THE EXISTENCE OF AN OPTIMUM INTERVAL BETWEEN BIRTHS[1]

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THE PHYSIOLOGICAL changes which occur in the female during pregnancy and parturition are more intense than those which take place during any other normal period of life. The time interval between the termination of one pregnancy and the beginning of the next may, therefore, be considered a period of biological readjustment and rest. The required period of rest will, no doubt, vary from individual to individual depending upon many factors. Nevertheless, it is important to inquire whether there is an average optimum interval between successive births which contributes to the better health of mother and infant.

The literature pertinent to this problem is meagre and inconclusive. The primary reason is that there are no data available on a sufficiently large representative sample of births[3] furnishing for each the minimum necessary information: parity, age of mother, course of pregnancy and its outcome and the precise interval between the termination of one pregnancy and the inception of the next. Lacking such data for a direct study of this problem, an indirect method is employed in this paper which is based on tabulations of more than seven million births and stillbirths which occurred to multiparae in the United States during the five-year period 1937-1941.

The rationale behind the indirect method of study is the fact that in general the interval between births for women of the same age decreases with increasing parity. For example, women in the 20-24 year age group who are being delivered of their sixth birth have had their births on the average at closer intervals than women of

[1] Summary of a paper appearing in the current (May) 1945 issue of Human Biology under the title "On the Interval Between Successive Births and its Effect on Survival of Infant. I. An Indirect Method of Study." The reader is referred to this paper for the supporting evidence for many of the statements made in the present summary.

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[3] In this connection, data from a single hospital may not be the best suited for this type of investigation. Much depends on the admission policies of the hospital. In the ward services of a number of hospitals, for example, priorities are given to primiparae, and multiparae are selected for admission on the basis of complications during the prenatal period or in previous deliveries.

the same age group who had had previously only 2, 3, or 4 births. It is, therefore, possible to investigate the effect of the interval between births by a detailed study of the stillbirth rates according to age of mother and order of birth (parity).

The reasoning involved may be illustrated by the following example. The stillbirth rate for infants of women aged 15-19 years was 30.1 for second births, and 100.6 for fifth births. Thus, the stillbirth rate for fifth births for this age group was higher than the rate for second births by 234 percent. This fact in itself yields little if any information on the interval between births since the increase of the rate for fifth births may be due entirely to the parity factor. However, during the same period the stillbirth rate for *all* second births (all ages of mother) was 22.2 and the rate for *all* fifth births was 34.7, an increase of only 56 percent. Moreover, the respective rates for second and fifth births to mothers aged 35-39 were 35.2 and 40.5, an increase for fifth over second births of only 15 percent. It is seen, therefore, that the extra risk of stillbirth for fifth births as compared with second births is not of the same magnitude in the different age groups. It is obvious that the interval patterns are very different in these age groups. Women aged 35-39 years with five births have had these births spaced at moderate intervals while the average interval for women aged 15-19 years of para 5 was very short. Conversely, the average interval for the older mothers who had only two births is likely to have been very long.

This illustration indicates in general, the method of approach in this indirect study. Briefly, it consists of a comparison of the manner in which the stillbirth rates vary with order of birth in one age group with that in another age group. A refinement of this basic procedure is accomplished in the detailed study[4] by determining "expected" stillbirth rates for the different subgroupings of the births on the assumption that interval between births does not affect the stillbirth rate. Comparison between the observed and the "expected" rates in the different classifications indicates the strength of the effect of interval between births and brings it into sharper focus.

[4] Yerushalmy, J.: "On the Interval Between Successive Births and Its Effect on Survival of Infant." I. An Indirect Method of Study." Human Biology, Volume 17, Number 2, May, 1945.

The Effect of Interval between Births on the Stillbirth Rate

In Table 1 are shown the stillbirth rates (number of stillbirths per 1,000 total viable births) according to order of birth (parity) and age of mother. These are based on 211,079 stillbirths which occurred among a total of 7,151,631 multiparous births.

TABLE 1

Stillbirth Rates (per 1,000 total births) by Order of Birth and Age of Mother
(in 5 year age groups)
Births to all Multiparae 15-44 years of age, United States 1937-1941

	Age of Mother						
Order of Birth	All ages	15-19	20-24	25-29	30-34	35-39	40-44
All Multiparae	29.5	33.7	23.3	24.5	30.4	42.0	56.2
Para 2	22.2	30.1	*19.4*	19.7	24.0	35.2	51.5
Para 3	26.4	45.1	23.8	*22.6*	27.5	36.6	54.1
Para 4	30.7	74.7	30.8	*25.7*	29.8	38.9	50.8
Para 5	34.7	100.6	41.4	*29.0*	31.9	40.5	54.3
Para 6	37.0	138.4	57.0	32.7	*32.0*	40.8	52.2
Para 7	40.0		76.4	40.4	*34.1*	40.3	52.5
Para 8	44.2		110.9	52.4	*39.4*	41.1	52.5
Para 9	49.6		102.3	73.9	46.8	*45.1*	53.7
Para 10	54.4		107.7	88.3	56.9	*50.7*	53.1
Para 11	60.1		100.8	108.4	64.6	*55.5*	59.9
Para 12	67.7			140.1	90.5	64.4	*61.3*
Para 13	75.5			163.5	87.1	77.6	*68.7*
Para 14	89.1			155.8	129.2	92.6	*79.0*
Para 15+	115.9			226.2	151.6	117.6	*109.4*

The variation of the stillbirth rate with order of birth is very marked. The rate increased continuously from a minimum of 22.2 for second births to a maximum of 115.9 for births of order 15 and over. The variation of the rate by age of mother is also very distinct. The rate was at the relatively high level of 33.7 for infants of mothers aged 15-19 years. It was at a minimum of 23.3 for ages 20-24 years, and increased thereafter with age of mother to 56.2 in the 40-44 years age group.

The first indication of the effect of interval between births on the stillbirth rate may be seen from a review of the different rows of Table 1. These show that the minimum rates for the different

birth orders (the rates that are underscored in Table 1) do not occur in the same age group. Instead the best rates appear at increasingly older age groups with increasing parity. The lowest rates among second births are found for births to mothers in the age group 20-24, for third, fourth, and fifth births the lowest rates are registered in the age group 25-29 years. For births of orders 6, 7 and 8 the minimum rates are at ages 30-34 years. For birth orders 9, 10, and 11 the optimum rates occur in the age group 35-39 years. For birth orders higher than 11 the best rates prevail among infants of the oldest mothers. Not only do the minimum rates for the various parities occur at increasingly older age groups but they do not occur at the youngest age group for any of the parity groups. Even among second births the best rates do not occur at ages 15-19 but at ages 20-24, and for infants of order 12 and over the best rates are actually for those of the oldest mothers. These findings do not support Eastman's recent statement: "for the best maternal and fetal outlook we are inclined to believe that youth is a better ally than child spacing." [5]

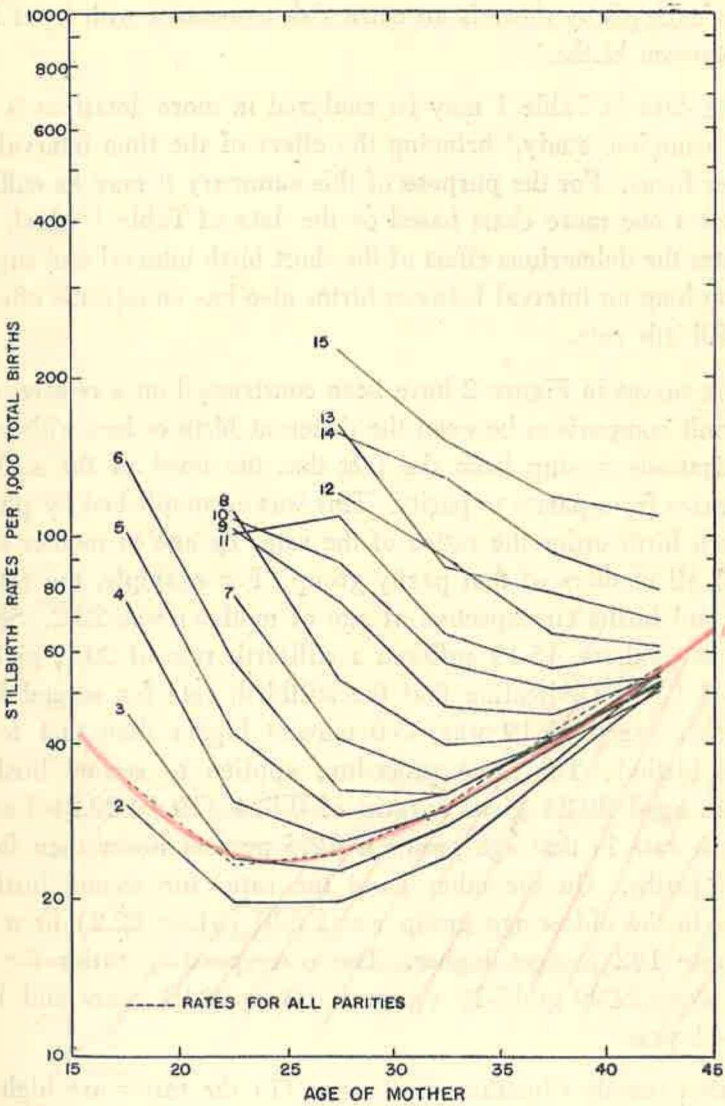
An overall view of the data in Table 1 and its general implication relative to the effect of the interval may be obtained from Figure 1. This presents individual curves for each order of birth showing the variation of stillbirth rate with age of mother. It is immediately obvious that the effect of age on the stillbirth rate is different for the different parities.

If the interval between births had no appreciable effect on the level of the stillbirth rate, these curves would be approximately parallel since the increase in the rate for one parity over another might be expected to be *proportionate* for the different age groups. For example, it may be seen that the curve for third births lies entirely above that for second births. This is due to the fact that the stillbirth rate for third births is higher than that for second births. If interval between births played no role, it might be expected that the increase in the rate for third over second births would be relatively as great for infants of mothers aged 15-19 as for those of mothers 20-24 or for any other age group. This would result in the curve for third

[5] Eastman, Nicholson J.: "The Effect of the Interval Between Births on Maternal and Fetal Outlook."—American Journal of Obstetrics and Gynecology; Vol. 46, Number 4, pp. 445-466, April, 1944.

FIGURE 1

STILLBIRTH RATES BY AGE OF MOTHER FOR EACH ORDER OF BIRTH AND FOR BIRTHS OF ALL PARITIES, BIRTHS TO ALL MULTIPARAE 15-44 YEARS OF AGE, UNITED STATES 1937-41.



Note that the curves are not parallel indicating that for each order of birth the increase in the rate is greater in the younger than in the older ages.

births not only lying above that for second births, but parallel to it. It is seen in Figure 1 that the curves are not at all parallel. Instead, in each order of birth the increase in the younger ages is relatively much greater than that in the older ages. It is, therefore, indicated that in each parity there is an extra risk associated with brief intervals between births.

The data in Table 1 may be analyzed in more detail as is done in the complete study,[6] bringing the effect of the time interval into sharper focus. For the purpose of this summary it may be sufficient to present one more chart based on the data of Table 1 which demonstrates the deleterious effect of the short birth interval and suggests that too long an interval between births also has an adverse effect on the stillbirth rate.

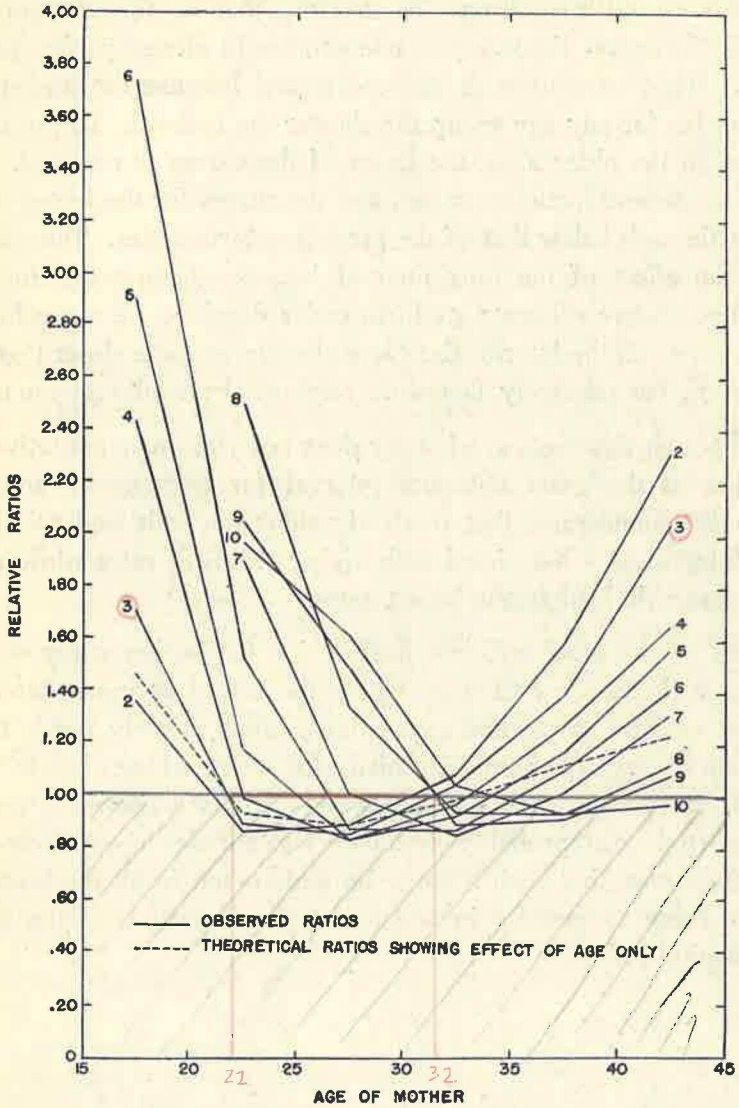
The curves in Figure 2 have been constructed on a relative basis to permit comparison between the different birth orders without the complications arising from the fact that the level of the stillbirth rate varies from parity to parity. This was accomplished by plotting for each birth order the ratios of the rates by age of mother to the rate of all mothers of that parity group. For example, the rate for all second births (irrespective of age of mother) was 22.2. Second births to mothers, 15-19 suffered a stillbirth rate of 30.1, giving a ratio of 1.356 (indicating that the stillbirth rate for second births to mothers aged 15-19 was 35.6 percent higher than that for all second births). The same procedure applied to second births to mothers aged 20-24 gives a ratio of 0.874 (19.4÷22.2) i.e., the stillbirth rate in that age group is 12.6 percent lower than for all second births. On the other hand the ratio for second births to women in the oldest age group was 2.320 (51.5÷22.2) or a stillbirth rate 132 percent higher. The corresponding ratios for fifth births were 2.899 at 15-19 years, 1.193 at 20-24 years and 1.565 at 40-44 years.

This example illustrates two facts: (1) the ratios are higher in each of these parities both in the youngest and the oldest ages, and (2) while in the youngest ages the ratios are higher for fifth than for second births, the reverse is true in the oldest ages, indicating

[6] loc. cit.

FIGURE 2

OBSERVED RELATIVE STILLBIRTH RATIOS BY AGE OF MOTHER FOR EACH BIRTH ORDER AND THEORETICAL RATIOS FOR AGE OF MOTHER WHEN THE EFFECT OF BIRTH ORDER IS ELIMINATED. BIRTHS TO ALL MULTIPARAE 15-44 YEARS OF AGE, UNITED STATES 1937-41.



Note that to the left the curves lie on top of one another in almost perfect parity order while to the right the order is reversed indicating the effect of both the short and the long interval.

on the one hand the adverse effect of too short an interval and on the other the deleterious effect of too long an interval.

Reference to Figure 2 shows that the above are not isolated examples, but that the curves appear to fall into a definite pattern which is very illuminating. To the left, that is, for younger age groups, the curves lie on top of one another in almost perfect parity order. This, of course, is to be expected because the higher the birth order for any age group the shorter the interval. To the right, that is, in the older ages, the order of the curves is reversed. The curve for second births is on top, and the curves for the higher birth orders lie each below that of the preceding birth order. This results from the effect of the long interval because the average interval becomes relatively longer, as birth order decreases in these higher age groups. At the intermediate ages the curves come closer together indicating the relatively favorable rates of the moderate intervals.

Although this method of study does not yield a quantitative expression of the exact optimum interval for each parity and age group it demonstrates that relatively short intervals and relatively long intervals are associated with higher stillbirth rates while moderate intervals lead to the lowest rates.

The results offer sufficient justification for further study on this subject with the view of determining the actual optimum intervals for the various parity and age groups. Such a study needs to be made on a very large number of births for which all the three factors: parity, age, and exact interval between births are known. Data for such a study can probably best be secured from hospital records. It is important that such a study be undertaken in all the hospitals of one large community in which a high proportion of the births are hospitalized.