

: , , Ballard examination,

New Ballard Examination (NBE)

* . **

가
1. (last menstrual period: LMP)
,
, 가
(, 1999). 가
가 .
(systemic
circulation) Dubowitz (Dubowitz, Dubowitz
& Goldberg, 1970) Ballard
(Newborn maturity rating)(Ballard,
Novak & Driver, 1979; Ballard, Khoury, Wedig,
Wang, Eilers-Walsman & Lipp, 1991)
, Newborn Ballard Examination (NBE)
가
35 42
가 ,
1 5 가
, 1991 . 22 44
, Ahn Koo(1998)

*

**

2001 8 20

2001 10 11

2002 3 4

NBE , NBE 가 , ,
LMP 가 NICU
, NBE , ,
2) :
NBE 가 가
Ballard (1991)
, 가 .
NBE
3) : 가
(gestational age: GA)
LMP 가
GA(GA-LMP) , NBE
GA(GA-NBE) 가
, 가 ,
LMP
Ballard
1.
NBE
NICU 50 27 , 23
2000
10 2001 2 5
NBE 가
NBE
2. 가 Ahn Koo(1998)
1) NBE , 36.6
2) NBE LMP
Dubowitz et al.
3) NBE (1970) Ballard et al.(1991) Ahn Koo
(1998) , NBE 12
inter-rater reliability
100% NBE
1) : “
”
/ , 2.
, ,

<Table 2> Birth history and high-risk factors of subjects

(N = 50)

Items	Frequency(%)	Items	Frequency(%)
Vaginal delivery	19(38)	Cesarean section	31(62)
Prematurity	36(72)	PROM(>24 hours)	11(22)
RDS	8(16)	Anomaly	6(12)
Dyspnea	5(10)	Feeding difficulty	3(6)
LGA/IUGR	3(6)	Maternal DM	2(4)
Maternal PIH	1(2)	Maternal hepatitis	1(2)
Meconium stain	1(2)	Asphyxia	1(2)
Jaundice	1(2)	Multiple birth	1(2)
Elderly mother	1(2)	Anemia	1(2)
Single mother	1(2)	Foreigner	1(2)

* Note : RDS = respiratory distress syndrome PROM = premature rupture of membrane
 LGA = large for gestational age I UGR = intrauterine growth retardation
 DM = diabetes mellitus PIH = pregnancy induced hypertension

24 (= 4.26) , 20
 , 118.91 (: 26-360, , 38 .
 = 136.29) 1.48 (: 1-3, = .68)
 . 20 - 38 29.4 가 .

<Table 3> The New Ballard Examination scores by Gestational age by LMP

(N = 50)

M(SD)		Neuromuscular maturity										Physical maturity				
GA-L	n	post- ture	square window	arm recoil	pop. angle	scarf sign	heel /ear	total	skin	lanu- go	plantar surface	breast	eye/ ear	genital ia	total	TOTAL
27	2	2.5 (2.12)	0 (.0)	2.0 (2.83)	1.0 (1.41)	-1.0 (.0)	0 (.0)	4.5 (6.36)	0 (.0)	1.5 (.71)	1.0 (.0)	0 (.0)	0 (.0)	.5 (.71)	3.0 (1.41)	7.5 (4.95)
29	1	3.0	2.0	4.0	0	-1.0	0	8.0	1.0	2.0	2	0	1	1	7.0	15.0
30	2	3.0 (0.0)	1.5 (2.12)	3.5 (.71)	0 (.0)	2.0 (.0)	0 (.0)	10 (2.83)	1.0 (.0)	1.0 (.0)	3.5 (.71)	0 (.0)	1.0 (.0)	1.0 (.0)	7.5 (.71)	17.5 (3.54)
31	2	2.5 (.71)	1.5 (2.12)	2.0 (1.41)	1.0 (2.83)	.5 (2.12)	.5 (.71)	8 (9.9)	1.0 (.0)	1.0 (.0)	4.0 (.0)	1.0 (.0)	1.5 (.71)	1.0 (.0)	9.5 (2.12)	17.5 (7.78)
32	1	3.0	2.0	3.0	3.0	2.0	2.0	15.0	1.0	1.0	3.0	2.0	3	2	12.0	27
33	6	3.67 (.52)	1.83 (.98)	3.17 (.75)	2.0 (1.55)	2.0 (.0)	1.0 (1.55)	13.67 (3.72)	1.67 (.52)	1.67 (.52)	2.33 (1.03)	1.83 (.41)	2.33 (.52)	2.17 (.41)	12.17 (2.32)	25.83 (5.81)
34	2	4.0 (.71)	2.5 (1.41)	2.0 (.71)	2.5 (.71)	2.0 (.0)	.5 (.71)	13.5 (2.12)	1.5 (.71)	2.0 (.0)	3.5 (.71)	1.5 (.71)	3.0 (.0)	1.5 (.71)	13.0 (.0)	26.5 (2.12)
35	3	3.33 (1.15)	2.33 (.58)	1.67 (2.08)	2.67 (1.53)	1.0 (1.73)	1.33 (1.53)	12.33 (6.11)	2.0 (1.0)	1.67 (1.15)	3.0 (1.0)	3.33 (1.15)	2.67 (.58)	2.67 (.58)	15.33 (4.73)	27.67 (9.71)
36	6	3.17 (.41)	2.33 (1.21)	3.0 (.0)	3.67 (.52)	1.67 (1.37)	1.67 (1.03)	15.83 (1.83)	2.17 (.75)	1.83 (.98)	3.67 (.52)	3.17 (1.17)	3.0 (.0)	3.0 (.63)	16.83 (2.85)	32.33 (3.39)
37	7	3.43 (.53)	2.86 (1.07)	3.29 (1.11)	3.29 (1.5)	2.57 (.53)	2.71 (1.5)	18.14 (4.41)	2.29 (.49)	2.14 (1.07)	3.29 (.76)	2.86 (.90)	2.71 (.49)	2.86 (.69)	16.88 (2.17)	34.29 (6.18)
38	8	3.75 (.46)	1.5 (1.93)	3.38 (1.06)	3.63 (1.77)	2.75 (.71)	2.13 (1.55)	17.13 (3.91)	2.75 (.71)	2.38 (.74)	3.5 (.53)	2.63 (1.41)	3.25 (.46)	2.75 (.89)	16.88 (2.17)	34.38 (5.8)
39	3	3.0 (1.00)	2.33 (1.15)	2.67 (1.53)	3.0 (.0)	2.0 (.0)	1.67 (.58)	14.67 (2.89)	2.33 (.58)	1.67 (.58)	2.67 (.58)	3.33 (.58)	3.33 (.58)	3.0 (1.0)	16.33 (2.52)	31.0 (1.73)
40	6	3.5 (.84)	3.0 (.89)	3.67 (.82)	3.5 (1.38)	2.67 (.82)	2.0 (1.10)	18.33 (2.66)	2.83 (.98)	2.0 (.89)	3.83 (.41)	3.0 (1.26)	3.5 (.55)	3.5 (.55)	18.67 (3.78)	37.0 (6.32)
41	1	3.0	3.0	3.0	5.0	4.0	3.0	21.0	4.0	4.0	2.0	4.0	4.0	4.0	22.0	43
total	50	3.36 (.72)	2.14 (1.32)	3.02 (1.15)	2.82 (1.65)	1.98 (1.25)	1.6 (1.39)	14.96 (5.06)	2.08 (.97)	1.9 (.89)	3.16 (.91)	2.4 (1.36)	2.7 (.95)	2.52 (1.01)	14.72 (4.61)	29.7 (9.01)

* note: 1. The Italic denotes the items of physical maturity on New Ballard Examination.

GA-LMP = gestational age by last menstrual period

2. New Ballard Examination

square window, arm recoil, eye/ear

NBE , 6 , GA-LMP NBE

12 GA-LMP GA-NBE NBE

, NBE <Table 3> <Table 4> NBE 12

. 가 27 , posture arm recoil 10

, 12 popliteal angle lanugo GA-LMP (.349 < r < .844)

10 가 41 NBE 12 GA-NBE ,

. 가 41 (.423 < r < .835)

6 4 square window , GA-LMP GA-NBE

, 6 5 가 (r = .349, p = .013; r =

가 .423, p = .002) . eye/ear GA-LMP

, arm recoil, plantar surface 가 (r = .844, p = .000) ,

27 가 , 가 skin GA-NBE 가 (r =

, 34 , 29 , 31 . GA-LMP

가 posture arm recoil GA-NBE

heel-to-ear

1.6(= 1.39) , 가 (r = .443, p = .00; r = .483, p = .001).

3.36(, NBE 12 eye/ear genitalia

= .72) . 12 가 10 GA-LMP GA-NBE

, 27 29 scarf sign . GA-LMP 35.7(

<Table 4> Relationship between NBE and GA-LMP, and GA-NBE (N = 50)

Items		GA-LMP		GA-NBE	
		r	p	r	p
Neuromuscular maturity	Posture	.238	.096	.443	.001
	Square window	.349	.013	.423	.002
	Arm recoil	.210	.114	.483	.000
	Popliteal angle	.586	.000	.829	.000
	Scarf sign	.629	.000	.651	.000
	Heel to ear	.498	.000	.726	.000
Physical maturity	Skin	.758	.000	.835	.000
	Lanugo	.360	.000	.399	.004
	Plantar surface	.394	.005	.535	.000
	Breast	.660	.000	.753	.000
	Eye/ear	.844	.000	.813	.000
	Genitalia	.771	.000	.744	.000

* Note : GA-LMP = gestational age by last menstrual period

GA-NBE = gestational age by New Ballard Examination

<Table 5> Comparison of GA between GA-LMP and GA-NBE (N = 50)

	M	SD	Min.	Max.	Statistics	
GA-LMP	35.70	3.49	27	41	t = .225	r = .894
GA-NBE	35.63	3.56	25	41	p = .825	p = .000

* Note: GA-LMP = gestational age by last menstrual period

GA-NBE = gestational age by New Ballard Examination

<Table 6> Relationship between GA and the maturity by NBE (N = 50)

	Neuromuscular maturity		Physical maturity		total NBE score	
	r	p	r	p	r	p
GA-LMP	.657	.000	.832	.000	.799	.000
GA-NBE	.915	.000	.903	.000	.980	.000

* Note : GA-LMP = gestational age by last menstrual period

GA-NBE = gestational age by New Ballard Examination

= 3.49, : 27-41), GA-NBE GA-LMP 5 가
 35.63(= 3.56, : 25-41) (r = .262, p = .078).
 , (t = NBE
 .225, p = .825), (r = <Table 8> .
 .804, p = .000; <Table 5>). 가 , NBE
 NBE ,
 (neuromuscular maturity) , (physical GA-LMP가
 maturity) , (t = -2.033, p = .048). 가
 GA-LMP GA-NBE 가 NBE
 . <Table 6> GA- (t = -2.568, p = .013; t =
 NBE , , -2.417, p = .019). 72%
 GA-LMP NBE
 GA-NBE 가 GA-LMP GA-NBE
 (r = .980, p = .000), GA-LMP RDS 가
 NBE 16% 8 ,
 NBE GA : 가
 . NBE : 가
 3. New Ballard 13.56: 16.61 , 가
 Examination (t = -2.210, p = .032).
 NBE , GA-LMP GA-NBE
 <Table 7> , 가
 , NBE , 가 (asphyxia), ,
 NBE GA
 (.490 < r < .800) . 1 5 ,
 가 NBE , NBE
 (.415 < r < .579), .

<Table 7> Relationship between Characteristics of Subjects and GA, and NBE (N = 50)

Correlation	GA-LMP	GA-NBE	Neuromuscular maturity	Physical maturity	NBE score
Birth weight	.797	.648	.490	.722	.646
Length	.800	.695	.526	.774	.695
Apgar at 1min.	.415	.574	.514	.557	.579
Apgar at 5min.	.262*	.513	.506	.438	.512

* p < .05

+ Note : GA-LMP = gestational age by last menstrual period

GA-NBE = gestational age by New Ballard Examination

<Table 8> The relationship between the characteristics of subjects and NBE (N = 50)

Health problems	Neuromuscular maturity	Physical maturity	Total NBE score	GA-LMP	GA-NBE
Anomaly					
No (n = 44)	14.52	14.39	28.93	35.34	35.31
Yes (n = 6)	18.17	17.17	35.33	38.33	38.00
t (p)	-1.989 (.098)	-1.399 (.168)	-1.661 (.103)	-2.033 (.048*)	-1.779 (.082)
Feeding difficulty					
No (n = 47)	14.62	14.32	28.96	35.53	35.44
Yes (n = 3)	20.33	31.00	41.33	38.33	38.67
t (p)	-1.951 (.057)	-2.568 (.013)	-2.417 (.019)	-1.360 (.180)	-1.547 (.128)
Prematurity					
No (n = 14)	18.21	18.21	36.36	39.21	38.43
Yes (n = 36)	13.69	13.39	27.11	34.33	34.54
t (p)	3.071 (.004)	3.665 (.001)	3.642 (.001)	5.687 (.000)	3.956 (.000)
RDS					
No (n = 42)	15.74	15.50	31.26	31.24	36.23
Yes (n = 8)	10.88	10.63	21.50	32.87	32.50
t (p)	2.639 (.011)	2.947 (.005)	3.034 (.004)	2.648 (.011)	2.918 (.005)
Sex					
Female (n = 27)	13.56	14.63	28.11	35.56	34.89
Male (n = 23)	16.61	14.83	31.57	35.87	36.50
t (p)	-2.210 (.032)	-.149 (.882)	-1.362 (.179)	-.314 (.755)	-1.623 (.111)

* Note : GA-LMP = gestational age by last menstrual period

GA-NBE = gestational age by New Ballard Examination

RDS = respiratory distress syndrome

GA(GA-NBE)가 , GA-LMP , GA-NBE가 NBE

가 , Ahn & Koo (1998)

GA-LMP NBE , NBE가 , GA

New Ballard Examination(NBE) , NBE , GA

LMP NBE GA

GA-LMP , GA-NBE

(GA-NBE) 50 (Table 6). Constantine, Kramer, Kendall-Tackett, Bennett, Tyson & Gross(1987), Parkin, Hey & Clowes(1976), Gold, Gluck & Kulovich (1977)

LMP GA(GA-LMP) NBE

가 . , 가 .

GA-NBE 가 NBE , 10

가 , 20 , 44

가 ,

New Ballard Examination(NBE)

NBE 12

36 가

plantar crease, breast nodule, earlobe, testes and scrotum

(Gomella, 50 New Ballard Examination(NBE)

1994). GA-LMP , GA-NBE

(.394 < r < .844).

가 .224 - .520

NBE가

1

가 NBE

(Table 7). 5

가 NBE

, GA-LMP

NBE가 LMP

가

GA-LMP NBE

LMP

LMP

LMP

가

NBE , 가

NBE

NBE

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- Abstract -

Assessment of Gestational Age using New Ballard Examination in High-Risk Infants

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Purpose: Knowing the accurate GA is critical in nursing care of high-risk newborns. A descriptive study was performed to examine the reliability and clinical applicability of the new Ballard examination (NBE) in high-risk infants. **Method:** A NBE was performed to measure GA by assessing the neuromuscular and physical maturity in the course of physical examination of a convenient sample of 50 high-risk infants.

Results:

- 1) There was a highly correlation between both the GA by LMP (GA-LMP) and GA by NBE (GA-NBE) ($r = .894$, $p = .000$)
- 2) There was a greater positive relationship in neuromuscular maturity than physical maturity in the GA-NBE of the high-risk newborn ($r = .657$ versus $r = .915$, $p < .05$).
- 3) The high-risk infants were those with congenital anomalies, prematurity, and RDS (Respiratory Distress Syndrome). Male

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infants showed a higher neuromuscular maturity, compared to female infants.

- 4) There was a positive correlation between neuromuscular, physical, total maturity, GA-LMP and GA-NBE in the birth weight, 1 minute Apgar score.

Conclusion: The study supports the

reliability and clinical relevance of NBE in assessment of the accurate GA in high-risk infants.

Key words : High-risk newborn, Maturity, Ballard examination, Gestational age