Denver Developmental Screening Test (DDST) Survey and Degree of Malnutrition Among Children Born to HIV Infected Mothers under the Prevention of Mother to-Child-Transmission (PMTCT) Program

Usa Hokjindee MA*, Virasakdi Chongsuvivatwong MD, PhD*,
Apiradee Lim PhD**, Nannapat Pruphetkaew MSc*

** Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, Thailand*
*** Department of Mathematics and Computer Science, Faculty of Science and Technology, Prince of Songkla University Pattani Campus, Pattani, Thailand*

Objective: *To examine morbidity experience, pattern of nutrition status and development of the children born to HIV infected mothers under the Prevention of Mother to Child Transmission (PMTCT) Program compared to the national standard.*
Material and Method: *In 2008, births given by mothers under PMTCT in five selected hospitals of Health Region 4 of Thailand between 2002 and 2006 were identified from the registered data and the medical records, were reviewed. Their homes were visited to collect the data.*
Results: *Among 138 mothers and 143 children studied, nobody died. Forty-four were healthy, 91 experienced mild episode of various infections and allergy within the past three months, one was admitted for pneumonia, two were HIV-positive, 53 were negative and the other 88 had no final blood tested. In the Denver Developmental Screening Test (DDST), all parameters were minimal, less than 5%. Overall, the suspected delay development is around 15.4%. For nutritional status assessment by height for age (HFA), weight for age (WFA) and weight for height (WFH) reported a quarter (23.1%) was stunting whereas 12.6% were thin and 5.6% were wasting, respectively.*
Conclusion: *Among the study PMTCT children, serious morbidity was rare. Nutritional deficiency was more common than delayed development.*

Keywords: *Nutritional status, Child development, HIV positive mothers, PMTCT*

J Med Assoc Thai 2010; 93 (12): 1458-62
Full text. e-Journal: *http://www.mat.or.th/journal*

In 2000, Thailand started to implement a national program to prevent mother-to-child transmission (PMTCT) of human immunodeficiency virus (HIV), following successful trials and operational pilots[1-6]. Free routine HIV testing and counseling during pregnancy, short course ZDV for the mother and ZDV syrup for the newborn and infant formula were provided[7,8]. In 2001-2002, the program began adding a single dose of nevirapine for both mothers and newborn. Subsequently, this was adopted as the national regimen[6].

Correspondence to:
Hokjindee U, Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
Phone: 074-451-165, Fax: 074-429-754
E-mail: hokjindee@yahoo.com

Amidst the strong policy and massive implementation, the effectiveness of PMTCT on child mortality, morbidity, growth and development had never been evaluated. The objective of the present study was, therefore, to document the afore-mentioned effectiveness in sample subjects in Health Region 4. The findings could be used to improve future care of this program.

Material and Method

The present study protocol was approved by the Ethics Committee, Prince of Songkla University. The investigation was a combination of retrospective cohort study, reviewing subject's medical records and field visit for the children's growth and development. Five collaborative hospitals in Health Region 4 participated in the project.

HIV infection is defined if a child had two or more positive tests using polymerase chain reaction or one positive test by two different assays (*e.g.* enzyme immunoassay or rapid test) drawn at 18 months or longer interval or having an AIDS-defining condition[7,8].

Assuming that 90% of the subjects would have normal nutrition and development status and 95% confidence limit of this estimate being 5% below and above this value, the required sample size was 138 subjects[9]. The hospital number, address and telephone number of PMTCT mother, delivered between 2002 and 2006, who were Thai were retrieved. Exclusion criteria were living beyond 30 km from the hospital, having serious congenital, and birth below 1,000 gm.

A semi-structured questionnaire was developed and pre-tested in a nearby province. The final version consisted of sections of socio-economic characteristics, health status of the parents and the child and health service used. To minimize recall error, information regarding history of access to HIV care, the child's birth data, antiretroviral drugs administration, blood tested for HIV and other treatments were validated against medical records wherever possible.

Nutritional status included weight-for-age (WFA), height-for-age (HFA) and weight-for-height (WFH) values, divided into five levels with cutoff points at $\leq$ -2 SD, $\leq$ -1.5 SD, $\leq$ +1.5 SD and $\geq$ +2 SD from age-specific means of Thai 1,999 standard growth curves[10,11]. The interpretation of these parameters: WFA, HFA and WFH $\leq$ -2 SD were classified as thin, stunting and wasting, respectively.

Denver II Development Screening Test (DDST) was used to assess personal-social, fine-motor adaptive, language and gross-motor domains. In each domain, a child was suspected if he/she had 2-or-more "caution" or any "delayed" items. These two were defined as not able to pass the level where 75% and 90% of normal children of the same age could pass, respectively.

R program with Epicalc package[12] was used for data analysis. Descriptive statistics and cross-tabulation were done with Chi-squared test and Fisher's exact test as appropriate. Statistical significance was set at < 0.05.

Results

Out of 188 women selectively retrieved from the database, 138 women and 143 children were completely approached and evaluated. The mothers had mean $\pm$ SD age of 29.5 $\pm$ 6.0 years. The majority were blue-collar workers (51.7%), having finished primary school education (62.2%), living together (93.0%), having less than 9,000 baht income per month (57.3%) and having antiretroviral drug prophylaxis (83.9%). Around three quarters (76.2%) had spontaneous vaginal delivery.

Children had mean $\pm$ SD gestational age at delivery of 38.7 $\pm$ 1.7 weeks, birth weight of 2,980 $\pm$ 406 grams, current age of 31.3 $\pm$ 14.3 months. A half (50.3%) was female. Over three quarters (76.9%) were given the first dose of nevirapine within 48 hours after birth, ZDV medication was completed in 74.8%. Only 2 in 143 children (1.3%) were HIV positive. Health status varied from healthy (30.1%), moderate (63.6%) and often sick (5.6%). One case had pneumonia and was hospitalized.

Table 1 compares the percentage of children suspected to have development problem among four surveys in Thailand[13-16] and the present study, using the same DDST. The percentage of each domain of the present study was the minimum, less than 5%. Overall, the suspected delay development was around 15.4%.

Table 2 compares nutritional status of children surveyed in 2004 and the present study. The percentage of thin (WFA $\leq$ -2 SD), stunting (HFA $\leq$ -2 SD) were 12.6% and 23.1% respectively in the present study was higher than those in the previous one of 6.9% and 8.3% respectively. Similarly, the percentage of wasting (WFH $\leq$ -2 SD) was higher (5.6% versus 4.9%).

Compared to the 2001 nation-wide survey results[17], the present study subjects had a higher risk for being in the lowest of WFA, HFA and WFH. There was no evidence that any demographic characteristic was associated with these parameters. Therefore, further breakdown was omitted.

Discussion

The PMTCT subjects were mainly from a relatively low socioeconomic background. Quite a few were diagnosed and given ARV therapy rather late in pregnancy and the majority still had vaginal delivery. Each of the four domains of the development screening test, Denver Developmental Screening Test (DDST) Survey, had suspected prevalence of less than 5%, which were distinctly lower than those in previous surveys[13-16]. However, nutritional deficiency was more common. Almost a quarter were stunted. One in eight had extremely low WFA values and more than one in twenty were seriously wasting. Finally, none of the demographic characteristics or history of HIV

Table 1. Comparison of time-different DDST surveys among Thai early childhood population with the present study

Year of study	No.	Percent suspect to delay developmental tasks				Total	
		Social & personal	Fine motor	Language	Gross motor	Normal	Suspected
1997 *[13]	3,063	14.3	30.4	14.4	21.0	83.5	16.7
1999 **[14]	3,042	3.2	10.1	13.7	4.1	71.1	28.3
2004**[15]	10,200	11.6	20.3	33.4	6.6	72.0	28.0
2007**[16]	1,548	6.2	8.1	21.8	4.0	67.7	32.3
present study, 2008	143	0	2.1	2.1	4.9	84.6	15.4

* National Institute for Child and Family Development (NICFD)
** Department of Health, Ministry of Public Health

Table 2. Distribution of various nutritional indices of under-five year children in the current and 2004 studies based on national standard*

Nutritional status group*	Weight for age		Height for age		Weight for height	
	Current study (n = 143)	The study in 2004 (n = 3,147)	Current study (n = 143)	The study in 2004 (n = 2,327)	Current study (n = 143)	The study in 2004 (n = 2,327)
SD	2 (1.4)	223 (7.1)	2 (1.4)	74 (3.2)	4 (2.8)	184 (7.9)
> +1.5 to+ 2 SD	1 (0.7)	121 (3.8)	0 (0)	80 (3.4)	8 (5.6)	69 (3.0)
-1.5 to+1.5 SD	120 (83.9)	2,232 (70.9)	107 (74.8)	1,766 (75.9)	117 (81.1)	1,790 (76.9)
< -1.5 to-2 SD	2 (1.4)	354 (11.2)	1 (0.7)	214 (9.2)	6 (4.2)	171 (7.3)
< -2SD	18 (12.6)	217 (6.9)	33 (23.1)	193 (8.3)	8 (5.6)	113 (4.9)

services utilization was associated with nutritional status and development outcome.

Among children who were born to HIV positive mothers, the reported mortality rate was lower than those in previous studies, especially in Thailand in the 1990's (10%)[4,18] where PMTCT had not been available. The impact of PMTCT in reduction of mortality in the present study, however, needs to be interpreted with caution. The selected patients included those who lived in a reachable distance and had been regularly followed-up. They might have lower mortality rate than the average PMTCT subjects. PMTCT effect on mortality needs to be evaluated with a larger study.

Previous studies reported common growth failure among HIV infected children[19,20]. HIV could penetrate into the nervous system thus delaying neural behavior development. Chronic co-infections among the HIV positive children can result in pneumonia, diarrhea and other diseases leading to growth retardation[21-24]. HIV infection often causes impairment of growth and development in children. Failure to gain weight could also be a direct consequence of HIV infection, secondary to HIV related illness, or be associated with the disease progression[25,26]. The challenges left to the surviving PMTCT children were higher prevalence of malnutrition than delayed development.

As mentioned, high loss to follow-up of the patients in the present program and 26% missing subjects may bias the authors' results toward better survival and health outcome. The incomplete information on HIV status of the study children did not allow the authors to assess the success rate of preventing HIV vertical-transmission.

In conclusion, among the present study PMTCT children, serious morbidity was rare. Nutritional deficiency was more common than delayed development.

References

1. Amornwichet P, Teeraratkul A, Simonds RJ, Naiwatanakul T, Chantharojwong N, Culnane M,

et al. Preventing mother-to-child HIV transmission: the first year of Thailand's national program. JAMA 2002; 288: 245-8.
2. Plipat T, Naiwatanakul T, Rattanasuporn N, Sangwanloy O, Amornwichet P, Teeraratkul A, et al. Reduction in mother-to-child transmission of HIV in Thailand, 2001-2003: Results from population-based surveillance in six provinces. AIDS 2007; 21: 145-51.
3. Kanshana S, Thewanda D, Teeraratkul A, Limpakarnjanarat K, Amornwichet P, Kullerk N, et al. Implementing short-course zidovudine to reduce mother-infant HIV transmission in a large pilot program in Thailand. AIDS 2000; 14: 1617-23.
4. Thisyakorn U, Khongphatthanayothin M, Sirivichayakul S, Rongkavilit C, Poolcharoen W, Kunanusont C, et al. Thai Red Cross zidovudine donation program to prevent vertical transmission of HIV: the effect of the modified ACTG 076 regimen. AIDS 2000; 14: 2921-7.
5. Shaffer N, Chuachoowong R, Mock PA, Bhadrakom C, Siriwasin W, Young NL, et al. Short-course zidovudine for perinatal HIV-1 transmission in Bangkok, Thailand: a randomised controlled trial. Bangkok Collaborative Perinatal HIV Transmission Study Group. Lancet 1999; 353: 773-80.
6. Kanshana S, Simonds RJ. National program for preventing mother-child HIV transmission in Thailand: successful implementation and lessons learned. AIDS 2002; 16: 953-9.
7. Thai Ministry of Public Health. National guidelines for the clinical management of HIV infection in children and adults. 7th ed. Nonthaburi, Thailand: Department of Disease Control, Ministry of Pubic Health; 2002.
8. Thai Ministry of Public Health, UNICEF, WHO and CDC. Guidelines for the clinical management of HIV mother and family. 7th ed. Nonthaburi, Thailand: Ministry of Pubic Health; 2003.
9. Cochran WG. Formula for calculating a sample for proportions determining sample size 1 [serial on the Internet]. 1963 [cited 2010 Aug 23]. Available from: http://edis.ifas.ufl.edu/pd006
10. de Onis M, Garza C, Onyango AW, Rolland-Cachera MF. WHO growth standards for infants and young children. Arch Pediatr 2009; 16: 47-53.
11. Department of Health. Reference values for weights and heights of Thai population aged 1 d - 19 years old. Nonthaburi: Department of Health, Ministry of Public Health, Thailand; 1999.
12. Chongsuvivatwong V. Epicalc: epidemiological calculator. R package version 2.11.1.0 [database on the Internet] 2010 [cited 2010 Aug 23]. Available from: http://CRAN.R-project.org/package = epicalc
13. Kotchabhakdi N, Ruangdarakanon N, Kunanusonthdi C. Health status and development of Thai children 1996-1997 Bangkok.
14. Department of Health. Health status development and growth of early childhood 1999. Nonthaburi, Thailand: Bureau of Health Promotion, Department of Health, Ministry of Public Health; 2001.
15. Department of Health. Health status development and growth of early childhood 2004. Nonthaburi, Thailand: Bureau of Health Promotion, Department of Health, Ministry of Public Health; 2005.
16. Department of Health. Health status development and growth of early childhood 2007. Nonthaburi: Bureau of Health Promotion, Department of Health, Ministry of Public Health; 2008.
17. Ladda Mo-suwan. Physical development of Thai children: growth, nutritional status and physical fitness; in the holistic development of Thai children study. Songkhla: HatYai Paper; 2004.
18. Chearskul S, Chotpitayasunondh T, Simonds RJ, Wanprapar N, Waranawat N, Punpanich W, et al. Survival, disease manifestations, and early predictors of disease progression among children with perinatal human immunodeficiency virus infection in Thailand. Pediatrics 2002; 110: e25.
19. Sanmaneechai O, Puthanakit T, Louthrenoo O, Sirisanthana V. Growth, developmental, and behavioral outcomes of HIV-affected preschool children in Thailand. J Med Assoc Thai 2005; 88: 1873-9.
20. Aurpibul L, Puthanakit T, Taecharoenkul S, Sirisanthana T, Sirisanthana V. Reversal of growth failure in HIV-infected Thai children treated with non-nucleoside reverse transcriptase inhibitor-based antiretroviral therapy. AIDS Patient Care STDS 2009; 23: 1067-71.
21. Iragui VJ, Kalmijn J, Thal LJ, Grant I. Neurological dysfunction in asymptomatic HIV-1 infected men: evidence from evoked potentials. HNRC Group. Electroencephalogr Clin Neurophysiol 1994; 92: 1-10.
22. Agostoni C, Zuccotti GV, Giovannini M, Decarlis S, Gianni ML, Piacentini E, et al. Growth in the first two years of uninfected children born to HIV-1 seropositive mothers. Arch Dis Child 1998; 79: 175-8.
23. Taha TE, Dallabetta GA, Canner JK, Chiphangwi JD, Liomba G, Hoover DR, et al. The effect of

human immunodeficiency virus infection on birthweight, and infant and child mortality in urban Malawi. Int J Epidemiol 1995; 24: 1022-9.
24. Williams PL, Marino M, Malee K, Brogly S, Hughes MD, Mofenson LM. Neurodevelopment and in utero antiretroviral exposure of HIV-exposed uninfected infants. Pediatrics 2010; 125: e250-60.
25. Ibieta MF, Cano JM, Amador JT, Gonzalez-Tome MI, Martin SG, Gomez MN, et al. [Growth of uninfected infants exposed to antiretrovirals born to HIV-infected woman]. An Pediatr (Barc) 2009; 71: 299-309.
26. Bailey RC, Kamenga MC, Nsuami MJ, Nieburg P, St Louis ME. Growth of children according to maternal and child HIV, immunological and disease characteristics: a prospective cohort study in Kinshasa, Democratic Republic of Congo. Int J Epidemiol 1999; 28: 532-40.

การสำรวจโดย Denver Developmental Screening Test (DDST) และระดับทุโภชนาการระหว่างเด็กเกิดจากมารดา ติดเชื้อเอสไอวีในโครงการป้องกันการติดเชื้อจากมารดาสู่เด็ก

อุษา ฮกยินดี, วีระศักดิ์ จงสู่วิวัฒน์วงศ์, อภิรดี แซ่ลิ่ม, นันท์นภัส พรุเพชรแก้ว

วัตถุประสงค์: *เพื่อตรวจสอบประสบการณ์การเจ็บป่วย สถานะรูปแบบของโภชนาการ และการพัฒนาของเด็กที่เกิดจากมารดา ในโครงการป้องกันการติดเชื้อจากมารดาสู่เด็กเปรียบกับมาตรฐานของประเทศ*

วัสดุและวิธีการ: *ในปี พ.ศ. 2551 ได้ค้นหาข้อมูลลงทะเบียน และทบทวนเวชระเบียนเด็กที่เกิดจากมารดาในโครงการป้องกันการติดเชื้อจากมารดาสู่เด็กที่คลอดในโรงพยาบาล 5 แห่งซึ่งเลือกจากเขตสุขภาพที่ 4 ระหว่างปี พ.ศ. 2545 ถึง พ.ศ. 2549 รวมถึงการเยี่ยมบ้านเพื่อเก็บข้อมูล*

ผลการศึกษา: *มารดา 138 คน และเด็ก 143 คน ไม่มีผู้เสียชีวิต ในจำนวนนี้ 44 ราย แข็งแรง 91 ราย ประสบการติดเชื้อหลากหลายและโรคภูมิแพ้ใน 3 เดือนที่ผ่านมา เด็ก 1 ราย อยู่โรงพยาบาลเพราะเป็นโรคปอดอักเสบ สำหรับการตรวจเลือดโรคเอดส์ 2 ราย ได้ผลบวก 53 ราย ได้ผลลบ และ 88 ราย ไม่มีผลการตรวจเลือดยืนยัน Denver Developmental Screening Test (DDST) ทุกตัวชี้วัดต่ำและน้อยกว่าร้อยละ 5 โดยรวม ร้อยละ 15.4 เป็นเด็กที่สงสัยว่าการเจริญเติบโตช้า ส่วนการประเมินสถานภาพด้านโภชนาการด้วยส่วนสูงเหมาะกับอายุ (height for age -HFA) น้ำหนักเหมาะกับอายุ (weight for age–WFA) และน้ำหนักเหมาะกับส่วนสูง (weight for height–WFH) พบว่าราวหนึ่งในสี่ หรือร้อยละ 23.1 แคระแกรน ในขณะที่ร้อยละ 12.6 ผอม และร้อยละ 5.6 ผอมทรุดโทรมตามลำดับ*

สรุป: *การศึกษาเด็กในโครงการป้องกันการติดเชื้อจากมารดาสู่เด็กพบอัตราป่วยน้อย ส่วนภาวะทุโภชนาการพบบ่อยกว่าการเจริญเติบโตช้า*