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SEASONALITY OF BIRTHS IS ASSOCIATED WITH SEASONALITY OF MARRIAGES IN MALTA

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Summary. This study was carried out to quantify secular trends in seasonal variation in births in Malta, a small Mediterranean country where the vast proportion of births occur in wedlock due to a predominantly Roman Catholic population. It also related such variations to seasonal variation in marriages. Annual seasonal peaks of marriages and births were analysed over the period 1950–1996 by X11 ARIMA. A significant peak in marriages ($n = 111{,}932$) in the third quarter of the year was found for almost the entire period under study. This was paralleled by a peak in births ($n = 299{,}558$) for the period 1970–1996, which lagged after the peak in marriages by 13–14 months. For the period 1994–1996, when monthly data for monthly pregnancies were available by pregnancy order, the peak in births was caused by first pregnancies only. Seasonal patterns in births occur almost universally due to cultural and/or biometeorological factors. The best known patterns include those of the southern United States, where births decline in April and May, and in northern Europe, where births peak in March and April. In Malta, the late summer peak in births appears to be due to a practical and planned approach by Maltese couples to contraceptive planning, probably influenced by the Roman Catholic ethos and social pressures, with unprotected intercourse occurring only after marriage. In Malta, birth control, albeit by so-called natural methods, was introduced in the 1960s. Prior to this period, births peaked towards the beginning/end of the year, and this may be the more natural seasonality of births in Malta.

Introduction

Seasonal variations in number of births have been described in many communities, and have been attributed to cultural and/or biometeorological factors. Recent studies appear to be more in favour of the latter (Roenneberg & Aschoff, 1990). Marriage has sometimes been implicated as a possible cultural factor leading to seasonality of births. Malta is an ideal country for the analysis of such trends as by law, all births and marriages must be notified to a central registry. Furthermore, the official religion is Roman Catholic and the vast majority of babies are born in wedlock. An additional advantage to conducting such a study in Malta is that termination of pregnancy is illegal and there is no antenatal screening programme for fetal malformations.

The aim of this study was to quantify secular trends in seasonal variation in births and marriages in Malta by X11 ARIMA (Box & Jenkins, 1976).

Methods

Vital statistics

This study analysed trends over 1950–1996. A breakdown of marriages and live births, by monthly totals, was available for the entire period (Central Office of Statistics, annual publications). A recently launched database, which is maintained by the Department of Health Information (Malta), provided a more detailed breakdown of first pregnancies and subsequent pregnancies by month for the period 1994–1996. These pregnancies included live births, antepartum stillbirths, intrapartum stillbirths, early neonatal deaths and late neonatal deaths.

Statistical techniques

Visual inspection of the data showed that seasonal peaks varied with time. Marriages and births were therefore analysed in ten periods from 1950 to 1989, and as a block for 1990–1996.

The data's seasonality was analysed by the X11 ARIMA (Auto-Regressive Integrated Moving Average) method (Box & Jenkins, 1976). The model chosen was multiplicative with parameters of (0,1,1) and (0,1,1) for trend and seasonality respectively. The natural logarithmic transformation was used in this model. Variations in lengths of months were included in the analysis.

Analysis of small numbers of years cannot be carried out with X11 ARIMA and was therefore carried out by Edwards' method, which fits a harmonic curve to the data by mathematically arranging monthly totals in a virtual circle that represents the annual cycle, each month being separated from other months by an angle of 30 deg. The distance from the centre of the imaginary circle for which the value of each month is plotted is a function of the total number of affected cases born in the month. The centre of gravity of the circle, as influenced by the weighting of the individual months, is then computed. The direction from the centre of the circle represents the time of the peak of the variable under study, and the distance from the centre represents the intensity of peak (Edwards, 1961). The final results are the angle representing the peak period in degrees (θ), and the significance level as a χ statistic with two degrees of freedom.

Excel and SPSS were the statistical and graphing packages used throughout. A p value $\leq 0{\cdot}05$ was taken to represent a statistically significant result.

Results

Marriages

There were a total of 111,932 marriages over 1950–1996. The annual number of marriages increased over this period (1600 in 1950, 2483 in 1994, mean = 2383 marriages per year, median = 2437 marriages per year; Fig. 1).

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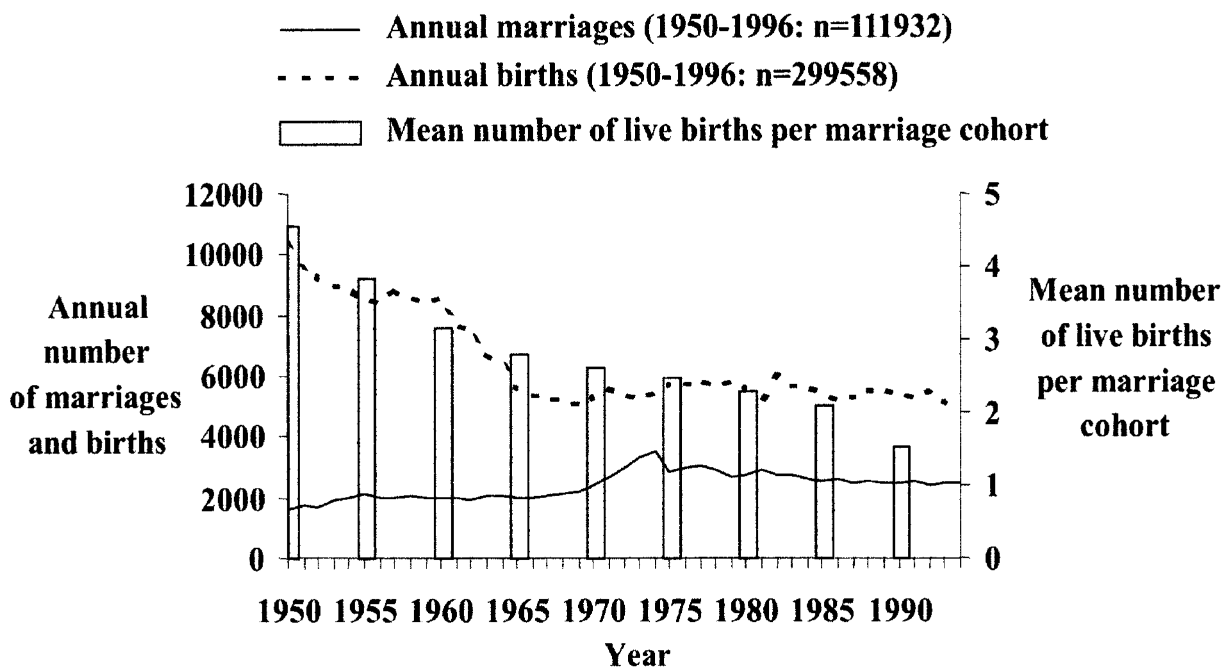

Fig. 1. Annual number of marriages and births and mean number of live births per marriage cohort for 1950–1994.

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A peak in marriages in spring and summer is found for all periods studied (Fig. 2). A smaller secondary peak is also seen in the December period. For the 1980s and 1990s, this summer peak becomes bimodal with a dip in July–August. Seasonality was significant throughout the period studied (Table 1).

Births

There were a total of 299,558 live births over 1950–1996. The annual number of births has declined (mean = 6357 births per year, median = 5615 births per year, range = 4826–9511 births per year; Fig. 1), and the decline is associated with a decline in the number of live births per marriage cohort (Fig. 1).

A significant end-of-year peak is present for the 1950s and 1960s (Fig. 3, Table 1). This peak moves to the third quarter of the year for the 1970s (p = ns) and 1980s (statistically significant), and flattens out almost completely for the 1990s.

First and subsequent pregnancies

First pregnancies showed a peak in the third quarter for the period when these data were available (1994–1996; Table 2). A significant peak was not found for second, third or fourth pregnancies, or for the sum of second and subsequent pregnancies.

Discussion

Many studies of this kind have summed monthly live births for large periods of time, but such techniques are inappropriate if a change in the seasonal peak is manifest over the period studied. Peaks for individual years are more sensitive, albeit more laborious to calculate.

Seasonal patterns in births occur in almost all observed communities, and have been attributed to cultural and/or biometeorological factors. Examples of cultural factors include festivals, such as an increase in September births following increased sexual activity in the Christmas period (Cowgill, 1966), agricultural cycles with swings in nutritional status (Mosher, 1979), and a possible link with seasonality of marriage (Stoeckel & Choudhury, 1972; Malina & Himes, 1977; Holland, 1989) . Biometeorological factors include changes that might be brought about by light, or temperature (Roenneberg & Aschoff, 1990).

The best described seasonal patterns occur in the southern United States, where births decline in April and May, and in northern Europe, where births peak in March and April (Lam & Miron,1994; Russell, Douglas & Allan, 1993). In the United States, this has been attributed to a diminished rate of conceptions in the hottest periods of the year, which may be due to an environmental effect on fertility, with a decrease in spermatogenesis or a decrease in sexual activity at this time of the year (Russell *et al.*, 1993). However, temperature does not appear to play a role in all seasonal variations in births that have been observed in different geographical localities, and such variations may be due to a complex interplay of factors.

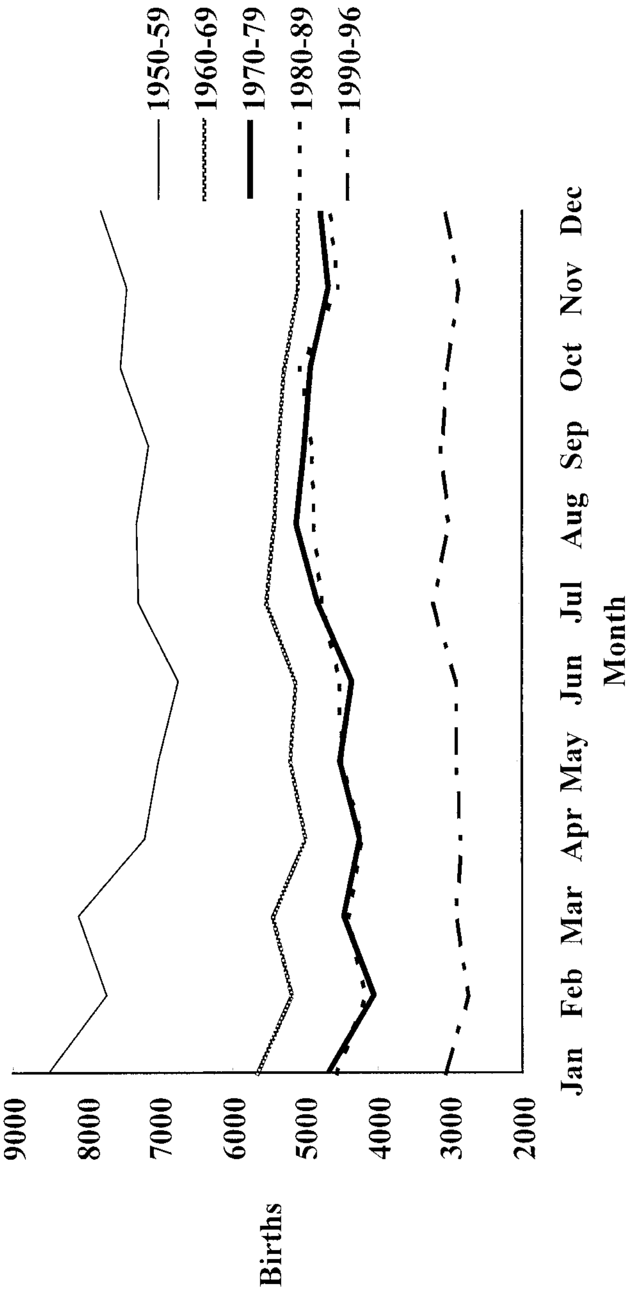

Fig. 2. Monthly marriages.

Table 1. X11 ARIMA seasonality testing for births and marriages

	Marriages					Births				
	1950–59	1960–69	1970–79	1980–89	1990–96	1950–59	1960–69	1970–79	1980–89	1990–96
Seasonality assuming stability (*F*)	7·9*	26·7*	31·7*	63·9*	131·7*	17·4*	6·2*	12·3*	9·1*	3·1***
Kruskall–Wallis test assuming stability	41·3**	74·9**	92·4**	99·7**	79·5**	94·8**	45·4**	71·8**	72·2**	41·8**
Moving seasonality test (*F*)	1·6***	1·5***	0·6***	2·6***	1·5***	0·9***	0·8***	1·3***	0·8***	1·6***
Identifiable seasonality	Present	Present	Present	Present	Present	Present	Present	Probably not present	Present	Probably not present
Test for presence of residual seasonality	None	None	None	None	None	None	None	None	None	None

*$p<0·01$; **$p<0·0001$; ***$p=$ not significant.

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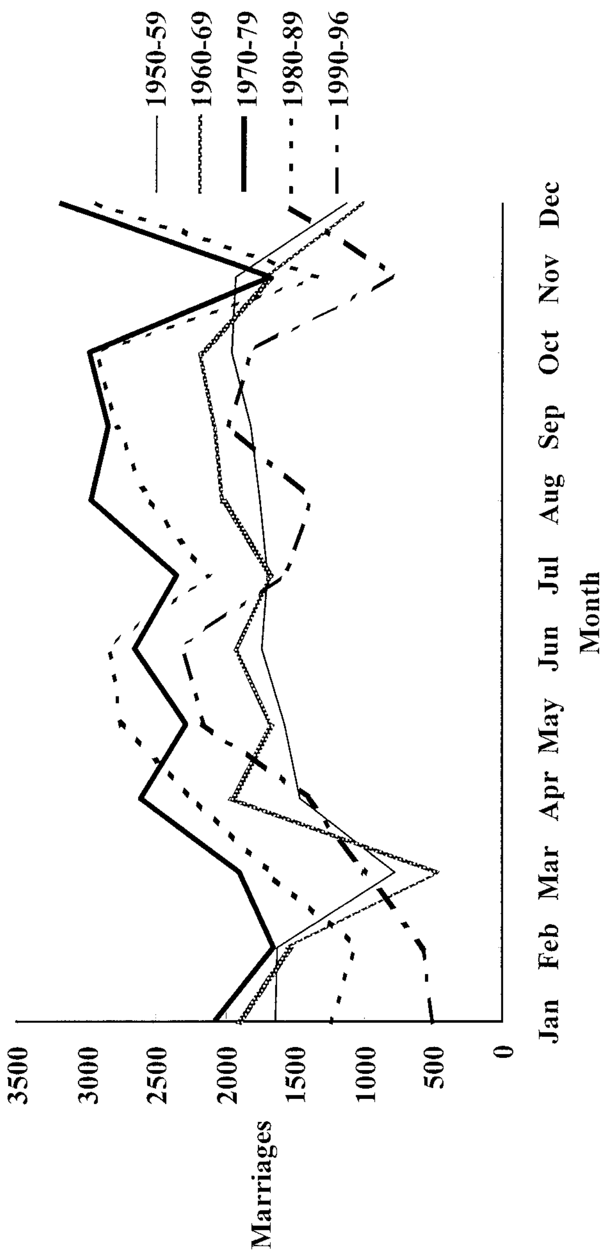

Fig. 3. Monthly live births.

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Table 2. Primigravida and multigravida pregnancies: 1994–1996

	Primigravida pregnancies	Multigravida pregnancies
Jan	446	459
Feb	423	397
Mar	489	402
Apr	459	383
May	422	397
Jun	469	429
Jul	507	482
Aug	504	400
Sep	496	439
Oct	480	412
Nov	424	408
Dec	462	421

In this study, a significant peak in marriages was found for virtually all of the period analysed (1950–1996; Fig. 2). The location of this peak was constant in the third quarter of the year. Births also showed a seasonal end-of-year peak in the December–January period for the 1950s and 1960s. There was no significant peak for the next 10 years, and during the 1970s and 1980s births peaked during the third quarter. This is not in accordance with findings of other studies, which have shown a drift in the peak of births towards the latter part of the year (Russell *et al.*, 1993; Matsuda & Kahyo, 1994), and this has been attributed to theoretical environmental factors that may affect fertility (Russell *et al.*, 1993).

In the 1950s, the lag of births after marriages was of about 3 months. This is certainly not due to pregnancies starting 6 months prior to marriage in this staunchly Roman Catholic country. Rather, this almost certainly reflects a 15-month lag (twelve plus three) from marriage to first-born delivery, with conception occurring some 6 months after marriage.

For the period 1970–1996, the peak in births lagged after the peak in marriages by 13–14 months. This study has also shown that for the period 1994–1996, the peak in births was caused by a peak in first pregnancies, and there is no reason to believe that this was not the case in earlier years. These peaks in births are therefore attributed to conscious family planning on the part of couples, who either abstain from sex prior to formal marriage, or who have sex under contraceptive cover, thus avoiding pregnancy, which, to date, is frowned upon when occurring out of wedlock (Savona-Ventura, 1993). Another factor that may be playing a role is that of simple economics. Couples may be postponing pregnancies (sexual abstention or contraception) until such a time when they are in a position to shoulder such a burden financially. It is the local custom to have long engagement periods during which a home is prepared for habitation prior to marriage. Marriage itself therefore marks the onset of a period when couples begin to face less financial strain. Data from the same period also show that there is no other seasonal peak in second and subsequent pregnancies, which occur at a constant rate throughout the year.

Marriages in Malta tend to involve large-scale weddings which are important family and social occasions, and an outdoor venue is generally preferred. These affairs generate substantial wedding bills, and it is therefore important for weddings to be planned in such a way so as to avoid inclement weather spoiling such occasions. Since the climate in Malta is warmly temperate (Chetcuti *et al.*, 1992), summer weddings are generally preferred, as shown by this study. The climatic influence on choice of wedding day is also seen in the July–August dip in the 1980s and 1990s. The July–August period is the hottest part of the year, with temperatures approaching and occasionally exceeding 40 °C, and this period is therefore less preferred. The Roman Catholic influence is also seen in the secondary December peak, where winter wedding dates would be chosen close to the Christmas holiday period.

There is no reason to suggest that subsequent births after the first experience any kind of influence that would tend to produce a seasonal peak identical to that of first births, as shown for the limited data available for the period 1994–1996 (Table 1). Second and subsequent births would therefore tend to obscure seasonality produced by first births. However, this effect is not seen in this study, arguing for a very strong seasonality for first births.

There is no ready explanation for the end-of-year peak in births in the early part of this study. This peak implies a peak in conceptions in the spring, an observation also noted in other studies (Smits *et al.*, 1998). This peak is probably a truer indicator of the natural seasonal variation than the peak described after the 1960s.

It has been shown that heavy manual labour by the female half of the population, with resultant weight loss, adversely affects fertility (Panter-Brick, Lotstein & Ellison, 1993). This effect was shown in a rural community where manual labour is associated with seasonal weather cycles. Since Malta was predominantly rural in the middle of the twentieth century, such an effect cannot be excluded.

In the past, certain seasonal peaks in births have been attributed to low socioeconomic standards, with peaks flattening out with increasing population affluence (Pasamanick, Dinitz & Knobloch, 1959). Such an effect was not noted in this study, despite a progressive increase in affluence and health care in Malta over the entire period under study.

The fluctuations in marriages observed in the 1960s in this study may be due to a combination of influences in this decade. There was a marked emigration drive in Malta that followed the Emigrants' Passage Assistance Scheme in 1948, which actively encouraged emigration due to the high local unemployment at the time. The high unemployment was partly brought about by the rundown in Malta of the British forces, who had formerly provided a large number of jobs for the local Maltese. Prior to 1948, emigration averaged fewer than 3000 departures per year. In 1950, 5400 persons left the island, in 1951 8500 left, climbing to 11,400 in 1955, and dropping to approximately 9000 per year in the following years. In the 1960s, emigration increased again with nearly 49,000 persons leaving the island during this decade (Central Office of Statistics, annual publications). Emigration was more likely to affect the younger and more fertile generation, and in fact, during this period, birth rates fell (Savona-Ventura & Grech, 1985).

Another influence on fertility in the 1960s was the Cana Movement, a lay organization that initiated family planning, albeit based on natural methods such as the rhythm method. This also contributed to the fall in the fertility rates (Savona-Ventura, 1993).

However, the proportion of children born out of wedlock has shown an increase from 0·75% of live births in 1959–1965 to a mean of 1·41% in 1986–1990 (Savona-Ventura, 1993). This may be due to more premarital sexual activity, with or without contraceptive protection (Savona-Ventura, 1995), or less coercion on couples to marry and have children in wedlock. These factors may change or abolish seasonal variations of births in Malta in future.

Conclusion

In Malta, the reason for a late summer peak in births appears to be the practical and planned approach by Maltese couples to contraceptive planning, with unprotected intercourse occurring only after marriage.

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