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Quantiles Regression Approach to Identifying the Determinant of Breastfeeding Duration

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Abstract: In this study, quantiles regression approach is applied to the data of Malaysian Family Life Survey (MFLS), to identify factors which are significantly related to the different conditional quantiles of the breastfeeding duration. It is known that the classical linear regression methods are based on minimizing residual sum of squared, but quantiles regression use a mechanism which are based on the conditional median function and the full range of other conditional quantile functions. Overall, it is found that the period of breastfeeding is significantly related to place of living, religion and total number of children in the family.

Key words: Breastfeeding, conditional quantiles regression

INTRODUCTION

Breast milk is known to be very essential for the baby. It has the perfect blend of nutrients in the exact right amounts for baby's nutritional needs. Breastfeeding is also an important contributory factor for healthy mothers. Breastfeeding promotes health, helps to prevent infant diseases and reduce health care costs (Hausman, 2003; Pediatrics, 2005).

The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), as well as many other health care organizations, currently suggest that babies should be exclusively breastfeed for the first six months of life and thereafter to continue breastfeeding for two years and beyond. Complementary foods should be introduced when the baby is six months old (WHO, 2003; Unicef, 2004). The teaching of Islam has acknowledge and emphasized this fact earlier, where in the Al-Qur'an is written that breastfeeding is a must for all mothers who can do and weaning should be carried out at about the time when the baby is two years of age.

Since 1970, the Ministry Health of Malaysia has implemented several strategies and conducted many activities to promote breastfeeding. The Malaysian National Breastfeeding Policy states that all mothers are encouraged to breastfeed their baby completely for between four to six months and continue to breastfeed until the child is two years old. In 1993, the program called Baby-Friendly Hospital Initiative (BFHI) was launched for the first time in Malaysia. The Hospital Rakan Bayi in

Malaysia, which is an example of a program identified under the BFHI, involves campaign to create conducive conditions in the hospital particularly for mothers who wish to breastfeed their babies successfully (susuibu.com, 2004; Health, 2006).

In this study, with using the data of Malaysian Family Life Survey reported by National Population and Family Development Board (1994), we investigate which factors are significantly related to the breastfeeding duration using the quantile regression approach. The factors include are place of living, ethnic group, religion, mother's education, mother's employment, child's gender, mother's age and total number of children in the family.

Both commercial formula milk and breast milk are the main source of nutrition for the baby. Although formula milk has more protein, breast milk is still the best for baby. Breast milk has all the essentials required by the baby, such as water, protein, carbohydrates, fats, vitamins and minerals, all of which are available in correct proportions. Considering the beneficial effect of breastfeeding on the survival of the baby, World Health Organization recommended that all mothers do breastfeed their babies for a sufficient length of duration.

Many studies have been carried out to determine factors which influence the duration of breastfeeding. Using data for Sri Lanka, Akin *et al.* (1981) has shown that mother's age, mother's work, usage of pill and number of children in the family as factors that can influence the duration of breastfeeding. Blyth *et al.* (2004) has also shown that maternal age in Australian population is

related to breastfeeding. Jacknowitz (2004) found out that mother's age, education of mother, ethnic and birth place are factors which have significant effect on influencing breastfeeding pattern. Factors influencing the success of breastfeeding are very complex, involving psychological and physical interaction between the baby and mother and difficulties for this interaction can lead to discontinuation (Jelliffe and Jelliffe, 1978; Jacknowitz, 2004; Nutriweb, 2005).

Breastfeeding duration is one of the factors that has been shown in many studies to have a strong association with the healthy growth and development of infants. Breastfeeding also protects babies against the risk of allergy and contribute to child spacing for the mothers (Pediatrics, 2005). The maternal bond is strengthened through breastfeeding, with the hormonal releases giving the mother positive feelings of nurture towards the child. Recent study (Uauy and Peirano, 1999) shown that children who have been breastfed are found to obtain the average score on the IQ tests higher than those who have not been breastfed. Studies that have been carried out by WHO have shown that malnutrition could cause 60% of the 10.9 million deaths annually among children under five. These deaths could possibly be associated to the feeding practices, particularly during the first year of babies' life (WHO, 2003).

MATERIALS AND METHODS

The breastfeeding data used in this study are based on retrospective study, reported in the Malaysian Family Life Survey (MFLS). Based on the MFLS report, 1,591 respondents were selected for the analysis considering that they have satisfied the requirements for this study. The identified respondents, represented 4,444 sample of households in Peninsular Malaysia, where each household consist of an ever married woman under the age of 50 years, with at least one child under the age of seven. This survey focused on the breastfeeding experience of the mothers to their youngest child, even if only for a short time and up to 29 months.

Based on the data gathered regarding the respondents, a summary for the characteristics of mothers are as shown in Table 1.

Based on the analysis of lengths of breastfeeding duration, it is found that most mothers practiced breastfeeding during the first two months of their babies' life. The distribution of breastfeeding duration is skewed, as shown in Fig. 1.

Quantile regression: As described by Gilchrist (2000), quantile is defined as the value that corresponds to a

Table 1: Number of respondents according to different variables and categories

Variables	Categories	Number
Place of living	Metropolitan	380
	Rural	346
	Urban	665
Ethnic group	Malay	1088
	Indian	279
	Chinese	224
Religion	Islam	1138
	Christian	49
	Hindu	209
	Buddhist	195
Mother's education	Primary	536
	Secondary-1	426
	Secondary-2	478
	High school	151
Mother's employment	Employee	970
	Housewife	621
Child's gender	Male	816
	Female	775
Mother's age (years)	15-20	57
	21-29	708
	30-39	732
	>39	94
No. of children	1-2	621
	3-4	615
	>4	355

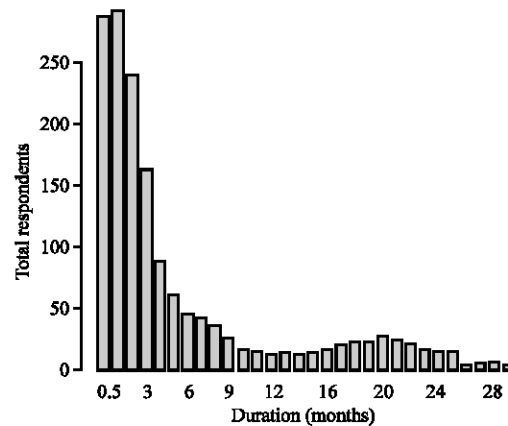


Fig. 1: Distribution of breastfeeding duration

specified proportion of a sample or population. Thus, we may defined τ th quantile as the value which divide the data into two parts, the τ fraction of the data below it and $1-\tau$ fraction of the data above it and $0 < \tau < 1$. Median is a commonly used quantile, which is equal to 0.5th quantiles of the ordered data. Quantiles regression as introduced by Koenker and Bassett (1978), is a statistical method used to estimate models based on conditional quantile functions. Unlike the classical linear regression methods that are based on minimizing sums of squared residuals and to estimate only one model based on conditional mean functions, quantile regression methods are based on minimizing absolute residuals and intended to estimate conditional median functions and a full range of other

conditional quantile functions (Koenker and Hallock, 2001). When compared to classical regression approach, quantile regression is more comprehensive since it provides the conditional distribution of variable of interest, say Y given a certain value of an explanatory variable X, at various quantile positions.

Consider a classical linear regression model;

$$y_i = X_i' \beta + e_i \quad i=1, \dots, n \quad (1)$$

Where:

- y_i = ith response
- x'_i = 1 × p row vector of constants so that $E(y_i) = x'_i \beta$
- β = p × 1 vector of parameters
- e_i = ith residual

The regression estimator can be estimated by minimizing the sum of squared residuals;

$$\min \sum_{i=1}^n (y_i - \hat{y}_i)^2 \quad (2)$$

Where:

\hat{y}_i = Predicted value for the ith observation.

When estimating the conditional median, we can define the solution as a problem of minimization the sum of absolute residuals, which can be calculated by:

$$\min \sum_{i=1}^n |y_i - \hat{y}_i| \quad (3)$$

We define a linear model for the ith quantile as:

$$y_i = X_i' \beta_\tau + e_i \quad i=1, \dots, n \quad (4)$$

Analogous to the concept of median, Koenker and Basset (1978) proposed a complete and different method for estimation of an unknown value, say α , for any τ in the interval (0,1), which may be defined as any solution to the minimization problem of the equation:

$$\min_{a \in \mathbb{R}} \left\{ \sum_{i=1}^n \tau |y_i - a| + \sum_{i=1}^n (1-\tau) |y_i - a| \right\} \quad 0 < \tau < 1 \quad (5)$$

In estimating models for conditional quantile function, we minimize a sum of asymmetrically weighted absolute residuals. This will contribute to different weights to positive and negative residuals. The general τ th sample quantile, which is the analogue to Eq. 5 can be given by

$$\hat{\beta}(\tau) = \min_{\beta \in \mathbb{R}^p} \left\{ \sum_{i=1}^n \tau |y_i - X_i' \beta| + \sum_{i=1}^n (1-\tau) |y_i - X_i' \beta| \right\}$$

and equivalently written as:

$$\hat{\beta}(\tau) = \min_{\beta \in \mathbb{R}^p} \sum_{i=1}^n \rho_\tau (y_i - X_i' \beta_\tau) \quad 0 < \tau < 1 \quad (6)$$

Several software packages can be used to implement the quantile regression method, such as S-plus (Yu, 2003), R-program (Faraway, 2005; Verzani, 2005) and Stata. In this research, R software was used to model the relationship of the duration of breastfeeding with characteristics of mothers as using the quantile regression approach.

RESULTS AND DISCUSSION

In this study, quantile regression approach is used to examine the relationships between the duration of breastfeeding and some potential explanatory variables. According to the different τ th quantile, it is found that the distribution of breastfeeding duration as provided by respondents, is shown in Table 2.

It is interesting to notice that about 35% of the respondents practiced breastfeeding during the first month period of their babies life. Fifty percent of the respondents, weaned breastfeeding when their baby are less than two months old, as shown by the mean duration of two months for the 0.5th quantile. About 10% of mothers have breastfed their babies for the period of 19 months and more.

To examine the relationship between the duration of breastfeeding and some potential explanatory variables, the quantile regression approach is used for the analysis. In most of the analysis of breastfeeding duration, least square regression method has been employed. However,

Table 2: Distribution of breastfeeding duration according to the different τ quantile

τ th quantile =	Mean duration of Breastfeeding (months)
0.05	0.5
0.10	0.5
0.15	0.5
0.20	1.0
0.25	1.0
0.30	1.0
0.35	1.0
0.40	2.0
0.45	2.0
0.50	2.0
0.55	3.0
0.60	3.0
0.65	4.0
0.70	5.0
0.75	7.0
0.80	9.0
0.85	14.0
0.90	19.0
0.95	22.0

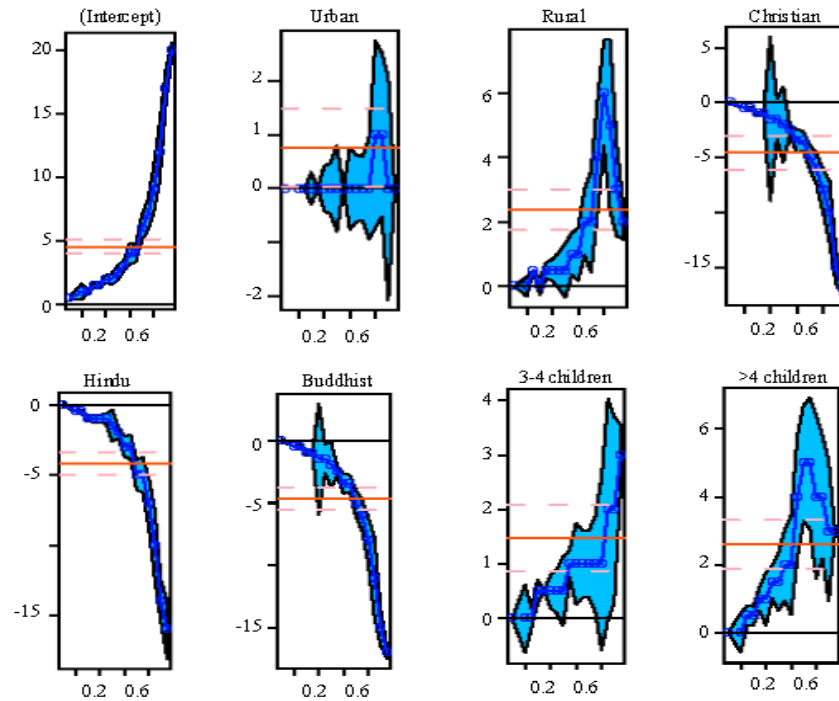


Fig. 2: Quantile regression estimation: breastfeeding duration

a more complete picture of the covariate effects can be provided based on the conditional quantiles regression functions. The variables are found to be significant in relation to the breastfeeding duration are place of living, religion and total number of children in the family. The reference categories that are used to define the place of living, religion and total number of children are metropolitan, Islam and one or two children in the family, respectively. The pattern of the relationships between these variables with the duration of breastfeeding for various conditional quantiles function, are as given in Fig. 2.

The dashed lines in Fig. 2 shows the ordinary least squares estimate of the conditional mean effect, with two dotted lines represent to 90 percent confidence intervals of mean. Duration of breastfeeding practiced by mothers who live in urban area is almost constant over the whole range of the distribution, except for the 0.8 and 0.85th quantiles. Mothers who live in rural area breastfed their babies for a longer period compared with mothers in the metropolitan. Using metropolitan as the reference category, the difference between breastfeeding durations for rural and metropolitan can be observed based on the mean at 0.4 and 0.6th quantiles, as indicated by the longer breastfeeding period of half and one month, respectively. The longest breastfeeding period can be seen at 0.8th quantile, employing that on the average mothers living in

Table 3: Quantile regression estimation: breastfeeding duration

Independent variables	Coefficient at quantiles				
	0.2	0.4	0.5	0.6	0.8
Urban	0.000	0.000	0.000	0.000	1.000
Rural	0.000	0.500*	0.500	1.000*	6.000***
Christian	-0.500	-1.500	-2.000	-3.500***	-8.000***
Hindu	-0.500	-1.000***	-1.500*	-3.000***	-7.000***
Buddhist	-0.500	-1.500	-2.000*	-3.500***	-8.000***
3-4 children	0.000	0.500**	0.500	1.000*	1.000
>4 children	0.000	1.000*	1.500**	2.000*	4.000**
Constant	1.000*	2.000***	2.500***	4.000***	9.000***

***: p-value ≤ 0.001 ; **: p-value ≤ 0.01 ; *: p-value ≤ 0.05

the rural practiced breastfeeding six months longer than mothers in the metropolitan.

Considering the religion, it is found that the mothers who believe in Christian, Hindu and Buddhist breastfed their babies for a shorter period, compared to mothers who believe in Islam. These patterns seemed to be consistent through out the whole range of the breastfeeding duration.

Children who live in the family with 3 or 4 children and more than 4 children, experienced breastfeeding duration longer than children who live in the family which have 1 or 2 children. The longest period of breastfeeding is found in the family whose have more than 4 children. This result suggested that the breastfeeding period practiced by mothers who have 3 or 4 children, are longer half month as shown by the mean for the 0.4 to 0.5th

quantiles and longer by one month as shown by the mean for the 0.6 to 0.8th quantiles. Based on the means of corresponding to 0.4, 0.5, 0.6 and 0.8th quantiles, mothers who have more than 4 children are found to breastfeed their babies by longer period 1.0, 1.5, 2.0 and 4 months, respectively, compared with mothers who have 1 or 2 children.

Furthermore, Fig. 2 show that some quantile regression estimates lie outside of the confidence intervals based on the ordinary least squares regression, indicate which the effects of these covariates on the mean breastfeeding duration are not constant, depending on the value of the independent variable. A summary to describe the explanatory variables which are found to be significantly related to breastfeeding duration for certain quantile position, is shown in Table 3.

CONCLUSION

The method of quantile regression can give a clear picture on the relationship between the explanatory variables with the breastfeeding duration for the whole range of the data distribution considered. Although the variables that are significant in overall of the model, may vary according to the quantile position. It is clear that the determinant of breastfeeding duration in Peninsular Malaysia are place of living, religion and total number of children in the family, which can be particularly observed for the higher quantile position.

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