

ARTICLE

Ordinal regression analyses of breastfeeding duration in the Philippines

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Abstract—This paper offers a different perspective in identifying significant correlates of breastfeeding duration. In particular, a proportional odds ordinal regression model with a cumulative logit link is fitted using NDHS 2008 data. Results of the analysis showed that female infants are 15% more likely to be breastfed longer than their male counterparts. Moreover, it was also observed that latter born children are 26% more likely to be breastfed longer than earlier born children. These findings suggest the necessity to perform in-depth studies to better explain the results. Moreover, the results of this analysis have verified previous literature findings relating increased modernity of mothers (mothers with higher educational attainment, higher wealth status, and domiciling in urban areas) with shorter breastfeeding practice. The latter findings suggest that with increased modernity being possibly related with gainful employment, improving breastfeeding practices among these mothers may be done through development of breastfeeding supports in work stations.

Keywords—breastfeeding duration, maternal characteristics, child characteristics, NDHS data, ordinal regression, Philippines

INTRODUCTION

The Child Protection Working Group (CPWG) mentioned that a practice that provides advantages with regard to general health of babies is breastfeeding (CPWG 2012). It has been accepted as the most beneficial and best nourishment for babies' health progress for many years. World Health Organization (WHO) defines *breastfeeding* as the normal way of providing young infants with the nutrients they need for healthy growth and development. Breastfeeding has been highlighted as the lead prevention intervention to improve child health and survival (Jones et al. 2003). Moreover, long-term benefits of breastfeeding have been noted in several studies which include positive effects on IQ and cognitive development of humans being associated with longer breastfeeding duration (Belfort et al. 2013, Horta and Victoria 2013). Aside from its positive effects on child growth, breastfeeding was also found to provide health benefits to mothers. One notable of which is the decreased risk of ovarian cancer and increased postpartum uterine activity, which can eventually lead to greater weight loss as compared with mothers who bottle-fed their children (Quigley et al. 2012). These benefits of breastfeeding practice for both babies and mothers are the reasons why WHO and UNICEF jointly recommend mothers to breastfeed their infants with appropriate complementary food up to two years of age and beyond to achieve optimal health, growth, and development.

Here in the Philippines, according to the most recent Philippine Nutrition Facts and Figures 2011 by Food and Nutrition Research Institute-Department of Science and Technology (FNRI-DOST), the mean duration of breastfeeding in 2011 was only 7.7 months and only 28.9% of children were breastfed by their mother for up to two years of age. Although there was an increase in the percentages of these factors compared to the last 2008 Facts and Figures of FNRI-DOST, these recent results still fell short of the WHO and UNICEF recommendations that all children should be breastfed until two years of age. With these results, health-governing bodies have recognized the need to address this problem with the aim of being able to promote ideal breastfeeding practices (FNRI-DOST 2010). One key component of such practice is breastfeeding duration, wherein longer durations were found to be ideal particularly in reducing infant mortality (Gartner et al. 2005, Adebayo 2004). Hence, a crucial preliminary step in investigating problems relating to breastfeeding practices is being able to understand significant correlates of breastfeeding duration including socio-economic, maternal-related, and child characteristics, as well as being able to quantify their impacts.

While several papers have explored the determinants of breastfeeding in the Philippines, majority of their works are focused on explaining breastfeeding initiation while suggesting indirect relationships with breastfeeding duration of at least six months (Dubois and Girard 2003, Lande et al. 2003, Tanaka 2008, Yahya and Adebayo 2013). A few have directly looked into breastfeeding duration, an example of which is the study of Abada et al. (2001). Employing Cox proportional hazards model on actual reported breastfeeding duration, Abada et al. (2001) noted that factors associated with higher levels of modernity (mother's educational attainment, availability of infant formula, provision of prenatal care by a medical doctor) are significant in explaining early termination of breastfeeding.

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However, with breastfeeding duration being recorded in the National Demographic and Health Survey (NDHS) in number of months subject to memory recall of the respondents, an accurate measure of duration may not be available due to the possible inclusion of recall bias (NSO 2012). Hence to address that issue, this paper offers a different perspective in determining significant determinants of breastfeeding duration. In particular, breastfeeding duration will be categorized into four categories as suggested by FNRI-DOST. Noting the ordinal nature of the response variable, an ordinal regression using proportional odds (PO) cumulative logit link is proposed to possibly minimize loss of efficiency (Menard 2002).

The main objective of this study is to identify and to assess the effects of several socio-economic, maternal-related, and child characteristics, and to study their degree of impacts on breastfeeding duration in the Philippines using a PO cumulative logit link ordinal regression model. It is intended that the results of this paper will aid the Department of Health (DOH) and other health authorities in formulating and implementing policies and programs targeted towards resolving issues on poor breastfeeding habits in the Philippines.

MATERIALS AND METHODS

Data

The data used in this study were taken from the Standard Demographic Health Survey Phase 5 (DHS-V) of the National Demographic Health Survey (NDHS). The 2008 NDHS, in particular, uses one of the four replicate samples from the 2003 Master Sample for Philippines Household Surveys by which each replicate is considered a national sample design. It utilized stratified multi-stage design with household as its ultimate sampling unit. It was designed to provide up-to-date information on fertility, family planning, family health, and nutrition in the Philippines (NSO 2012). Specifically, the respondents are women who have at least one child born in the last five years prior to the date of the survey. Furthermore, women who never breastfed their child were excluded since the aim of the study was to quantify which factors significantly affect the odds of breastfeeding duration. Hence, initiation of breastfeeding is a necessary condition.

The main variable of interest is *breastfeeding duration*. On the other hand, the explanatory variables were chosen through the different literature findings that characterize breastfeeding duration, which includes maternal-related factors and socio-economic variables (Dubois and Girard 2003, Lande et al. 2003). Apart from these variables, information about the breastfed children were also included such as the birth order of the child, sex, size of child, type of child born, place of delivery, and type of delivery. Table 1 shows the list of explanatory variables together with their descriptions, outcomes, and their corresponding reference categories.

Lastly, with only 3,958 out of 5,773 child observations having complete information, the remaining respondents with incomplete information were excluded from the study. To account for non-response bias, sampling weights were duly adjusted after the deletion of the 1,815 respondents.

Analysis

Proportional odds (PO) cumulative logit model was fitted to the data. The outcome variable of interest, *breastfeeding duration*, was classified into four levels: 0-5 months, 6-12 months, 13-23 months, and ≥ 24 months of breastfeeding. Thus, for any *i*th subject in the sample, the response variable $Y_i, i = 1, \dots, n$ is defined by:

$$Y_i = \begin{cases} 0, & \text{if breastfeeding duration is within 0 to 5 months} \\ 1, & \text{if breastfeeding duration is within 6 to 12 months} \\ 2, & \text{if breastfeeding duration is within 13 to 23 months} \\ 3, & \text{if breastfeeding duration is at least 24 months} \end{cases}$$

Categorical covariates with more than two classifications were categorized to sets of independent indicator variables.

The PO cumulative logit ordinal regression model is formulated as follows. Let Y be the ordinal dependent random variable taking values $0, 1, \dots, J - 1$. Let $x = (x_1, x_2, \dots, x_p)'$ be the covariates used to explain such dependent variable. The PO model compares the probability of an equal or smaller response, $Y \leq j$, to the probability of larger response, $Y \geq j$,

$$\begin{aligned} g_i(x) &= \log \left[\frac{P(Y \leq j|x)}{P(Y > j|x)} \right] \\ &= \log \left[\frac{\pi_0(x) + \dots + \pi_j(x)}{\pi_{j+1}(x) + \dots + \pi_J(x)} \right] \\ &= \alpha_j - x'\beta, \end{aligned}$$

for each category $j = 0, 1, \dots, J - 1$, where $\pi_j = P(Y = j)$ is the probability that the subject belongs to category j with respect to the response Y and $\beta = (\beta_1, \beta_2, \dots, \beta_p)'$ is the coefficient vector. The maximum likelihood estimator $\hat{\beta}$ of β was obtained through the Newton-Raphson algorithm.

Jackknife (delete 1-PSU) was performed to estimate the coefficient variance as it was noted that the procedure performs well in estimating smooth functions. Backward elimination process was applied on the initial full model until statistically significant variables were left. All necessary statistical procedures were done with Stata v12.0.

TABLE 1. Variable code, descriptions, categories/range and reference class.

Variable Code	Description/Label	Categories	Reference Class
duration	The breastfeeding duration of the mother for the particular child	0 – 0-5 months 1 – 6-11 months 2 – 12-23 months 3 – at least 24 months	N/A
educn (n = 1, 2, 3)	Educational Attainment of the mother (respondent) of the child	1 – No education or primary education 2 – Secondary Education 3 – Tertiary Education	1 – No education or primary education
wealthn (n = 1, 2, 3)	Wealth Index of the family	1 – Poor 2 – Middle 3 – Rich	2 – Middle
pregnant	Whether the pregnancy of the child was wanted or not	0 – Not Wanted 1 – Wanted	0 – Not Wanted
residence	Type of place of residences of the family	0 – Rural 1 – Urban	0 – Rural
childsex	Sex of the child	0 – Female 1 – Male	0 – Female
childtype	Whether the child was a single birth or part of a multiple birth	0 – Single 1 – Multiple	0 – Single
order	Birth order of the child	0 – 4 th child or after 1 – 1 st , 2 nd , or 3 rd child	0 – 4 th child or after
delivery	Type of operation of the delivery of the child	0 – Normal Operation 1 – Caesarean Operation	0 – Normal Operation
hospital	Whether the child was delivered in a hospital or not	0 – Not Hospital 1 – Hospital	0 – Not hospital
Variable Code	Description/Label	Range	
age	Age of the respondent in years	14 – 49	
childwgt	Weight of the child at birth in kilograms	0.450 - 6.800	

RESULTS AND DISCUSSION

Descriptive Statistics

The counts of children classified according to breastfeeding duration per categorical variable are shown in Table 2. For the variable pregnant, as much as 62% have answered 'wanted'. This shows that majority of the deliveries of the child are planned by the mothers. In addition, it can be observed that the distribution of breastfeeding duration according to whether the pregnancy is wanted or not do not significantly differ from one another, with the most being breastfed only for a duration of 0-5 months and the least being breastfed for at least 24 months. The same findings were observed according to the sex of the child.

On the other hand, the variable pertaining to the mother's educational attainment (educn) provided an interesting pattern. Majority of the children whose mothers had finished tertiary education (50.71%) were breastfed for 0-5 months, while almost the same proportion was true among children whose mothers attained at most primary education (43.47%) but at longer breastfeeding durations (12-23 months). A similar pattern was also observed between children whose mothers are classified as rich against those whose mothers are classified as poor (wealthn). That is, mothers of richer mothers are more oriented towards shorter breastfeeding duration (54.00%), while poorer mothers are more oriented towards longer breastfeeding duration (40.90%). The same applies for type of area of residence (residence), wherein children born to mothers living in urban areas seem to have been breastfed for a shorter duration as compared to children born to mothers living in rural areas.

Additionally, it was observed that breastfeeding duration was typically longer for a normally delivered child. From the sample, more than half of caesarean-delivered children (53.84%) were breastfed for 0-5 months, while the proportion was less for normally-delivered children (35.30%). Similarly, this trend can be observed according to place of delivery (hospital), wherein babies delivered in a hospital experienced shorter duration of breastfeeding as compared to babies not delivered in a hospital.

These results suggest a trend wherein a higher proportion of mothers with higher education, higher wealth status, and living in urban areas practice shorter durations of breastfeeding. On the contrary, mothers domiciling in rural areas, considered poor, and have lower educational level tend to breastfeed their child for a longer duration.

TABLE 2. Weighted means/frequency (percentage in parenthesis) distribution of determinants of breastfeeding duration.

Determinants (Factors)	Factor Categories	Breastfeeding Duration								Total	
		0-5 months		6-11 months		12-23 months		24 months			
		1485	(37.53%)	792	(20.01%)	1228	(31.02%)	453	(11.44%)	3958	(100.00%)
educn	No Education or Primary	164	(22.03%)	153	(20.53%)	324	(43.47%)	104	(13.97%)	744	(18.80%)
	Secondary	712	(35.38%)	383	(19.02%)	670	(33.28%)	248	(12.33%)	2012	(50.84%)
	Tertiary	609	(50.71%)	257	(21.38%)	235	(19.53%)	101	(8.37%)	1202	(30.36%)
wealthn	Poor	406	(24.60%)	331	(20.05%)	676	(40.92%)	238	(14.42%)	1652	(41.73%)
	Middle	290	(34.30%)	178	(21.09%)	268	(31.79%)	108	(12.83%)	844	(21.33%)
	Rich	789	(54.00%)	283	(19.34%)	284	(19.40%)	106	(7.27%)	1462	(36.94%)
pregnant	Wanted	965	(39.42%)	484	(19.75%)	737	(30.09%)	263	(10.74%)	2448	(61.86%)
	Not Wanted	520	(34.45%)	309	(20.46%)	491	(32.53%)	190	(12.56%)	1510	(38.15%)
residence	Urban	341	(52.85%)	104	(16.06%)	125	(19.34%)	76	(11.75%)	645	(16.31%)
	Rural	1144	(34.54%)	689	(20.80%)	1103	(33.29%)	377	(11.37%)	3313	(83.70%)
childsex	Male	808	(39.01%)	400	(19.31%)	656	(31.65%)	208	(10.04%)	2072	(52.35%)
	Female	677	(35.91%)	392	(20.78%)	572	(30.34%)	245	(12.98%)	1886	(47.64%)
childtype	Multiple	256	(53.84%)	85	(17.82%)	99	(20.74%)	36	(7.60%)	475	(12.00%)
	Single	1230	(35.30%)	707	(20.31%)	1129	(32.43%)	417	(11.96%)	3483	(87.99%)
order	1st, 2nd, or 3rd	1195	(41.47%)	573	(19.90%)	833	(28.92%)	280	(9.71%)	2881	(72.79%)
	4th child or after	291	(26.99%)	218	(20.29%)	395	(36.65%)	173	(16.06%)	1077	(27.20%)
delivery	Caesarean	256	(53.84%)	85	(17.82%)	99	(20.74%)	36	(7.60%)	475	(12.00%)
	Normal	1230	(35.30%)	707	(20.31%)	1129	(32.43%)	417	(11.96%)	3483	(87.99%)
hospital	Hospital	1025	(46.61%)	433	(19.67%)	555	(25.25%)	186	(8.46%)	2199	(55.56%)
	Not Hospital	460	(26.16%)	359	(20.43%)	672	(38.23%)	267	(15.18%)	1759	(44.44%)
age		28.03		28.58		27.92		30.03			
childwgt		2.98		3.03		2.97		3.01			

Proportional Odds Model

Table 3 shows the estimates of the fitted ordinal regression model using the PO cumulative logit link. After performing a backward selection procedure, the variables that significantly affect breastfeeding duration are shown in the first column. The discussions of the significant covariates are divided according to *maternal characteristics* and *child characteristics*.

TABLE 3. Coefficient estimates of the final PO model.

Factors	Coefficient	Odds Ratio (OR)	Standard Error	p-value
educ3	-0.2963	0.744	0.0822	<0.001
wealth1	0.1709	1.186	0.0923	0.065*
wealth3	-0.5815	0.559	0.0990	<0.001
residence ^a	-0.2876	0.750	0.1343	0.033
childsex	-0.1627	0.850	0.0599	0.007
order	-0.3014	0.740	0.0708	<0.001
hospital	-0.3945	0.674	0.0877	<0.001
constant 1	-1.3490	0.259		
constant 2	-0.4530	0.636		
constant 3	1.3920	4.023		

*-significant at $\alpha=0.10$ but not significant at $\alpha=0.05$

^a-significant factor in PO model but not in CR model

Maternal Characteristics

For breastfeeding duration as explained by the mother's educational attainment, only the difference between those who finished at least a tertiary education and those who finished at most a primary education was found to be significant. That is, supposing all other variables are held fixed, the odds of a child being breastfed for a longer duration by mothers attaining at least a tertiary education are almost 25% lower than those of a child by mothers attaining at most a primary education. This means that mothers who finished at least a tertiary level education are more likely to terminate breastfeeding at an earlier time.

In addition, an analysis on wealth classifications of mothers determined that the odds that a child will be breastfed longer by a richer mother (wealth3) are lower by almost 45% and the odds that a child will be breastfed longer by a poorer mother (wealth1) are about 19% higher. This means that mothers belonging in the upper wealth class are more likely to terminate breastfeeding earlier as compared to those belonging in the middle wealth class. On the other hand, mothers belonging in the lower wealth class are less likely to terminate breastfeeding earlier as compared to those belonging in the middle wealth class. However, it should be noted that the latter result is only supported by a weak amount of evidence, i.e., only significant at $\alpha=10\%$.

Regarding domiciliation of mothers in either urban or rural areas (residence), the odds of providing a prolonged breastfeeding duration by mothers living in urban areas are 25% less than the odds of the same by mothers residing in rural areas at the time they delivered their babies. This result translates to an almost one-third increase in the likelihood of longer breastfeeding duration by mothers domiciling in rural areas as compared to their urban counterparts.

Child Characteristics

Results of the model fitting procedure showed that children delivered in hospitals are less likely to be breastfed longer as compared to those who were not. The odds for those who were delivered in a hospital are almost 33% less than the odds for those who were delivered outside of a hospital facility.

An interesting result concerning birth order of the child was also found. Results show that odds of being breastfed longer are 26% less among first, second, or third born children as compared to fourth born children or after. This result suggests that earlier born children are more likely to experience shorter breastfeeding duration than latter born ones. Lastly, it was also observed that female children are almost 15% more likely to be provided longer breastfeeding than their male counterparts.

Discussion

From the set of all covariates considered in the study, only a few were found to be significantly related with breastfeeding duration. The list of the significant covariates includes variables relating to both maternal characteristics (educational attainment, wealth classification, and place of residence) and child characteristics (place of delivery, birth order, and sex). Planned pregnancy, delivery method, child type, and weight of child at birth, on the other hand, were found to be statistically insignificant to the breastfeeding duration in the fitted model.

Further expounding on the observed results, the identified patterns concerning maternal characteristics find parallels to those of Abada et al. (2001), which showed that for Filipino mothers, possession of higher educational attainment and belongingness to higher wealth class generally lead to early termination of breastfeeding. These characteristics were identified to relate to increased modernity. Moreover, the results pertaining to decreased likelihood of longer breastfeeding duration by mothers domiciling in urban residences and to children delivered in hospitals also provide supports to Abada et al.'s (2001) hypothesis that increased modernity is related with shortened breastfeeding duration.

Concerning birth order, it is interesting to note that earlier born children are placed at a disadvantage in terms of breastfeeding duration than their latter born counterparts. While not directly seen, this result may provide support to the findings of Tanaka (2008) relating longer breastfeeding duration by mothers who have higher parity. That is, a mother is more likely to immediately follow an earlier born child with younger siblings; hence, resulting in an earlier breastfeeding termination for the older child due to the shift in the mother's behavior in providing infant care. Lastly, regarding the sex of the child, the observed result pertaining to longer breastfeeding duration given to females provide a different outlook on how female infants are treated in comparison with male infants here in the Philippines despite the country being traditionally male dominant. The result was found to contradict the findings of Jayachandran and Kuziemko (2011), wherein girls were less likely to receive beneficial breastfeeding behaviors than males alluding to the male dominant society of India.

CONCLUSION

Through ordinal regression using a proportional odds cumulative-logit link, several determinants of breastfeeding duration relating to both maternal and child characteristics have been identified. Several interesting findings in this study can be noted. One, it was observed that female infants were found to be breastfed longer than male infants. This result calls for an in-depth exploration of why such is the case despite the country being traditionally male dominant. Another insightful result of this study is that earlier born children are more likely to be breastfed shorter than latter born children. Taken together with the known result that increased parity generally leads to longer breastfeeding practice, these results may suggest the need to explore more on the dynamics of maternal behavior concerning parity and child order in the form of birth intervals.

Moreover, the results of this analysis have verified that factors relating to increased modernity contribute negatively towards lengthened breastfeeding. In particular, mothers with higher educational attainment, higher wealth status, and domiciling in urban areas are more likely to terminate breastfeeding earlier. It is notable that the same factors still contribute significantly in the same manner towards breastfeeding duration despite the fact that the data used in this study were collected more recently than those in the literature to which they were compared. This may suggest that even in the years passed, improvements in breastfeeding practice have been slow. Thus, with increased modernity being related positively with mothers belonging to the working class or those who are gainfully employed, a possible solution to improve breastfeeding practices among these mothers may be to provide them substantial support in forms such as creation of lactating station in their workplace and providing them break-intervals to breastfeed their child during office hours.

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CONFLICTS OF INTEREST

None

CONTRIBUTIONS OF INDIVIDUAL AUTHORS

J Abolencia and A Quipit, Jr. are the main authors of the study. This study is part of their undergraduate thesis at the Mathematics Department of De La Salle University. Both are involved in the collection and analysis of the data, with cross-validation of results by J Abolencia and writing of the algorithm by A Quipit, Jr.

This research was written under the joint supervision of RN Leong and F Co. Both are involved in the analysis and interpretation of the fitted models, with RN Leong providing assistance in writing the algorithm and F Co as the overall in charge of the preparation of the journal manuscript.

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