

## THE SEASONAL PATTERN OF LIVE BIRTHS IN PUERTO RICO

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**ABSTRACT:** In this study the authors analyzed the seasonal pattern of births in Puerto Rico from the 1930's to the present (1981). For this purpose data published by the Department of Puerto Rico were utilized. In addition, special tabulations were made for 1979 and 1980.

The analysis of these data shows that before the middle of the 1950's the peak of births, although yearly unstable, occurred during the spring season. However, from 1954 the peak has shifted to the months of September and October and the seasonal pattern has become very stable since then. Moreover, the seasonal pattern of fertility in Puerto Rico shows an extraordinary degree of replication among different groups of mothers: medium-aged, and older mothers behave in

a similar fashion; mothers of first parity, like all other mothers; consensually-married, like legally married; and rural, like urban residents. In relation to mother's schooling and father's occupation no significant differences seem to exist.

Although the authors have been unable to find a sound explanation for this phenomenon, they speculate that the rise in the use of contraception and changes in the seasonal pattern of sexual intercourse may be the most important forces affecting the shift from spring peak of the September-October pattern which has prevailed since the 1950's. (Key words: *Social Factors — Economic Factors — Fertility — Contraception*).

### INTRODUCTION

**I**N a recent paper Edwing (1) reviewed the most important of the existing studies on seasonal variation in births in human populations and summarized what is known about the described patterns as well as the explanations which have been given to these phenomena. As a general rule the peak of births occurs in spring. Thus, in the northern hemisphere it corresponds to the months of March, April, and May whereas in the southern hemisphere it comprises August, September, and October. Notable exceptions to this pattern have been observed (e.g., in the United States) with changes over time (e.g., Puerto Rico), as well as with marked differences between different groups within the same country (e.g., West Malaysia). Latitude, temperature, and other climatic factors have been mentioned as associated with the seasonality of births, as have marriage patterns and cultural and socio-economic variables.

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The seasonal pattern of births in Puerto Rico was analyzed by Cowgill (2) who found a notable shift from a European to a United States pattern during the period between 1941 and 1961. He observed that the peak of births occurred in April, May, and June, during 1941-1945 changing to September, October, and November by 1956-1961. He attributed the change to socioeconomic factors without elaborating on this explanation.

A descriptive analysis of seasonality of births in Puerto Rico was also undertaken by Bangdiwala and Fuertes de la Haba (3) for the period 1950-1971. They concluded that the pattern was extremely regular and stable over time showing three distinct seasonal trends: an increasing trend occurring during the months from July to September; a declining one from October to February and a nadir including the months from March to June. The peak of births which occurred in September and October was explained in terms of changes in sexual behavior during the Christmas season (December and January).

Shortcomings in most of these studies have limited the analysis of the causal relationships between sea-

sonality of births and the sociocultural milieu. These shortcomings are the result of the available data which are usually limited to the number of births by month of occurrence and, therefore, do not permit establishing an association between seasonality of births and marriages. If any relationship exists between these two events it is only with first-order births that marriages can be reasonably correlated. In countries like Puerto Rico, where many marriages are consensual and, therefore, are not registered, the exclusion of illegitimate births from this analysis is obligatory. In 1940, for example, 37% of all registered births were illegitimate. In 1981, this figure was 22% × (4).

Another bias introduced into this correlational analysis is the indiscriminate inclusion of pre-term and post-term births as full term. Pre-term and post-term births belong to different cohorts corresponding to different months of conception. Thus, the effect of such inclusions needs to be examined.

Finally, to visualize births as a simple result of the timing and frequency of sexual intercourse as these are molded by the physical and social environments constitutes a serious error in orientation. Contraception practice is today a very important determinant of patterns of conception and has to be taken into consideration in the analysis of the seasonality of births. Among groups where contraceptive practice is generalized the seasonal pattern of births (if any) will depend, to a great extent, on changes in this practice during the year. In these cases, the effect of changes in sexual behavior (timing and frequency) has to be tied to changes in contraceptive practice.

In this research, the authors will analyze the seasonal pattern of births in Puerto Rico from the beginnings of the 1930's to the present. In trying to explain this seasonality of births, the authors will utilize birth data crossclassified by month of occurrence and such variables as order of birth, duration of pregnancy, legitimacy, and mother's residence and education.

#### METHODS

In Puerto Rico a complete series of data of births by month is available from 1913. However, a preliminary examination of these data demonstrated that prior to 1931 this information referred to month of registration rather than to month of occurrence. (Late registration was apparently very common in times of disaster, e.g., hurricanes, floods, and epidemics). In addition, birth registration was very incomplete during the first decades of the century (5). Because in August 1931 the demographic registry of Puerto Rico was completely centralized and transferred from the Department of Justice to the Department of Health, the registration of births improved considerably. By 1932 tabulations were made by month of occurrence rather than by month of registration, which was the previous practice. For these reasons this analysis will be limited to the period between 1932

and 1981. Special tabulations for the years of 1979 and 1980 were produced by the authors.

Births by month of occurrence were classified by order of birth, duration of pregnancy, legitimacy, and several socioeconomic variables. In the analysis of the seasonal pattern a correction was introduced to take into account the difference in days between the months of the year. To treat all the months as if they were equal in length would introduce some bias. Monthly indexes were computed by dividing the average number of births per day for a given month by the average number of births per day for the year.

$$I_i = \frac{b_i/d_i \times 100}{B/365}$$

Where:

- $I_i$  = index for month  $i$
- $b_i$  = births occurred in month  $i$
- $d_i$  = number of days in month  $i$
- $B$  = births occurred during the year

For a leap year the divisor was changed to 366 and the divisor for February to 29. In the case of periods longer than a year, annual averages were utilized in the formula.

#### RESULTS

During the 1930's and 1940's the peak of births occurred during the spring season. From 1932 to 1950, May was the month with the highest average of births per day on six occasions, April was the leading month five times, and June occupied the first position three times. However, the shape of the curve changed from one year to the next showing a very unstable seasonal pattern.

Since the middle of the 1940's the peak of births began to shift to the months of September and October, and by 1954 this new pattern was clearly established (Figure 1). From 1954 to the present this seasonal pattern has remained almost unchanged without noticeable fluctuations from one year to the next. During the period 1954 to 1981 September was the month with the highest average of births per day on 27 occasions. (The only exception during this 28-year period occurred in 1970: in that year the leading position corresponded to November while September and December shared second place.) Further, October occupied the second position 26 times during this period. In 1975, it shared the first place with September and in 1970 it occupied the third position, very close to September and December which were tied for second place. During this period August and November interchanged the third and fourth positions while December was in the fifth place most of the time; the months of April, May, and June, which represented the peak of births during the period of 1935-1944, began to decline over time and since 1954 they have occupied, together with March, the lowest points on the curve.

Figure I

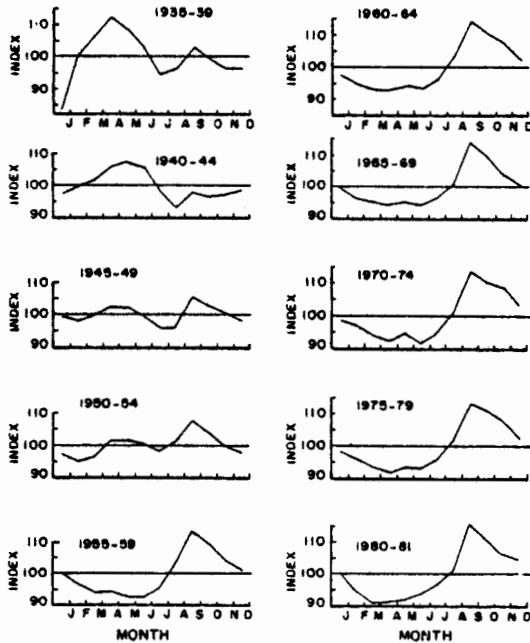


FIGURE 1. Monthly index of births of several periods Puerto Rico, 1935-39 to 1980-81.

In sum, the seasonal pattern of births in Puerto Rico is characterized by an increasing trend from July to September, a declining period from November to March, and a nadir which extends from March to June. The pattern would be a U-shaped curve were the monthly observations begun in September.

In trying to clarify the seasonal pattern of fertility in Puerto Rico we undertook an analysis of births by weeks of gestation and found that the groups below and above the general norm had more irregular patterns than those with a normal gestation (39 to 41 weeks). (See Fig. 2.) The peak of the curve for those with a gestation below the norm (38 weeks or less) continued to be September but the value for the month of October decreased considerably. In the case of births with a gestation above the norm (42 weeks or more) the peak shifted to October and November. This is to be expected if these births behave in the same way as births of a normal gestation in terms of month of conception. At the same time, the seasonal pattern of births with a normal gestational period (39-41 weeks) did not differ from that observed among all births. Thus, we need not exclude births with a gestational period above and below the norm from the analysis of the seasonality of births in Puerto Rico. (In addition, these births represent a relatively small proportion of all births, only 22% in 1979-80.)

Figure II

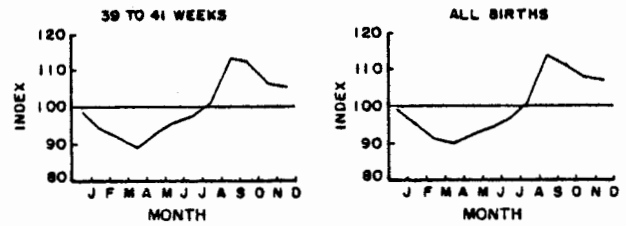
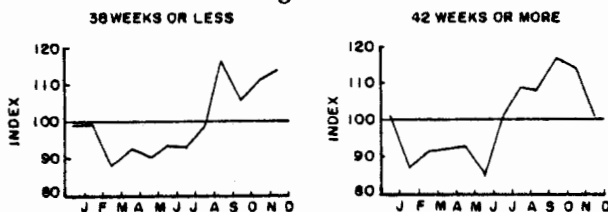


FIGURE 2. Monthly indexes of births by weeks of gestation Puerto Rico: 1979-1980.

In trying to correlate the seasonal patterns of births and marriages, we took into account both order of birth and legitimacy. If the marriage trend has any effect upon fertility this has to be noted only among first-order, legitimate births. (The cohabitational arrangements in which illegitimate births are conceived are not registered.) However, no significant differences existed between the seasonal pattern of first-order births and those of a higher order. (See Fig. 3.) Moreover, the trend of births of legally married mothers is very similar to that of consensually-married mothers and of unwedded mothers. Similar, when seasonality was analysed by residence of the mother and her socioeconomic status a replication of the general pattern was observed: rural residents have a seasonal pattern similar to urban residents. Finally, no significant differences were evident with respect to mother's schooling or father's occupation.

Figure III

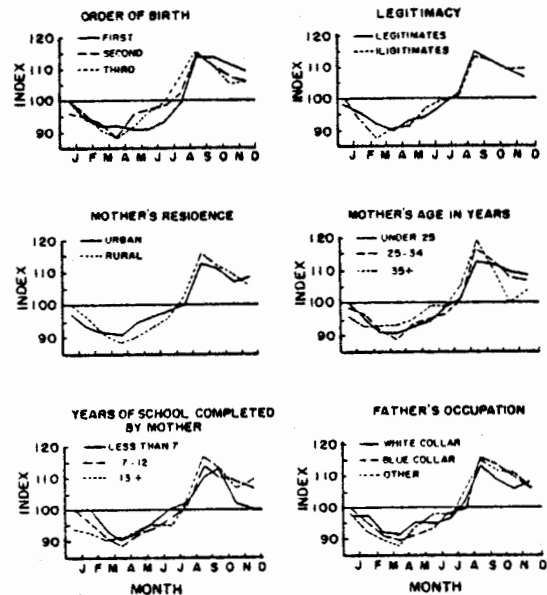


FIGURE 3. Monthly indexes of births by several characteristics Puerto Rico: 1979-1980.

DISCUSSION

The analysis of seasonality of births in Puerto Rico shows two striking features: a remarkable regularity over time since the beginnings of the 1950's, and an

extraordinary degree of replication among different population groups. We have been unable to find a similar situation in any other country of the world. However, as Cowgill (2) noted, some similarities exist between the seasonality of births in Puerto Rico and in the United States. In both countries a marked increase in the number of births occurs during the second half of the year with a peak in the month of September. Whereas in Puerto Rico the second and third highest points in the curve correspond to the months of October and November, in the United States they are observed in August and July. In other words, the United States pattern has a summer peak whereas the Puerto Rican one is more autumnal. In addition, the September peak in Puerto Rico is approximately twice as high as that of the United States: 15% above the annual average in Puerto Rico against 7% in the United States. At the same time, the Puerto Rican pattern is more stable from one year to the next than the United States one (6). Although we have been unable to find an empirical basis for these phenomena, we speculate that changes in contraceptive practices are an important determinant of the seasonal pattern of births in Puerto Rico.

The peak of births which occurs in September and October has been associated with the Christmas season. Some have argued that during this season the frequency of sexual intercourse increases in Puerto Rico due to climatic factors and to the peculiarities of the celebration of Christmas on the Island (3). December and January are characterized by cool weather, long nights, and frequent rain. At the same time, festivities with music, dancing, and abundant alcoholic beverages begin early in December and last through the second week of January. Many holidays occur during this period and many persons are on vacation. In addition, December represents the peak of the marriage seasonal pattern: the daily average number of marriages is 50 to 60% higher than the corresponding annual average.

If one is to take popular expressions as evidence, this increase in sexual relations during Christmas is true. People commonly talk about "Christmas pregnancies" or about "pregnancies due to the coolness of Christmas". But does the presumed increase in sexual intercourse have any effect upon fertility? In trying to answer this question we analyzed births by month of occurrence and age of mother. We assumed that the frequency of sexual relations decreases as the age of the women increases. Among young mothers, most of whom are recently married, intercourse is so frequent throughout the year that little room remains for significant variations due to climatic factors or special events. With increasing age the effect of such factors on the frequency of intercourse should be more intensive. Thus, if these assumptions are true, one should expect marked differences be-

tween the seasonal patterns of births of the different age groups. We found none.

During the Christmas season the frequency of sexual intercourse increases at the same time that contraceptive practices become more lax and erratic. During this festive period regular users of contraceptives take more chances than in any other period of the year due to the euphoria of the time and to the rise in the consumption of alcoholic beverages. In addition, the "exposed to the risk" population is increased considerably by the rise in the number of marriages which take place in December. During the following months (from February on) the "at risk" population, which have been reduced considerably by the great number of conceptions of the Christmas period, is then subject to normal risks in terms of both sexual behavior and use of contraceptives. Conceptions continue to decline until the effect of the attrition of the "exposed to the risk" group is overcome and a new cycle begins. In other words, the seasonality of births in Puerto Rico is mainly the result of a significant increase in the risk of conception during the months of December and January and, to a lesser extent, of the number of marriages which take place in December. The rest of the curve is a product of cyclical changes in the exposed population due to the perturbation which recurrently occurs during the Christmas season.

But how does this line of speculation explain the seasonal pattern of births which prevailed during the 1930's and 1940's when births peaked in the spring? That pattern was also closely associated with the monthly marriage trend and apparently with the seasonal pattern of sexual intercourse at that time. However, the available data show that marriages peaked during the months of June and July although a moderate increase was observed in December (7). At that time, Puerto Rico was an agricultural, rural society dominated by the sugar cane industry. In 1940, for example, 70% of the population lived in the rural area and 58% of the male labor force was employed in agricultural occupations (5). The sugar cane harvest, the most intensive work period of the year, usually began at the end of December and finished in early June. June, July, and August were months of extremely high unemployment for the sugar cane laborer. During this slack season, after the tiring work of the harvest, an increment of sexual intercourse among sugar cane workers was to be expected. This situation also accounted for the increase in marriages during the months of June and July. The marked fluctuations which were observed from one year to the next were due to the unstable nature of the marriage seasonal pattern, and probably to the effect of some non-recurrent events which can only be detected and assessed through a year-by-year historical analysis.

The shift in the seasonal pattern of sexual intercourse during the last three decades was the result of economic and socio-cultural changes. Agriculture began to lose importance by the middle of the 1940's decade being progressively displaced by manufacturing and construction. As a result, the rural population began to move in great numbers to the urban areas and to the United States; Puerto Rico was becoming an urban and an industrial society. By the 1940's most of the employed women were low class or low-middle class engaged in domestic jobs (domestic servants, cooks, laundresses, etc.) and in home needlework. As a result of the industrial changes of the 1950's great numbers of middle class women began to work in factories and in clerical occupations while home oriented jobs began to disappear. These and other social changes had a significant impact on the wife's status and roles. Her participation in social activities increased markedly. She began to accompany her husband to almost all *fiestas* including the numerous Christmas parties, and to take part in the singing, the dancing, and the intake of alcoholic beverages. She also began to have a more active role with respect to sexual relations. This close and joint participation of husband and wife in social activities was very uncommon in the rural-agricultural Puerto Rico of the 1930's and 1940's. In the 1950's contraception began to be an important determinant of fertility (8, 9). This rise in the use of contraceptive methods plus changes in marital patterns and sexual intercourse effected a shift from the spring peak of births to the September-October pattern which has prevailed since 1945.

Although these speculations are consistent with known trends and beliefs they are, still, mere speculations. More important, however, will be their conversion to research hypotheses and their evaluation through empirical procedures. We hope that this paper will serve to initiate such efforts.

#### RESUMEN

En este estudio los autores analizan el patrón estacional de los nacimientos en Puerto Rico desde la década del 1930 hasta el presente (1981). Para estos propósitos se utilizó la información publicada por el Departamento de Salud de Puerto Rico. Además, se prepararon tabulaciones especiales para 1979 y 1980.

El análisis de estos datos demuestra que hasta mediados de la década del cincuenta, la cúspide de los nacimientos, aunque anualmente inestable, ocurría durante la primavera. Sin embargo, a partir de 1954 el patrón estacional cambió notablemente y desde entonces septiembre y octubre se convirtieron en los meses en que ocurre el mayor número de nacimientos.

Dos hechos resaltan en este estudio: la extraordinaria regularidad en el patrón estacional de los nacimientos desde la década del 1950 y su alto grado de similaridad entre los diferentes grupos de madres estudiadas: no existen diferencias apreciables entre madres de diversas edades ni entre madres primíparas y múltiparas. El patrón para madres en uniones consensuales es muy semejante al de las casadas legalmente. Tampoco parecen existir diferencias con relación a la residencia y al nivel de instrucción de la madre ni en cuanto a la ocupación del padre.

Aunque los autores no han podido encontrar una explicación satisfactoria para este fenómeno, especulan que el aumento en el uso de métodos anticonceptivos y los cambios en el comportamiento sexual durante el periodo navideño son los factores determinantes del patrón estacional de los nacimientos en Puerto Rico y de los cambios observados desde mediados de la década del cincuenta.

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