

# Relationship between adequacy of prenatal care utilization index and pregnancy outcomes

Tahereh Tayebi<sup>1</sup>, Shahnaz Turk Zahrani<sup>2</sup>, Rezaali Mohammadpour<sup>3</sup>

## ABSTRACT

**Background:** Prenatal care is a comprehensive antepartum care program involving a coordinated approach to medical care and psychosocial support that is optimally offered before conception. Inadequate care during pregnancy can lead to undesirable outcomes, including preterm labor and low birth weight. One of these new, accurate, and comprehensive indicator measurements is adequacy of prenatal care utilization index. This study aimed to assess the adequacy of care and its relationship with preterm labor and low birth weight.

**Materials and Methods:** This analytic historical cohort study was performed on 420 mothers who referred to health centers in Sari during 2010. Data were collected by interviews and questionnaires. Based on the adequacy of prenatal care utilization, this care was classified into four groups: intensive, adequate, intermediate, and inadequate. Data were analyzed using chi-square test, analysis of variance (ANOVA), Spearman correlation coefficient, and relative risk (RR).

**Results:** Of the 420 mothers who were studied, inadequate care was observed in 151 (36%) cases, which was the highest percentage of care. There was a significant relationship between the adequacy of prenatal care utilization and preterm labor and low birth weight (for both  $P < 0.05$ ). Performing inadequate care, the rate of preterm labor was RR = 1.36 times and the rate of low birth weight was RR = 1.08 times more than in adequate and intensive care.

**Conclusion:** According to the programs that reduced the number of referrals of pregnant mothers (standardization protocol for mothers in Iran), this study confirms the efficacy of adequacy of prenatal care on reducing preterm labor and low birth weight. This study emphasizes on minimum care performance and the importance of conducting further studies to assess the relationship between quantities of care and other outcomes.

**Key words:** Adequacy of prenatal care utilization index, Iran, low birth weight, pregnancy outcome, prenatal care, preterm birth

## INTRODUCTION

Prenatal care refers to performance of accurate principles with the aim of maintaining a healthy pregnancy, and optimal mental and physical health of the mother, child, and families.<sup>[1]</sup> Research has shown that adequate prenatal care is an effective intervention in improving pregnancy outcomes.<sup>[2]</sup> Adequate prenatal care provides opportunity for consulting and reducing complications associated with pregnancy and childbirth.<sup>[3]</sup> A great percentage of maternal and fetal mortality, preterm

births, or low-weight births is due to inappropriate and inadequate prenatal care during pregnancy, which could be greatly reduced in childhood and future complications. The overall rate of fetal death was 2.7 in 1000 births in care and 14.1 in 1000 births in no care. In other words, the lack of prenatal care increases the relative risk (RR) of death 3.3 times and that of preterm labor 2 times more.<sup>[4]</sup> In a research aiming to determine the factors associated with inadequate prenatal care in Ecuadorian women, findings showed that inadequate prenatal care would increase the rate of abortion or intrauterine fetal death.<sup>[5]</sup> The results of another research also showed that among women who had received prenatal care, a significant reduction in low birth weight and premature birth was observed.<sup>[6]</sup> On the other hand, Walker and his colleagues showed no adverse effect on maternal or neonatal outcomes in low-risk pregnant women who followed a reduced visit schedule. In this study that was performed by Michigan State University College of Nursing to describe adequacy and satisfaction with prenatal care among rural low-income women, despite there being less-than-adequate prenatal care in 50% of the women, they were satisfied with their care and the outcomes

<sup>1</sup>Department of Midwifery, faculty of Nursing and Midwifery, Mazandaran University of Medical Sciences, Sari, Iran,

<sup>2</sup>Department of Midwifery, faculty of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran,

<sup>3</sup>Department of Biostatistics, faculty of Public Health, Mazandaran University of Medical Sciences, Sari, Iran

**Address for correspondence:** Ms. Shahnaz Turk Zahrani, Department of Midwifery, faculty of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Valiasr Street, Niayesh Highway, Tehran, Iran.  
E-mail: tayebi28@yahoo.com

for infants were good. Comparison with women who received adequate prenatal care showed that there were no differences between this group and the other group of women who had received adequate prenatal care.<sup>[7]</sup>

The new index used for more accurate and comprehensive measurement of prenatal care is called adequacy of prenatal care utilization (APNCU). This index assesses the adequacy of prenatal care by the time of the first visit and the number of its cares. The new index Top of Form does not measure the quality of service, but measures the quantitative caretaking.<sup>[8]</sup> Since there is not adequate evidence about the effective quantity of prenatal care in pregnancy outcomes in Iran, therefore the researcher decided to do careful assessment in effective of poor prenatal care to adverse prenatal outcomes.

## MATERIALS AND METHODS

The present analytical and historical cohort study was conducted on 420 mothers who referred to the health centers in Sari in 2010. Data collection included checklist of basic characteristics and a questionnaire of 27 questions. The study population consisted of mothers who had delivered and referred to health centers in Sari to receive postpartum care and infant health care in less than 2 years. Profile of the study subjects included: age range of 18-35 years, singleton in the last pregnancy, lack of medical and psychiatric illnesses during the last pregnancy, lack of adverse pregnancy outcomes in previous pregnancies, and having prenatal care profiles registered in a family file. For sampling, the list of health centers that provided prenatal care was prepared and six centers were selected randomly for the study. Regarding sampling based on entry and exit, sampling was conducted based on availability method (purpose based).

The questionnaire was validated by obstetrician and gynecology faculty before the study. To determine the reliability of the tool, test-retest method was used; correlation analysis between the two tests was 100%. In this study, preterm labor was explained by delivery signs after 20 weeks until before 37 weeks of pregnancy (or less than 259 days from the last menstrual period). Low birth weight was defined as weight of a fetus or infant at delivery, which is 2500 g or less.<sup>[4]</sup>

An assessment of the adequacy of prenatal care was made using the APNCU Index (often referred to as the Kotelchuck Index), a composite measure based on gestational age of the newborn, the trimester prenatal care began, and the number of prenatal visits made.<sup>[9]</sup> It is based on ACOG standards (one visit per month through 28 weeks, one visit every 2 weeks through 36 weeks, and one visit per week thereafter, adjusted for data of initiation of PNC).

Assessment in the newly measured dimension of the APNCU Index is based on the following categories:

Intensive: Prenatal care begins by the 4<sup>th</sup> month and 110% or more of recommended visits received

Adequate: Prenatal care begins by the 4<sup>th</sup> month and 80%-109% of recommended visits received

Intermediate: Prenatal care begins by the 4<sup>th</sup> month and 50%-79% of recommended visits received

Inadequate: Prenatal care begins after the 4<sup>th</sup> month or less than 50% of recommended visits received

Given the pattern of referrals of pregnant women in Iran, APNCU measured, based on standardized protocol of mothers, according to the instructions of the Ministry of Health and Medical Education Iran, that the usual number of cares for low-risk pregnancy is eight (based on gestation weeks). It considered two cares in the first half of pregnancy (6-20 weeks) and six cares in the second half (21-40 weeks).<sup>[10]</sup> Specific criteria were excluded in our study, such as the absence of a history of preterm labor, low birth weight, or absence of chronic diseases that affect the pregnancy outcome. At the end of sampling, statistical analysis was performed using SPSS software, chi-square test, analysis of variance (ANOVA), Spearman correlation coefficient, and the RR.

## RESULTS

The mean age and standard deviation (SD) of the mothers studied was 25.511 (4.383) years and larger number of mothers were in the age range 28-35 years. Chi-square test showed that there were no significant difference between the studied groups ( $P = 0.443$ ). The t-test also showed no significant difference between mother's age and preterm labor ( $P = 0.639$ ) and low birth weight ( $P = 0.725$ ).

The majority of mothers (86.4%) were unemployed and 54.5% were high school graduates. Chi-square test showed no statistically significant relationship between APNCU and maternal employment and education ( $P = 0.805$  and  $P = 0.189$ , respectively). Preterm labor and low birth weight were not statistically significant in relation to employment ( $P = 0.975$  and  $P = 0.261$ , respectively) and education ( $P = 0.509$  and  $P = 0.168$ , respectively). The results showed that most of the mothers (60.6%) had normal body mass index (BMI). There was no statistically significant difference between APNCU and the mother's BMI with Spearman correlation test ( $P = 0.205$ ). There was no statistically significant difference between the mother's BMI and preterm labor in chi-square test ( $P = 0.035$ ) [Tables 1-3].

**Table 1: Distribution of care (APNCU index) in terms of demographic characteristics**

Variable		APNCU*				P value
		Inadequate	Intermediate	Adequate	Intensive	
Occupation	Unemployed	131 (36.1)	79 (21.8)	151 (31.7)	38 (10.5)	0.845
	Employed	20 (35/1)	14 (24/6)	19 (33/3)	4 (7)	
Education	Primary	21 (28)	21 (28)	23 (30/7)	10 (13/3)	0.187
	Diploma	84 (36.7)	48 (21)	76 (33.2)	21 (9.2)	
	University	46 (39.7)	24 (20.7)	35 (30.2)	11 (9.5)	
BMI	Underweight (<19.8)	7 (22.6)	12 (38.7)	9 (29.0)	3 (9.7)	0.205
	Natural (19.8-26)	44 (21.5)	59 (28.8)	83 (40.5)	19 (9.3)	
	Overweight (26.1-29)	28 (18.4)	53 (34.9)	51 (33.6)	20 (13.2)	
	Obese (>29)	10 (32.3)	10 (32.3)	5 (16.1)	6 (19.4)	
Completion of Yes pregnancy test	Yes	81 (19.8)	135 (33.0)	147 (35.9)	46 (11.2)	0.000
	No	8 (72.8)	0 (0)	1 (9.1)	2 (18.2)	
Participation in childbirth preparation classes	Yes	19 (14.1)	52 (38.5)	48 (35.6)	16 (11.9)	0.097
	No	69 (24.3)	84 (29.2)	100 (35.2)	32 (11.3)	

\*Values are prevalence (percentage)

**Table 2: Distribution of preterm labor in terms of demographic characteristics**

Variable		Preterm labor*		P value
		Yes	No	
Occupation	Unemployed	22 (6.1)	341 (93.9)	0.780
	Employee	4 (7)	53 (93)	
Education	Primary	2 (2.7)	73 (97.3)	0.342
	Diploma	15 (6.6)	214 (93.4)	
	University	9 (7.8)	107 (92.2)	
BMI	Underweight (<19.8)	3 (9.7)	28 (90.3)	0.064
	Natural (19.8-26)	12 (5.9)	194 (94.1)	
	Overweight (26.1-29)	6 (3.9)	146 (96.1)	
	Obese (>29)	5 (16.1)	26 (83.9)	
Number of visits	1-4	20 (10.5)	171 (89.5)	0.003
	5-8	5 (2.3)	213 (97.7)	
	9-14	1 (9.1)	10 (90.9)	
Ultrasound number	<2	3 (6.4)	44 (93.6)	0.766
	2-5	21 (6.0)	331 (94.0)	
	>5	2 (10.0)	18 (90.0)	
Completion of pregnancy test	Yes	22 (5.4)	387 (94.6)	0.000
	No	4 (36.4)	7 (63.6)	
Participation in childbirth preparation classes	Yes	0 (0)	135 (100.0)	0.001
	No	26 (9.2)	259 (90.9)	
Iron intake	Every day	23 (5.8)	371 (94.2)	0.475
	Sometimes	2 (10.5)	17 (89.5)	
	Lack of	1 (14.3)	6 (85.7)	
Multivitamin intake	Every day	12 (4.2)	276 (95.8)	0.021
	Sometimes	11 (12.2)	79 (87.8)	
	Lack of	3 (7.1)	39 (92.9)	
Folic acid intake	Every day	19 (5.0)	362 (95.0)	0.004
	Sometimes	6 (20.0)	24 (80.0)	
	Lack of	1 (11.1)	8 (88.9)	

\*Values are prevalence (percentage)

**Table 3: Distribution of low birth weight in terms of demographic characteristics**

Variable	Low birth weight*		P value	
	Yes	No		
Occupation	Unemployed	27 (7.4)	336 (92.6)	0.094
	Employee	8 (14)	49 (86)	
Education	Primary	2 (2.7)	73 (97.3)	0.108
	Diploma	20 (8.7)	209 (91.3)	
	University	13 (11.2)	103 (88.8)	
BMI	Underweight (<19.8)	5 (16.1)	26 (83.9)	0.035
	Natural (19.8-26)	14 (6.8)	191 (93.2)	
	Overweight (26.1-29)	10 (6.6)	142 (93.4)	
	Obese (>29)	6 (19.4)	25 (80.6)	
Number of visits	1-4	24 (12.6)	167 (87.4)	0.014
	5-8	10 (4.6)	208 (95.4)	
	9-14	1 (9.1)	10 (90.9)	
Ultrasound number	<2	2 (4.3)	45 (95.7)	0.455
	2-5	32 (9.1)	320 (90.9)	
	>5	1 (5.0)	19 (95.0)	
Completion of pregnancy test	Yes	32 (7.8)	377 (92.2)	0.021
	No	3 (27.3)	8 (72.7)	
Participation in childbirth preparation classes	Yes	6 (4.4)	129 (95.6)	0.047
	No	29 (10.2)	256 (89.8)	
Iron intake	Every day	32 (8.1)	362 (91.9)	0.792
	Sometimes	2 (10.5)	17 (89.5)	
	Lack of	1 (14.3)	6 (85.7)	
Multivitamin intake	Every day	18 (6.3)	270 (93.8)	0.047
	Sometimes	13 (14.4)	77 (85.6)	
	Lack of	4 (9.5)	38 (90.5)	
Folic acid intake	Every day	27 (7.1)	354 (92.9)	0.008
	Sometimes	7 (23.3)	23 (76.7)	
	Lack of	1 (11.1)	8 (88.9)	

\*Values are prevalence (percentage)

Also, the results showed, by chi-square test, that the most employed delivery method was cesarean section (74%), and there was statistically significant association between APNCU and delivery ( $P = 0.004$ ). So, the RR was determined by calculating the likelihood of cesarean section in poor health (RR = 1.37 times more) than adequacy of care. Based on the results of chi-square test, it was found that most of the mothers studied (97.4%) had completed pregnancy tests and in those who did complete these tests, there was a significant relationship with APNCU ( $P = 0.000$ ), preterm labor ( $P = 0.000$ ), and low birth weight ( $P = 0.021$ ). Those who had completed pregnancy tests, had adequate care, and there were reduced preterm labor and low birth weight. The majority of the mothers studied (about 2-5 times) did the ultrasound. The results of the Spearman correlation coefficient test showed significant relationship between

the number of ultrasound and adequacy of prenatal care ( $P = 0.004$ ), but there was no significant relationship with preterm delivery and low birth weight ( $P = 0.766$  and  $P = 0.455$ , respectively).

Most of the mothers studied (67.9%) did not participate in childbirth classes and there was no significant relationship between participation in childbirth classes and APNCU ( $P = 0.097$ ); so, there was significant relationship between participation in childbirth classes with preterm birth and low birth weight ( $P = 0.001$  and  $P = 0.047$ , respectively). In other words, those who participated in the course had reduced preterm labor and lesser incidence of low birth weight [Tables 1-3].

Base on the findings of this study, of the 420 mothers studied, there was inadequate care in 151 cases (36%),

intermediate care in 93 cases (22.1%), adequate care in 134 cases (31.9%), and intensive care in 42 cases (10%) on calculation of the APNCU index. Based on the classification of APNCU index, inadequate care was found in the majority of cases in this study. The findings of this study showed 26 (6.2%) of the mothers had preterm labor; by use of APNCU index, the rate of preterm labor was 9.9% in inadequate care, 2.2% in intermediate care, zero in adequate care, and 21.4% in intensive care. Based on the results of chi-square test, APNCU index was found to have a statistically significant relationship with preterm birth ( $P < 0.05$ ). So, the rate of preterm birth in inadequate care was  $RR = 1.36$  times more than in adequate care [Table 4].

The findings of this study showed that of the 420 mothers studied, 35 (8.3%) had a low birth weight. By use of APNCU index, the rate of low birth weight was 11.9% in inadequate care, 3.25% in intermediate care, 2.2% in adequate care, and 26.2% in intensive care. Based on the results of chi-square test, APNCU index was found to have a statistically significant relationship with low birth weight ( $P < 0.05$ ). So, the rate of low birth weight in inadequate care was  $RR = 1.08$  times more than in adequate care [Table 5].

As shown in Tables 2 and 3, chi-square test showed no significant relationship between iron intake with preterm labor and low birth weight ( $P = 0.475$  and  $P = 0.792$ , respectively). But there was statistically significant

**Table 4: Distribution of preterm labor in terms classification of care by APNCU index**

APNCU	Preterm labor*		Statistical results
	Yes	No	
Inadequate	15 (9.9)	136 (90.1)	$\chi^2=31.89$
Intermediate	2 (2.2)	91 (97.8)	df=3
Adequate	0 (0)	134 (100)	$P=0.000$
Intensive	9 (21.4)	33 (78.6)	$RR=1.36$
<b>Total</b>	26 (6.2)	394 (93.8)	$CI=95\%$

\*Values are prevalence (percentage)

**Table 5: Distribution of low birth weight in terms classification of care by APNCU**

APNCU	Low birth weight*		Statistical results
	Yes	No	
Inadequate	18 (11.9)	133 (88.1)	$\chi^2=29.76$
Intermediate	3 (3.25)	90 (96.8)	df=2
Adequate	3 (2.2)	131 (97.8)	$P=0.000$
Intensive	11 (26.2)	31 (73.8)	$RR=1.08$
<b>Total</b>	35 (8.3)	385 (91.7)	$CI=95\%$

\*Values are prevalence (percentage)

relationship between the multivitamin intake ( $P = 0.021$ ) and folic acid ( $P = 0.004$ ) with preterm labor and between the multivitamin intake ( $P = 0.047$ ) and folic acid ( $P = 0.008$ ) with low birth weight. So, in the mothers who were taking both supplements (multivitamin and folic acid) every day, preterm labor and low birth weight were less.

## DISCUSSION

This study showed that inadequate care (36%) showed the highest percentage of the mothers studied. Krueger *et al.* also showed that the highest percentage of care was inadequate care (36.8%), which agrees with the results of this study.<sup>[11]</sup> While most studies that were conducted based on the American College of Obstetricians and Gynecologists (ACOG) reported that the highest percentage of care was in the adequate group, Heaman *et al.* reported the highest percentage of the mothers' care to be adequate care (39.5%).<sup>[12]</sup>

The highest percentage of care was in adequate and intensive care groups (77.6%) in Kansans Department study<sup>[13]</sup> and in adequate care group (43%) in the study of Alexander *et al.*,<sup>[14]</sup> which differ from the results of this study. The possible causes of this difference could be that although the Deputy Minister of Health (2010) said that prenatal covering are about 94% in Iran (health news site), the findings of this study showed that the quantity of care in the studied population was inadequate, so in this study, only 31.9% of maternal care was adequate.<sup>[10]</sup> The possible reasons could be factors such as performance program of reducing the number of pregnant visits in Iran (The New Protocol), which advised to refer in longer time (e.g. in the range of 70 days) that may lead some of the mothers to forget and/or they tend to receive more specialized services to other centers, which in this study was not measurable. The findings indicate that other maternal variables play important roles on pregnancy outcomes. The result is a fact that perhaps the social responsibility of mothers, along with other responsibilities at home and child care have decreased their attention to their health status.

Among the other factors that reduce the quantity of care are delay in initiation of care, lack of knowledge of her pregnancy, and time of the first visit that may be due offer poor health care service and counseling before pregnancy. So, offering training programs before pregnancy will be necessary to improve the knowledge of mothers about pregnancy signs and take necessary actions.

The findings of this study showed that the odds of preterm labor increase in low-risk women with inadequate prenatal care (by APNCU). So, the  $RR$  of preterm labor

in inadequate care is 1.36 more than in other groups of care. There are studies that confirm the above findings. For example, the study of Heaman *et al.*<sup>[12]</sup> showed that the rate of preterm birth in the inadequate care was 7.2%, which approximately was twice the rate in the adequate care group (3.5%). By APNCU, inadequate care was associated with preterm labor significantly with OR = 1.2. In other words, the rate of preterm birth in the inadequate care was 20% more.<sup>[12]</sup>

Krueger *et al.*<sup>[11]</sup> also demonstrated that the risk of preterm labor in women who had inadequate care was twice more than women who had received adequate or intermediate care (OR = 2.1). The findings of this study also showed that the odds of low birth weight increase in low-risk women with inadequate prenatal care. So, the RR of low birth weight in inadequate care is 1.08 more than in other groups of care. Prenatal care is a critical component of health care for pregnant women and a key step toward having a healthy pregnancy and baby. Early prenatal care is especially important because many important developments take place during the first trimester, screenings can identify babies or mothers at risk for complications, and health care providers can educate and prepare mothers for pregnancy. Women who received prenatal care have consistently shown better outcomes than those who did not receive prenatal care. This result is consistent with the findings of our study.

There are studies that confirm the above findings. The study of Heaman *et al.*<sup>[12]</sup> showed that low birth weight increased about 30% more inadequate care and no care. Howard *et al.*<sup>[15]</sup> also showed increase in the quantity of care in the first trimester of pregnancy causes increased birth weight (120.5 mg per visit). Rohparvarzade *et al.*<sup>[16]</sup> showed the prevalence of infants with low birth weight was 4% in maternal care and 5% in no care. With chi-square test, we did not observe significant differences in the two groups ( $P = 0.5$ ). The Department of Kansans study<sup>[13]</sup> reported different results, so 80% of mothers who had delivered underweight babies had adequate and intensive care.

The results of this study and comparison with similar studies can emphasize once again the importance of the quantity of prenatal care on pregnancy outcome, especially low birth weight and preterm labor. Based on the study of Howard *et al.*<sup>[15]</sup> and Vahdaninia *et al.*,<sup>[17]</sup> the expected rate of preterm labor and low birth weight in high-risk pregnant women with poor care was more than the results of this study. By conducting further studies and by increased provider vigilance, it is hoped that we can curb this significant health problem and improve pregnancy and neonatal outcomes.

## CONCLUSION

The results of this study confirmed that inadequate prenatal care is associated with an increased risk of preterm birth and low birth weight. The study limitations are that since access to patients in private centers was not possible and the protocol is binding only in public health centers, this study is confined to the number of cases registered in household records.

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