SOCIOECONOMIC AND SEASONAL VARIATIONS IN BIRTHS
A Replication

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The present paper is concerned with examining the relation between seasonal variations in births and socioeconomic status. In effect, this paper and the analysis contained herein represent a replication of an earlier study by Pasamanick, Dinitz and Knobloch.[1] In that study the authors examined the indicated relation using births to Baltimore City residents during the five-year period 1952 to 1956; socioeconomic status of the mothers was determined by census tract of residence, with median rental or value of the dwelling property being the determinant of the socioeconomic category of a tract. In that analysis the white population was divided into five socioeconomic levels; nonwhites were treated as a single group.[2] The authors reportedly found:[3]

> . . . a very pronounced but not quite perfect gradient in the percentage of summer and spring births. As predicted, the amount of over-representation of summer births varies inversely with socioeconomic status. The highest summer birth rates are to be found in the nonwhite group and in the lowest three-fifths of the socio-economic continuum. Even more significantly from the point of view of this paper, the greatest spring trough occurs in these same groups. On the other hand, *the highest socio-economic status category exhibits the smallest monthly variability in births. The curve for this group comes close to approximating a straight line.*

Although the bulk of this discussion is in terms of quarterly (i.e., spring and summer) births, reference also is made to monthly events as indicated above. In an earlier statement the authors claim: "The higher the socio-economic group, the less the departure from the normal expectancy of 8.3 per cent."[4]

In attempting to explain or account for these differential patterns, the authors suggest:[5]

> It would appear therefore that a variety of socio-economically determined factors are operating to create these monthly rate disparities. These probably include, among others, the ability of the higher socio-economic status groups to modify, by air conditioning, suburban homes, and country vacations, the effects of climate. With better nutritional practices they are also able to minimize protein and other dietary deficiencies. Finally family planning practices resulting from the greater frequency and efficiency of utilization of birth control devices help randomize the monthly birth rates.

How these factors operate, however, or the mechanisms by which they lead to a rectilinear pattern of monthly births for the higher socioeconomic status groups, is a question the authors do not explore.

The present study also is based on births to Baltimore City residents for a five-year period, in this instance 1961 to 1965. The determination of socioeconomic status is the same as in the earlier study—namely, census tract of residence of mother, with census tracts allocated by median rental or value of dwelling property. This study, however, examines seasonal patterns of births for Negroes as well as for whites and in both instances for the highest and the lowest socioeconomic fifths only.[6]

In effect, the monthly distributions of births for the highest and the lowest socioeconomic fifths, for whites and Negroes, will be examined to see if they differ from a rectilinear pattern. Based on the earlier study a test of this question would be expected to show, at least for white births, that the lowest fifth differs significantly from rectilinearity, but that the highest fifth does not. This question was tested using the Kolmogorov-Smirnov one-sample test (of goodness of fit), a nonparametric test based on the maximum absolute difference between the cumulative per cent distribution of

observed events (in this case of the number of births by month) and the cumulative per cent distribution of expected events (in this case of 8.3 per cent of the births per month). According to Guilford, the general opinion is that the Kolmogorov-Smirnov test of goodness of fit is more powerful than the chi square test used for the same purpose.[7] For each of the four groups, this difference is significant at the .05 level (for the lowest fifths, white and Negro, the difference is significant at the .01 level).

Thus, in the case of births occurring to Baltimore City residents during the five-year period 1961 to 1965, it cannot be said, on the basis of the statistical test used here, that the monthly distribution of births for the highest socioeconomic category is rectilinear (or that the differences from rectilinearity are such as might be expected by chance); nor, of course, can this be asserted for any of the three other groups examined.

One word of caution concerning this conclusion needs to be introduced however. The expected distribution of 8.3 per cent of the births per month implicitly assumes no secular trend in births during

TABLE I. CUMULATIVE DISTRIBUTIONS OF MONTHLY BIRTHS IN HIGHEST AND LOWEST SOCIOECONOMIC FIFTHS, FOR WHITES AND NEGROES

	White		*Negro*	
	Socioeconomic Fifth			
	Highest	*Lowest*	*Highest*	*Lowest*
Month	%	%	%	%
January	7.5	8.2	7.1	9.0
February	15.6	16.5	15.3	17.1
March	24.2	24.4	22.2	24.8
April	32.1*	32.1	29.9	32.5
May	40.5	40.0	38.6	40.4
June	48.9	48.1*	46.1	48.6*
July	57.8	56.8	54.3*	57.7
August	66.1	66.1	63.3	66.3
September	74.9	74.9	73.1	75.1
October	83.3	83.3	82.5	83.3
November	91.6	91.7	91.7	91.7
December	100.0	100.0	100.0	100.0
N =	15,914	8,865	1,554	16,215

* Month in which maximum absolute difference between actual cumulative distribution and expected cumulative distribution (based on 8.3 percent per month) occurs.

the period 1961 to 1965. The presence of a trend, even in the absence of any monthly variability in births, would mean that the expected percentage of births in each month was something other than 8.3. Thus, if the trend of births was downward during 1961 to 1965, the sum of the births occurring in the five Januarys would exceed the sum of the births occurring in the five Februarys, which would in turn exceed those occurring in the five Marchs, and so forth (see Table 1).

An examination of the annual births does in fact indicate a downward trend for white births occurring in the highest and lowest socioeconomic fifths and for Negro births in the lowest socioeconomic fifth; Negro births in the upper fifth, on the other hand, reveal an upward trend. A test of the monthly variability of these distributions, which took account of secular trend, would require numerical determination of the trend line. This has not been attempted. A logical argument can be made, however, for the three groups that had declining births, that a test of monthly variability against an expected distribution that accounted for a downward secular trend would result in differences even greater than those obtained where secularity had been ignored, and would therefore be even less probable or likely by chance than those obtained.

Thus, in the case of the three groups affected by a downward trend in births, the cumulative per cent distributions (ogives) of actual births are almost always below the ogive of the expected distribution and the maximum absolute differences occur where the actual is less than the expected. An ogive that was based on expected births and that allowed for a downward trend would everywhere exceed the ogive for expected births, ignoring trend and the differences between the "expected-with-trend;" and the actual distributions would be even greater than between the "expected-without-trend" and the actual. Greater differences would necessarily lead to rejection of the (null) hypothesis of no monthly variability (which was already rejected). This line of reasoning supports the earlier claim that white births in the highest and lowest socioeconomic fifths and Negro births in the lowest socioeconomic fifth reveal significant degrees of monthly variability. Less confidence can

perhaps be placed in the finding concerning Negro births in the highest socioeconomic fifth.

These results raise a second question; namely, do the monthly distributions of births for the highest and lowest socioeconomic fifths differ from each other or do they essentially represent two samples from the same universe? This question was tested using the Kolmogorov-Smirnov two-sample test. This test is based on the maximum absolute difference between the cumulative per cent distributions of the two samples—in this instance the distributions of births for the highest and lowest socioeconomic fifths. Acceptance of the null hypothesis (that the distributions of births for the highest and lowest socioeconomic fifths do not differ—or differ only by chance—and therefore the two can be regarded as samples from the same universe) would follow from a maximum absolute difference in ogives that is not statistically significant.

In the case of whites, this difference is not significant, not even at the .10 level. In the case of Negroes, the difference is significant at the .10 level. However, even regarding this as an acceptable level of statistical significance, it would not be known whether to attribute the difference in ogives to differences in secular trend or to differences in monthly variability (or a combination of the two). In fact, given the upward trend of births in the highest socioeconomic fifth, and the downward trend in the lowest fifth, the moderate level of statistical significance between the two distributions is surprising. All of these factors lead to the claim that certainly in the case of whites, and possibly in the case of Negroes, the monthly distributions of births for the highest and lowest fifths do not differ.

These findings led to a reexamination and reanalysis of the data of the earlier study. Using the data presented by the authors for white births occurring in 1952 to 1956 in the highest and lowest socioeconomic fifths, the Kolmogorov-Smirnov test was applied to determine if these distributions approximated a rectilinear pattern. In the case of the highest fifth, the difference is significant at the .05 level and in the case of the lowest fifth at the .01 level. Thus, the test, unlike that used by Pasamanick, does not lead to the conclusion that the curve for the highest socioeconomic fifth comes close

to approximating a straight line (with zero slope).[8] The two distributions were also tested to see if they differed from one another. In this instance the difference between the two cumulative distributions was significant (at the .05 level).

An analysis of births occurring to Baltimore City residents during the periods 1952 to 1956 and 1961 to 1965 indicates that during both of these intervals the highest socioeconomic category had a monthly distribution of births that reflected significant degrees of variability—i.e., that seasonal variation occurred. The present analysis also suggests that, in the latter period at least, the distributions of births for the highest and lowest socioeconomic fifths were not different—or differed only by chance.

Although upper socioeconomic status categories can modify the effects of climate to a greater extent than can lower socioeconomic status categories, practice better nutritional habits and utilize birth control devices more frequently and more efficiently, nothing about these activities need necessarily lead to a uniform monthly distribution of births. In fact, greater control of climate, nutrition and fertility could just as easily lead to increasing amounts of monthly variability. The timing of births—or of conceptions—is subject to a good deal of uncontrolled variability. Even more importantly (in terms of nonuniform distributions of births), factors such as holidays, timing of school year, customary vacation practices and so forth also may play a part in the timing of births; a part heightened by greater control of climate and fertility.

REFERENCES

[1] Pasamanick, B., Dinitz, S. and Knobloch, H., Socio-Economic and Seasonal Variations in Birth Rates, *Milbank Memorial Fund Quarterly,* 38, 248–254, July, 1960.

[2] The Baltimore City Health Department has classified census tracts, according to the above criterion, into socioeconomic deciles; the authors collapsed the ten levels into socioeconomic fifths.

[3] *Ibid.,* p. 253 (italics added). In the last sentence the authors presumably mean a particular kind of straight line; i.e., one with a zero slope or one horizontal to the x-axis (time). The authors go on to add that: "Tests of significance

for the various distributions add statistical validity to this graphic picture. The spring trough in births was significantly different whether the white births were divided into highest and lowest socio-economic deciles, fifths, or even into halves." However, they do not indicate what the tests of significance were or what level of significance was achieved.

[4] *Ibid.*, p. 251.

[5] *Ibid.*, p. 254.

[6] In the present study as well as in the earlier one, births have been adjusted for differences in the number of days in the months. In both studies there is an anomoly also in that, for whites, the number of births in the highest socioeconomic fifth exceeds the number of births in any of the other socioeconomic fifths.

[7] Guilford, J. P., FUNDAMENTAL STATISTICS IN PSYCHOLOGY AND EDUCATION, Fourth Edition, New York, McGraw-Hill Book Co., 1965, p. 262.

[8] Annual figures for total white births 1952 to 1956 do not indicate the presence of any secular trend during this period (see City of Baltimore, *Annual Report of the Department of Health,* 1966). However, figures are not available for annual births by socioeconomic fifths for these years. Secular trends for the highest and lowest socioeconomic fifths during this interval could possibly affect the results and conclusions stated above. It should be noted however, that such trends would also affect the results and conclusions of the previous study by Pasamanick, *et al.*