Implications of Family Protective-Risk Index for Screening Cognitive Development of Children Aged 13-15 Years

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Background: *A simple screening tool is essential for priority setting and operating activities in communities.*
Objective: *The present study aimed to identify the implications of a family protective-risk index (FPRI) for screening cognitive development of children aged 13-15 years.*
Material and Method: *The cross-sectional survey among 319 children aged 13-15 years old was conducted in one district. The cognitive development was measured by TONI version 3. Studied family factors consisted of parents' education, parents' occupation, sufficiency of family income, family relationships, stressful life events in the family, family type, and quality of child care. The protective characteristic of each factor was given one point and the risk was given zero point. FPRI was constructed in three models. The FPRI 1 was the cumulative effects of nine family factors mentioned above. The FPRI 2 was the cumulative effects of seven family factors that were significantly associated with cognitive development in the present study by Chi-square test: parents' education, parents' occupation, family relationship, stressful life events and family type. The FPRI 3 was constructed from 4 family factors that were significantly associated with cognitive development by logistic regression analysis: mother's education, mother's occupation, family relationship and stressful life events. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were applied to identify the optimal cut off point of prediction.*
Results: *The present results showed that 52% of the sample had an intellectual level lower than 90. The FPRI 1 at 6 or 7 scores and the FPRI 2 at 4 or 5 scores yielded the same phenomena, high sensitivity but moderate specificity, PPV and NPV. The FPRI 3 at 2 scores gave high PPV and moderate for the rest. The FPRI 3 at 3 scores gave high sensitivity and NPV, moderate PPV and low specificity. Among three indices, the FPRI 3 was found to be the best index as its Receiver Operating Characteristic (ROC) curve was furthest into the top left corner.*
Conclusion: *The FPRI 3 at 3 scores can be used as a preliminary screening tool for health personnel to identity families at risk of having children with slow cognitive development and then, provide urgent support and help.*

Keywords: *Family protective-risk index, Cognitive development, Children aged 13-15 years*

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Quality of children today is the quality of the nation in the future. Thus, children should be developed according to their age and intelligence. Proper development of human beings begins with love and care from families and enriched environment[1-4]. Many family factors influence cognitive development of children. The cumulative effects of each factor play more important roles than any single factor.

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In 2002, Isaranurug et al proposed the Family protective-risk index (FPRI) to screen families at risk of having children under 12 years old with low cognitive development[5]. It is a simple and moderately sensitive tool for health personnel at grass-root levels to predict families at risk. Families with low score of FPRI or high risk families are most likely to have children with delayed development or below average of cognitive development, and vice versa.

The cognitive development of Thai children is not at a favorable level. According to the survey of Thai Population in 1998[6], by using the Test of Nonverbal Intelligence version 2 (TONI 2), the results revealed that the average intellectual quotient (IQ) of children aged 6 to 12 years was 91.96 and 44.1% of these children had an IQ less than 90. There was a difference of children's IQ in each region of the country, children in Bangkok had the highest average IQ (96.54) and the lowest average IQ was found in the northeastern region. Another study showed the situation was even worse among children of families in slum areas, 52.2% of children of the same age group had an IQ less than 90[7].

From the above situation the proactive interventions are essential and a simple tool is necessary to help health personnel at the grass-root levels to find out the families at risk of having children with low cognitive development. Therefore, the FPRI could be applied for this matter. The present study extended the implications of FPRI to the late childhood period.

Material and Method

The cross sectional survey among 319 children aged 13-15 years old was conducted in one district as a school-based study. The school-based study is relevant because 93.4% of children of this age group in the study district were enrolled in the school. The cognitive development was measured by TONI version 3[8]. The family relationship was evaluated by FACI of McCubbin HI, et al[9]. The stressful life events covered sickness and death in the family, unemployment, imprisonment, and family debt. Child care included information for facilitating child's learning experiences.

The FPRI was constructed in three models. The FPRI 1 was cumulative effects of nine family factors that were associated with cognitive development shown by various studies. They were parents' education, parents' occupation, family income, family relationship, stressful life events in the family, family type, and quality of child care. The FPRI 2 was cumulative effects of seven family factors that were significantly associated with cognitive development by bivariate analysis in the present study. They were parents' education, parents' occupation, family relationship, stressful life events in the family, and family type. The FPRI 3 was cumulative effects of four family factors that were significantly associated with cognitive development by logistic regression analysis in this study. They were maternal education, family relationship, stressful life events in the family, and maternal occupation. The protective characteristic of each factor was given one point and the risk characteristic was given zero point and their percentage distribution is shown in Table 1.

The reliability of the measurement was ensured by pre-testing 40 cases. Based on the Cronbach's

Table 1. Characteristics of each family factor and their score (n = 319)

Family factor	Protective character (1 score)	%	Risk Character (0 score)	%
1. Mother's education	higher than primary level	44.2	primary level or lower	55.8
2. Father's education	higher than primary level	53.0	primary level or lower	47.0
3. Mother's occupation*	officer, professional	26.3	unskilled worker	73.7
4. Father's occupation*	officer, professional	32.0	unskilled worker	68.0
5. Family income**	sufficient	12.2	insufficient	87.8
6. Family relation	midrange, balanced	90.0	extreme, moderate	10.0
7. Stressful life events	no	19.4	yes	80.6
8. Family type	nuclear family	84.3	extended family	15.7
9. Quality of child care***	moderate to high	85.0	poor	15.0

Note: * officer or professional means jobs that need technical skill such as teachers, doctors, nurses, military officers, civil officers etc

** The sufficiency of income is a perception of respondent's parents about their family income

*** There are 20 questions of parent-child interaction to support cognitive development. Poor quality of child care means score less than 33.4% of total score

alpha coefficient of the instrument, measure of family relation was 0.7033 while the quality of child care was 0.7872.

The sensitivity (Sens), specificity (Spec), positive predictive value (PPV), and negative predictive value (NPV) were applied to identify the optimal cut off point of the FPRI to predict the child's cognitive development.

Statistical analysis

Expressing the primary data by means of mean, standard deviation and percentage. Using statistical method of chi-square test and logistic regression analysis with $p < 0.05$ as the significant level.

Results

The results showed that 52.0% of the sample had an intellectual level lower than 90, of which 5.6% had an intellectual level of less than 70 and only 0.3% were gifted children. The average IQ of the respondents was 90.35 with a standard deviation of 14.85 (Table 2).

Table 3 shows the results of Logistic Regression Analysis. Only four family factors still had an influence on cognitive development of children. Children in extreme or moderate families, families with stressful life events, and of low educated and unskilled occupation mothers had a higher risk of having an intellectual level less than 90: 2.6, 2.1, 2.3, and 2.2 times, respectively after adjusting father's education and occupation, sufficiency of family income, family type and quality of child care.

The FPRI was constructed into three models as mentioned above. Families with high scores of the FPRI had a high proportion of children with normal intellectual level and families with low scores of FPRI were vulnerable for having a high proportion of children with cognitive development below normal that were seen in three models (Table 4-6).

The sensitivity, specificity, PPV, and NPV were analyzed. To ensure the prediction ability of the FPRI, the high sensitivity, specificity, PPV, and NPV of the cut-off point were encouraged. If it is not possible, the high sensitivity and high PPV of the cut-off point should be chosen. The cut-off point at 4 and 5 scores of the FPRI 2 revealed the same phenomena as the cut-off point at 6 and 7 scores of the FPRI 1, high sensitivity but moderate specificity, PPV, and NPV (Table 4, 5). The cut-off point at 2 scores of the FPRI 3 provided moderate sensitivity, specificity and NPV but high PPV

Table 2. Number and percentage of children by intellectual level (n = 319)

IQ level	Number	Percent
<70	18	5.6
70-79	54	16.9
80-89	94	29.5
90-110	117	36.7
111-120	20	6.3
121-130	15	4.7
>130	1	0.3

Mean = 90.35; SD = 14.85; Min = 66; Max = 138
$\bar{X} \pm$ SD (range) 90.35 ± 14.85 (66-138)

Table 3. Logistic regression coefficient and odds ratio of family factors influenced intellectual level

Family factors	Bivariate analysis		Multivariate analysis	
	β	OR	β	Adjusted OR
Extreme and moderate family (a)	1.3078*	3.7	0.9612*	2.6
Having stressful life events (b)	1.1064*	3.0	0.7601*	2.1
Poor child care (c)	0.5034	1.6	0.0446	1.0
Father's education at primary level (d)	0.9873*	2.7	0.1926	1.2
Mother's education at primary level (d)	1.3399*	3.8	0.8533*	2.3
Unskilled occupation of father (e)	0.8816*	2.4	-0.2035	0.6
Unskilled occupation of mother (e)	1.3294*	3.8	0.7808*	2.2
Insufficient income (f)	0.5345	1.7	-0.1369	0.9
Extended family type (g)	0.6855*	2.0	0.7038	2.0

Note: *statistical significant at $p < 0.05$
Reference group (-): a = midrange and balanced family, b = no stressful life events, c = good child care, d = secondary level and above, e = professional and officers, f = sufficient income, and g = nuclear family

Table 4. Number and percentage of children by FPRI 1 score and intellectual level

FPRI Score	Total n (n = 319)	Total %	IQ less than 90 n (n = 166)	IQ less than 90 %	IQ 90 and more n (n = 153)	IQ 90 and more %	Sens	Spec	PPV	NPV
9	14	4.4	2	14.3	12	85.7	98.8	7.8	53.8	85.7
8	43	13.5	13	30.2	30	69.8	91.0	27.5	57.6	73.7
7	33	10.3	13	39.4	20	60.6	83.1	40.5	60.3	68.9
6	35	11.0	12	34.3	23	65.7	75.9	55.6	64.9	68.0
5	54	16.9	24	44.4	30	55.6	61.4	75.2	72.9	64.2
4	76	23.8	52	68.4	24	31.6	30.1	90.8	78.1	54.5
3	45	14.1	36	80.0	9	20.0	8.4	96.7	87.5	48.8
2	16	5.0	12	75.0	4	25.0	1.2	99.3	66.7	48.1
1	3	0.9	2	66.7	1	33.3	-		-	-

Table 5. Number and percentage of children by FPRI 2 score and intellectual level

FPRI Score	Total n (n = 319)	Total %	IQ less than 90 n (n = 166)	IQ less than 90 %	IQ 90 and more n (n = 153)	IQ 90 and more %	Sens	Spec	PPV	NPV
7	15	4.7	2	13.3	13	86.7	98.8	8.5	45.1	86.7
6	44	13.8	14	31.8	30	68.2	90.4	28.1	57.7	72.9
5	33	10.3	12	36.4	21	63.6	83.1	41.8	60.8	69.6
4	36	11.3	14	38.9	22	61.1	74.7	56.2	64.9	67.2
3	66	20.7	30	45.5	36	54.5	56.6	79.7	75.2	62.9
2	94	29.5	67	71.3	27	28.7	16.3	97.4	87.1	65.4
1	26	8.1	23	88.5	3	11.5	2.4	99.3	80.0	48.4
0	5	1.6	4	80.0	1	20.0				

Table 6. Number and percentage of children by FPRI 3 score and intellectual level

FPRI Score	Total n (n = 319)	Total %	IQ less than 90 n (n = 166)	IQ less than 90 %	IQ 90 and more n (n = 153)	IQ 90 and more %	Sens	Spec	PPV	NPV
4	23	7.2	5	21.7	18	78.3	97.0	11.8	54.4	78.3
3	62	19.4	18	29.0	44	71.0	86.1	40.5	61.1	72.9
2	73	22.9	28	38.4	45	61.6	69.3	69.9	71.4	67.7
1	142	44.5	99	69.7	43	30.3	9.6	98.0	84.2	50.0
0	19	6.0	16	84.2	3	15.8				

whereas the cut-off point at 3 scores provided high sensitivity and NPV, moderate PPV but low specificity (Table 6).

Discussion

Maternal education and occupation played important roles on cognitive development of young adolescent in the present study. Usually mothers are in close contact with young children, providing and responding to their needs and facilitating children's learning abilities. High-educated mothers may have a good chance to access much information including appropriate child care. High-educated mothers also have more chance to get a good occupation and earn more income. These factors may provide more opportunities for families to establish an enriched environment to support proper growth and development for their children[10,11].

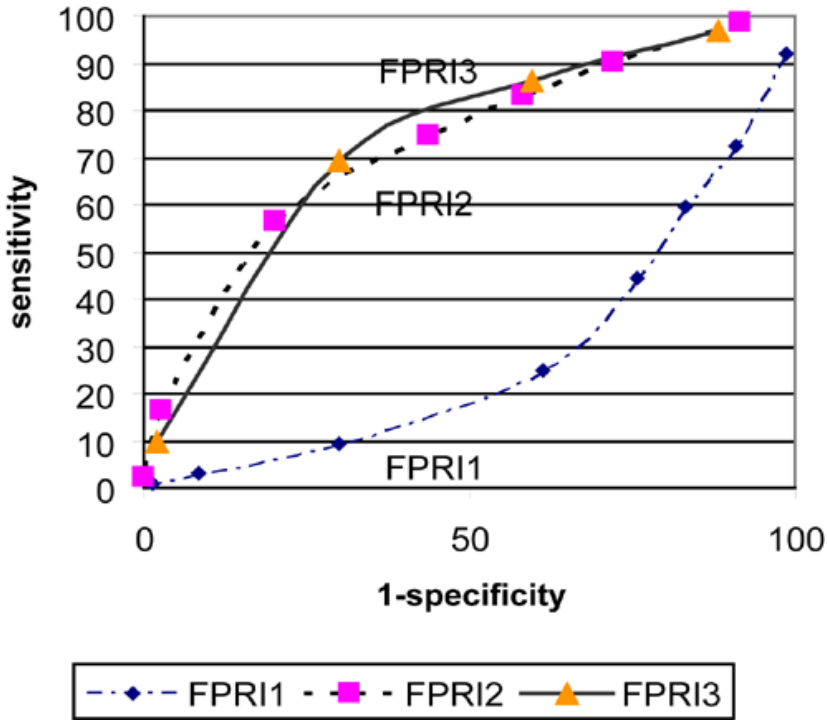

Fig. 1 Receiver operating characteristic (ROC) curve of each FPRI

Family atmosphere is very important for child growth and development, particularly the older children since they may be more sensitive to such a situation. Good family relationship builds love and warmth for its members. The psychological healthy environment offers and supports the child's cognitive development[2]. Children, who have learning support and self adaptation, have better results in higher education. Stressful life events in the family affect the harmony of the family[11,12]. Parents usually spend more time to solve the crises and have less time to be interactive with their children. Usually, child care is an essential factor for child growth and development[13,14]. Although there is no statistically significant association it should not be neglected. In the present study, 85% of children received moderate to high levels of supporting learning ability.

As cumulative protective effects of family factors will enhance the child outcomes, the implications of the FPRI will be useful to identify families at risk of having children with a poor outcome. Among three indices, the FPRI 3 was found to be the best index as the receiver operating characteristic curve was furthest into the top left corner shown in Fig. 1[15]. The FPRI 3 consists of only four simple factors and the information is easy to obtain. In Thailand, a health center is located at the sub-district level. At village level there are 10 to 20 village health volunteers working cooperatively with health personnel. Since the volunteers are local people, they know the situation of the families they are working with quite well. The information of family factors as mentioned earlier could therefore be easily obtained from the volunteers. The families with a FPRI score of less than three points should receive urgent support before poor child outcome happens. Thus, the FPRI will be one tool for health personnel to prioritize families at risk.

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การใช้ดัชนีปัจจัยปกป้องและปัจจัยเสี่ยงของครอบครัวในการคัดกรองพัฒนาการด้านปัญญาเด็กอายุ 13-15 ปี

ศิริกุล อิศรานุรักษ์, สุมาลี กลิ่นแมน, จิราพร ชมพิกุล, สุธรรม นันทมงคลชัย, รัตโนทัย พลับรู้การ

ความนำ: *เครื่องมือคัดกรองอย่างง่ายเป็นสิ่งที่เป็นประโยชน์ต่อการจัดลำดับความสำคัญและการดำเนินงานในชุมชน*
วัตถุประสงค์: *เพื่อศึกษาการใช้ดัชนีปัจจัยปกป้องและปัจจัยเสี่ยงของครอบครัวในการคัดกรองพัฒนาการด้านปัญญาเด็กอายุ 13-15 ปี*
วัสดุและวิธีการ: *เป็นการศึกษาเชิงสำรวจในเด็กอายุ 13-15 ปี จำนวน 319 คน ที่กำลังศึกษาในโรงเรียนในอำเภอหนึ่ง วัดพัฒนาการด้านปัญญาโดยใช้เครื่องมือ TONI ฉบับที่ 3 ปัจจัยครอบครัวที่ศึกษาได้แก่ ระดับการศึกษาของพ่อและแม่ ลักษณะอาชีพของพ่อและแม่ ความเพียงพอของรายได้ครอบครัว ลักษณะครอบครัว สัมพันธภาพในครอบครัว ภาวะวิกฤตในครอบครัว และคุณภาพการเลี้ยงดู คุณลักษณะเชิงบวกของแต่ละปัจจัยครอบครัวให้ 1 คะแนน ส่วนคุณลักษณะเชิงลบให้ 0 คะแนน นำปัจจัยครอบครัว 9 ปัจจัยนี้มาสร้างเป็นดัชนีปัจจัยปกป้องและปัจจัยเสี่ยงของครอบครัว (Family Protective-Risk Index FPRI) โดยมี 3 รูปแบบ รูปแบบที่ 1 สร้างจาก 9 ปัจจัยดังกล่าว รูปแบบที่ 2 สร้างจาก 7 ปัจจัย ที่มีความสัมพันธ์อย่างมีนัยสำคัญรายคู่กับพัฒนาการด้านปัญญาของเด็กในการศึกษาครั้งนี้ ได้แก่ การศึกษาพ่อแม่ ลักษณะอาชีพพ่อแม่ สัมพันธภาพในครอบครัว ภาวะวิกฤตในครอบครัว และลักษณะครอบครัว ส่วนรูปแบบที่ 3 สร้างจาก 4 ปัจจัยที่มีความสัมพันธ์อย่างมีนัยสำคัญพร้อมกันกับพัฒนาการด้านปัญญาของเด็ก ได้แก่ การศึกษาแม่ อาชีพแม่ สัมพันธภาพในครอบครัว และภาวะวิกฤตในครอบครัว นำค่า FPRI ทั้ง 3 รูปแบบมาหาค่าความไว ความจำเพาะ ค่าทำนายเชิงบวกและลบ ในระดับคะแนนต่างๆ เพื่อทำนายพัฒนาการด้านปัญญาของเด็ก*
ผลการศึกษา: *กลุ่มตัวอย่างร้อยละ 52 มีระดับสติปัญญาต่ำกว่า 90 FPRI รูปแบบที่ 1 ที่คะแนน 6 หรือ 7 และรูปแบบที่ 2 ที่คะแนน 4 หรือ 5 มีความไวสูง แต่มีความจำเพาะ และค่าทำนายเชิงบวกและลบปานกลาง FPRI รูปแบบที่ 3 ที่ 2 คะแนน มีค่าทำนายเชิงบวกสูง แต่ค่าอื่นๆ อยู่ระดับปานกลาง ในขณะที่ 3 คะแนน มีความไว และค่าทำนายเชิงลบสูง ค่าทำนายเชิงบวกปานกลาง แต่ความจำเพาะค่อนข้างต่ำ และจากการเปรียบเทียบดัชนีทั้ง 3 ตัวด้วย Receiver Operating Characteristic curve พบว่า FPRI รูปแบบที่ 3 มีความเหมาะสมที่สุด*
สรุป: *FPRI รูปแบบที่ 3 สามารถใช้เป็นเครื่องมือคัดกรองเบื้องต้นสำหรับบุคลากรทางการแพทย์และสาธารณสุขในท้องถิ่นใช้ค้นหาครอบครัวเสี่ยงที่ส่งผลเชิงลบต่อพัฒนาการด้านปัญญาของเด็ก เพื่อให้การช่วยเหลือป้องกันก่อนเกิดปัญหาดังกล่าว*