The effect of birth spacing on child survival in Kassena-Nankana Districts of Northern Ghana

Paul Welaga, Cornelius Debpuur, Timothy Awine

Introduction:

Evidence on the relationship between birth-spacing and child survival is still not clear and recommendations for birth spacing made by international organizations are based on information that was available several years ago [1]. While several publications on the effect of birth spacing on child survival recommend waiting at least 2–3 years between pregnancies to reduce infant and child mortality, and also to benefit maternal health, recent studies supported by the United States Agency for International Development (USAID) have suggested that longer birth spacing, 3–5 years, might be more advantageous [1, 2]. In view of this debate, country and regional programmes have requested that WHO clarify the significance of these findings [1]. This resulted in a review of evidence on birth interval during which they called for quality longitudinal studies that take more potential confounding factors into account to clarify the observed associations between birth-to-pregnancy intervals and maternal, infant and child outcomes.

We attempt to contribute to this debate by providing evidence based information using current and well documented longitudinal data to examine the effect of birth spacing on neonatal, post neonatal, infant and child survival in a district with a continuous demographic surveillance system in northern Ghana.

Studies have shown birth interval to be a risk factor for child mortality [1,2,3,4]. Short birth intervals have also been shown to increase the mortality risk of the first child of the interval pair even before the birth of the second child [5,6]. If the age difference with the elder sibling is small, the competition for the care of the mother, food and scarce family resources may have a negative effect on the health of the second child of the interval pair. Majority of children in developing countries are breastfed, and because of low contraceptive use, women tend to give birth at close intervals. When a woman gets pregnant when her last child is still breastfeeding, the pregnancy may compel the woman to stop breastfeeding either because she thinks that milk of a pregnant mother is bad or poisonous for a baby, or because the amount of milk is decreasing [4]. The child is usually weaned within a short time and this increases the overall risk of death of the child especially from malnutrition and other diseases. Birth interval is an indirect determinant of mortality. It is through intermediate biological and behavioural factors that are associated with short birth intervals that lead to higher mortality [5]. A quick succession of pregnancies can have a deleterious effect on the health status of the mother, and consequently affect the health conditions of the baby during child development in the womb [4], and this could invariable affect the immunity of the baby and lead to an increased risk of death.

The overall aim of our study is to determine which birth interval is most beneficial to child survival.

Specific Objectives:

1. To compare infant mortality rates between index children with preceding and succeeding birth intervals of 3 to 5 and 2 to 3 years

2. To determine differences in neonatal mortality rates between index children with preceding and succeeding birth intervals of 3 to 5 and 2 to 3 years
3. To determine any difference in under-five mortality rates between index children with preceding and succeeding birth intervals of 3 to 5 and 2 to 3 years

Methods:

Study Area

The study area is in the Kasena-Nankana District[1] in the northern part of Ghana and covers a land area of 1675km^2 with an estimated population of 150,000 under continuous demographic surveillance. The district is typical of many rural areas in sub-Saharan Africa in that agriculture is the main stay of the local economy, with about 90% of the people being farmers. The district exhibits many of the health and development problems that characterize the guinea savannah region of Africa. Research findings from this district have relevance for many rural African communities. On health service delivery, the district has a hospital located in the district capital with five health centres, a private clinic and community health compounds located in some selected communities across the district.

The Kassena-Nankana district was the site for a large-scale community-based intervention trial known as the Navrongo Community Health and Family Planning project which was a quasi-experimental study designed to test the hypothesis that introducing health and family planning services in a traditional African setting can induce and sustain reproductive change[7]. Detailed description of the Navrongo project as well as the socio-demographic context of the Kassena-Nankana district can be found elsewhere [7,8]. Before the end of the project in 2003 changes in mortality and fertility were already evident in the Kassena-Nankana district. The results of this intervention led to the current Ghanaian policy on community-based health service delivery known as Community-based Health Planning and Services (CHPS). Fertility and mortality has generally declined over the with total fertility rate now at 4 per woman.

Demographic and Health Surveillance System (DHSS)

The district is the field site of the Navrongo Health Research Centre (NHRC), which has been conducting demographic and health research since 1992. Over the years, NHRC has built an elaborate infrastructure for research in this mainly rural community. A demographic surveillance system, known as the Navrongo Health and Demographic Surveillance System (NHDSS) collects longitudinal data on births, deaths, pregnancies, marriages and migration since 1993. Field workers visit all households in the area three times a year and update demographic information, including the residence, migration, births and survival status of all household members during each visit. Community Key Informants (CKI) located in the various communities in the district complement the efforts of field workers by registering all new births, pregnancies and deaths that occur in their catchment area to ensure that vital events including neonatal deaths are not missed. Details can be found elsewhere [9].

[1] In 2008 the Kassena-Nankana District was split into two districts – Kassena-Nankana East and Kassena-Nankana West districts. In this paper we use the original name of the district to refer to the two districts.

Data
Data for this study come from the Navrongo Demographic and Health Surveillance System (NDHSS), a continuous population monitoring system that keeps track of births, deaths and migrations in a population of 150,000 people. The socioeconomic status of households was obtained from a survey of all households in the area which documented household possessions. A wealth index was calculated using principal component analysis (PCA) from the household assets. The survival status of preceding and index births, preceding birth interval, subsequent birth interval, birth order, sex, place of delivery and mother's age at birth was ascertained by linking HDSS information. Mother's education was obtained from annual survey data on the educational status of all residents aged 6 years or above in the study area. Mother's age at birth was grouped into three categories; <20, 20-29, 30-39 and 40+ years. Mother's education was also categorized into no education, primary/Junior secondary, Secondary and tertiary. Place of delivery was categorized as home, health facility, Traditional birth attendant, and don't know.

Statistical Analysis

To examine the effect of preceding birth interval on mortality, children with a second or higher order singleton live birth (index children) that occurred in the area from 1st January 2002 to 31st December 2007 were used in the analysis. All first births were excluded from the analysis for the effect of preceding birth interval on child survival. Preceding birth interval which is defined as the difference between the birthdates of the index and immediately preceding birth were categorised into <24, 24-35, 36-59 and 60+ months to help determine the preceding birth interval associated with the least mortality risks.

To examine the effect of subsequent birth interval on mortality after age one, all children with at least one subsequent birth in the follow-up period were used. A child's death can only be associated or linked to the length of the subsequent interval if it occurs after the mother became pregnant or given birth again and therefore children who died before the estimated date of conception of the subsequent birth were excluded. The date of conception was estimated by subtracting 274 days (approximately nine months) from the date of birth. Mortality rates were expressed per 1000 live births for neonatal mortality per 1000 child years of risk for post-neonatal, infant and under-five mortality.

We used multivariable logistic regression models to examine the effect of birth interval on neonatal mortality and Cox proportional regression models for post-neonatal, infant and under-five mortality. Potential confounding factors such as mother's age at birth, season of birth, mother's education, place of delivery, socioeconomic status using wealth index, survival status of immediately preceding sibling, sex, year of birth and birth order were controlled for in the analysis.

Results

In all, 17,785 children born between 1st January 2002 and 31st December 2008 were included in the analysis to examine the effect of preceding birth interval on child survival. A total of 1,295 under-five deaths were recorded.

From the preliminary results of our analysis, postnatal children with preceding birth interval of 24 to 35 months were 1.33 times more likely to die compared to those with preceding birth interval of 35 to 59, [adjusted HR=1.33 (1.08–1.64)]. However, preceding birth interval was not a significant predictor of neonatal and infants.

On the effect of succeeding birth intervals on child survival, 11,097 under-five children with succeeding births were included in the analysis. Out of this, 1,166 of them died. Children with succeeding birth interval of less than two years had higher risk of dying at neonatal, post neonatal, infant and under-five years of age than children with subsequent birth interval of 3 to 5 years [Table 2].

In concluding, preceding and succeeding birth intervals of 36 to 59 months generally appears to be beneficial to child survival and the beneficial effect of longer birth spacing becomes evident at the neonatal stage for preceding birth interval. Short birth intervals could be a consequence of child mortality rather than cause and this need to be further investigated.

Reference

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Table 1: Relative risk for multivariate models for neonatal, post neonatal, infant and under-five mortality by preceding birth interval

	Neonatal mortality	Post neonatal mortality	Infant mortality	Under-five mortality
Varaible	Odds Ratio [95% CI] (adjusted)	Hazards Ratio [95% CI] (adjusted)	Hazard Ratio [95% CI] (adjusted)	Hazard Ratio [95% CI] (adjusted)
Preceding birth interval				
< 24 months	1.01 [0.62 – 1.65]	1.40 [1.0–1.97]	1.26 [0.96 - 1.66]	1.14 [0.89 – 1.44]
24-35	0.74 [0.53 – 1.04]	1.33 [1.08–1.64]	1.08 [0.90 – 1.28]	1.14 [0.99 – 1.32]
36-59	1	1	1	1
60+	0.92 [0.68 - 1.24]	1.15 [0.92–1.44]	1.06 [0.89 – 1.26]	1.03 [0.89 – 1.19]

Variables controlled for were sex, mother's education, age, mother's age at birth, season of birth, survival status of previous child and socioeconomic status.

Table 2: Relative risk for multivariate models for neonatal, post neonatal, infant and under-five mortality by succeeding birth interval

	Neonatal mortality	Post neonatal mortality	Infant mortality	Under-five mortality
Varaible	Odds Ratio [95% CI] (adjusted)	Hazards Ratio [95% CI] (adjusted)	Hazard Ratio [95% CI] (adjusted)	Hazard Ratio [95% CI] (adjusted)
Preceding birth interval				
< 24 months	42.02 [27.2 –64.9]	25.4 [18.8–34.2]	27.2 [21.3–34.8]	18.5 [15.5 – 22.1]
24-35	3.55 [2.24 – 5.64]	3.11 [2.3 – 4.22]	3.27 [2.6 – 4.21]	2.75 [2.31 – 3.27]
36-59	1	1	1	1
60+	1.85 [0.86-3.96]	0.71 [0.38–1.31]	1.0 [0.62–1.77]	1.0 [0.74 – 1.35]

Variables controlled for were sex, mother's education, age, mother's age at birth, season of birth, survival status of previous child and socioeconomic status.

Table 3: Distribution of deaths by Subsequent birth interval: 2002-2008

Subsequent Birth Interval	Number (N)	Dead	Pyrs	MR per 1000 dead/Pyrs
<24	917	531	1185.15	448.05
24-35	3,074	332	9233.77	35.95
36-59	5,774	245	21729.04	11.28
60+	1,332	58	5736.33	10.11
Total	11097	1166	37884.29	30.78

Table 4: Distribution of deaths by preceding birth interval: 2002-2008

Preceding Birth interval	Number (n)	dead	Pyrs	MR per 1000 dead/pyrs
<10-23	1,024	82	2951.9213	27.78
24-35	3,642	290	10127.423	28.64
36-59	9,066	635	26439.086	24.02
60+	4,053	288	11355.174	25.36
Total	17,785	1295	50873.6043	25.46