Acta Genet Med Gemellol 36:313-323(1987)

The Non-Decline in U.S. Twin Birth Rates, 1964-1983

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Abstract. Detailed twin birth rates for the United States are unavailable since 1964. In 1983 the crude twinning rate for women of white race was higher than in 1964, but there had been great changes in maternal age and parity. Indirect standardization for maternal age and birth order provides estimated total twinning rates that can be compared over the entire period. The adjusted rates for whites show a nearly continuous increase except after a 2-year reporting hiatus, 1969-70, when rates dropped back 10%. In blacks the adjusted rate increased between 1966 and 1978, except for the 1968-71 shift. The distributions of rate increases by maternal age and by race argue against effects of medical ovulation stimulants, but a disproportionate increase of triplets argues for such effects. Study is needed of rates specific for maternal age and parity, rather than of total rates.

Key words: Twinning rates, Maternal age, Parity, Race, Ovulation stimulants

INTRODUCTION

Falling twin birth rates in both the United States (US) and Italy attracted attention over 30 years ago [5,10] and the decline was attributed to changing composition of the population of mothers. A few years later Scheinfeld and Schachter [15,16] reported declines of twinning in six European countries as well as the United States. They assumed that the declines were due to changes in age and parity. In 1962 Jeanneret and McMahon [9] showed that changes in age and parity could not explain the twinning decline that occurred in the US between 1938 and 1958. In other words, they showed that the decline was intrinsic to twinning or, more simply, the decline was "real".

Since 1960 there have been further and perhaps more dramatic losses in European twinning rates. James [8] showed that the decline in Italy was real, and Parisi and Caperna [14] have shown a real decline for Italy throughout the 1960s and 1970s. In other Euro-

pean countries the reality of twinning declines is not entirely established, as the rates have been standardized only for maternal age [4] or in some cases not at all.

There is also some agreement that the decline in twinning rates has ended in the developed countries [3,13], but again this shift cannot with certainty be separated from demographic changes. If the decline has ended, it might be only because twinning is artificially maintained by widespread use of ovulation stimulants [17].

Twin birth statistics are not as detailed in the US as in Italy, but large numbers offer other advantages. In 1964 all twin birth reports were extracted and matched, over 38,000 pairs both born alive. These were analyzed in detail by Heuser [7], providing baseline twinning rates specific for sex-concordance, race, maternal age, and parity.

Since 1964 the only published statistics of US twin births have counted live births in twin deliveries in a portion of the births (50% in all states through 1971, 100% in an increasing number of states subsequently) [11,12]. These are tabulated by maternal age, but not by sex-concordance or parity.

The reporting of live births in twin deliveries permits direct study of crude rates and of age-specific rates from 1964 to 1983. Since the parity distribution of all live births has also been documented, adjustment can be made for changes in parity. Thus with a little computing we can assemble a 20-year record (interrupted in 1969-70) of approximate total twinning rates indirectly standardized for birth order and 5-year maternal age groups. These estimates indicate that real twinning rates in the US have not only ended their decline, but have risen substantially since 1964.

The twinning rate discussed here is the number of live births in twin deliveries per 1,000 live births. It is a little more than twice the rate of cases of twins both born alive among all deliveries with one or more live births, which Heuser used to summarize the 1964 twinning data. Where possible I have excluded maternal ages under 15 and over 44, which constitute less than 0.5% of white births and about 1.0% of black births. In the earliest years of the series, except 1964, data on blacks *per se* were not published, but the rates can be estimated rather well by adding 3.0% to the published nonwhite rates, which include Asians with low twinning rates.

UNADJUSTED DATA

In 1964 there were 18.4 live births of twins per 1000 white live births; in 1983 the rate was 19.2 (Fig. 1). Among blacks, the rate was 26.6 in 1964 and 24.3 in 1983. These numbers are misleading because they are not adjusted for changes in maternal age and parity and perhaps because of an artifact in the 1968-1971 discontinuity.

In 1969 the National Center for Health Statistics found that a newly issued birth report form was not being properly coded for twinning status, and the data could not be used. In 1971 they thought the problem had been resolved, but it appears from Fig. 1 that something was still wrong. This remains a puzzle, and we do not know whether there was a real drop in twinning rates, amounting to about 10%, whether coding improved gradually in the next few years, or whether there was some other loss of twin birth reports. If the problem still persists, the 1983 rates may be higher than those shown here.

In other respects the statistics appear to be reliable. Heuser's detailed data for 1964 confirm the rates in the 50% sample of live births in twin deliveries for that year, and the

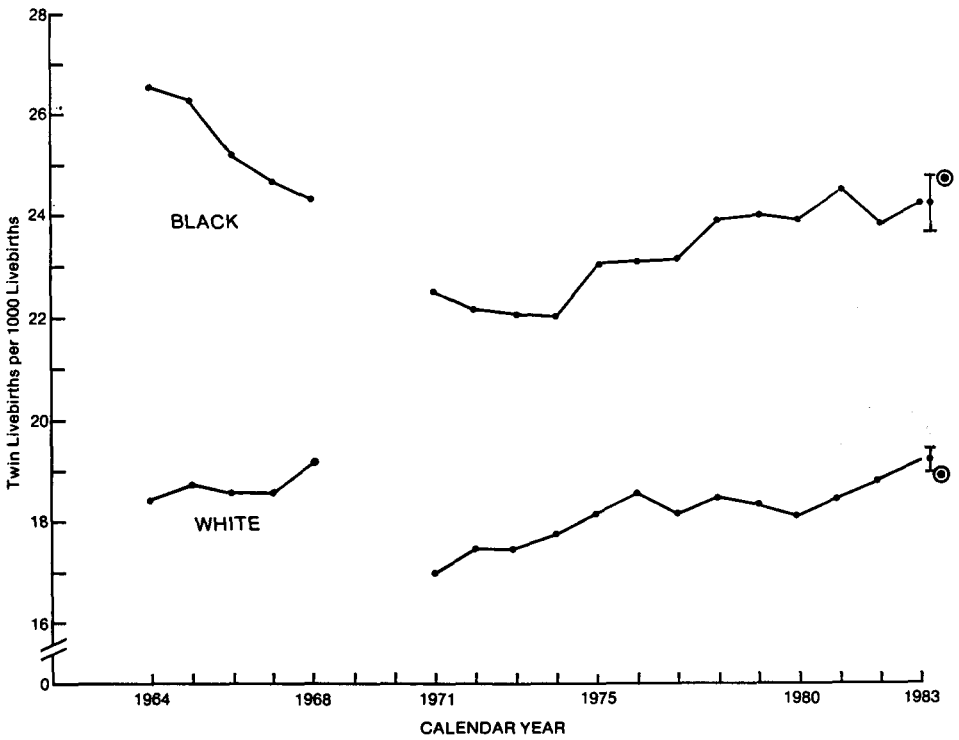

Fig. 1 - Reported live births in twin deliveries per 1,000 live births, United States, 1964 to 1983, plotted separately for mothers of black and white race. [Sources, 11,12]. Vertical lines represent 95% confidence intervals for 1983 computed as if all states had reported only a 50% sample. Circled dots represent age-adjusted values for 1983.

corresponding 50% tables for 1963 and 1965 were also very close. Hence, at least the trends to 1968 are reliable, and after the 1969-70 break the curves continued with the same slopes. White twinning rates increased until 1976. The vertical lines at the ends represent the 1983 values plus and minus two standard errors based on 50% sampling (actually, by 1983 most states reported on 100% of births). Thus, sampling errors are small at least for whites, and it appears that the increase continued or resumed in the 1980s, ending 4.2% above the 1964 rate.

For the black population of the US the 1969-70 discontinuity is less evident, and the curve is compatible with either continuous change or a 10% drop as in the white population. In contrast to the white population, crude twinning rates declined precipitously in the 1960s and the decline continued to 1974, after which the rate assumed nearly the same upward slope as that of whites from 1971 to 1976.

AGE STANDARDIZATION

Since the available twin data are given for 5-year maternal age groups, they can be directly adjusted to the same age composition as the 1964 data. The age-adjusted rates are shown

with circled dots at the right of each curve. The adjustments are small, and the rates remain a little higher than 1964 for whites, considerably lower than 1964 for blacks. This is similar to the experience of some other authors, who have found little effect of maternal age on changes in the twinning rate. In the best known tables of twinning rates by maternal age and birth order, age groups have more effect than parity groups on twinning rates. This would seem to mean that when maternal age has little effect on the rates, the effects of birth order can be ignored. Quite the contrary in these data; birth order makes a much larger difference than maternal age. The seeming paradox disappears when one considers that mean parity can change drastically while mean age hardly changes at all; they can even change in opposite directions, and have done so in the US.

PREDICTION OF TWINNING RATES FROM MATERNAL AGE AND PARITY

The annual volumes of US vital statistics [11,12] report twin births without giving birth order, but they tabulate live births as a whole by eight levels of parity within maternal age groups. This permits one to apply the known 1964 twinning rates for each age and parity cell to the live births of any preceding or subsequent year and predict the total twinning rate on the assumption that cell-specific rates did not change.

Fig. 2 shows the relative effects of maternal age and birth order on twinning over 20 years. The calculation of these curves is just the opposite of standardization. For each race, the broken line is the twinning rate predicted by applying 1964 age-specific twinning rates to the age distribution reported each year for all live births. The solid line shows the curve predicted when birth order is brought into the calculation. If there had been no changes in age and parity, the prediction would be a straight line at the 1964 level.

At the end-point, 1983, age alone predicts a slight rise for whites, but the total prediction including birth order is a 7% decline. For blacks, age predicts a 3% decline and the total predicted decline is 16%. These surprising effects can be explained by the age and parity changes shown in Figs. 3 and 4.

Fig. 3 contrasts the age distribution for 1964 and 1983. Even though the predicted total effect of age on twinning was small, there were some relatively large changes in the age distribution. The median maternal age rose from 25.1 to 26.0. Mothers under age 25 declined by 13% and women in the 35-40 age group declined by 35%. The young mothers have the lowest twinning rates and the older group has the highest twinning rate, so the effects of these changes on twinning nearly cancelled.

In contrast to maternal age, parity has a simple, consistent relation to twinning, and as shown in Fig. 4, parity declined strongly in every age group over the 20 years, and continuously in some age groups. Thus parity alone would predict declining twin rates throughout the period.

Referring again to the predicted rates in Fig. 2, in the first part of the 20-year period age changes had a negative effect on twinning. In the second half of the curve this was reversed. The effect of parity is represented by the spread between the broken and solid curves, and it was almost uniformly negative; that is, the spread increased. After 1973 the positive effect of age outweighed the negative effect of parity to give a combined prediction of a slightly rising twinning rate. This rise was not enough to overcome the large

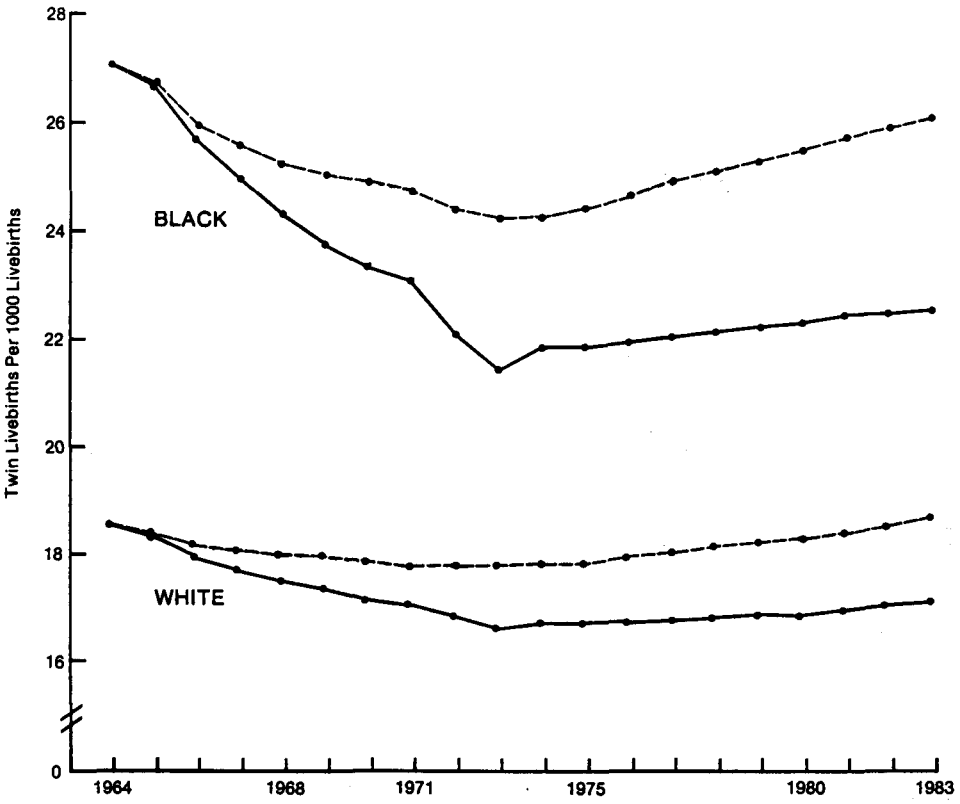

Fig. 2 - Twinning rates predicted for 1965 to 1983 by applying 1964 age and parity specific rates to age and parity distributions for each subsequent year. Broken lines: rates predicted from maternal age alone. Solid lines: rates predicted from age and parity together.

negative changes of the first decade, so that by 1983 the predicted rate of twinning was still far below the 1964 rate for both black and white populations.

INDIRECT STANDARDIZATION

The twinning rates predicted from changes in age and parity can now be used in an *indirect* standardization of the reported rates. To explain the process briefly: If changes in age and parity are such as to predict a 10% decrease in total twinning from 1964 to 1983, it tells us that the 1983 population was demographically inclined to lower twinning. Whatever the total rate might be for 1983, it would *increase* about 10% if adjusted to the 1964 age and parity composition. The specific 1983 rates, if they were known and could be applied to 1964 age and parity, would give a total that was nearly the same proportion above 1964 as the reported 1983 total is above the 1983 prediction. *This assumes that any changes in rate are distributed almost proportionally over all ages and parities.*

For whites the ratio of 1964 to the 1983 prediction is 1.075. This multiplied by the

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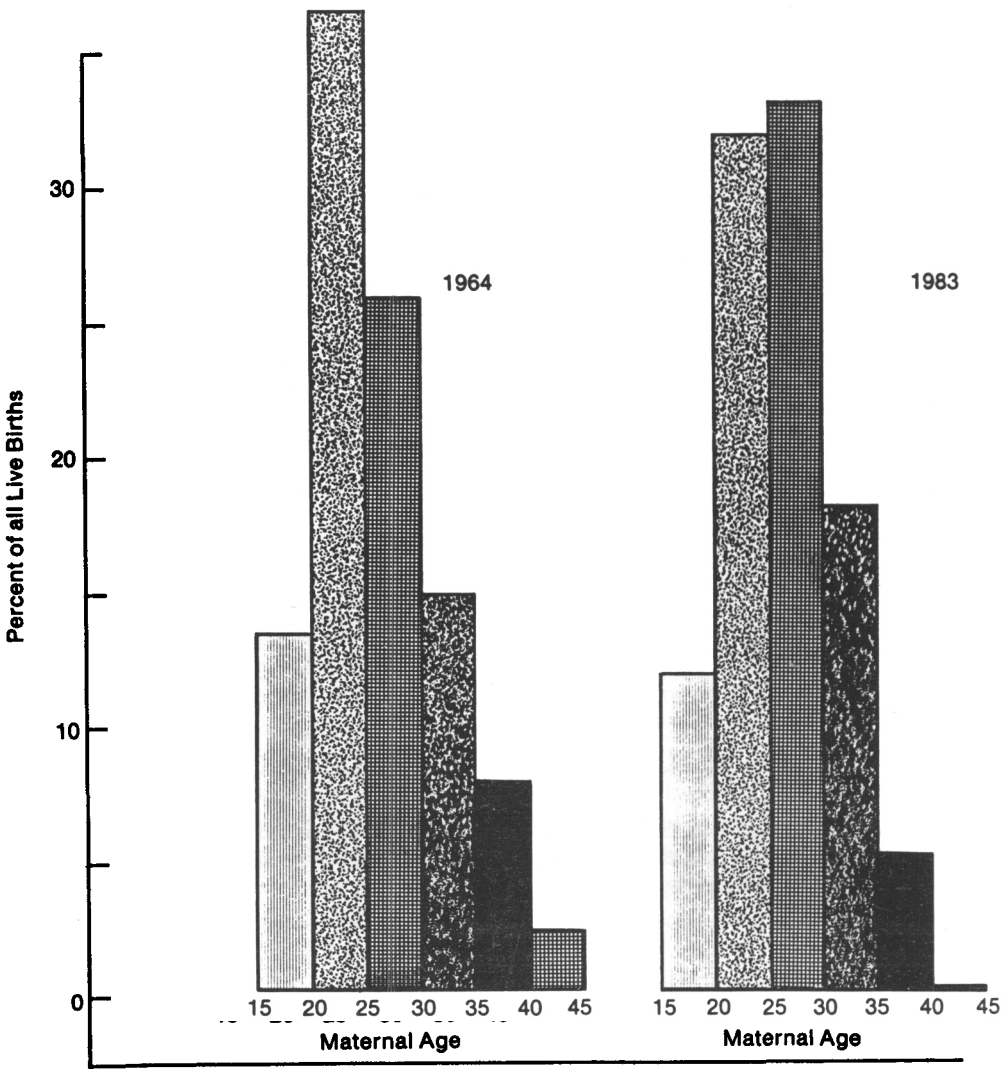

Fig. 3 - Distribution of white births in 5-year maternal age groups by percent of total, 1964 and 1983.

reported 1983 twinning rate yields a rate, at 1964 age and parity, of 20.7 live births in twin deliveries per 1,000 live births, 12% higher than in 1964. This 12% combines the effect of adjustment with the 4% rise in the reported rate (see Fig. 5).

In the black population there was a large net decline predicted by *both* maternal age and parity. Indirect standardization of the 1983 rate gives 29.0 compared with 26.8 in 1964.

Also possible by a more laborious process is direct standardization by age after indirect standardization *of age groups* by birth order. The resulting rate estimates for 1983 are 20.4 for whites and 27.9 for blacks. This method estimates only a little less

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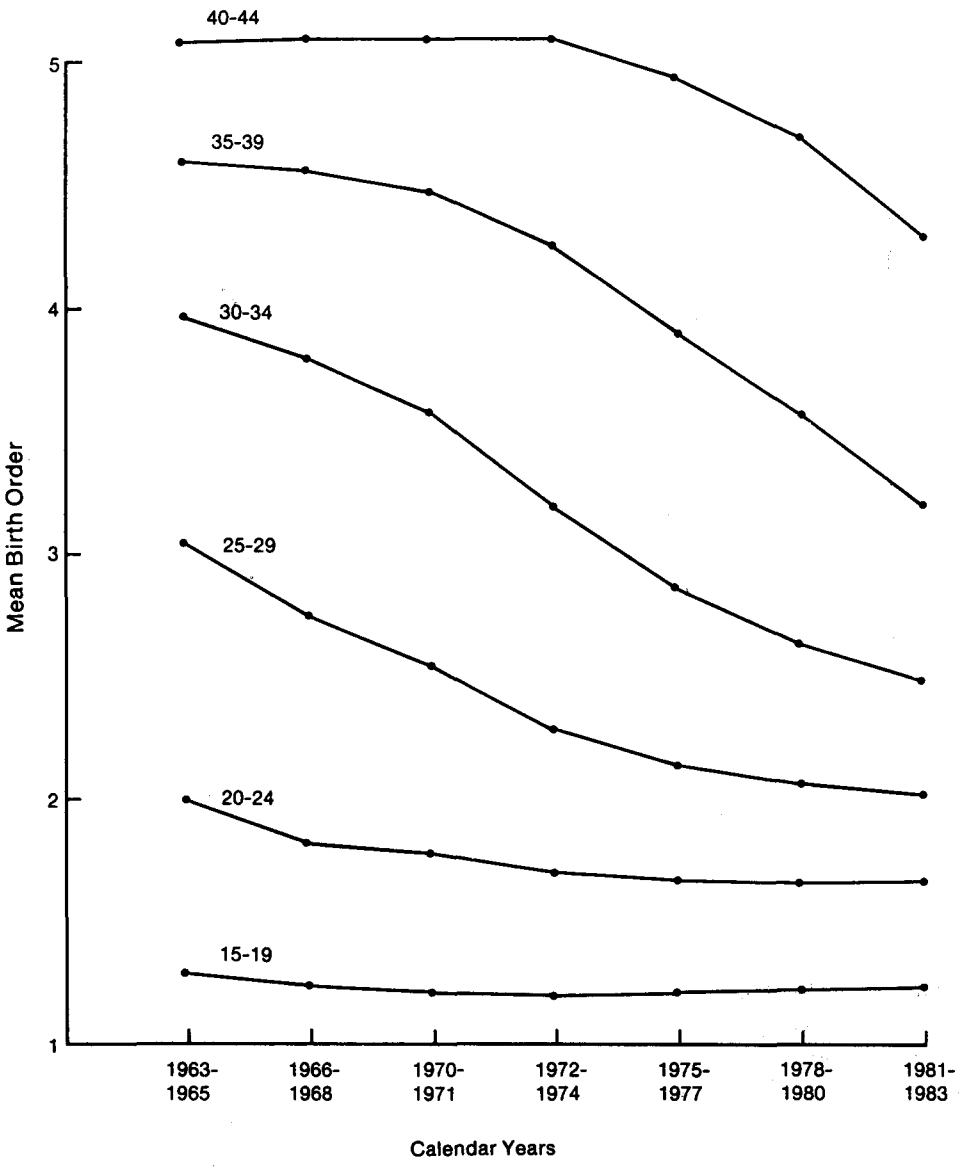

Fig. 4 - Changes in mean birth order (= parity + 1) for 5-year maternal age groups from 1963 to 1983; means for 3-year intervals, white live births.

increase in whites, but much less in blacks than the first method, and is presumably more accurate.

Fig. 6 shows the crude rates of reported live births in white triplet deliveries. Although each point represents three years of data, the sampling variance is large, particularly for the 35-39 age group. The oldest age group, 40-44, varies so much from point

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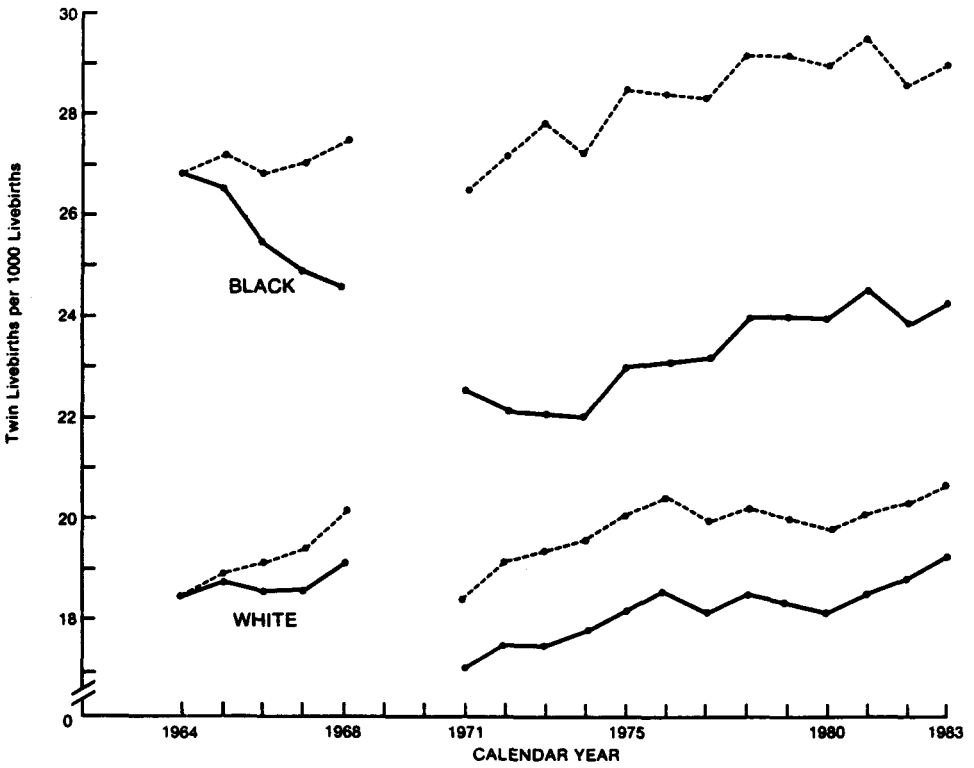

Fig. 5 - Live births in twin deliveries per 1,000 live births, for mothers of black and white races, 1964 to 1983. Solid lines, as reported; broken lines, indirectly standardized to 1964 distributions of maternal age and birth order.

to point that it is not worth showing at all. The triplet rate has increased more than the crude twinning rate. Excepting age groups between 20 and 30, there is a drop of rates after the reporting hiatus similar to that in all age groups of twins. The drop was extraordinary for the 35-39 age group, and that rate remained relatively low for nine years, so its low level can probably not be entirely ascribed to sampling variance.

These triplet rates are unadjusted, and yet the 1981-3 points all show substantial rises relative to 1963-5. Age-and-parity-specific triplet rates are not available for 1964, but if indirect standardization were possible, it would undoubtedly increase the 1983 triplet rates as much as it did the twin rates.

DISCUSSION

When 1964 rates used in this analysis were applied to data for 1941, 1942 and 1943, they predicted lower rates than those of 1964, and thus by indirect standardization implied that the crude rates of 1941 should be raised for comparison with 1964. Live births in twin deliveries were thus adjusted to 20.4 for 1941-3, higher than 18.4 for 1964 as expected [9]. It seems that 1964 was near the low point for twinning in the United States.

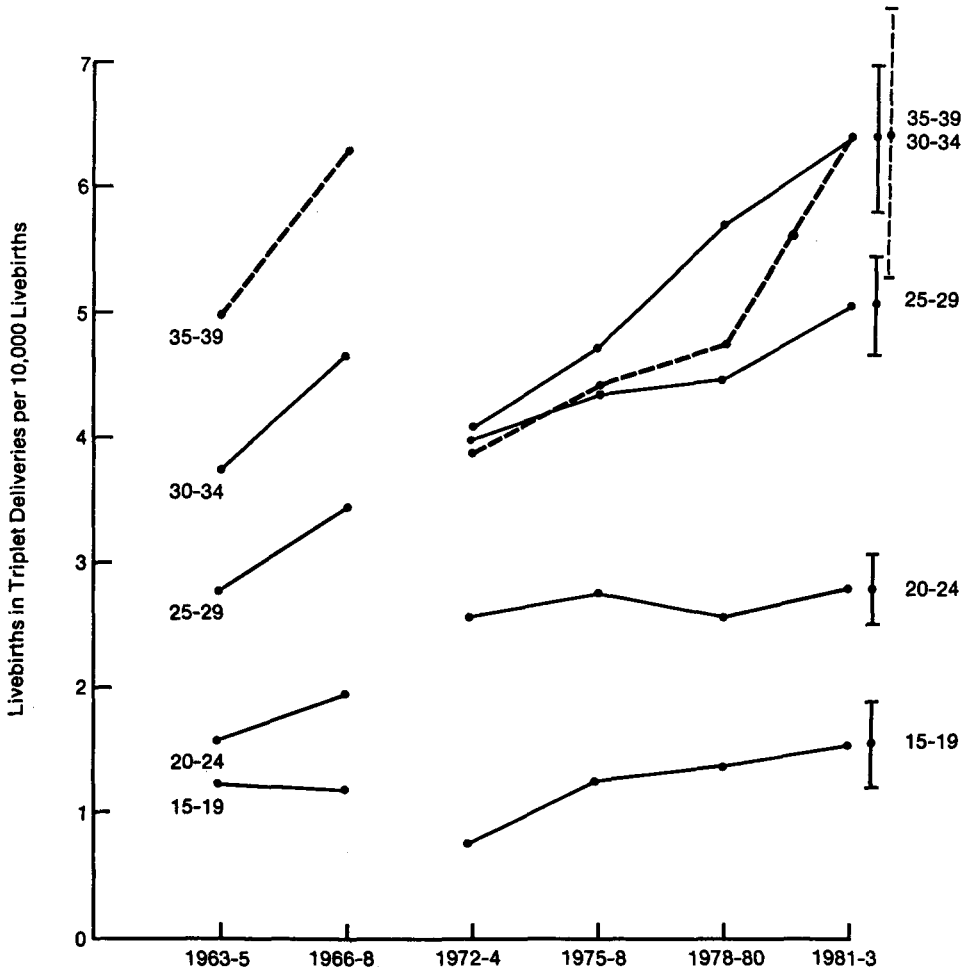

Fig. 6 - Reported live births in white triplet deliveries per 10,000 live births, by 5-year maternal age groups; means for 3-year intervals, 1963 to 1983. Vertical lines show 95% confidence intervals for 1981-1983 computed as if all states had reported only a 50%sample.

Webster and Elwood [17] credited fertility drugs with ending the decline of twinning in England. Is it possible that in the US ovulation stimulants were doubly effective, actually turning a decline into an increase? If so, we should see the most increase of twinning in those years and mothers with the highest use of fertility drugs.

In the white population the crude and the adjusted rates started to increase in the late 1960s, and slowed about 1976. It appears that the use of fertility drugs was mainly experimental until the 1970s [18], but this may have been sufficient to produce an increase in twinning.

With respect to age, it seems unlikely that many women under age 20 would be given ovulation stimulants, but they showed a 7% increase (adjusted for parity) in twinning rate. The increase of twinning in black women after 1974 was as great as that in whites three

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years earlier, although the predominantly lower economic status of blacks would make them less frequent subjects for administration of ovulation stimulants. Thus with respect to age and race the increase of twinning in the US did not seem to depend on fertility drugs.

Positive evidence for an effect of fertility drugs on twinning rates is afforded by the frequency of triplets. If the increase in twinning were simply due to an increased general tendency toward extra ovulation, the expected increased triplet rate would be approximately the square of the increased twin rate, by Hellin's law. That implies about a 20% increase in triplets for 1981-3 compared to 1964. The reported increase is 68%, and the adjusted rate would doubtless be higher still. If a small fraction of women are made much more twin-prone by fertility drugs, Hellin's law applied to that fraction predicts a disproportionate overall increase in the triplet rate. Alternatively, the triplet data might be explained without reference to ovulation stimulants by modifying some parameters under Hellin's law [1], but such *ad hoc* adjustments are difficult to justify.

According to United States data [2], oral contraceptives may produce a rebound effect on ovulation that would increase twinning, and this would explain the observation by years, ages and race rather better than fertility drugs. But data from England [17] showed no such effect of oral contraception, and in France a negative effect has been observed [6]. It is possible that these reported differences result from use of different contraceptive drugs or regimens in different countries, but this is not a very promising explanation of the increased twinning and triplet rates.

In conclusion, both the twinning rate and the triplet rate appear to have increased in the United States from 1964 until at least 1976, and this increase is not entirely consistent with presumed patterns of fertility drug usage. However, indirect standardization, though better than using crude rates, yields only tentative estimates. Direct standardization for age showed less increase than indirect standardization, which means that twinning changed more in some age groups than in others. Ideally, one should study changing twinning rates for individual age-by-parity cells, and at present this is possible and has been done [14] only in Italy.

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