International Journal of Population Studies

RESEARCH ARTICLE

Transition in risks of higher order births in Nepal: a life table analysis

Ramesh Babu Kafle*

Centre for Population and Development, Purbanchal University, Biratnagar, Nepal

Abstract: This paper examines declining fertility in a low development setting. Specifically, this paper analyzes transitions in age at first birth and of the length of birth intervals, the variations of the length of birth intervals by selected socioeconomic and demographic factors, and the determinants of the risk of higher order birth in Nepal by using the DHS data. There is very little change in the age at start of fertility schedule but the proportion of women progressing to the next higher order birth from the second, third and fourth births has declined over time. Increases in the median length of higher order birth intervals and decline in the ultimate proportions of women attaining higher order births drive declines in the pace of childbearing and overall fertility level. Controlling for other factors, higher order births are more likely among women who had given a previous birth before the survey period or women who had a female birth compared to women who did not have such births. Significantly, lower hazard ratio of the second birth is observed among women who are more educated, working in non-agriculture sector, from well-to-do households, with higher age at first birth, and whose first child survived during infancy.

Keywords: age at first birth, birth interval, pace of childbearing, relative risk, life table

*Correspondence to: Ramesh Babu Kafle, Centre for Population and Development (CPAD), Purbanchal University, Biratnagar, Nepal; Email: rbkafle@gmail.com

Received: October 31, 2016; **Accepted:** December 4, 2016; **Published Online:** January 5, 2017

Citation: Kafle R B. (2016). Transition in risks of higher order births in Nepal: a life table analysis. *International Journal of Population Studies*, vol.2(2): 58–73. http://dx.doi.org/10.18063/IJPS.2016.02.005.

1. Introduction

1.1 Rationale

Fertility has been declining in Nepal for more than three decades in spite of its low development setting. Nepal is one of the poorest countries to join the set of developing countries undergoing fertility decline (Caldwell, 1998). Over the past 35 years, the total fertility rate (TFR) in Nepal declined from 6.33 in 1976 to 2.6 in 2011 (CBS, 2003; MOHP, New ERA and ICF International, 2012). The decline began in the early 1980s with a slow pace (Acharya, 1998; CBS, 2003; Das Dangol, Retherford and Thapa, 1997) and has accelerated over time. The first half of the first decade of the 21st century saw an unprecedented decline, with TFR declining from 4.1 in 2001 to 3.1 in 2006. The pace of decline has since slowed. Nepal's TFR reached 2.6 in 2011.

Fertility decline is a result of limiting the number of children by couples that is associated with multiple factors. These factors include late start of childbearing due to late marriage or late entry into sexual union; stopping childbearing due to voluntary sterilization; and prolonged birth spacing due to wide use of contraception and abortion. Differences in the risk of first birth, in transitions to higher order births, and in lengths of time between successive births cause fertility differentials (Conde-

Agudelo, Rosas-Bermúdez, Castaño, *et al*., 2012; Fotso, Cleland, Mbreu *et al.*, 2013).

Lower ages at first birth and shorter birth intervals are associated with higher fertility. Age at first birth influences the effective reproductive period available for a woman's exposure to the risk of birth and the momentum by which women progress to successive higher order births represents the pace of childbearing. Lower risk of transiting to higher order births and delayed transitions to higher order births indicate a decline in both the pace and level of fertility during fertility transition.

In the past, contraceptives were mainly used to stop child bearing in Nepal, but an increased proportion of couples now use contraceptives to space births (MOHP, New ERA and ICF International, 2012). This behavioral change likely influenced the length of birth intervals. Moreover, evidences show that birth spacing influences maternal, perinatal and infant and child health through various mechanisms related to the body physiology of the mother, nutritional depletion, and sibling competition (Condo-Agudelo, Rosas-Bermúdez, Castaño, *et al*., 2012). Prior research has found a clear association between the length of birth interval and infant and early childhood mortality (Fotso, Cleland, Mbreu *et al.*, 2013) and also indicates that appropriate birth spacing helps to prevent adverse perinatal outcomes (Condo-Agudelo, Rosas-Bermúdez, and Kafury-Goeta, 2006). These empirical findings highlight the importance of analyzing birth intervals.

A substantial body of research explains the fertility transition in Nepal (Acharya, 1998; Aryal, 1998; CBS, 2003; Das Dangol, Retherford and Thapa, 1997; Karki and Krishna, 2008; Retherford and Thapa, 2004; Retherford and Thapa, 1999; Retherford and Thapa, 1998; Subedi, 1998). However, these studies mainly highlight the trends and patterns of fertility decline along with differentials and determinants of fertility. Only a few studies have attempted an analysis of birth interval dynamics in Nepal (for example, Rajbhandary, 1999; Suwal, 2001). An assessment of transitions in the risks of higher order births and their determinants will provide more insight into the family building process during fertility transition. Analyzing the dynamics of transition to the first and higher order births and the length of birth intervals is important for better understanding the fertility transition in Nepal.

With this background, this paper examines transitions in age at first birth, in progressions to higher order births, and in the lengths of birth intervals in the recent past in Nepal. Lengths of birth intervals are further examined by different socioeconomic and demographic factors. Some socioeconomic and demographic determinants of the risk of higher order births are also analyzed.

1.2 Factors Affecting Birth Intervals

Women of reproductive age of various socioeconomic and cultural backgrounds are differently exposed to the risk of pregnancy due to differences in their behavioral and physiological factors; these cause fertility differentials. Bongaarts (1978) identified four proximate factors—marriage, postpartum infecundability, contraception, and abortion—through which all socioeconomic and cultural factors operate to influence human fertility. However, a direct influence of socioeconomic factors on birth interval dynamics has been argued by Rindfuss, Palmore and Bumpass (1987). This argument is supported by Baschieri (2004), who notes that some socioeconomic variables—mainly education, work status, and residence—have direct effects on the second birth interval. Although the differences in birth intervals are explained by differences in fecundity, incidence of abortion, coital frequency, breastfeeding practices, and contraceptive use (Trussell, Martin, Feldman *et al.*, 1985), these may also be influenced by different socioeconomic, demographic, and cultural factors.

The risk of birth of different orders and the length of birth intervals are differently influenced by socioeconomic and demographic factors. A falling proportion of women proceeding to higher parities after the second parity coupled with widening differential in birth intervals by socioeconomic and demographic variables at higher order births have been observed in Orissa, India (Ramesh, 2006). The first birth interval is not influenced strongly by factors like modernization and urbanization. Rather, it depends more on social norms (Kamal and Pervaiz, 2013). Place of residence may be a factor that influences the risk of childbirth and the length of birth interval. An urban woman may

have better knowledge of health and contraception and better access to contraceptives, which might lead to longer birth intervals among urban women. On the other hand, the lifestyle in urban areas differs from that of rural areas. Urban women may breastfeed less frequently and for shorter duration, which may support a shorter birth interval as compared to rural women. A longer second birth interval among urban women is observed as compared to those of rural women in Egypt (Baschieri, 2004), however, place of residence had little influence on transitions to higher order births after the second birth in Ramesh's (2006) study in India.

Evidence shows a mixed effect of women's education on birth intervals. Trussell *et al*. (1985) found women's education to be an insignificant predictor of risk of pregnancy in Malaysia, the Philippines, and Indonesia. In contrast, studies of Nepal (Suwal, 2001), Tamil Nadu, India (Singh, Tripathi, Kalaivani *et al.*, 2012), and Banglandesh (Saha and van Soest, 2013) found women's education was an important factor for extending the birth interval. The longer birth interval among educated women might be due to their enhanced capacity to adopt new contraceptive technology (Kim, 2010).

In societies where there is a stronger preference for a son than a daughter, birth intervals after a son are found to be longer when compared to those after a daughter (Rajbhandary, 1999; Ramesh, 2006; Sahoo, 2011; Singh, Tripathi, Kalaivani *et al*., 2012). Birth spacing also increases with maternal age (Saha and van Soest, 2013). Survival status of the previous child has strong effect on subsequent birth interval; shorter intervals are associated with the death of the previous child (Rajbhandary, 1999; Ramesh, 2006; Sahoo, 2011). Women's work status, their exposure to mass media, and household economic status also influence birth intervals (Kamal and Pervaiz, 2013; Ramesh, 2006; Singh, Tripathi, Kalaivani *et al*., 2012).

2. Data and Methods

2.1 Data Sources

This study primarily uses data from the Nepal Demographic and Health Survey (hereafter NDHS) in 2011. However, data from the NDHS in 2001 and the NDHS in 2006 are also used. These surveys were based on a two-stage stratified national representative sample of households. Wards of a Village Development Committee (VDC) and sub-wards of a Municipality were considered as Primary Sampling Units (PSUs) in all the three rounds of surveys. In the first stage, PSUs were selected from both rural PSUs and urban PSUs following systematic sampling procedures with a probability of selection proportional to size. Complete house-listing was done in the selected PSUs. In the second stage, households were selected from the selected PSUs by applying a systematic sampling technique in 2001 and 2006 and simple random sampling in 2011. In all three surveys, oversampling of urban PSUs was made to obtain statistically reliable estimates for urban areas. All women of age 15–49 from selected households were interviewed in 2006 and 2011; only ever married women of the same age group were interviewed in 2001. In 2001, a total of 8,726 ever married women of age 15–49 from 8,602 households were interviewed; in 2006, a total of 10,793 women of age 15–49 from 8,707 households were interviewed; in 2011, a total of 12,674 women of age 15–49 from 10,826 households were interviewed.

2.2 Dependent and Independent Variables

The median age at first birth and the cumulative percentage of women who had a first birth by a certain age are used to examine transitions in the age at first birth. The cumulative proportions of currently married women transiting to the next higher order birth and the median length of the birth interval are used to analyze dynamics of birth intervals. The determinants of higher order birth are analyzed by using the hazard ratio of a higher order birth. Variations in birth intervals are examined by taking place of residence, women's education, women's work status, exposure to media, household wealth index, age at previous childbirth, birth year of previous child, sex of previous child, and survival status of previous child during infancy as independent variables. The same set of va-

riables is used for analyzing the risk of higher order births.

2.3 Analytical Approaches

The median age at first birth and the cumulative percentage of women who had their first birth by a certain age are obtained for different cohorts of women based on the NDHS 2011 dataset. The cumulative proportions of women transiting to the next higher order birth are obtained based on life tables constructed by taking all women who are exposed to the risk of birth of that particular order. Proportions for the transitions to the second, third, and fourth birth are computed from NDHS datasets in 2001, 2006, and 2011 to analyze the aggregate changes in the transition probabilities to higher order births. The lengths of the second, third, fourth and fifth birth intervals and the risk of higher order birth are further examined from the NDHS 2011 dataset. Details of the methodology are given in the following paragraphs.

The interval between k^{th} birth and $(k+1)^{th}$ birth is called $(k+1)^{th}$ closed birth interval. If women had not given $(k+1)^{th}$ birth by the survey date, this $(k+1)^{th}$ birth interval is called an open birth interval. Analysis of closed birth intervals depicts the pace of childbearing but cannot reflect parity progression. For this, one should also take the open birth intervals into account. The life table technique used in this paper is based on a combination of both closed and open birth intervals and considers the cases of open birth intervals as censored cases in analysis. Life tables constructed by pooling open and closed birth intervals and treating open birth intervals as censored cases are a better way of analyzing family building process (Lee 1993; Srinivasan, Pandey and Rajaram, 1994). Transition probabilities between k^{th} and $(k+1)^{th}$ births and the k^{th} order open birth interval are computed with this approach. This approach of analyzing birth intervals enables explanation of the fertility transition both in terms of the amount and the pace of decline. Changes in the median birth interval indicate the pace of fertility change and changes in the ultimate proportion of women who had their next child within a certain period (parity transition) indicates the amount of fertility change. The use of this method has been well documented in prior work (Srinivasan, Pandey, and Rajaram, 1994).

Monthly life tables are constructed for a time period of 10 years following prior birth (a negligible number of births occur after an interval of 10 years from previous birth). The calculations are made for all currently married women who have married only once. In the analysis, all multiple births are treated as a single birth. The conditional probability of giving k^{th} birth between time t_i and t_{i+1} is given by $q_i = \frac{d_i}{n_i}$ with $n_i = n_i^* - \frac{C_i}{2}$ where, n_i^* is the number of women exposed to k^{th} birth at the start of the interval (t_i, t_{i+1}); d_i is the number of women who gave i^{th} birth in the same interval and C_i is the number of women who reached and terminated from the same interval without giving k^{th} birth. Then, $p_i = 1 - q_i$ gives the conditional probability of not giving k^{th} birth in the interval (t_i, t_{i+1}). The product Πp_i gives the proportions not giving k^{th} birth by the end of the interval (t_i, t_{i+1}) and $S_i = (1H)\ p_i$ gives the probability that a woman gave k^{th} birth by the end of the interval (t_i, t_{i+1}). The proportions of women who gave k^{th} birth by the end of 24 months, 60 months, and 120 months are tabulated; the curve of these monthly proportions is drawn and the median birth intervals are also tabulated. Here, median birth interval refers to the length of the k^{th} birth interval in months by which 50 percent of women give k^{th} birth.

Cox Proportional Hazard Model (also called Cox regression) is used to analyze the determinants of the risk of occurrence of higher order births. Controlling for a set of background variables, the relative effect of a particular characteristic of women on the risk of next higher order birth is examined. The model is semi-parametric and can be used even when the underlying distribution of the hazard rate is unknown (Retherford and Choe, 1993). The other benefits of using this model are that it is flexible, can accommodate time varying covariates, and also takes censored data into account (Tarling, 2009). In this model, the failure rate of an event (i.e., birth of next higher order in the

present paper) or hazard rate $h(t)$ at any time t is given by $h(t) = h_0(t)e^{\sum_i b_i x_i}$ where, $h_0(t)$ is the baseline hazard function when the x_i are set equal to zero and indicates the expected risk of failure with the explanatory variables set at zero; x_i are explanatory variables and b_i are the coefficients to be estimated in the model.

The study is based on cross-sectional database and it does not capture how individuals might have changed their fertility behavior through time. This inherent limitation of cross-sectional data over panel data is a limitation of this paper.

3. Results

3.1 The First Birth and Birth Intervals

The median age at first birth in Nepal was almost constant over the period 1996–2011. More than 85% of women of different age cohorts had their first birth before age 25; the median age at first birth for women ages 25–49 was around age 20 in 2011 (MOHP, New ERA, and ICF International, 2012; MOHP, New ERA and Macro International, 2007; MOH, New ERA and ORC Macro, 2002; Pradhan, Aryal, Regmi, *et al.*, 1997). The median age at first birth for different age cohorts of women in NDHS-2011 is shown in Table 1. The results show little variation in the median age at first birth for different cohorts of women. The median age at first birth is around age 20 for all age cohorts. The cumulative percentage of women of different age cohorts who had their first birth by certain exact age based on the NDHS 2011 data is presented in Figure 1, showing very little change in the age at first birth across cohorts. Slightly lower proportions of women of the youngest cohort (ages 25–29) had experienced the first birth by age 25 than other older cohorts did; however, the figures are already more than 80%.

The changes in the life table proportions of women attaining higher order (the second, third, and fourth) births over time are presented in Figure 2A, Figure 2B, and Figure 2C. The second birth has remained almost universal over time. The ultimate proportion of women attaining the second birth within 10 years from the first birth has remained nearly constant (around 0.95) (Figure 2A). However, there is a noticeable decline in the pace of progression to the second birth, with greater delays over time (Figure 2A). According to Figure 2B, the curve of cumulative proportions of women

Table 1. Median age at first birth (Years) for different cohorts of women, NDHS-2011

Ages at survey	25–29	30–34	35–39	40–44	45–49
Median age at first birth	20.1	20.2	20.1	20.3	20.7
Number of women	2101	1734	1557	1285	947

Source: Computed by the author from NDHS 2011 data

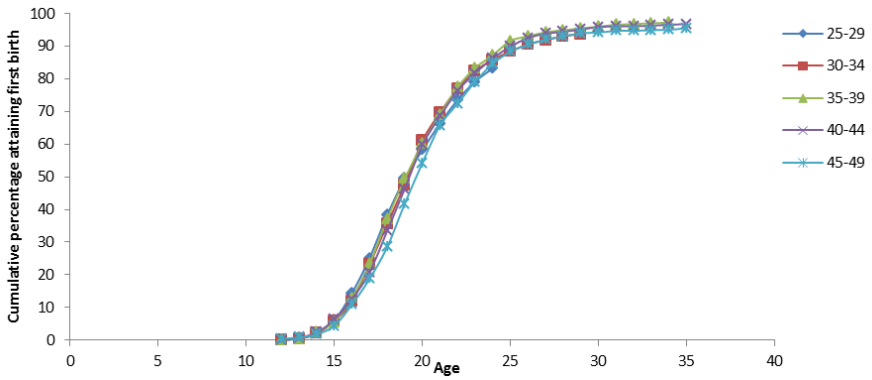

Figure 1. Cumulative percentage of women who had their first birth by certain age, for different ages at survey, NDHS-2011
Source: Computed by the author from NDHS data 2011

attaining the third birth reached an asymptote of 0.9 in 2001, but it tapered to around 0.75 in 2011. Both a declining prevalence of third births and slower pace of transition are evident over time. Analysis for transitions to the fourth birth reveals patterns similar to those observed for the third birth (Figure 2C). When observed across each survey, the prevalence as well as the pace of attaining the third and fourth order birth is smaller as compared to the second birth; Figure 3 highlights these differences in the 2011 survey. The results indicate an increase in the proportions of couples having only two children.

The median birth interval increases as the birth order increases (see Tables 2a, 2b, 2c and 2d). Variations in the second, third, fourth, and fifth birth intervals are observed in the NDHS 2011 dataset for different background characteristics. Analysis of the second birth interval shows that the median birth interval is shorter among women residing in rural area as compared to their urban counterparts; among the uneducated as compared to the educated; among those working in agricultural sector as compared to those working in non-agricultural sector; among women from the poorest household wealth index as compared to those from the richest; and among women with low exposure to media as compared to those with high exposure. Women who had their first birth at higher ages and women whose first birth had a male child have a longer second birth interval. Women who lost their first child in infancy have a considerably shorter second birth interval (23 months) in comparison to those whose first child survived during infancy (34 months). Relatively shorter second birth intervals are also observed as one goes further back from the survey date. For example,

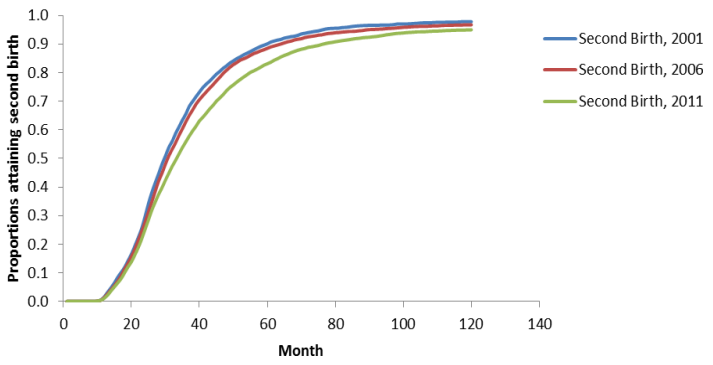

Figure 2A. Life table proportions attaining second birth within certain months from first birth for currently married women who are married only once NDHS-2001, 2006, and 2011
Source: Computed by the author from NDHS data 2001, 2006 and 2011

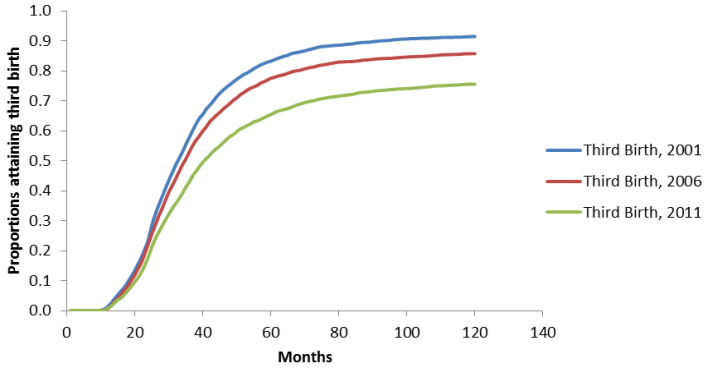

Figure 2B. Life table proportions attaining third birth within certain months from second birth for currently married women who are married only once NDHS-2001, 2006, and 2011
Source: Computed by the author from NDHS data 2001, 2006 and 2011

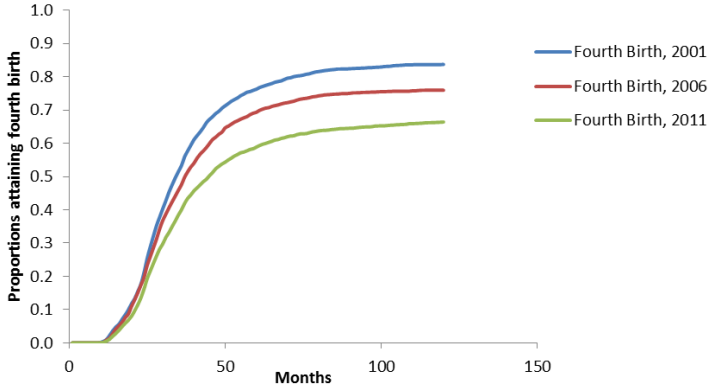

Figure 2C. Life table proportions attaining fourth birth within certain months from third birth for currently married women who are married only once, NDHS-2001, 2006, and 2011
Source: Computed by the author from NDHS data 2001, 2006 and 2011

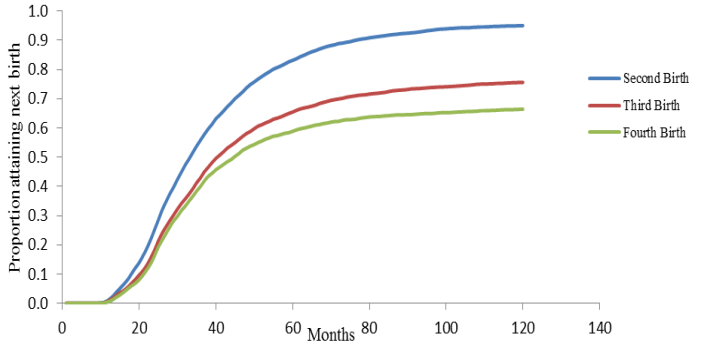

Figure 3. Life table proportions attaining subsequent births within certain months from previous birth for second, third and fourth births, for currently married women who are married only once, NDHS-2011
Source: Computed by the author from NDHS data 2011

Table 2a. Life table analysis of the second birth interval of currently married women who have married only once by selected background characteristics, NDHS-2011

Background characteristics	Number of cases	Months by which 50% women attained second birth	Proportion attaining second birth within (Months)		
			24	60	120
Year of first birth					
2003–2011	2701	40.20	0.193	0.712	-
1993–2003	3077	32.89	0.256	0.839	0.949
Before 1993	2178	29.93	0.300	0.903	0.982
Residence					
Urban	2197	35.64	0.225	0.774	0.921
Rural	5759	32.41	0.261	0.853	0.961
Women's Education					
No education	3899	30.64	0.294	0.893	0.976
Primary	1502	33.06	0.229	0.827	0.949
>Primary	2555	40.33	0.190	0.712	0.895
Work Status of Women					
Not working	1677	34.25	0.248	0.793	0.924
Agriculture	4758	31.85	0.261	0.872	0.970
Non-agriculture	1521	37.08	0.221	0.740	0.911
Exposure to Media					
Low	2715	31.41	0.278	0.873	0.974
High	5241	34.37	0.236	0.809	0.936
Household wealth Index					
Poorest	1560	30.74	0.279	0.913	0.979
Poorer	1466	32.12	0.269	0.863	0.975
Middle	1512	31.77	0.269	0.861	0.968
Richer	1566	33.90	0.233	0.813	0.951
Richest	1852	38.18	0.213	0.727	0.890
Age of mother at first birth					
Less than 20	4338	32.28	0.260	0.867	0.967
20–24	3051	33.81	0.245	0.818	0.941
25 and more	567	40.53	0.208	0.686	0.843
Sex of first child					
Male	4105	34.62	0.238	0.806	0.939
Female	3851	31.81	0.264	0.858	0.962
Survival of first child					
Survived >1 year	7328	34.4	0.224	0.822	0.946
Died in infancy	628	22.8	0.555	0.937	0.993
All	**7956**	**33.28**	**0.251**	**0.831**	**0.950**

Source: Computed by the author from NDHS 2011 data

if the first birth occurred within eight years before the survey, the median length of the second birth interval would be 40 months, whereas it would be 30 months if the first birth had occurred eighteen years before the survey.

Similar variations were observed for the third and higher birth intervals. Since educated women have curtailed their fertility, only 48% of women with secondary or higher education proceeded to the third birth. The ultimate proportion of women attaining a fourth birth within 10 years from the

Table 2b. Life table analysis of the third birth interval of currently married women who have married only once by selected background characteristics, NDHS-2011

Background characteristics	Number of cases	Months by which 50% women attained third birth	Proportion attaining third birth within (Months)		
			24	60	120
Year of second birth					
2003–2011	2261	64.21	0.118	0.481	-
1993–2003	2600	40.55	0.190	0.641	0.732
Before 1993	1536	32.56	0.241	0.833	0.912
Residence					
Urban	1716	51.98	0.152	0.537	0.636
Rural	4681	38.12	0.193	0.699	0.802
Women's Education					
No education	3594	34.80	0.221	0.778	0.872
Primary	1195	45.51	0.177	0.587	0.698
>Primary	1608	NA	0.089	0.380	0.482
Work Status of Women					
Not working	1219	46.80	0.175	0.592	0.696
Agriculture	4009	36.99	0.196	0.722	0.830
Non-agriculture	1169	65.48	0.137	0.485	0.563
Exposure to Media					
Low	2318	35.21	0.215	0.765	0.874
High	4079	46.03	0.162	0.591	0.688
Household wealth Index					
Poorest	1338	32.94	0.259	0.822	0.929
Poorer	1223	36.94	0.194	0.744	0.859
Middle	1227	40.42	0.169	0.668	0.788
Richer	1227	44.60	0.174	0.610	0.716
Richest	1382	76.69	0.113	0.450	0.528
Age of mother at second birth					
Less than 20	1346	34.59	0.232	0.756	0.850
20–24	3677	39.49	0.186	0.668	0.769
25 and more	1374	58.93	0.116	0.503	0.609
Sex of second child					
Male	3386	45.91	0.153	0.582	0.674
Female	3011	36.52	0.214	0.735	0.848
Survival of second child					
Survived >1 year	6035	42.03	0.162	0.636	0.742
Died in infancy	372	24.44	0.481	0.931	0.968
All	**6397**	**40.38**	**0.181**	**0.654**	**0.756**

Note: 'NA' means the median is not applicable for that category because less than 50 percent women attained next birth within 120 months from the previous birth
Source: Computed by the author from NDHS 2011 data

third birth is 66% with significant variation. For example, 38% of women with secondary or higher education transited to the fourth birth interval compared to 89% of women whose third child died during infancy. The increasing median length of higher order birth intervals indicates a reduced pace of childbearing of higher order births; the declining ultimate proportions attaining all higher or der births indicate decreased prevalence of higher order births, and hence the fertility decline.

Table 2c. Life table analysis of the fourth birth interval of currently married women who have married only once by selected background characteristics, NDHS-2011

Background characteristics	Number of cases	Months by which 50% women attained fourth birth	Proportion attaining fourth birth within (Months)		
			24	60	120
Year of third birth					
2003–2011	1,388	85.30	0.112	0.432	-
1993–2003	1,823	43.10	0.173	0.599	0.662
Before 1993	896	35.60	0.201	0.728	0.801
Residence					
Urban	944	62.50	0.113	0.496	0.550
Rural	3,163	41.91	0.176	0.618	0.701
Women's Education					
No education	2,852	38.71	0.178	0.662	0.739
Primary	681	62.31	0.156	0.484	0.559
>Primary	574	NA	0.082	0.321	0.381
Work Status of Women					
Not working	664	50.44	0.163	0.540	0.586
Agriculture	2,862	41.46	0.169	0.627	0.710
Non-agriculture	581	86.02	0.125	0.454	0.523
Exposure to Media					
Low	1,736	38.10	0.184	0.682	0.772
High	2,371	53.99	0.145	0.522	0.588
Household wealth Index					
Poorest	1,064	35.84	0.197	0.762	0.868
Poorer	866	40.11	0.181	0.639	0.722
Middle	798	53.91	0.137	0.532	0.624
Richer	737	53.64	0.149	0.515	0.570
Richest	642	NA	0.124	0.421	0.467
Age of mother at third birth					
Less than 25	2,240	39.58	0.180	0.645	0.720
25 and more	186	54.35	0.139	0.518	0.593
Sex of third child					
Male	2,169	52.52	0.144	0.528	0.590
Female	1,938	38.74	0.182	0.656	0.746
Survival of third child					
Survived >1 year	3,843	46.57	0.142	0.572	0.648
Died in infancy	264	25.06	0.441	0.815	0.887
All	**4,107**	**44.73**	**0.162**	**0.589**	**0.664**

Note: 'NA' means the median is not applicable for that category because less than 50 percent women attained next birth within 120 months from the previous birth
Source: Computed by the author from NDHS 2011 data

These differentials observed in the birth intervals and the proportions attaining higher order births may be attributable to different socioeconomic and demographic factors. Therefore, it is worthwhile to study the net effect of selected socioeconomic and demographic determinants on the risk of higher order births by using Cox regression. The models are fitted to calculate the risks of having second, third, fourth, and fifth births for a particular group of women as compared to specified reference categories of women.

Table 2d. Life table analysis of the fifth birth interval of currently married women who have married only once by selected background characteristics, NDHS-2011

Background characteristics	Number of cases	Months by which 50% women attained fifth birth	Proportion attaining fifth birth within (Months)		
			24	60	120
Year of third birth					
2003–2011	774	97.00	0.095	0.413	-
1993–2003	1,200	49.50	0.161	0.532	0.595
Before 1993	415	32.64	0.280	0.745	0.802
Residence					
Urban	476	NA	0.132	0.420	0.476
Rural	1,923	45.36	0.172	0.574	0.642
Women's Education					
No education	1,878	44.79	0.117	0.585	0654
Primary	325	120.00	0.128	0.432	0.500
>Primary	186	NA	0.039	0.264	0.282
Work Status of Women					
Not working	327	57.70	0.155	0.503	0.561
Agriculture	1,787	45.99	0.173	0.564	0.630
Non-agriculture	275	81.30	0.117	0.450	0.522
Exposure to Media					
Low	1,147	40.92	0.170	0.626	0701
High	1,242	79.35	0.159	0.468	0.527
Household wealth Index					
Poorest	750	38.64	0.191	0.691	0.775
Poorer	538	48.42	0.175	0.544	0.640
Middle	433	64.86	0.153	0.483	0.550
Richer	385	100.83	0.128	0.465	0.501
Richest	283	NA	0.142	0.371	0.415
Age of mother at fourth birth					
Less than 25	640	38.84	0.201	0.635	0.713
25 and more	1,749	57.99	0.150	0.508	0.567
Sex of fourth child					
Male	1,201	73.58	0.147	0.470	0.536
Female	1,188	40.92	0.181	0.618	0.683
Survival of fourth child					
Survived >1 year	2,247	52.43	0.144	0.530	0.596
Died in infancy	142	25.41	0.477	0.740	0.797
All	**2,389**	**49.56**	**0.164**	**0.543**	**0.608**

Note: 'NA' means the median is not applicable for that category because less than 50 percent women attained next birth within 120 months from the previous birth
Source: Computed by the author from NDHS 2011 data

3.2 The Second Birth

Results in Table 3 show that the age of mother at first birth, sex of the first child, survival status of the first child beyond infancy, and the year of birth are the most significant factors to determine the occurrence of the second birth. Similarly, women's education, work status and household wealth also have some net significant effect on the occurrence of the second birth. Relative risk of the

Table 3. Relative risk ratios from Cox regression analysis of the second, third, fourth and fifth births for currently married women who have married only once, NDHS-2011

Background Characteristics	2nd Birth	3rd Birth	4th Birth	5th Birth
Year of previous birth				
2003–2011 (Ref.)	1.00	1.00	1.00	1.00
1993–2003	1.39***	1.45***	1.56***	1.69***
Before 1993	1.57***	2.13***	2.15***	2.95***
Residence				
Rural (Ref.)	1.00	1.00	1.00	1.00
Urban	0.96	0.94	0.93	0.82*
Women's Education				
No education (Ref.)	1.00	1.00	1.00	1.00
Primary	0.93*	0.79***	0.84**	0.81*
>Primary	0.80***	0.56***	0.60***	0.54***
Work Status of Women				
Not working (Ref.)	1.00	1.00	1.00	1.00
Agriculture	0.96	0.86***	0.82**	0.82*
Non-agriculture	0.87**	0.73***	0.78***	0.96
Exposure to Media				
Low (Ref.)	1.00	1.00	1.00	1.00
High	1.03	0.95	0.88**	0.84**
Household wealth Index				
Poorest (Ref.)	1.00	1.00	1.00	1.00
Poorer	0.91*	0.82***	0.79***	0.68***
Middle	0.93	0.70***	0.59***	0.59***
Richer	0.85***	0.64***	0.56***	0.50***
Richest	0.75***	0.50***	0.47***	0.44***
Age of mother at previous birth				
Less than 20 (Ref.)	1.00	1.00		
20–24	0.95*	0.88**	1.00#	1.00#
25 and more	0.69***	0.62***	0.76***	0.74***
Sex of previous child				
Male (Ref.)	1.00	1.00	1.00	1.00
Female	1.19***	1.48***	1.42***	1.47***
Survival status of previous child				
Died in infancy (Ref.)	1.00	1.00	1.00	1.00
Survived >1 year	0.52***	0.48***	0.48***	0.50***
Model χ^2 (d.f.)	927(16) ***	1726.9(16) ***	794.5(15) ***	448.2(15) ***
–2log likelihood	102289.7	64577.8	36233.9	18151.3
Number of cases	7956	6396	4107	2389

Note: denotes p < 0.05, ** denotes p < 0.01 and *** denotes p < 0.001.*
 # Two categories 'Less than 20' and '20–24' were combined due to small frequency and treated as the new reference category.

second birth is significantly higher (relative risk 1.57, $p < 0.001$) if the first birth had occurred before 1993 as compared to the first births that occurred during 2003–2011 (in the recent past before the survey period). Therefore, some pure temporal effect is noticed on the risk of second birth after controlling for other socioeconomic and demographic factors.

The risk of second birth declined significantly by 31% (relative risk 0.69, $p < 0.001$) for women who had their first birth after age 25 as compared to those who had their first birth before reaching age 20. Having a first child daughter is associated with an increased risk of second birth. The risk of second birth after a first daughter is increased by 19% (relative risk 1.19, $p < 0.001$) as compared to having a son as the first child. Women whose first child survived during infancy had significantly reduced risk of having second child by 48% (relative risk 0.52, $p < 0.001$) as compared to those whose first child died during infancy. There is only a small difference in the risk of attaining the second birth between uneducated women and women with some primary education. But, with reference to uneducated women, the risk of second birth is reduced by 20% (relative risk 0.8, $p < 0.001$) for women with more than primary education. The reduced risk (around 13%) of the second birth is also found for women working in the non-agricultural sector (relative risk 0.87, $p < 0.01$) as compared to women who are not working. A significantly lower risk of the second birth is also observed for women from the richer wealth quintile by 15% (relative risk 0.85, $p < 0.001$) and the richest wealth quintile by 25% (relative risk 0.75, $p <0$ .001, respectively) as compared to those from the poorest wealth quintile.

3.3 The Third Birth

Factors influencing transition from the second birth to the third birth are similar to those from the first to the second birth. Place of residence and women's exposure to media have no net effect on the risk of attaining the third birth. The risk of the third birth is significantly higher for women whose second child was a daughter (relative risk 1.48, $p < 0.001$) compared to those whose second child was a son. The earlier the timing of the second birth, therefore the higher the risk of the third birth. Similarly, the higher the mother's age at the second birth, the lower the risk of transiting to the third birth. Risk of the third birth is significantly lower for women whose second child survived to the end of the first year of life (relative risk 0.48, $p < 0.001$) as compared to those whose previous child died as infant.

The influence of women's education, work status, and household wealth quintile are more significant for the third birth than the second birth. Compared to the risk of the third birth among uneducated women, the risk among women with more than primary education is almost half (relative risk 0.56, $p < 0.001$). Similarly, the risk of the third birth among women working in the non-agricultural sector is three-fourths the risk of women who are not working. With reference to women from the poorest wealth quintile, as one moves to upper quintiles, the risk of attaining the third birth significantly and substantially declines as one moves to upper quintiles (for women in the richest wealth quintile, relative risk is 0.50, $p < 0.001$).

3.4 The Fourth and Fifth Birth

The transition probabilities to the fourth birth showed similar results to those observed for the third birth. The only difference is that there is some significant net effect of media exposure on transition to the fourth birth; the better the women are exposed to mass media, the lower their transition probability to the fourth birth (relative risk for better exposed women is 0.88, $p < 0.01$). Better education, working in the non-agricultural sector, belonging to upper household wealth quintiles, a recent third birth, and older age are all associated with a reduced risk of the fourth birth.

Risk ratios of fifth birth for different categories of socioeconomic and demographic variables are similar to those obtained for the risk of fourth birth except for the fact that urban-rural difference is significant for the fifth birth. Women living in urban areas have lower transition probabilities to the fifth birth than women in rural areas (relative risk 0.82, $p < 0.05$).

4. Discussion

Only a slight transition in the age at first birth in Nepal has occurred. The first birth is universal and

achieved by age 30 at the latest; almost half of women had the first birth by age 20. Though there has been a delay in the age at entry into sexual union over time (MOHP, New ERA, and ICF International, 2012; MOHP, New ERA and Macro International, 2007; MOH, New ERA and ORC Macro, 2002), this has had minimal impacts on the age at initiation of childbearing at an aggregate level. Women marrying at relatively older ages have a tendency to start childbearing earlier after marriage, mostly for making up. These findings are similar to those obtained in Orissa and Goa, India (Rajaram, Rao and Pandey, 1994; Sahoo, 2011). Early and universal first birth followed by universal second birth is one unique feature of fertility in Nepal.

In accordance with previous studies, this study finds socioeconomic and demographic factors influence birth interval dynamics. Socioeconomic factors such as women's education, work status, and household economic condition, and demographic factors such as age at previous birth, sex of previous child, and survival status of previous child are significant determinants of higher order births in Nepal. Although the second birth is almost universal, substantial variation exists in the length of the second birth interval. A significantly lower risk of the second and higher order births is found among more educated women, those working in the non-agricultural sector, and those who are from a better economic background. Similarly, a reduced risk of the second and higher order births is found among women who start giving birth at older ages and whose first child survived during infancy. This could be the result of declining ideal number of children (MOHP, New ERA, and ICF International, 2012; MOHP, New ERA, and Macro International, 2007; MOH, New ERA, and ORC Macro, 2002) and a more effective use of family planning by women who are better educated or work in non-agricultural sector or are in a better economic status. Declining risk of higher order births over time represents women's increasing capacity to control fertility. Moreover, women who are more educated or working in the non-agricultural sector or from sound household economic condition are more capable of prolonging birth intervals and limiting the number of children.

A substantial decline in fertility in Nepal is largely driven by decline in both the pace and the prevalence of the third and higher order births. The rapid decline in fertility in the recent past is attributed to a steep decline in the proportions of women transiting to the third and higher order births. In the years to come, it is likely that majority of the couples will have two children and they will avoid higher order births. These results are in the line with those found in Orissa, India (Sahoo, 2011). Controlling for other factors, there is evidence of some pure temporal effect in fertility decline. This could be the general experience during the course of demographic transition. A persistent higher preference for sons is also noticeable: couples want to have a son as early as possible and will either delay the next birth or stop childbearing after having a son. Similar results are found in Orissa, India (Sahoo, 2011).

This paper aims to have a better understanding on the fertility transition in Nepal by examining the dynamics of the age at first birth, the lengths of second and higher order birth intervals, and the risk of higher order births. This paper also examined the influences of different socioeconomic and demographic factors on occurrence of the second and higher order births. Life table approach and Cox proportional hazard models were used to analyze the dynamics of birth interval and risk of birth. Birth interval dynamics in Nepal were first analyzed when the fertility transition was in its initial stage with a slower pace (Suwal, 2001). The present paper re-examined the birth interval dynamics in Nepal for the recent time period, a time in which fertility declined substantially and at a faster pace, and contributed to fulfill the research gap. Prior studies of Nepal have only used the hazard model, which cannot show the exact lengths of birth intervals, rather it compares the interval lengths in terms of relative risks. The novel contribution of this paper is that it has also used the life table method and depicted the median lengths of birth interval as well as the proportions of women attaining next higher order birth after certain period.

When interpreting our findings, the following limitations should be taken into consideration. First, quantitative findings of this study are based on birth history data, which are subject to content errors due to recall lapse of the date of event (birth). Second, the analysis is based on cross-sectional survey

data and does not reflect the behavioral changes related to fertility decisions that are occurred over time. Future studies from prospective cohorts are clearly warranted.

5. Conclusion

An early start of childbearing and having at least two children is still prevalent in Nepal. A substantial decline in both the pace and the incidence of childbearing after two children is clearly visible with some temporal effect. Factors associated with delay of the second birth include being from a younger age cohort, having more education, working in the non-agricultural sector, having a first birth more recently and at older age, having a male first child, and being from better economic status. Socioeconomic and demographic factors play a more pronounced role in explaining variation in birth intervals for higher order births. There is further scope of decline in the pace of childbearing and also the fertility level among uneducated women, those from poorest household wealth quintiles, and those working in agriculture sector. Similarly, improvement in child survival status and the elimination of son preference would also help fertility decline further.

Author Contributions

Ramesh B K conceptualized, performed data analysis, and wrote the paper.

Conflicts of Interest and Funding

No conflict of interest is reported by all authors.

Acknowledgements

The author acknowledges Prof PM Kulkarni for his guidance in preparation of this paper. Similarly, the author also acknowledges the anonymous reviewers and the editor for their valuable inputs in the paper.

References

Acharya L B. (1998). Determinants of fertility in the 1970s and 1990s in Nepal. *Contributions to Nepalese Studies*, 25 (special issue): 95–108.

Aryal R H. (1998). Fertility transition in Kathmandu. *Contributions to Nepalese Studies*, 25 (special issue): 79–93.

Baschieri A. (2004). *The second birth interval in Egypt: The role of contraception.* S3RI Applications and Policy Working Papers, A04/05. UK: University of Southampton. http://eprints.soton.ac.uk/8157/1/8157-01.pdf

Bongaarts J. (1978). A framework for analyzing the proximate determinants of fertility. *Population and Development Review*, 4(1): 105–132. http://www.jstor.org/stable/1972149

Caldwell J C. (1998). The global fertility transition and Nepal. *Contributions to Nepalese Studies*, 25(special issue): 1–7.

Central Bureau of Statistics [CBS]. (2003). *Population Monograph of Nepal, Vol. I.* Kathmandu, Nepal: National Planning Commission Secretariat.

Conde-Agudelo A, Rosas-Bermúdez A, and Kafury-Goeta A C. (2006). Birth spacing and risk of adverse perinatal outcomes: A meta-analysis. *Journal of American Medical Association*, 295(15): 1809–1823. https://doi.org/10.1001/jama.295.15.1809.

Conde-Agudelo A, Rosas-Bermúdez A, Castaño F, *et al*. (2012). Effects of birth spacing on maternal, perinatal, infant, and child health: A systematic review of causal mechanisms. *Studies in Family Planning*, 43(2): 93–114. https://doi.org/10.1111/j.1728-4465.2012.00308.x.

Das Dangol B, Retherford R D, and Thapa S. (1997). Declining fertility in Nepal. *Asia-Pacific Population Journal*, 12(1): 33–54.

Fotso J C, Cleland J, Mbreu B, *et al.* (2013). Birth spacing and child mortality: An analysis of prospective data from the Nairobi urban health and demographic surveillance system. *Journal of Biosocial Sciences*, 45(6): 779–798.

https://doi.org/10.1017/S0021932012000570.

Kamal A and Pervaiz M K. (2013). Determinants of marriage to first birth interval in Pakistan. *Journal of Statistics*, 20: 44–68.

Karki Y B and Krishna R. (2008). *Factors responsible for the rapid decline of fertility in Nepal—An interpretation: Further analysis of the 2006 Nepal Demographic and Health Survey.* Calverton, Maryland, USA: Macro International Inc.
https://dhsprogram.com/pubs/pdf/FA52/FA52.pdf

Kim J. (2010). Women's education and fertility: An analysis of the relationship between education and birth spacing in Indonesia. *Economic Development and Cultural Change*, 58(4): 739–774.
https://doi.org/10.1086/649638.

Lee E T. (1993). Functions of survival time. In D J Bogue, E E Arriaga, D L Anderton (Eds.) *Readings in population research methodology, Volume 6* (*Advanced basic tools*). New York: United Nations Population Fund (UNFPA).

Ministry of Health and Population (MOHP) [Nepal], New ERA, and ICF International Inc. (2012). *Nepal Demographic and Health Survey 2011.* Kathmandu, Nepal: Ministry of Health and Population and New ERA, and Calverton, Maryland: ICF International.
http://dhsprogram.com/pubs/pdf/fr257/fr257[13april2012].pdf.

Ministry of Health and Population (MOHP) [Nepal], New ERA, and Macro International Inc. (2007). *Nepal Demographic and Health Survey 2006.* Kathmandu, Nepal: Ministry of Health and Population and New ERA, and Calverton, Maryland: Macro International Inc.
http://dhsprogram.com/pubs/pdf/fr191/fr191.pdf.

Pradhan A, Aryal R H, Regmi G, *et al.* (1997). *Nepal Demographic and Health Survey 1996.* Kathmandu, Nepal: Ministry of Health and New ERA, and Calverton, Maryland: Macro International Inc.
http://dhsprogram.com/pubs/pdf/FR78/FR78.pdf.

Ministry of Health (MOH) [Nepal], New ERA, and ORC Macro. (2002). *Nepal Demographic and Health Survey 2001*. Kathmandu, Nepal: Family Health Division, Ministry of Health and New ERA, and Calverton, Maryland, USA: ORC Macro.
http://dhsprogram.com/pubs/pdf/fr132/fr132.pdf.

Rajaram S, Rao S R, and Pandey A. (1994). Birth interval dynamics in Goa: A parity specific analysis. *Demography India*, 23(1–2): 67–81.

Rajbhandary S. (1999). *The impact of child death on birth interval: A hazard model analysis of micro data from Nepal, Working Paper No. 99-20*. Boulder, Colorado: University of Colorado.
http://www.colorado.edu/econ/papers/papers99/wp99-20.pdf.

Ramesh P. (2006). *European Population Conference 2006 (EPC–2006) on Population Challenges in Ageing Societies, June 21–24, 2006, Liverpool, UK: Determinants of birth interval dynamics in Orissa, India.*
http://www.infostat.sk/vdc/epc2006/papers/epc2006s60487.pdf

Retherford R D and Choe M K. (1993). *Statistical models for causal analysis.* New York: John Wiley and Sons.

Retherford R D and Thapa S. (2004). Recent trends and components of change in fertility in Nepal. *Journal of Biosocial Sciences*, 36(6): 709–734.
https://doi.org/10.1017/S0021932003006448.

Retherford R D and Thapa S. (1999). The trend of fertility in Nepal, 1961–1995. *Genus*, 55(3–4): 61–97.
http://www.jstor.org/stable/29788610.

Retherford R D and Thapa S. (1998). Fertility trends in Nepal, 1977–1995. *Contributions to Nepalese Studies*, 25(special issue): 9–58.
http://himalaya.socanth.cam.ac.uk/collections/journals/contributions/pdf/CNAS_25_sp_02.pdf.

Rindfuss R R, Palmore J A, and Bumpass L L. (1987). Analyzing birth intervals: Implications for demographic theory and data collection. *Sociological Forum*, 2(4): 811–828.
https://doi.org/10.1007/BF01124385.

Saha U R and van Soest A. (2013). Contraceptive use, birth spacing, and child survival in Matlab, Bangladesh. *Studies in Family Planning*, 44(1): 45–66.
https://doi.org/10.1111/j.1728-4465.2013.00343.x.

Sahoo H. (2011). *Fertility Decline in Orissa since the 1970s: Transition in conditions of low development.* (Thesis). Jawaharlal Nehru University, New Delhi.

Singh R, Tripathi V, Kalaivani M, *et al.* (2012). Determinants of birth intervals in Tamil Nadu in India: Developing Cox hazard models with validations and predictions. *Revista Colombiana de Estadística*, 35(2): 289–307.

Srinivasan, K, Pandey A, and Rajaram S. (1994). Birth interval differentials in Goa. In K B Pathak, U P Sinha, and A

Pandey (Eds.) *Dynamics of population and family welfare.* India: Himalaya Publishing House.

Subedi B P. (1998). Regional patterns of fertility in Nepal. *Contributions to Nepalese Studies*, 25(special issue): 145–156. http://himalaya.socanth.cam.ac.uk/collections/journals/contributions/pdf/CNAS_25_sp_08.pdf.

Suwal J V. (2001). Socio-cultural dynamics of birth intervals in Nepal. *Contribution to Nepalese Studies*, 28(1): 11–33. http://himalaya.socanth.cam.ac.uk/collections/journals/contributions/pdf/CNAS_28_01_02.pdf.

Tarling R. (2009). *Statistical modeling for social researchers: Principles and practice.* Oxford, UK: Routledge.

Trussell J, Martin L G, Feldman R, *et al.* (1985). Determinants of birth interval length in the Phillippines, Malaysia, and Indonesia: A hazard-model analysis. *Demography*, 22(2): 145–168. http://www.jstor.org/stable/2061175.