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# Prenatal Training Improves New Mothers' Understanding of Jaundice

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**Background:** Mothers' knowledge of neonatal jaundice (NNJ) is grossly deficient or inaccurate, which may adversely affect the actions of mothers in the recognition of NNJ and cause a delay in seeking medical attention.

**Material/Methods:** A total of 1036 primiparas were separated randomly into the intervention group and the control group, with 518 primiparas in each group.

**Results:** All (100%) mothers in the intervention group understood that NNJ is a yellow discoloration of the skin and sclera; 94.19% of them considered that NNJ is a common problem in newborns; 82.80% and 95.27% replied that jaundice appearing within the first 36 hours and lasting more than 2 weeks usually indicates pathological NNJ; 96.34%, 80.86%, and 90.32% realized that premature newborns, low birth weight, and perinatal asphyxia, respectively, are more likely to be accompanied by NNJ; 97.41%, 78.71%, and 64.95% knew that maternal-fetal blood group incompatibility, infection, and glucose-6-phosphate dehydrogenase deficiency, respectively, are the common inducements to NNJ; 94.84% could associate NNJ with brain damage; 92.26%, 93.12%, and 74.62% agreed that phototherapy, strengthen feeding, and exchange blood transfusion, respectively, can greatly relieve NNJ. However, some respondents in the control group responded in other ways, such as stopping breastfeeding (9.19%), placing newborns in sunlight (10.24%) and traditional Chinese medicine (10.24%), which was significantly higher than that of the intervention group. There was also a significant delay for respondents in the control group in consulting a pediatrician, and 6.30% of them did not seek medical help until after the interview.

**Conclusions:** Prenatal training could significantly improve new mothers' understanding of NNJ.

**MeSH Keywords:** **Jaundice, Neonatal • Pediatric Nursing • Randomized Controlled Trial**

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## Background

Neonatal jaundice (NNJ), characterized by a yellow discoloration of the skin and sclera, is highly prevalent in newborns and is as a major cause of neonatal mortality. Although an imbalance between bilirubin production and elimination likely plays a key role in NNJ onset, the exact etiology is not yet fully understood. According to a prospective study of 1238 full-term Chinese newborns, 87% developed NNJ during the first few days of life [1]. Another epidemiological survey conducted by Ding et al. indicated that 34.3% of Chinese newborns had a peak serum bilirubin concentration greater than 220.5  $\mu\text{mol/L}$  [2]. NNJ usually becomes noticeable during the first 3–5 days of life and may progress to kernicterus or even death. On the other hand, taking into account the cost-containment measures implemented by managed care companies, mothers and their newborns are commonly discharged within 48 hours after vaginal delivery or 96 hours after cesarean delivery [3]. In this context, NNJ may not be apparent at the time of hospital discharge. Therefore, enhancing the self-recognition of NNJ in new mothers and enforcing post-discharge visits are of particular importance.

Childbearing involves major biological and social transitions for mothers. Antenatal health education is an essential component of primary health care, aiming to cope with several health problems during the perinatal period and to reduce maternal and neonatal mortality [4]. However, the main topic of antenatal health education seems to focus on breastfeeding, and little information about NNJ is received by mothers. Poon et al. [5] investigated mothers' knowledge of NNJ among Chinese in Singapore, and found that 20% of respondents had never heard of NNJ, 52% were unsure about its seriousness, and 23% thought that NNJ was not serious and would resolve spontaneously. The mothers' knowledge of NNJ is grossly deficient or inaccurate, which may adversely affect the actions of mothers in the recognition of NNJ, and result in delay in seeking medical attention. It is therefore recommended that health care providers should provide more health education on NNJ to pregnant women.

To the best of our knowledge, very little analytical research on the effectiveness of antenatal health education on NNJ has been reported. Most reports available are descriptive and lack interventional measures. In the present study, we carried out, for the first time in mainland China, a prospective study to evaluate the gaps of knowledge and practices about NNJ between the first-time mothers who received or did not receive antenatal health education, and sought to identify deficient areas of knowledge in current health education programs and to revise the predischarge guidance from health care providers.

## Material and Methods

### Subjects and treatment

This prospective study was conducted at the Department of Obstetrics and Gynecology, the First Affiliated Hospital of Anhui Medical University from 1<sup>st</sup> January to 30<sup>th</sup> June 2013. A total of 1036 primiparas, admitted during the study period, were separated randomly into 2 observation groups, with 518 primiparas in each group. Subjects in the intervention group received an educational pamphlet addressing various aspects of NNJ such as definition, causes, symptoms, complications, treatment, and risk factors [6], and assistance was obtained from the investigators whenever requested by the interviewees. In contrast, subjects in the control group received routine health education except for the information on NNJ. Primiparas experiencing miscarriage or stillbirth were excluded from the subsequent investigation. When infants were 28 days old, a structured questionnaire consisting of 16 items was administered to all the first-time mothers to assess the knowledge of NNJ. Moreover, another structured questionnaire consisting of 3 items was given to the mothers whose infants had NNJ to assess their management of the NNJ. All questions were designed using a yes/no or multiple-choice format. The study protocol was reviewed and approved by the Health Sciences Ethics Review Committee of Anhui Medical University.

### Statistical analyses

Data are presented means  $\pm$  standard deviation or percentages. Student's *t* test was performed to determine the significance of differences in some demographic and socioeconomic characteristics between the intervention group and the control group. The  $\chi^2$  test was applied to estimate the differences in the knowledge and managements of NNJ between the 2 groups. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 11.5. A value of  $p < 0.05$  was considered significant.

## Results

### Demographic and socioeconomic characteristics of respondents

Live infants were delivered by 503 primiparas in the intervention group and 507 primiparas in the control group. Among them, 465 first-time mothers in the intervention group and 452 in the control group completed the questionnaires on their knowledge of NNJ. Thus, study questionnaires were returned at high rates from both groups. The response rates were 92.45% and 89.15% in the intervention group and the control group, respectively, and were almost identical between

**Table 1.** Demographic and socioeconomic characteristics of respondents.

Characteristics	Intervention group (n=465)	Control group (n=452)	p value
Mothers' age (years)	28.3±5.6	29.1±5.4	0.894
Gestational age (weeks)	38.7±4.4	38.3±4.9	0.963
Birth weight (grams)	3407.2±867.1	3380.5±896.8	0.454
Apgar score	8.7±2.9	8.3±2.7	0.925
Singleton/multiplet	363/102	356/96	0.798
Urban/rural	297/168	285/167	0.797
Years of education	14.7±4.6	13.5±4.1	0.733
Annual family income (RMB)	138664.2±17342.5	134826.7±16954.8	0.251

the 2 groups ( $\chi^2=3.276$ ,  $p=0.070$ ). Demographic and socioeconomic characteristics of respondents are shown in Table 1. No significant differences in mothers' age, gestational age, birth weight, Apgar score, singleton/multiplet ratio, urban/rural ratio, duration of education, or annual family income were observed between the 2 groups ( $p>0.05$ ).

### Knowledge of NNJ in the first-time mothers

The knowledge of NNJ in the first-time mothers are presented in Table 2. All the first-time mothers who received the educational pamphlets understood that NNJ is a yellow discoloration of the skin and sclera, and 94.19% (438/465) considered that NNJ is a common problem in newborns, which was significantly higher than that of the control group (87.61%,  $\chi^2=59.216$ ,  $p=0$ ; 58.19%,  $\chi^2=165.036$ ,  $p=0$ , respectively). As for the occurrence and duration time of NNJ, 82.80% (385/465) and 95.27% (443/465) of respondents in the intervention group replied that jaundice appearing within the first 36 hours and lasting more than 2 weeks usually indicates pathological NNJ, significantly higher than that of the control group (52.43%,  $\chi^2=96.830$ ,  $p=0$ ; 82.08%,  $\chi^2=39.988$ ,  $p=0$ , respectively). Antenatal health education should put more emphasis on the perinatal risk factors associated NNJ onset, such as premature delivery, low birth weight, and asphyxia. In the intervention group, 96.34% (448/465) of the first-time mothers realized that premature newborns have higher risk of NNJ, 80.86% (376/465) thought that low birth weight is related to NNJ, and 90.32% (420/465) considered that newborns with perinatal asphyxia are more likely have NNJ, as compared with 65.04%, 32.96%, and 69.91%, respectively, in the control group ( $\chi^2=145.413$ ,  $p=0$ ;  $\chi^2=214.836$ ,  $p=0$ ;  $\chi^2=60.275$ ,  $p=0$ ). Investigation of awareness of common causes demonstrated that 97.41% (453/465), 78.71% (366/465), and 64.95% (302/465) of respondents in the intervention group knew that maternal-fetal blood group incompatibility, infection, and glucose-6-phosphate dehydrogenase (D6PD) deficiency are the common inducements to NNJ, comparable to that in the control group (62.17%,  $\chi^2=178.304$ ,

$p=0$ ; 27.65%,  $\chi^2=240.183$ ,  $p=0$ ; 25.88%,  $\chi^2=140.932$ ,  $p=0$ , respectively). However, most of the first-time mothers in both groups were not aware that biliary atresia can lead to NNJ (28.17% in the intervention group vs. 17.48% in the control group), but considered that blood tests help identify the causes of NNJ (97.85% in the intervention group vs. 92.26% in the control group). Antenatal health education could boost the knowledge of NNJ complications like cerebral palsy, deafness, and seizure disorders. There were 94.84% (441/465) of respondents in the intervention group who could associate NNJ with brain damage, as compared with 38.27% in the control group ( $\chi^2=331.463$ ,  $p=0$ ). After receiving antenatal health education, most of the first-time mothers agreed that phototherapy (92.26%), strengthening feeding (93.12%), and exchange blood transfusion (74.62%) can greatly relieve NNJ.

### Managements of NNJ in first-time mothers

Among 465 first-time mothers in the intervention group, 386 (83.01%) declared that their newborns experienced NNJ, very close to the morbidity in the control group (84.29%, 381/452). Another structured questionnaire consisting of 3 items was given to the mothers whose infants had NNJ to assess their managements (Table 3). There were 70.98% (274/386) of mothers in the intervention group who first found their newborns had NNJ, whereas only 40.68% (155/381) of mothers in the control group first took note of this abnormality ( $\chi^2=78.898$ ,  $p=0$ ). Although a majority of the first-time mothers in both groups (85.23% in the intervention group vs. 68.77% in the control group) elected to consult a pediatrician after NNJ was detected, many respondents in the control group turned to other ways, such as stopping breastfeeding (9.19%), placing newborns in sunlight (10.24%), and traditional Chinese medicine (10.24%), which was significantly higher than that of the intervention group ( $\chi^2=35.129$ ,  $p=0$ ). There was also a significant delay for respondents in the control group in consulting a pediatrician, and 6.30% (24/381) of them did not seek medical help until the research interview ( $\chi^2=70.465$ ,  $p=0$ ).

**Table 2.** First-time mothers' knowledge of NNJ.

Knowledge of NNJ	Intervention group (n=465) Yes/No	Control group (n=452) Yes/No	$\chi^2/p$ value
NNJ is a yellow color of the skin and sclera	465/0	396/56	59.216/0
NNJ is a common problem in newborns	438/27	263/189	165.036/0
NNJ appearing within the first 36 hours is abnormal	385/80	237/215	96.830/0
NNJ lasting more than 2 weeks is abnormal	443/22	371/81	39.988/0
Premature newborns have higher risk of NNJ	448/17	294/158	145.413/0
Newborns weighting less than 2500 g at birth have higher risk of NNJ	376/89	149/303	214.836/0
Newborns resuscitated at birth have higher risk of NNJ	420/45	316/136	60.275/0
Newborns whose blood group is incompatible with their mothers' blood group have higher risk of NNJ	453/12	281/171	178.304/0
Infection will cause NNJ	366/99	125/327	240.183/0
G6PD deficiency will cause NNJ	302/163	117/335	140.932/0
Biliary Atresia will cause NNJ	131/334	79/373	14.846/0
Blood tests help determine the causes of NNJ	455/10	417/35	15.364/0
Severe NNJ can result in brain damage	441/24	173/279	331.463/0
Phototherapy is a safe treatment	429/36	244/208	171.951/0
Severe cases need exchange blood transfusion	347/118	95/357	263.798/0
More fluids and breastfeeding are encouraged for jaundiced newborns	433/32	102/350	469.419/0

## Discussion

NNJ, which is benign in most newborns, is still a leading cause of preventable brain damage, physical and mental handicap, and even early death during the neonatal period [7]. In the past 3 decades, there was a skyrocketing increase in the prevalence of NNJ in Hong Kong, which has been attributed in part to early hospital discharge and mothers' deficient knowledge of NNJ [8]. Particularly, the latter reason may adversely affect the actions of mothers in the recognition of NNJ and cause a delay in seeking medical attention. It is therefore recommended that health care providers provide more health education on NNJ to enhance mothers' self-recognition of this disorder.

In the present study, we carried out a prospective study to evaluate the gaps of knowledge and practices about NNJ between the first-time mothers with or without antenatal health education. Our results suggested that the knowledge of NNJ was deficient to some extent in the control group, which was consistent with previous reports from other developing countries. According to the cross-sectional study conducted in the Tuanku Jaafar Hospital, Malaysia, only 34.3% of mothers were aware that NNJ appearing during the first 36 hours of life is

abnormal, less than 20% knew about G6PD deficiency and that maternal-fetal blood group incompatibility could cause NNJ, and only 38.4% realized that severe NNJ could result in hearing impairment [9]. Furthermore, in the latest research from Benin City, Nigeria, Egube et al. also found that 85.9% of mothers were aware of this condition, 77.4% knew how to recognize the symptoms of NNJ, and 71.7% understood the treatment principle, whereas 52.7% could not identify any danger signs of complications [10]. Distinct from our study, most reports available are descriptive and lack of interventional measures. Low socioeconomic status may be responsible for the deficient recognition of NNJ among mothers in developing countries [11]. Clinical and public health leadership should take appropriate measures to curtail the risk and burden of NNJ in several low-income and middle-income countries [12].

Antenatal health education can significantly improve mothers' knowledge of NNJ. Because no significant differences in mothers' age, gestational age, birth weight, Apgar score, singleton/multiplet ratio, urban/rural ratio, duration of education, and annual family income were observed between the 2 groups, we believe that the significant improvement in the mothers' knowledge of NNJ is mainly attributed to antenatal

**Table 3.** Management of NNJ in first-time mothers.

Managements of NNJ	Intervention group (n=386)	Control group (n=381)	$\chi^2/p$ value
Who first found the newborn had NNJ?			
Mother	274	155	
Friends or relatives	29	33	
Visiting nurse	51	140	
Pediatrician	32	53	78.898/0
How did mothers manage their newborns after NNJ was detected?			
Consulted a pediatrician	329	262	
Stopped breastfeeding	18	35	
Put newborns in sunlight	22	39	
Turned to traditional Chinese medicine	17	39	
Waited until NNJ was more obvious	0	6	35.129/0
When did mothers consult pediatricians about their newborns after NNJ was detected?			
As soon as jaundice was detected	281	208	
Within 24 hours	63	49	
24 to 72 hours	27	61	
After 72 hours	15	39	
Did not seek medical help	0	24	70.465/0

health education, instead of the higher socioeconomic status in the intervention group. It is noteworthy that although antenatal health education could deepen the understanding of NNJ caused by biliary atresia to some degree, this awareness was still deficient in both groups. Biliary atresia is a major cause of extrahepatic obstructive jaundice among newborns and is also the leading indication for liver transplantation in children [13]. Based on the data from Taiwan, the overall incidence of biliary atresia is 1.48 per 10 000 live births. Early diagnosis and early intervention have been proven to be associated with a better jaundice-free rate and overall survival. Popularizing the knowledge of biliary atresia and the stool color card screening are expected to increase mothers' awareness of biliary atresia [14]. In this study, it is encouraging that most of the respondents in both groups considered that blood tests help identify the causes of NNJ. Since the levels of serum total bilirubin reflect erythrocyte turnover and the levels of serum alpha-fetoprotein (and possibly albumin) reflect liver maturity, these parameters might be used to predict the development of hyperbilirubinemia after birth [15].

Among the 917 first-time mothers in both groups, 83.64% (767/917) declared that their newborns experienced NNJ, similar

to the report of Fok et al. [1]. Another structured questionnaire consisting of 3 items was given to mothers whose infants had NNJ to assess their managements. Our results showed that 70.98% of mothers in the intervention group first took note of their newborns with NNJ in comparison to 40.68% in the control group. All the NNJ cases first detected by mothers were later confirmed by medical personnel or laboratory findings. It is unquestionable that antenatal health education can significantly enhance the self-recognition of NNJ in first-time mothers. Although most first-time mothers in both groups elected to consult a pediatrician, many respondents in the control group chose other ways, such as stopping breastfeeding (9.19%), putting newborns in sunlight (10.24%), and traditional Chinese medicine (10.24%). A survey on parenting practices among Chinese in Singapore indicated that 86% of respondents thought that breastfeeding should be stopped if jaundice developed and 87% of respondents considered that placing a child in sunlight was an acceptable method to prevent NNJ [5]. It seems that a large gap of practices exists among Chinese mothers from Singapore and the Chinese mainland. Consistent with our findings, a cross-sectional, descriptive study from Turkey showed that 12.7% of respondents claimed that sun exposure was good for NNJ, and only a small proportion of mothers reported using sunscreen

for their babies before sun exposure [16]. To the best of our knowledge, there are no reports or recommendations about the benefit of sun exposure for NNJ in the medical literature. Herbal treatment of NNJ has been practiced in China as early as 3000 years ago. Even now, a variety of herbal items, including “Yin-chin” (*Artemisia*), “Huang-qin” (*Scutellaria*), “Da-huang” (*Rheum officinale*), “Gan-cao” (*Glycyrrhiza*), and “Huang-lin” (*Coptis chinensis*), are still being prescribed to jaundiced newborns [17]. However, their effectiveness remains doubtful and there is no convincing evidence of their efficacy. In the present study, there was also a significant delay by respondents in the control group in consulting a pediatrician. In a similar study in Iran, 33.3% of mothers consulted a pediatrician within 24 hours, while 13.8% of mothers declared that they did not seek medical help until NNJ was more obvious [18].

## Conclusions

Prenatal training can significantly improve new mothers' understanding of NNJ. However, it is worth noting that although antenatal health education could to some degree improve understanding of NNJ caused by biliary atresia, this awareness

was still deficient in all the mothers in our study. Popularizing the knowledge of biliary atresia and use of stool color card screening may increase mothers' awareness of biliary atresia. When asked about their management of NNJ, our results demonstrated that antenatal health education could significantly enhance the self-recognition of NNJ in first-time mothers, and most of them elected to consult a pediatrician as soon as jaundice was detected, whereas many mothers in the control group turned to other approaches, such as stopping breastfeeding, putting newborns under sunlight, traditional Chinese medicine, or even waiting until NNJ became more obvious. Thus, antenatal health education needs to focus more attention on the knowledge of biliary atresia, and newborns with NNJ need close monitoring and require immediate medical attention. In addition, there are some limitations in this study. The educational pamphlet contained some medical jargon that may have made it more difficult to read; thus, the antenatal health education could be improved by using simple, interesting audiovisual content.

## Conflicts of interest

None declared.

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