.

Effect of certain nutritional markers on neonatal outcome

[1].Mohammed Jalil Alwan

M.B.CH.B , F.I.C.M.S(ped.)

Welfare Teaching Hospital/Medical city

محمد جليل علوان

طبيب اختصاص اطفال/ شهادة البورد العراقي في طب الاطفال

مستشفى حماية الاطفال التعليمي-دائرة مدينة الطب

[2] Faten Alaa Jaafar

M.B.CH.B , F.I.C.M.S(ped.)

Central Child Teaching Hospital

د.فاتن علاء جعفر/ شهادة البورد العراقي في طب الاطفال

مستشفى الطفل المركزي التعليمي- دائرة صحة بغداد الكرخ

[3] Hala Sameh Arif

M.B.CH.B , D.C.H , C.A.B.P

Al-Nahrain University

د.هالة سامح عارف/ شهادة البورد العربي في طب الاطفال

كلية الطب - جامعة النهرين

[4].Sinan Abdulrazzaq Ibrahim

M.B.CH.B , F.I.C.M.S(ped.) , F.I.C.M.S (cardio)

Al-Nahrain University

سنان عبد الرزاق ابراهيم/ شهادة البورد العراقي في طب الاطفال – تخصص دقيق قلب اطفال

كلية الطب – جامعة النهرين

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Abstract

Background and Aims :

Several micronutrient deficiencies are well established to be contributors to abnormal prenatal development and pregnancy outcomes. We aimed to correlate these poor neonatal outcomes with nutritional status of their mothers during pregnancy.

Subjects and Methods :

A total of 100 pregnant women at time of delivery with their newborns were investigated for their PCV , blood film , S.Ca and S.Po4 in the obstetrical ward in Al-Khadhimya teaching hospital during the period between the 15th of March to the 15th of May 2009. Vitamin D status is estimated from the levels of S.Ca and S.Po4 . the questionare involved questions about age , parity, economy,educational level, and ANC of the mothers , and also sex , GA, anthropometric measures and outcomes of the newborns.

Results :

From 100 pregnant women who were included in our study , 74 of them delivered by NVDand 26 delivered by C/S with the product of 54 male and 46 female . eleven of the newborns were preterms and another three of them were small for gestational age, with one newborn presented with birth asphyxia and one was stillborn. Forty percent of mothers were anemic , from the anemic mothers only 42.5% were with hypochromic microcytic anemia. Non of the newborns presented with anemia. Thirty-two percent of mothers had hypovitaminosis D and thirty-five percent of newborns also. There was strong correlation between maternal and neonatal vitamin D estimated level. Both anemia and/ or vitamin D deficiency had negative effect on the anthropometric measures of the newborns. Presence of both deficiencies (anemia and vitamin D deficiency) at the same time led to more adverse neonatal outcomes.

Conclusion:

1- anemia and /or low vitamin D status affected badly neonatal outcomes interms of anthropometric measures and prematurity.

2- malnurished mothers even when delivered full terms , although such babies were in the normal anthropometric range , but they were much lower than babies of well nurished mothers.

Key words : Pregnancy, Anemia, Vitamin D deficiency , Combined micronutrient deficiency , poor neonatal outcomes.

Introduction

Maternal nutrition and metabolic factors affect the developmental process of the fetus which consequently influence the birth weight of the newborn(1). During pregnancy, many physiological and metabolic functions are changed to a great extend(2). Pregnant woman need adequate energy and nutrient to meet the increased nutritional for growth of the fetus and to satisfy the increased body demands of the mother(3). Poor maternal nutritional status has been related to different adverse birth

outcome including intrauterine growth restriction and low birth weight (LBW), which can have lifelong consequences for development[4,5,6]. Thus, improving maternal nutritional status before conception and during pregnancy are essential to improve birth outcome of newborns[7]. Hence, the pregnant mothers diet must contain adequate and balanced nutrient to decrease the percentage of LBW babies. Therefore, different strategies such as intensive health education should be planned and carried out to improve the nutritional status of the pregnant women and to reduce the risk of poor birth outcome[8]. Anemia has been a global health burden since it can affect anyone without considering age or gender group. It is an important global health problem affecting nearly 529 million women of reproductive age[9]. Maternal anemia is a major contributor of adverse neonatal outcome, particularly compromised birth weight and head circumference[10]. Iron deficiency is the most common nutritional deficiency worldwide, particularly among pregnant women. Maternal iron deficiency anemia may contribute to low newborn iron status, prematurity, IUGR and poor health of infants[11]. Vitamin D deficiency is identified as a public health problem in many countries, and pregnant women have been identified as a high- risk group, among whom the prevalence of vitamin D deficiency ranges between 20-40%[12] .

At birth , the newborn's vitamin D status is directly related to maternal vitamin D status and maternofetal transfer of vitamin D and its metabolites. Serum levels of both 25-hydroxyvitamin D and calcitriol are lower than maternal levels , and babies whose mothers have marked vitamin D deficiency will have a compromised vitamin D status.[13] Rickets is often considered a 19th century disease . however , despite the availability of vitamin D and demonstration of its effecacy in preventing rickets, vitamin D deficiency rickets still still exists as a public health problem with significant morbidity in the middle east.[14] And in many other countries.[15] With more studies , there are reports from many countries of a high prevalence of vitamin D deficiency in women of child bearing age .[16] And during pregnancy and in nursing mother[17], with likely adverse consequences for women , fetus and growing infants and children.[18].in addition to rickets and other possible consequences of disturbed calcium homeostasis.[19] epidemiological evidence suggest that the lack of vitamin D supplements in infancy and early childhood may increase the incidence of type 1 diabetes[20].in adults , new evidence supports the role of vitamin D in maintaining the innate immunity and in the prevention of certain disease states including autoimmune disease , multiple sclerosis[21],SLE[22], type2 diabetes.[23].

Subjects and methods :

This study is a cross- sectional study included 108 pregnant women who attended to the obstetrical ward in Al-Khadhimya Teaching Hospital for labour, in the period between the 15th of March to the 15th of May 2009, and during the hours between 1:00 PM to 4:00 PM of each day during the above period . seventy eight delivered with NVD , and thirty were delivered by C/S. all these 108 pregnant women were without chronic diseases where pregnant women with such diseases had been excluded from the study.for each

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delivery 4 samples of blood were aspirated, 2 from the mother before delivery and 2 from the placental side of umblical cord , 8cc of blood was aspirated for PCV ,blood film, Ca, Po4 from the mother and umblical cord.the questionare included information about age and parity of the mother ,economical status ,educational level, intake of tonic during pregnancyand attendance to the ANC. Mothers according totheir educational level were classified into illitrate,read and write , primary school,intermediate school ,secondary school, and higher(institute or college).regarding to the maternal impression and employment of the father and income of the family ,the mothers were classified as low , intermediate , and high economical status , where families with income far less below five hundred thousands dinars were considered a low economic status, families with income around this number were considered as intermediate economic status and families with income far above this number were considered as high economic status.the quetionare included another set of information belong to the newborns which were sex , gestational age , mode of delivery , anthropometric measures (weight, length ,head circumference) and neonatal outcome (either normal or presence of adverse neonatal outcome such as prematurity , IUGR, RDS, Sepsis, and etc). according to the WHO definition of anemia in pregnancy , mothers with PCV less than 33% considered as anemic mothers31. Regarding to the newborn normal range of PCV is between 40-65%.Blood film resulted were either normochromic normocytic or hypochromic microcytic.anemic mothers with normochromic normocytic blood films were considered to have dilutional anemia of pregnancy. normal ranges of serum calcium and phosphorus for the mother (S.Ca=8.8-10 mg/dl , S.Po4=2.5-6 mg/dl), and normal ranges for the newborns(S.Ca=8.8-11.3 mg/dl, S.Po4=4.8-7.4 mg/dl)[24]. Vit D level in mothers and newborns calculated by the following equation: Vit D estimate =S.Ca (mg/dl)* S.Po4 (mg/dl) , and normal range =40-70 mg/dl. [25]from 108 mothers and newborns eight blood samples were hemolysed and therefore excluded from the study.Data were analysed using SPSS13 computer software , P value less than 0.05 was considered significant.

Results :

from 100 pregnant women who were included in our study , 74of them delivered by NVD and 26 by C/S ,with the product of 54 male and 46 females , eleven of the newborns were preterms and another three of them were small for gestational age, with one newborn presented with birth asphyxia and one was stillborn.mothers were grouped according to the presence or absence of certain nutritional deficiencies as:

Group I : mothers with no abnormality with no anemia and no evidence of Vit D defieciency

Group II : mothers with isolated anemia

Group III : mothers with isolated evidence of Vit D deficiency, in the absence of anemia

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Group VI : mothers with combined deficiency (anemia and Vit D defiency)

Our study showed that group IV mothers had 26.47 times prevalence risks of having newborns of poor outcomes in comparison to the reference group (group I mothers) ,while group III mothers had 15 times prevalence risk,in the two groups the relation was statistically significant, in group II mothers there was no significant association as shown in table 1.

Types of adverse neonatal outcomes with their numbers and percentages in relation to groups of mothers were shown in table 2. Anthropometric measures of full term newborns were correlated with maternal nutritional status. The Z score of weight for age was more remarkably affected in group IV mothers,followed in severity by group II mothers , then group III mothers . A similar affection was shown in other measures (weight for length , length for age and head circumference for age) as shown in table 3.

In relation to neonatal Vit D status , group IV mothers had the highest effect on the newborns to be presented with Vit D deficiency , followed by group III mothers then group II mothers as shown in table 4.There was significant association ($p<0.001$) and very strong linear correlation coefficient ($r=0.934$) between maternal Vit D status and that of their newborns.there was significant association ($p<0.001$) and strong linear correlation coefficient ($r=0.66$) between maternal blood P.C.V. and neonatal blood P.C.V.

Our study demonstrated thet the number of anemic mothers was 40, 23of them had dilutional anemia and 17 had hypochromic microcytic anemia ,table 5 showed that mothers with hypochromic microcytic anemia had 5.41 times prevalence risk of having adverse neonatal outcome in comparison to mothers with dilutional anemia. Maternal hypochromic microcytic anemia had led to a statically significant reduction in weight for length of full term newborns,while it did not affect other growth parameters as shown in table 6.table 7 showed that maternal nutritional deficiencyies increased in the ones with lower economic status and lower educational levels. All mothers with no prenatal care suffered from certain types of nutritional deficiencies while only 26.2% of those with prenatal care had nutritional deficiencies.

Table 1 the rate of overall adverse neonatal outcome by nutritional status of mother

Nutritional status in mother	Total N	Adverse neonatal outcome N %	PR	96 % CI for PR	P value
No abnormality (I)	45	12.2	Ref		
Isolated anemia(II)	23	00	**	**	0.66(NS)
Isolated vit D	15	533.3	15	(1.9-	0.003

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deficiency(III)				118.4)	
Combined anemia + vit D deficiency (IV)	17	10 58.8	26.47	(3.66-191.43)	<0.001

Table 2 : the rate of selected types of adverse neonatal outcome by nutritional status of mother

Nutritional status in mother	Absent N %	Preterm N %	IUGR N %	Birth asphyxia N %	Death (still born) N %	Total N %
Group (I)	44 97.8	0 0	0 0	1 2.2	0 0	45 100
Group (II)	23 100	0 0	0 0	0 0	0 0	23 100
Group (III)	10 66.7	5 33.3	0 0	0 0	0 0	15 100
Group (IV)	7 41.2	6 35.3	3 17.6	0 0	1 5.9	17 100
P(Chi-square		<0.001	0.002	0.75 (NS)	0.18 (NS)	

Table 3 the mean of selected anthropometric indices by nutritional status of mother for a group of full term neonates

Neonatal anthropometrics	Group I	Grou p II	Group III	Group IV	P(ANOVA)
Weight for length Z score range Mean+/-SE N	(-1.6to1.4) 0.1+/-0.1245	(-1.3 to -0.5) -1+/-0.0523	(-1.3 to 0.3) -0.4+/-0.1810	(-1.6to -0.5) -1.2+/-0.1510	<0.001
Weight for age Z score range Mean+/-SE N	(-1.5to 1.1) -0.1+/-0.1145	(-1.5 to-0.4) -1.1+/-0.0723	(-1.4 to 0) -0.5+/-0.1410	(-2.8to -0.4) -1.5+/-0.2510	<0.001
Length for age Z score range Mean +/-SE N	(-0.6to0.7) 0.1+/-0.0445	(-0.8 to 0.3) -0.2+/-	(-0.1to 0.3) 0.1+/-0.0510	(-2.9to0.3) -0.7+/-0.410	<0.001

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		0.07 23			
Head circumference for age Z score range Mean+/-SE N	(-0.9to0.2) -0.2+/-0.0545	(-0.9 to 0.2) -0.5+/-0.08 23	(-0.4to0.2) -0.2+/-0.110	(-2.6to0.2) -0.8+/-0.3410	0.003

Table 4 the rate of neonatal vitamin D deficiency by nutritional status of mother

Nutritional status in mother	Total N	Neonatal Vit D deficiency N %	PR	96% CI for PR	P value
Group I	45	12.2	Ref		
Group II	23	4 17.4	7.83	(0.93-66.05)	0.038
Group III	15	13 86.7	39	(5.56-273.64)	<0.001
Group IV	17	17 100	45	(6.48-312.55)	<0.001

Table 5 : the rate of overall adverse neonatal outcome by type of maternal anemia

Type of maternal anemia	Total N	Adverse neonatal outcome N %	PR	96% CI for PR by Ln method	P value
Dilutional anemia	23	28.7	Ref		
Hypochromic microcytic anemia	17	8 47.1	5.41	(1.31-22.32)	0.007

Table 6 : the mean of selected anthropometric indices of the neonates by type of maternal anemia for agroup of full term neonates.

Neonatal anthropometrics	Dilutional anemia	Hypochromic microcytic anemia	P(t-test)
Weight for length Z score range Mean+/-SE N	(-1.3to-0.5) -0.9+/-0.0621	(-1.6to -0.6) -1.2+/-0.119	0.034
Weight for age Z score range Mean+/-SE N	(-2.4to0.4) -1.1+/-0.122	(-2.8to -0.8) -1.4+/-0.211	0.17(NS)

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Length for age Z score range Mean +/-SE N	(-2.2to0.3) 0.3+/-0.12 22	(-2.9to0.3) -0.5+/-0.32 11	0.37(NS)
Head circumference for age Z score range Mean+/-SE N	(-2to0.2) -0.5+/-0.11 22	(-2.6to0.2) -0.7+/-0.27 11	0.57(NS)

Table 7 the rate of maternal nutritional deficiencies (defined as anemia with or without vitamin D deficiency) by selected socio-demographic variables

	Total N	Anemia and /or vit D deficiency in mother N %	P
Economic status Low Intermediate high	28 68 4	27 96.4 28 41.2 0 0	<0.001
Maternal educational level Illiterate Read and write only Primary school Intermediate school Secondary school Higher school	1 4 14 11 26 44	1 100 4 100 14 100 11 100 19 73.16 13.6	<0.001
Prenatal care for the mother Negative positive	39 61	39 100 16 26.2	<0.001

Discussion:

Adequate maternal micronutrient status is especially critical during pregnancy and lactation.In our study , we drew attention to micronutrient issues that are sometimes nglected in the context of the care of pregnant and lactating mothers.one of these is the importance of recognizing the continuum of maternal micronutrient status from the periconceptional period through lactation,and of fetal and infant dependency on adequate maternal status through this time.Another is the fact that multiple micronutrient deficiencies are likely to be present in many situations, some of which have been insufficienly appreciated as contributors to poor pregnancy outcomes and infant development.[26]

Regarding to mother-newborn vitamin D status,our study depended on calcium and phosphorus levels to estimate vit D

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status of the mothers and newborns where obtaining direct level of vit D was not possible. Our study showed that 32% of mothers had hypovitaminosis D and 35% of newborns also. Maternal vitamin D deficiency during pregnancy was going with the increment of vit D deficiency around the world where deficiency of this vitamin documented in a number of studies ,18% of pregnant women in UK [27],25% in UAE[28], 80% in Iran[29], 42% in northern India[30] ,61% in New Zealand[31], these studies raise the concern that infants are entering the world with vitamin D deficit that begins in utero [32], our study demonstrated thet there was strong correlation between vitamin D status of the mothers and their newborns where maternal hypovitaminosis D associated with hypovitaminosis D in newborns. This is supported by recent studies from many countries [28,29,33,34), which also demonstrated positive correlation between vitamin D status of the mothers and their newborns. In our study we found that maternal vitamin D deficiency during pregnancy also associated with negative effect on neonatal outcomes represented by prematurity and adverse effect on anthropometric measures of full terms(IUGR). Two studies from Tehran ,one in 2002 in Tehran University education hospitals demonstrated the presence of strong correlation between maternal and cord blood serum concentrations of vitamin D[35). Another study in 2004 studied the effect of maternal hypovitaminosis D on their neonatal anthropometric measures and the result was that only one-third of the mothers had adequate vitamin D status and mean length at birth, birth weight and 1-min apgar score were higher in newborns whose mothers with adequate vitamin D status than in newborns whose mthers had hypovitaminosis D[36). In another study done on pregnant women attending the teaching hospital in Nigeria in 1996, vitamin D levels were lower in women practicing purdah(the use of veils) and their newborns than those not practicing purdah and their newborns .[37] The main two causes that are responsible for hypovitaminosis D in mothers and their newborns and subsequently the poor neonatal outcomes shown by our study and other studies in the world are insufficient sun exposure especially in Muslim women due to religious practices (the use of viels) , and a poor quality diet. [38] Our study also focused on the relationship between maternal anemia and perinatal outcome where we found that maternal anemia during pregnancy was associated with fetal complications such as IUGR , preterm birth, and low birth weight. Our study had shown that hypochromicmicrocytic anemia had higher effect on neonatal outcome than dilutional anemia of pregnancywhere 47.1% of newborns whose mothers had hypochromic microcytic anemia had poor neonatal outcome in comparison to only 8.7% of newborns whose mothers had dilutional anemia of pregnancy. In a study done in turkey between january 2003 and december 2006, on two groups of pregnant women (first group with anemia and second group without anemia), the result was that percentages of preterms , IUGR, and neonatal care unit admission were higher in anemic group than in non-anemic group. [39] In another study done in

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paakistan in 2004 , they found that preterm birth risk was 4 times , low birth weight risk was 1.9 times,low apgar score was 1.8 times and intrauterine fetal death was 3.7 times more common in anemic pregnant women compared to non anemics.(40) In another study done in Nepal 2001 , used the first antenatal visit hematocrit levels as parameter, and concluded that low birth weight and preterm birth rates were significantly higher when the maternal hematocrit was under 24%.(41) Another study done on anemic mothers in India in 2002 , reported thaat severe anemia increased the risk for low birth weight babies much more than mild anemia did.(42) In a study done on severely anemic pregnant women who had 5 g/dl or lower hemoglobin at the third trimester in Mexico, (2005). They found that preterm birth rate 69.2%, fetal distress 23%, low birthweight 24.6% and neonatal death rate 35%.(43)although in our studied sample newborns of anemic mothers had normal PCV measurement, there was a positive correlation between maternal and neonatal PCV measurement. Several studiesthet were reported in countries as divers as Niger(44), India (45), China (46), Japan(47), and Ireland (48) there was lack of association between maternal hemoglobin concentrations at or near term and cord blood hemoglobin concentrations , but in a study reported by sisson TR and Lund CJ in UK, they found that newborns born to non-anemic mothers had distinctly higher blood volumes ,and hemoglobin mass than those of newborns born to anemic mothers (49). Finally , our study demostrated that when there is combined nutritional deficiencyvitamin D deficiency and anemia) of mothers,this will lead to more poor neonatal outcomes than each deficiency alone , where mothers with combined nutritional deficiency had 26.47 times prevalence risk of having newborns with poor neonatal outcomes in comparison to mothers with no nutritional deficiency , where mothers with combined deficiency had 35.3%premature delivery, 17.6% IUGR and 5.9% still-born. There are two explanations for this result :

First: there will be double effect on neonatal outcome because each deficiency has negative effect on neonatal anthropometric measures as shown previously in this chapter.

Second : iron is often found to be poorly regulated or even deficient in vitamin D deficiency , leading to more adverse effect of anemia on neonatal outcome.(50) our study demonstrated that maternal nutritional deficiencies and accordingly poor neonatal outcomes increased when economoic status and educational level of mothers decreased, also we found that all mothers without prenatal care had certain types of nutritional deficiencies while only 26.2% of those with prenatal care had nutritional deficiencies . a number of studies also showed the same relationship between economic status , educational level and antenatal care of the mothers with their nutritional status and then with their neonatal outcomes. (36,51,52)

Conclusion:

1- our study showed that 32% of mothers and 35% of newborns had hypovitaminosis D, also we found that

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40% of mothers had anemia and non of the newborns had anemia. We found that approximately two-third of mothers received iron and folate supplementation during pregnancy and non of them received vit D supplementation.also we found that when economic status and educational level of the mothers decreased ,nutritional deficiencies of them increased.

2- strong correlation was found between maternal vitamin D levels and its levels in their newborns. On the other hand there was also correlation but to a lesser degree between maternal PCV and neonatal PCV

3- Each of maternal anemia or hypovitaminosis D had led to poor neonatal outcomes such as IUGR ,prematurity , and low birth weight.

4- combined deficiency (anemia and vitamin D deficiency) had the largest effect on the neonatal outcome in comparison to each deficiency alone, where mothers with combined deficiency had 26.47 times prevalence risk of having newborns with poor neonatal outcomes in comparison to the reference group (mothers without anemia aand vitamin D deficiency).

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الخلاصة:

الخلفية والاهداف:

من الواضح ان نقص اي من العناصر الغذائية المتعددة من الممكن ان يسهم في تطورات ونتائج غير طبيعية في الجنين قبل الولادة وبعدها . نحن نهدف من خلال هذا البحث ان نربط بين مشكلات الرضع (حديثي الولادة) وبين الوضع الغذائي لامهاتهم خلال الحمل .

الموضوع وطريقة العمل:

تمت الدراسة على مائة امراة حامل في وقت الولادة وعلى مواليدهم الجدد ، حيث تم اخذ عينات خاصة لهم تتضمن نسبة الدم وصورة كاملة له مع عينات من مصل الدم لقياس نسبة الكالسيوم والفسفور وذلك في ردهة التوليد في مستشفى الكاظمية التعليمي للفترة مابين ٢٠٠٩/٣/١٥ م الى ٢٠٠٩/٥/١٥ م . نسبة فيتامين دال تم تخمينها من خلال معرفة نسب كل من الكالسيوم والفسفور في الدم . الاستبيان تضمن اسئلة تخص الام وهي عمرها وتاريخها الولادي ومستواها العلمي والحالة

المعاشية للعائلة مع معرفة ماذا كانت تراجع الرعاية الصحية اثناء الحمل ام لا .

تضمن الاستبيان ايضا معلومات تخص المولود الجديد من حيث الجنس والفترة التي قضاها داخل الرحم وقياسات الطول والوزن ومحيط الراس مع معلومات عن حالته الصحية العامة .

النتائج:

من مجموع مائة ام تمت عليها الدراسة ، كان هناك ٧٤ ولادة طبيعية و ٢٦ عملية قيصرية مع ولادة ٥٤ ذكر و ٤٦ انثى . احد عشر مولود كانوا من الخدج وثلاثة مواليد يعانون من نقص النمو داخل الرحم ، مع وجود ولادة واحدة لطفل اصيب باختناق ولادي واخر ولد ميتا . ٤٠ % من الامهات مصابون بفقر الدم و ٤٢.٥ % من تلك الفئة مصابون بفقر دم نقص الحديد ، لا يوجد من بين المواليد من هو مصاب بفقر دم . ٣٢ % من الامهات و ٥ % من المواليد الجدد يعانون من نقص فيتامين دال . وجدت الدراسة علاقة قوية بين مستوى فيتامين دال في الامهات ومستواه في في المواليد الجدد ، ووجدت الدراسة ايضا ان لكل من فقر الدم ونقص فيتامين دال تاثيرات سلبية على المواليد الجدد من حيث قياسات الطول والوزن ومحيط الراس . لقد اوضحت الدراسة ان وجود فقر الدم ونقص فيتامين دال في نفس الوقت يقود الى تاثيرات اكبر على المواليد الجدد .

الاستنتاج:

اولا : فقر الدم ونقص فيتامين دال يؤثر بشكل سلبي على المواليد الجدد فيما يتعلق بمقاييس النمو مع زيادة احتمالية الولادات الخديجة .

ثانيا : مواليد الامهات اللواتي لديهن سوء تغذية وان كانوا ضمن القياسات الطبيعية للنمو الا انهم اقل من اقرانهم الذين امهاتهم بصحة جيدة .

كلمات مفتاحية :

الحمل ، فقر الدم ، نقص فيتامين دال ، النقص الغذائي المركب ، مشكلات المواليد الجدد .