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Cyclic Variations of Twin Births at Isle-aux-Coudres: A Case/Control Approach

P. Philippe
Department of Social and Preventive Medicine, Faculty of Medicine, University of Montreal, Canada

Abstract. Twins and singletons were matched for several confounding factors. The monthly distribution of twin births and that of singleton births were compared with a uniform allocation of births over the year. Opposite seasonal variations emerged that were confirmed by a case/control comparison. Twins occurred more often in winter and early spring while singletons proved to be relatively few; singleton peaked in the fall season when the risk of a twin birth was low. These trends held across maternal age at birth and the time period of birth. Results suggest that the conception of a twin pair is higest in spring and early summer and lowest in winter. The role of sunlight in the twinning liability is discussed along with the role of sexual intercourse. That twin-prone mothers are usually more fecund in spring and early summer is a distinct possibility.

Key words: Seasonal variation, Twin births, Sexual intercourse

INTRODUCTION

If twinning is to some extent due to environmental factors, a consistent monthly and/or seasonal clustering of twin births might show off. Few studies adressed this issue in the past, that were reviewed by James [4]. Most did not report seasonal variations; exceptions were Finland and Hungary where twin births clustered in spring. In England and Wales, an excess of twins was noted during the second half of the year [4]. More recently, a study from Japan [3] reported a high prevalence of conceptions of twins in April; and Richter et al [9], using historical parish records, found variable seasonal trends according to twin birth level in Gorlitz, Germany.

All studies on seasonality of twins were descriptive in that monthly analyses were carried out without reference to a matched control group. We propose here to compare the monthly and seasonal distribution of twin births to that of carefully paired singletons, and to investigate the role of potential confounding and interactive factors.

MATERIALS AND METHODS

The data base of the present study has previously been described in length by the author [6-8]. To sum up, it is composed of all twins (N = 77) born in the isolated population of Isle-aux-Coudres (Quebec). These are hereafter called: case births. Only three of them were discarded because matched controls could not be found. Criteria for pairing of case births with singletons (control births) were maternal birth cohort (± 3 yr), exact birth order of the index child, and residence of the parents. The current analyses thus rely on 74 cases and as many controls for whom the month of birth was sorted out from the parish registries of the population. This type of data is accurate and valid.

Interactive variables investigated in the course of the present study are the time period of the index births and age of the mother at birth of the index child.

Several tests, parametric and nonparametric, are available to look into data for possible monthly or seasonal variations of epidemiologic events. Specific seasonality tests attempt to point out cyclic departures from a uniform distribution. However, any cyclic trend of twin births might entirely be accounted for by a corresponding cyclic variation of births. Thus, account has to be taken of a possible seasonality of confinements in the target population. This is of utmost importance in small populations where seasonal variations of life habits are the rule. Then, standard analyses of two-way contingency tables have to be relied upon to compare case and control births.

In the following, we made use of two types of tests, combining specific and standard statistics. First, in order to examine departure from a uniform monthly distribution, we relied on Roger's goodness-of-fit test [10] for cases and controls separately. This test is preferred to Edward's statistics [1] that produces hig levels of type I errors, and is particularly relevant for small sample size. Since our aim is also to compare seasonality of twin births to that of singleton births, we further made use of a standard goodness-of-fit test, the log-likelihood ratio test (G-statistics) [11].

RESULTS

First, case births and control births were studied separately in order to identifiy any possible departure from a theoretical uniform monthly allocation of index births. Data were analyzed as a whole and then broken down into two time periods (before and after 1900) believed to reflect in some way previously documented changes in mothers' fertility. Data were also scrutinized according to maternal age at birth of the index child. These two variables are treated as potential interactive factors in this and following analyses.

Roger's test was applied throughout; results are shown in Table 1. No one result happens to be statistically significant for either twins or singletons. However, R values point to monthly variations for all controls, for those born after 1900, and for those born to

Table 1 - Roger's test (R) for monthly variation of case and control births

Test	Cases		Controls	
	R*	P	R	P
All index births	0.47	0.791	4.5	0.105
Time period				
< 1900	4.3	0.116	1.1	0.577
> 1900	0.95	0.622	5.1	0.078
Maternal age				
< 30 years	1.8	0.407	4.7	0.095
> 30 years	0.16	0.923	1.2	0.549

* R is a χ^2 variable with 2 df.

mothers aged less than 30 years. Fig. 1 depicts the differences between the relative frequencies of singleton births and the corrisponding frequencies from a uniform distribution of births throughout the year for all three trends observed in Table 1. Positive and negative values thus point to a respective excess and deficit of births over expectation. A tendency for singletons to be born in the last four months of the year along with a clear deficit of births in the first four months, is obvious.

Table 1 also shows that, on the contrary, case births do not seem to follow any cy-

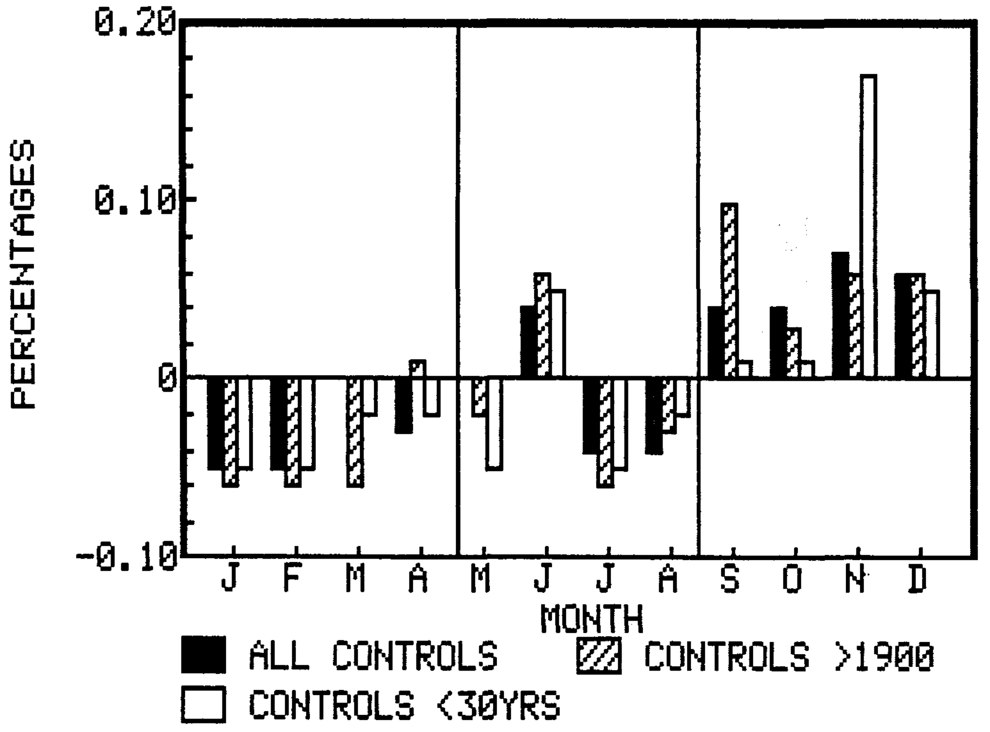

Fig. 1. Monthly departure of singleton births from a uniform distribution.

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clic trend except perhaps for those born before 1900. Fig. 2, an analogue of Fig. 1, shows a much less clear pattern of twin births distribution over the year. While the picture seems to fit a model of random allocation, comparison of Figs. 1 and 2 on a four months basis yields two slight opposite trends: first, the excess of births in the four last months of the year correlates with a lack of twin births and, second, close inspection of the first four months suggests a relative excess of twin births coinciding with a lack of births. Admittedly, the cyclic variations of twin births are far less impressive than those of singleton births.

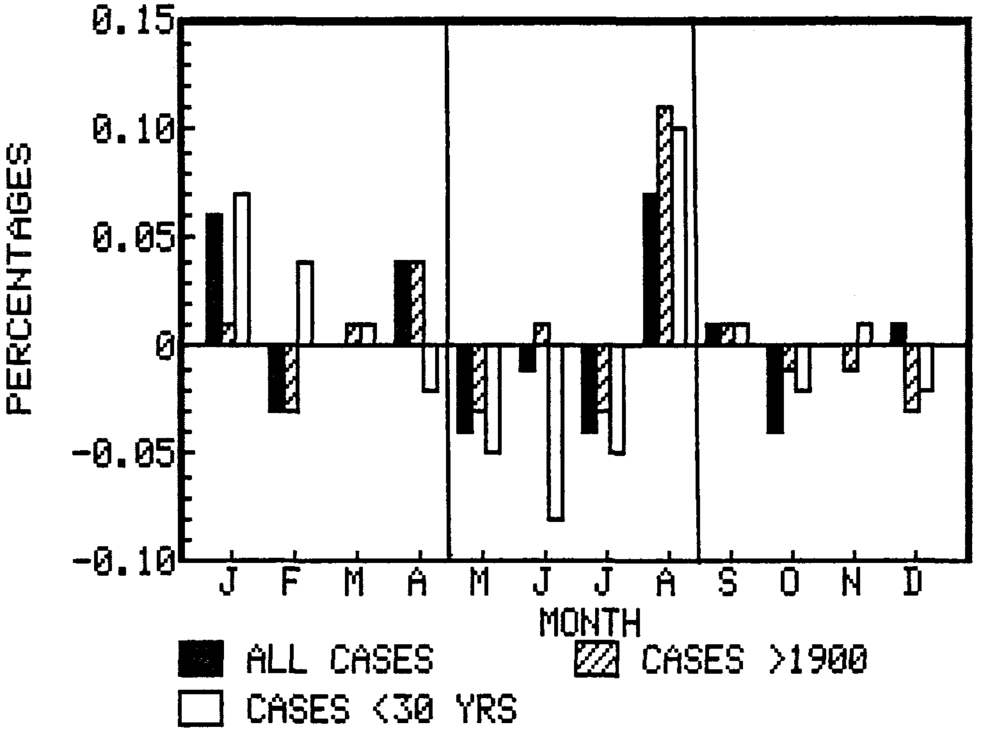

Fig. 2. Monthly departure of twin births from a uniform distribution.

Be it as it may, a test for opposite trends in case and control births, on a four-months basis, is now warranted. Births were thus grouped in three time periods starting with the first four months. Results, shown in Table 2, are concerned, first, with a crude comparison of all case and control births. The comparison also takes into account the birth period and the age of the mother at birth as interactive variables. The G-statistics confirms the trends pointed out previously in Figs. 1 and 2, that is: seasonal variations between all cases and all controls not only stand out as predicted but are highly significant, hold for children born after 1900, and for those born before age 30 years of mothers. Examining the corresponding Fig. 3 brings up an even clearer picture of the two opposite trends between case and control births.

Furthermore, the other two categories involved but not shown in Fig. 3 (eg, children

Table 2 - *Log-likelihood ratio test for seasonal variations between case and control births*

Test	G*	P
All index births	9.5	0.008
Time period		
< 1900	3.3	0.189
> 1900	8.2	0.017
Maternal age		
< 30 years	5.7	0.059
> 30 years	4.1	0.128

* G is a χ^2 variable with, in the cases above, 3 df.

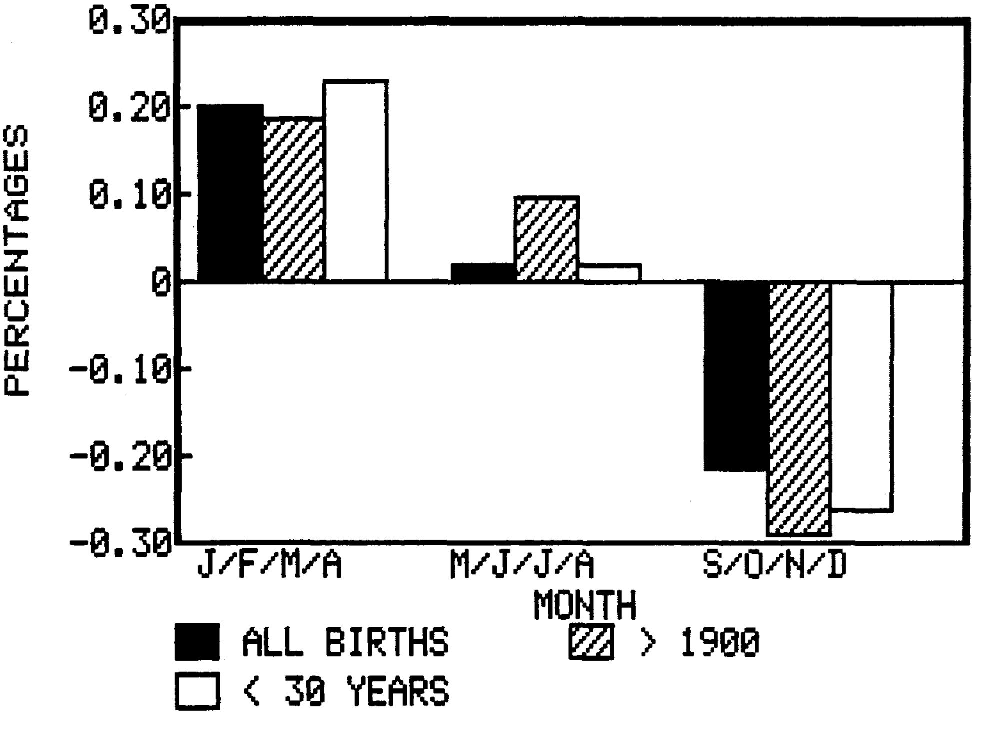

Fig. 3. Seasonal differences between twin and singleton births.

born < 1900 and those born to mothers aged > 30 years) also present the same pattern of relationship but with less definite trends. Ignoring the four intermediate months, a *posteriori* relative risks corrected for small sample size have been estimated in all categories by the method of Haldane [2]. Results are presented in Table 3. Except for time period < 1900, relative risks are all significant with upper bound confidence limits as high as 13. This is seen as an important association between twinning and the first four birth

Table 3 - Association between twinning and season of birth

Test	Relative risk	95% confidence limits
All index births	3.4	1.5 to 7.7
Time period		
< 1900	2.4	0.75 to 7.9
> 1900	4.2	1.4 to 12.7
Maternal age		
< 30 years	3.9	1.2 to 13.0
> 30 years	2.9	1.0 to 8.3

months of the year, though its strength is mainly due to a displacement of singleton births at the end of the year.

DISCUSSION

Our results confirm those of several other studies which found cyclic variations in twin births. These studies reported that twins occur more often in the spring season [4] and in April [3]. Other studies, on the contrary, identified season peaks in summer and winter [9] and in summer and fall [4]. However, our methodology differed from previous studies in that we dealt with the seasonal distribution of case and control births matched for potential confounders. This could have alleviated biases which plagued some previous studies.

Even though twin births have a shorter gestation period than singleton births, this was not accounted for directly in the present study. However, the grouping of months of birth, which occurred in the case and control comparison, controlled indirectly for the error thus committed. It is therefore unlikely that the comparison of twins with singletons is affected by a possible backshift in time in the birth of twins.

What was found in the present study is two-fold. Not only were singleton births liable to a definite seasonal effect but twin births showed some trends converse in direction, though the evidence in twins is less compelling. Indeed, a slight excess of twin births coincided with very few singleton births and, conversely, twin births proved to be lacking when singleton births peaked. In other words, the light seasonal variations of twins did not plot against a uniform distribution of births but rather against some converse image of births. Admittedly, the seasonal variations of both types of births differed, and this could also involve some kind of repulsion in cyclic trends. Generally, the trends held across maternal age at birth and across the time period of birth.

Now, going back to conceptions, the high and relatively low prevalence of singleton and twin births during the fall season (S/O/N/D) refer to winter (D/J/F/M) conceptions, and the relatively high and low prevalence of twin and singleton births during the winter and early spring (J/F/M/A) season refer to spring and early summer (A/M/J/J) conceptions.

The underscoring of a converse distribution of conceptions in mothers of singletons and in mothers of twins is new and intriguing. It is either compatible with two distinct factors acting independently of each other, or with a single factor with two opposite effects pending on features of the hosts. The regularity of the pattern does not lend much credence to the two-factor hypothesis. Be this as it may, the hypothesis is still tenable in view of the different order of magnitude of the two converse trends. However, the one-factor hypothesis is more complex but much more heuristic: from a speculative viewpoint, the factor would enhance fecundity in mothers of twins in A/M/J/J; simultaneously, it would inhibit fecundity in the majority of women. Further, vanishing in D/J/F/M, the factor would be repressive of twinning; at the same time, fecundity in most women would be increased. We, however, admit that the main trend rather concerns singleton births, with definitely no concordance of twin births.

Another interesting possibility is that we could be in the presence of two types of women, prone to coinceive at two different times during the year. Were it so, the factor would not be related specifically to twinning but rather to the mothers of twins. In order to discriminate between these two aspects of the hypothesis, it would be necessary to study the seasonal pattern of other births, in the family of mothers of twins and in the family of mothers who do not bear twins. That twin-prone mothers are usually more fecund in A/M/J/J is a distinct possibility.

Sunlight is an obvious candidate to explain the pattern of relationships of twin births to season in our study. However, it would be hard to explain the inverse relation of singleton births to season by a direct casual path since the hypothesis involves that sunlight exposure is deleterious for fecundity in most women (who do not bear twins) while non-exposure increases their fecundity. Therefore, an intermediate variable in the casual path has to be postulated so that sunlight rather becomes an indirect cause of the variability of fecundity. Because of its crucial role in fecundity and its relation to environmental factors, the frequency of sexual intercourse [5] might be this intervening variable. Incidentally, it could be postulated that the return of light may have different effects (different mechanisms?) in mothers of twins and in mothers of singletons by way of variations in coital rates.

Seasonal variations in twin births are a complex matter that cannot be assessed without considering those of singleton births. We have shown that singletons differ from twins mainly because of the cyclic trend of the former. However, it is not impossible that twins also are subjected to their own cyclic seasonal pattern, admittedly of less amplitude, but in a direction opposite to that of singletons.

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Correspondence: Dr. P. Philippe, Department of Social and Preventive Medicine, University of Montreal, Pav. Marguerite d'Youville, Montreal H3C 3J7, QC, Canada.