Hematological profile in pregnancy and its effect on birth outcomes; a longitudinal study in the Komfo Anokye Teaching Hospital

Abstract

Background: Pregnancy causes remarkable and dramatic changes in haematological variables which have an impact on pregnancy and its outcome.

Objective: This descriptive longitudinal study examined maternal hematological parameters during pregnancy and its effect on pregnancy outcomes.

Methods: Three hundred and fifty (350) pregnant women with singleton pregnancies who delivered at the Obstetrics and Gynecology Unit of the Komfo Anokye Teaching Hospital (KATH) were randomly selected into the study. Blood sample was collected from each participant for the estimation of full blood count (FBC) and a well-structured questionnaire used to collect socio-demographic and obstetric history of participants.

Results: Haemoglobin levels steadily decreased from first trimester to third trimester, with a rise during parturition and neonatal periods. Anaemia was most prevalent in the third trimester of pregnancy (47.1%). WBC increased from the first trimester till the neonatal period. PLT count was similar in the three trimesters, with a significant decrease at parturition and neonatal stage. Except for MCV, all the other hematological indices did not show a significant correlation with Apgar score <7 at the 5^{th} minute in our study (P> 0.05). No correlation was found between maternal haematological indices at parturition and neonatal birth weight (P> 0.05). Maternal WBC showed positive significant relationship (β =0.095, P=0.012) with the neonatal WBC count.

Conclusion: Pregnant women have altered haematological indices during pregnancy, parturition and neonatal periods. Parturient haematological indices did not have any significant association with Apgar score <7 at the 5^{th} minute and birth weight.

Keywords: Haematological indices, parturient, Apgar score, birth weight, birth outcome

Introduction

Maternal and child health is an important problem of public health, influencing the development of the family and the community. Pregnancy is characterized many physiological changes, which may appear to be pathological in the non-pregnant state [1]. It is capable of causing remarkable and dramatic changes in haematological variables[2].

Anaemia is a widely identified haematological abnormality. Although recent prevalence of anaemia worldwide suggests a decline in prevalence of iron deficiency anaemia among pregnant women in industrialized regions, more than half of pregnant women are still anaemic, with about 80% of them found in the middle and low income countries such as Ghana [3, 4].

Factors such as the inadequate intake and absorption of iron coupled with the loss of blood during pregnancy might also be some of the precipitating causes of anaemia during pregnancy and research has shown it to be connected with outcomes such as maternal mortality, premature deliveries and low birth weight [5, 6]. A number of studies have also suggested that a fall in maternal haemoglobin is associated with a significant rise in perinatal mortality rate [7, 8]. Few studies have assessed the effect of haematological indices on pregnancy outcomes in Africa. Also, of these, most examined the haematological parameters only during the three trimesters of pregnancy. There is therefore a need to monitor the haematological profile during pregnancy, at parturition and neonatal stages and its effects on neonates. This study, hence, sought to examine maternal haematological parameters during pregnancy, parturition and neonatal period and its effect on pregnancy outcomes at the Komfo Anokye Teaching Hospital in the Ashanti region of Ghana.

Methods

Study Design/Study Setting

This is a descriptive longitudinal study conducted at the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana. It is the second largest hospital in the country and the only tertiary health institution in the Ashanti Region. KATH (Gee) as known by the public is one of the autonomous and self-funded referral centers within the northern sector of Ghana consisting of the Ashanti, Brong Ahafo, Northern, Upper East and Upper West Regions.

Study Population

A total of 350 pregnant women with singleton pregnancies who delivered at the labour ward of Obstetric and Gynaecological Unit were randomly enrolled into the study. Pregnant women or parturients who did not agree to the terms of the study and therefore did not consent to be part of the study were excluded. Mothers with multiple pregnancies and also pregnant women who were psychologically unstable were also excluded from the study

Ethical Considerations

Approval for study was sought from the KATH Research and Development unit and the Committee on Human Research Publication and Ethics(CHRPE), SMS, KNUST. Informed written consent was sought from the participants after being given adequate information on the objectives and benefits of the project. The study was carried out following WHO Guidelines for good clinical practice (WHO, 1995).

Questionnaire administration

A well-structured pre-tested questionnairewasused to collect demographic data and obstetric history of each participant.

Data Collection Technique

A questionnaire was used to collect data. Relating to age, marital status, educational status, occupation, religion and ethnicity, the number of ANC visits, whether the first pregnancy and number of pregnancies. The clinical and obstetric histories of the women were recorded.

Blood Sampling:

Mother: Five (5) mls venous blood was collected into a labeled ethylenediaminetetra acetic acid (EDTA) containing tube.

Baby (Neonate): Three (3) mls cord blood was aspirated from the umbilical vein and transferred into a labelled ethylenediaminetetra acetic acid (EDTA) containing tube.

Haematological Analysis

Full blood count was estimated by an automated hematologic analyzer (Mindray BC- 3000 plus system, China).Standardization, calibration of the instrument, and processing of the samples were done according to the manufacturer's instructions.

Determination of Apgar score and Body Mass Index

The Apgar scores, the length and weight of the newborn were evaluated immediately after birth in the delivery room at the labour ward. The Apgar score was done twice, once at 1st minute and again at 5th minutes after birth. The BMI (Body Mass Index) of the baby was calculated after the fifth minute.

Data Analysis

Data was entered into Microsoft Excel and analyzed with SPSS version 16.0 (SPSS Inc., Chicago, IL,USA). The results were expressed as mean ± standard deviation and ANOVA was used to compare means. Correlation and linear regression analyses were used to find relationship between variables. A p value of ≤ 0.05 was considered statistically significant.

Results

Table 1 shows the obstetric history of the study participants. Majority of the participants (85.7%) visited the antenatal clinic 1 to 5 times before delivery. Most (72%) of them were multigravida, with about 57% having one child.

Haemoglobin levels steadily decreased from first trimester to third trimester, with a rise during parturition and neonatal periods.HCT and MCV were similar during the first, second and third trimesters, however, but increased at parturition and neonatal stage. Trends of RBC, MCH and MCHC were comparable at first to third trimesters, with a decrease at parturition and then an increase at neonatal stage except RBC which continued to decrease.Furthermore, PLT and PCT were similar at first, second and third trimesters with a dramatic decrease at parturition and a sharp increase in PCT at neonatal stage. On the other hand, WBC increased steadily from the first to third trimesters,with a significant increase during parturition and neonatal stages (Figure 1).

MCV showed a significant negative correlation with Apgar score <7 after the 5^{th} minute. The other full blood count indices did not show a significant correlation with Apgar score <7 after the 5^{th} minute (Table 2).

Prevalence of Anaemia at the various stages of pregnancy is presented in Figure 2. Anaemia was most prevalent in the third trimester of pregnancy followed by second trimester, neonatal period, with first trimester having the least prevalence.

Table 3 compares the hematological indices of different gestational periods. A significant difference ($P< 0.05$) was found between all the hematological indices at parturition and the various trimesters, except between MCV at first trimester.

Neonatal full blood count indices did not show significant correlation with Apgar score after 5 minutes ($P>0.05$) (Table 4).

Low birth weight did not show significant correlation with haematological indices at parturition (P> 0.05). (Table 5)

Table 6 presents the relationship between neonatal hematological indices and the parturient indices. MCV (β =0.119, p=0.018), MCHC (β =0.132, p≤0.001) and WBC (β =0.095, p=0.012) showed positive significant relationships between mothers in labour and the neonatal indices at birth. (Table 6).

Discussion

Pregnancy is one of the physiological conditions capable of causing remarkable and dramatic changes in haematological variables. The haematological indices also have an impact on pregnancy and its outcome [2]. This study examined maternal haematological parameters throughout pregnancy and its effect on pregnancy outcomes among parturients.

Haemoglobin levels steadily decreased from first trimester to third trimester, with a rise during parturition and neonatal periods. Anaemia was most prevalent in the third trimester of pregnancy. This is consistent with the findings of previous studies and have been attributed to an increased demand for iron as pregnancy progresses or hemodilution in the third trimester of pregnancy [9, 10].

WBC increased from the first trimester till the neonatal period. This agrees with previous work by [11], who asserted that WBC count rising in early pregnancy will remain elevated through pregnancy. [12] also observed an increased WBC count from the first to third trimester in a study conducted in Lagos, Nigeria. The increase might be due to an increase in neutrophils as a response to stress due to redistribution of the WBCs between the marginal and circulating pools[12]. Also, white blood cells are responsible for body defense during pregnancy and the continuous rise may be as a result of the body building the immunity of the fetus[13]. This hypothesis is further supported by our finding of a significant positive correlation between maternal and neonatal WBC counts.

PLT count was similar in the first, second and third trimesters, with a significant decrease at parturition and neonatal stage. This is consonance with the finding of no significant differences in the three trimesters by [14] in a study conducted at Port Harcourt, Nigeria. This has been associated with gestational thrombocytopenia which is due to hemodilution and increased platelet activation and accelerated clearance. The condition requires no specific treatment andcorrects itself spontaneously after delivery [15].

The Apgar score describes the condition of the newborn infant immediately after birth[16] . A low Apgar score at 5 minutes in term infants correlates poorly with future neurologic outcomes (American Academy of Pediatrics, 2006). Except for MCV which had a significant negative correlation, all the other hematological indices did not show a significant correlation with Apgar score <7 after the 5^{th} minute in our study. This is in line with the finding of no significant correlation of maternal hemoglobin, hematocrit and RBC count with Apgar score at the 5^{th} minute by [17]. Neonatal full blood count indices also did not show significant correlation with Apgar score after 5 minutes.

Maternal hemoglobin has been significantly associated with physical growth of neonate [18, 19]. On the contrary, no correlation was found between maternal hemoglobin at parturition and neonatal birth weight in this study. A Nigerian study by [20] also showed no significant relationship between maternal parameters and birth weight of the newborn. In another longitudinal study by [21], there was no significant difference between maternal hemoglobin and Apgar scores and birth weight. The differences in the various observations could be attributed to differences in geographical locations, race, socio-economic status and cultural practices.

Maternal hemoglobin, RBC count, hematocrit and MCH were not associated with that of the neonates. This is consistent with the findings of [19] in which maternal hemoglobin had no effect on neonatal Haemoglobin, mean corpuscular haemoglobin (MCH) at birth.

Though the has strength in it, to the best of our knowledge, being the first study to examine haematological changes thoughout the stages of pregnancy, our inability to assess the cause of haematological changes among the parturients served as a limitation to this study.

Conclusion

Alteration in haematological indices occurs throughout pregnancy to the neonatal period. Parturient and neonatal haematological indices did not have any significant association with Apgar score <7 at the 5th minute and birth weight.

References

1. Wadhwa PD, Entringer S, Buss C, Lu MC: **The contribution of maternal stress to preterm birth: issues and considerations**. *Clinics in perinatology* 2011, **38**(3):351-384.
2. Yip R: **Significance of an abnormally low or high hemoglobin concentration during pregnancy: special consideration of iron nutrition**. *The American journal of clinical nutrition* 2000, **72**(1):272s-279s.
3. Mumbare SS, Maindarkar G, Darade R, Yenge S, Tolani MK, Patole K: **Maternal risk factors associated with term low birth weight neonates: a matched-pair case control study**. *Indian pediatrics* 2012, **49**(1):25-28.
4. Diagne N, Rogier C, Sokhna CS, Tall A, Fontenille D, Roussilhon C, Spiegel A, Trape J-F: **Increased susceptibility to malaria during the early postpartum period**. *New England journal of medicine* 2000, **343**(9):598-603.
5. Sharma P, Nagar R: **Hematological profile of anaemic pregnant women attending antenatal hospital**. *IOSR J Nursing Health Sci* 2013, **1**(Suppl 4):11-15.
6. Rasheed P, Koura M, Al-Dabal B, Makki S: **Anemia in pregnancy: A study among attendees of primary health care centers**. *Annals of Saudi medicine* 2008, **28**(6):449.
7. Matthew AK, James OOA, Bolanle D, Stephen OO: **Hamatological parameters and malaria parasite infection among pregnant women in Northwest Nigeria**. *Asian Pacific Journal of Tropical Disease* 2013, **3**(1):47-50.
8. Osonuga I, Osonuga O, Osonuga A, Onadeko A, Osonuga A: **Effect of artemether on hematological parameters of healthy and uninfected adult Wistar rats**. *Asian Pacific journal of tropical biomedicine* 2012, **2**(6):493-495.
9. Imam T, Yahaya A: **Packed cell volume of pregnant women attending Dawakin Kudu General Hospital, Kano state, Nigeria**. *Int Jor P App Scs* 2008, **2**(2):46-50.
10. Osungbade KO, Oladunjoye AO: **Preventive treatments of iron deficiency anaemia in pregnancy: a review of their effectiveness and implications for health system strengthening**. *Journal of pregnancy* 2012, **2012**.
11. Luppi P: **How immune mechanisms are affected by pregnancy**. *Vaccine* 2003, **21**(24):3352-3357.
12. Akinbami AA, Ajibola SO, Rabiu KA, Adewunmi AA, Dosunmu AO, Adediran A, Osunkalu VO, Osikomaiya BI, Ismail KA: **Hematological profile of normal pregnant women in Lagos, Nigeria**. *International Journal of Women's Health* 2013, **5**:227-232.
13. Ichipi-Ifukor PC, Jacobs J, Ichipi-Ifukor RN, Ewrhe OL: **Changes in haematological indices in normal pregnancy**. *Physiology Journal* 2013, **2013**.

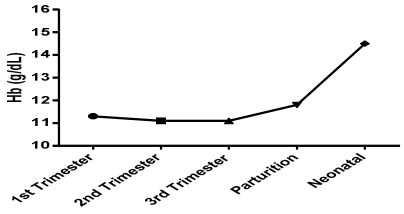
14. Amah-Tariah F, Ojeka S, Dapper D: **Haematological values in pregnant women in Port Harcourt, Nigeria II: Serum iron and transferrin, total and unsaturated iron binding capacity and some red cell and platelet indices**. 2014.
15. Ahmed Y, Iddekinge B, Paul C, Sullivan MH, Elder MG: **Retrospective analysis of platelet numbers and volumes in normal pregnancy and in pre-eclampsia**. *BJOG: An International Journal of Obstetrics & Gynaecology* 1993, **100**(3):216-220.
16. Papile L-A: **The Apgar score in the 21st century**. In.: Mass Medical Soc; 2001.
17. Papadopol V, Damian O, Palamaru I, Adam C, Florescu N, Dămăceanu D: **Maternal hematological and biochemical parameters and pregnancy outcome**. *The Journal of Preventive Medicine* 2001, **9**(3):27-33.
18. Singla P, Tyagi M, Kumar A, Dash D, Shankar R: **Fetal growth in maternal anaemia**. *Journal of Tropical Pediatrics* 1997, **43**(2):89-92.
19. Dalal E, Shah J: **A Comparative Study on Outcome of Neonates Born to Anemic Mothers versus Non Anemic Mothers**. *National Journal of Medical Research* 2014, **4**(4):270-273.
20. Ugwuja E, Akubugwo E, Ibiam U, Onyechi O: **Impact of maternal iron deficiency and anaemia on pregnancy and its outcomes in a Nigerian population**. *The Internet Journal of Nutrition and Wellness* 2010, **10**(1):1-11.
21. Al-Mudallal SS, Al-Moeen MA: **Evaluation of the effect of mode of delivery on hematological parameters of healthy full-term newborns**. *Iraqi Journal of Medical Sciences* 2000:29.

Results

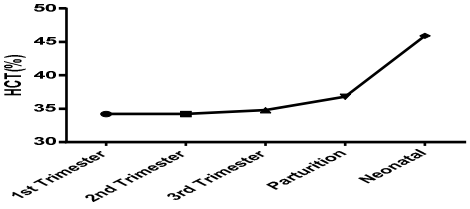
Table 1: Obstetric characteristics of study participants

Variable	Frequency (n=350)	Percentage (%)
Number of ANC visits		
1-5 times	300	85.7
6-10 times	44	12.6
11-15 times	6	1.7
First pregnancy		
No	252	72
Yes	98	28
Number of previous pregnancies		
None	98	28
One	199	56.9
Two	43	12.3
Three	8	2.3
Four	2	0.6

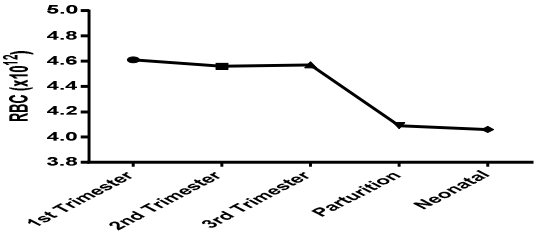
A



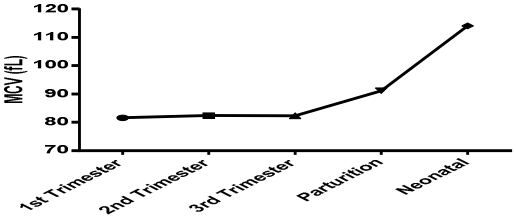
B



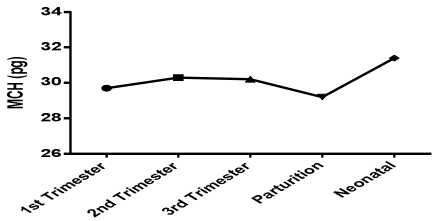
C



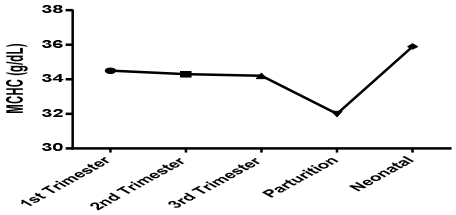
D



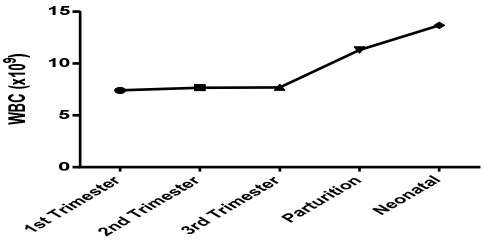
E



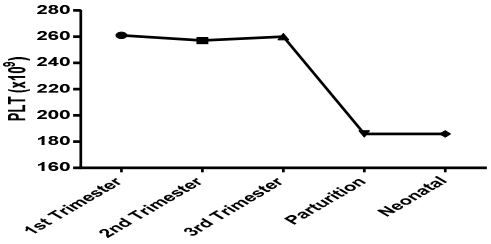
F



G



H



I

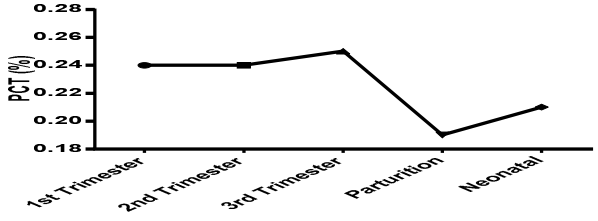


Figure 1: A-I; Haematological indices of the participants from first trimester to neonatal period.

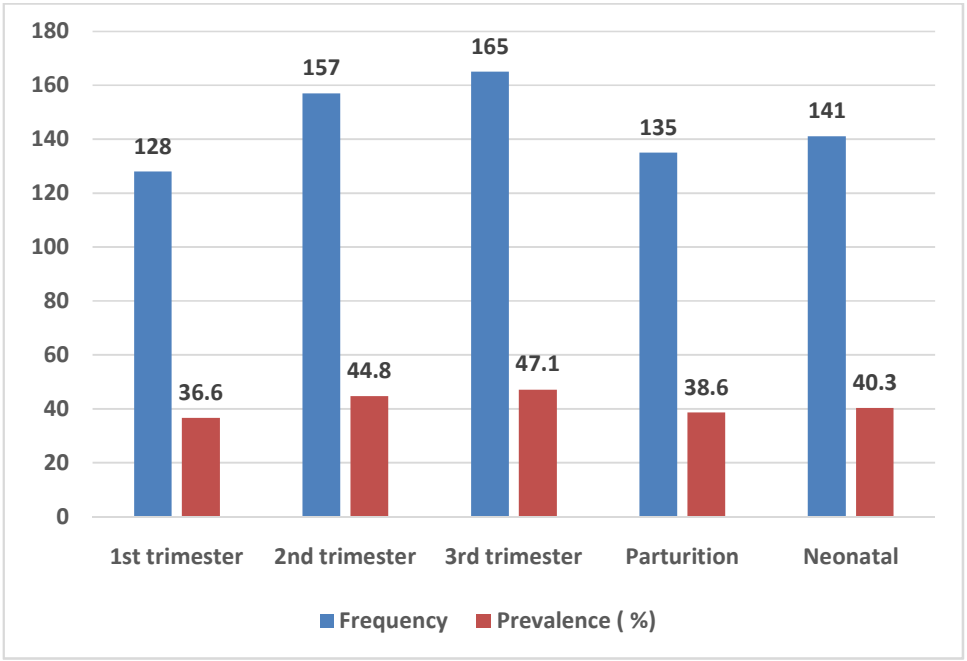


Figure 2: Prevalence of Anaemia at the various stages of pregnancy

Table 2. Pearson Correlation between hematological parameter of parturition and Apgar score

Hematological parameter at Parturition	Apgar score_< 7 after 5th_minutes	
	R	p-value
Hb (g/dL)	0.087	0.675
RBC ($10^{\wedge 12}$/L)	0.367	0.070
HCT (%)	0.038	0.854
MCV(fL)	-0.557	**0.003**
MCH (pg)	-0.316	0.124
PCT (%)	0.196	0.367
MCHC (g/dL)	0.033	0.875
WBC (10^9)	0.154	0.461
PLT (10^9/L)	0.114	0.605

Table 3: Comparative differences between Hematological Indices for the trimesters and parturition

	1st & Part.*		2nd & Part*		3nd & Part*	
Index	**Diff. (se)**	**p-value**	**Diff. (se)**	**p-value**	**Diff. (se)**	**p-value**
HGBg/dl	-0.44 (0.14)	0.002	-0.62 (0.15)	<0.001	-0.66 (0.14)	<0.001
RBC (x 10^{12})	0.52 (0.07)	<0.001	0.46 (0.07)	<0.001	0.48 (0.07)	<0.001
HCT (%)	-2.6 (0.50)	<0.001	-2.5 (0.54)	<0.001	-2.01 (0.54)	<0.001
MCV (fL)	-9.60 (0.80)	<0.001	-8.0(0.76)	<0.001	-8.92 (0.77)	<0.001
MCH (pg)	0.51 (0.26)	0.054	1.07 (0.27)	<0.001	1.03 (0.27)	<0.001
PCT (%)	5.44 (0.53)	<0.001	5.79 (0.60)	<0.001	6.04 (0.60)	<0.001
MCHC (g/dl)	2.53 (0.22)	<0.001	2.35 (0.21)	<0.001	2.24 (0.23)	<0.001
WBC (x 10^9)	-3.85 (0.25)	<0.001	-3.58(0.30)	<0.001	-3.55 (0.27)	<0.001
PLT (x 10^9)	75.4 (5.09)	<0.001	70.6 (5.01)	<0.001	74.4 (4.80)	<0.001

Table 4: Pearson Correlation between hematological parameter of neonates and Apgar score

Hematological parameter of Neonate	**Apgar score_< 7 after 5th_minutes**	**p-value**
	r	
Hb (g/dL)	0.088	0.6734
RBC(10^{12}/L)	0.257	0.2133
HCT (%)	0.106	0.6137
MCV(fL)	-0.284	0.1683
MCH (pg)	-0.368	0.0697
PCT (%)	-0.016	0.9426
MCHC (g/dL)	-0.142	0.4954
WBC (x10^9)	0.103	0.6288
PLT (x10^9/L)	-0.009	0.9657

285 **Table 5. Pearson Correlation between hematological parameter at parturition and low**
286 **birth weight**

Hematological parameter at Parturition	Low birth weight (<2.5kg) R	p-value
Hb (g/dL)	-0.132	0.359
RBC(10^{12}/L)	0.090	0.532
HCT (%)	-0.146	0.312
MCV(fL)	-0.043	0.767
MCH (pg)	0.007	0.963
PCT (%)	0.065	0.653
MCHC (g/dL)	0.054	0.712
WBC (10^9)	0.014	0.921
PLT (10^9/L)	0.190	0.187

287

288

289 **Table 6: Relationship between neonatal hematological indices and parturientindices**

Index	B	p-value
Hb (g/dL)	-0.009(0.05)	0.846
RBC (10^{12}/L)	0.054(0.06)	0.405
HCT (%)	-0.009(0.04)	0.840
MCV(fL)	0.119(0.05)*	0.018*
MCH (pg)	0.111(0.08)	0.154
MCHC (g/dL)	0.132(0.04) *	<0.001*
WBC(10^9)	0.095(0.04) *	0.012*
PLT (10^9/L)	0.048 (0.04)	0.213
PCT (%)	0.038(0.04)	0.346

290