
Total	50	50

Table 2: Mode of delivery

Type of delivery	High altitude	LBW	Low altitude	LBW
Spontaneous	44	26	40	10
Instrumental	04	01	07	00
LSCS	02	01	03	00
Total	50	28	50	10

LSCS: Lower segment cesarean section, LBW: Low birth weight

Table 3: Sex ratio

Sex	High altitude	LBW	Low altitude	LBW
Male	28	13	24	06
Female	22	15	26	04
Total	50	28	50	10

LBW: Low birth weight

Table 4: APGAR score at birth

APGAR score	High altitude	LBW	Low altitude	LBW
1 min <7	3	2	2	2
7-10	47	26	48	8
5 min <7	0	0	0	0
7-10	50	28	50	10

LBW: Low birth weight, APGAR: Appearance, pulse, grimace, activity, respiration

Initially, it was thought that the lower pressure at high altitude means less oxygen is available in the air and because of this, the child receive less oxygen as well as other

nutrients in the womb of mother residing at high altitude. These results are especially apparent in third trimester of pregnancy when a child grows fast and need for oxygen and nutrients is at their peak.

Less oxygen = a slower metabolism = slow

Growth = small babies

Mechanism-

At high altitude - hypoxia

⇅

Decrease transplacental oxygen partial pressure gradient

⇅ And/or

Decrease uteroplacental vasodilators

⇅

Leading to reduced uterine blood flow

⇅

Unmatched fetal oxygen demand

⇅ Trigger

Release of fetoplacental hormones and factors that control tissue accretion and differentiation in fetus during late gestation such as insulin, thyroxin, cortisol & IGF.

⇅

Decline in birth weight and size of fetus.

More recently, researchers noted the possibility of a second biological mechanism that involves a glucose pathway. Zamudio *et al.* found that umbilical venous and arterial glucose concentration were lower at high altitude, resulting in lower glucose delivery to and consumption by the fetus. Anaerobic consumption of glucose by the placenta at high altitude appears to reduce glucose availability to the fetus. Hypoglycemia may, therefore, also explain lower birth weight at a high altitude.[7,8] Several studies have confirmed the growth-retarding effect of high altitude.[9-12]

CONCLUSION

According to the present study, we concluded that high altitude acts independently from other factors to reduce birth weight.

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