MMJ

Malta Medical Journal, 2026; 38(2)

http://mmsjournals.org/index.php/mmj/48

ORIGINAL ARTICLE

Seasonality of pregnancies, births and marriages in Malta

Victor Grech, Dorota Zammit, Elizabeth Grech, Miriam Gatt

Objectives: Seasonality of births is almost universal, including in Malta, wherein for 1950-1996 there was a significant peak in marriages paralleled by a peak in births. This study was carried out to ascertain whether this has persisted and to identify potential deviations due to the COVID-19 pandemic.

Study Design and Methods: Anonymous monthly data for 1999-2020 was obtained. This included First birth, First pregnancy (including miscarriages) and total marriages. Analyses were performed with unprocessed monthly time series and seasonally adjusted time series.

Results: All series exhibited minor seasonal variation. Marriages peaked in June and September. First birth and First pregnancy series peaked in October and September, respectively. There was a positive correlation at lag - 11 months for First births with Marriages, and First pregnancies with Marriages and this was higher for Pregnancies than Births. There was a constant negative gap between the actual data and forecasted values for the three series from August 2020.

Conclusion: A higher average number of marriages leads to higher-than-average births 11 months after. The Maltese peaks are associated with month preference for marriage. Marriages, First births and First pregnancies in Malta dropped 72% 17% and 11% respectively during March-August 2020 (Marriages) and December 2020 (First births and First pregnancies) compared to the expected forecasted values, implying a negative impact that is temporally associated with the brunt of the COVID-19 pandemic.

Prof Victor Grech, MD, PhD
Department of Paediatrics
Mater Dei Hospital,
Msida, Malta
https://orcid.org/0000-0002-3373-0478

Dorota Zammit
National Statistics Office,
Valletta, Malta

Dr Elizabeth Grech, MD
Department of Paediatrics
Mater Dei Hospital,
Msida, Malta

Dr Miriam Gatt
MD, MSc (Public Health), MHSCR (Sheffield)
Directorate for Health Information and Research
G'Mangia, Malta

Seasonality of births has been noted in various countries, including in Malta.[1–3] Indeed, an earlier study in Malta had shown that for the period 1950-1996 there was a significant peak in marriages paralleled by a peak in births which lagged after the peak in marriages by 13-14 months. The peak in births was caused by first pregnancies only.[3]

This study was carried out to ascertain whether seasonality at birth has persisted in relation to first pregnancies, i.e., first time mother has been pregnant and delivered at 22+ weeks of pregnancy, never having suffered a previous miscarriage). Furthermore, potential deviations from expected norms due to the COVID-19 pandemic were also sought.[4,5]

METHODS

Data

Anonymous aggregated data for births by month and birth order for 1999-2020 was obtained from the National Obstetric Information System, Directorate for Health Information and Research. Monthly marriages were obtained from Malta's National Statistics Office. Since this is an anonymous and aggregated dataset, ethical approval was not needed, and neither was informed consent, for the same reason.

Analysis

The following time series were studied: First pregnancies (as defined above) and Total marriages. Analyses were performed with unprocessed monthly time series and seasonally adjusted time series.

Seasonal adjustment refers to a technique wherein independent trends in time series data are preserved after removing seasonal variations. It employs a series of mathematical and statistical operations, such outlier detection, model identification, decomposition etc., which can be specified in the software.

Seasonality in this study was analysed using JDemetra+ software (version 2.2.2) with Tramo-Seats and RSA5 specifications. JDemetra+ provides seven predefined specifications for both TRAMO/SEATS and X-13 and uses some default specifications for each method.

The data's seasonality was analysed by the TRAMO/SEAT and RSA5 method. It is a model-based seasonal adjustment method that, in the first step, detects deterministic calendar variation and outliers, and corrects for missing values whilst applying a regression model to the data. T trading day effect and the leap year effect are pre-tested and taken in account. A Malta-specific calendar was used, with pre-specified national holidays.

The regression ARIMA (linear, autoregressive integrated moving average) model chosen was multiplicative with parameters of (3,1,1) (0,1,1) for Marriages and (0,0,0) (0,1,1) for First pregnancies.

In further steps, the following seasonality tests were carried out: the Friedman test for stable seasonality, the Kruskal-Wallis test, for seasonality presence assuming stability, and evaluative seasonal test for detecting the presence of identifiable seasonality. These tests were merged within the final combined seasonality test, which determines whether seasonality is present within the series.

A direct seasonal adjustment approach was carried out with the monthly series First pregnancies, from January 1999 to December 2020. The data series Total marriages was seasonally adjusted for January 1999 to February 2020, due to end-of-series outliers between March-December 2020 caused by COVID-19 effects.

A p value ≤0.05 was taken to represent a statistically significant result.

RESULTS

Seasonally adjusted and unadjusted data for the variables in studied are shown in **Table 1**. Both series exhibited minor seasonal variation, as per **Figure 1** and **Figure 2**. The time series for Marriages exhibits a peak of seasonal variation in June and in September (**Table 2**). The First pregnancies (**Table 3**) series exhibits peaks of seasonal variation in September and March.

The actual, non-seasonally adjusted data for Marriages and First pregnancies were compared, with forecasted values for March-December 2020, as can be seen in **Figure 3** and **Figure 4**. The time series 1999-February 2020 served as a base for the forecast. From August 2020, there was a constant, negative gap between the actual data and forecasted values for the three series. **Figure 3** illustrates the difference.

Table 1 *Marriages / First pregnancies (non- adjusted, seasonally adjusted)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	156	129	153	144	140	138	178	162	190	160	143	145
2000	153	147	141	160	138	167	162	152	153	157	142	169
2001	128	133	159	134	136	158	159	137	156	156	146	117
2002	164	141	139	145	152	144	151	163	157	152	150	142
2003	139	153	131	132	136	147	178	173	162	176	166	174
2004	155	143	152	118	144	141	137	152	165	149	145	175
2005	145	131	159	128	157	136	143	125	143	164	127	151
2006	156	136	156	159	139	166	124	159	158	173	150	148
2007	137	123	160	140	138	146	135	148	168	162	146	151
2008	167	141	150	141	141	154	158	204	182	177	157	174
2009	159	141	162	143	137	158	184	154	160	171	183	176
2010	174	126	153	139	137	125	162	149	171	140	174	156
2011	168	130	172	150	151	143	180	190	199	167	161	158
2012	168	148	149	127	151	142	171	176	181	188	155	166
2013	151	136	155	130	150	134	152	156	168	169	152	172
2014	157	134	159	143	156	129	176	172	181	167	181	158
2015	184	135	180	163	139	148	167	149	157	174	166	174
2016	195	141	149	165	152	150	141	183	205	193	179	162
2017	150	143	178	143	170	141	172	171	169	183	175	161
2018	153	134	173	135	142	157	156	192	167	158	193	163
2019	154	132	159	147	153	144	178	188	182	182	173	171
2020	184	175	157	159	141	145	175	189	153	166	163	147

Table 2 *Marriages Total monthly data – non-adjusted data*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	74	81	130	186	313	326	279	173	299	246	117	210
2000	83	74	128	194	323	357	256	175	277	232	99	198
2001	46	74	127	166	272	341	204	177	278	231	104	191
2002	51	61	112	205	277	360	248	208	260	242	105	177
2003	51	75	148	171	334	331	256	232	277	253	105	181
2004	78	63	121	195	343	353	274	176	295	251	100	165
2005	60	52	125	216	301	347	290	182	307	249	94	151
2006	50	61	123	231	309	389	275	232	321	242	108	195
2007	37	60	117	187	293	426	302	253	322	222	107	153
2008	51	52	104	161	342	347	298	313	310	252	91	161
2009	36	57	90	159	359	381	295	240	287	224	75	150
2010	58	56	86	175	369	412	360	222	312	299	90	157
2011	45	57	92	162	308	462	372	244	303	253	125	139
2012	59	56	133	186	329	575	345	297	339	218	95	191
2013	52	54	111	179	344	479	304	268	313	223	91	160
2014	55	62	127	189	438	492	340	306	315	266	123	158
2015	69	76	149	203	436	491	387	299	326	281	96	189
2016	65	86	95	249	382	540	429	272	332	282	124	178
2017	84	74	140	222	387	478	410	262	339	236	117	185
2018	73	83	130	221	349	533	311	254	319	247	130	181
2019	73	79	154	186	360	482	305	212	273	213	155	182
2020	68	88	66	45	51	56	61	125	193	164	88	152

Table 3 *First Pregnancy Total monthly data – seasonally adjusted data*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	155	143	153	156	149	143	171	155	175	149	142	143
2000	152	163	141	173	147	173	156	146	141	147	141	166
2001	127	147	159	145	145	164	153	131	144	146	145	115
2002	162	156	139	157	162	150	146	156	145	142	149	139
2003	138	170	131	144	145	154	173	165	149	164	164	170
2004	153	159	152	129	153	148	133	145	152	139	143	171
2005	143	146	158	139	167	143	139	119	132	152	125	147
2006	154	152	155	173	148	175	121	151	145	161	148	144
2007	135	138	159	153	148	154	132	141	154	151	143	147
2008	164	159	149	154	151	163	154	193	167	165	153	169
2009	156	159	161	156	147	169	179	146	147	159	178	171
2010	170	142	152	152	147	134	157	141	157	130	169	152
2011	164	147	171	164	162	154	175	179	182	155	156	154
2012	164	167	148	139	162	153	166	166	166	175	150	162
2013	147	154	154	143	161	145	148	147	154	157	147	168
2014	153	152	158	157	167	140	171	161	167	155	174	154
2015	179	153	178	178	149	161	162	140	145	162	159	170
2016	190	160	148	180	163	163	137	171	189	179	172	159
2017	146	162	176	156	182	154	167	159	156	170	167	158
2018	150	152	171	148	153	171	152	178	155	147	184	160
2019	150	149	158	161	165	157	173	174	169	169	165	168
2020	180	198	156	174	152	158	170	175	142	155	156	145

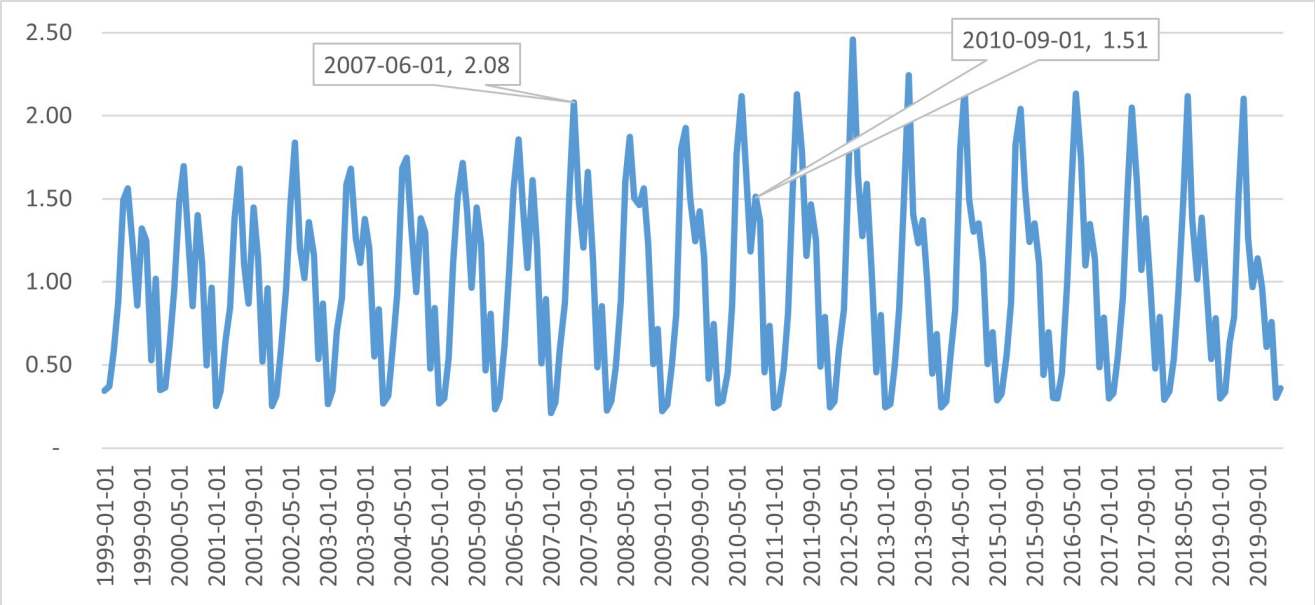

Figure 1 *Seasonal patterns for Malta 1999-2020: Marriages.*

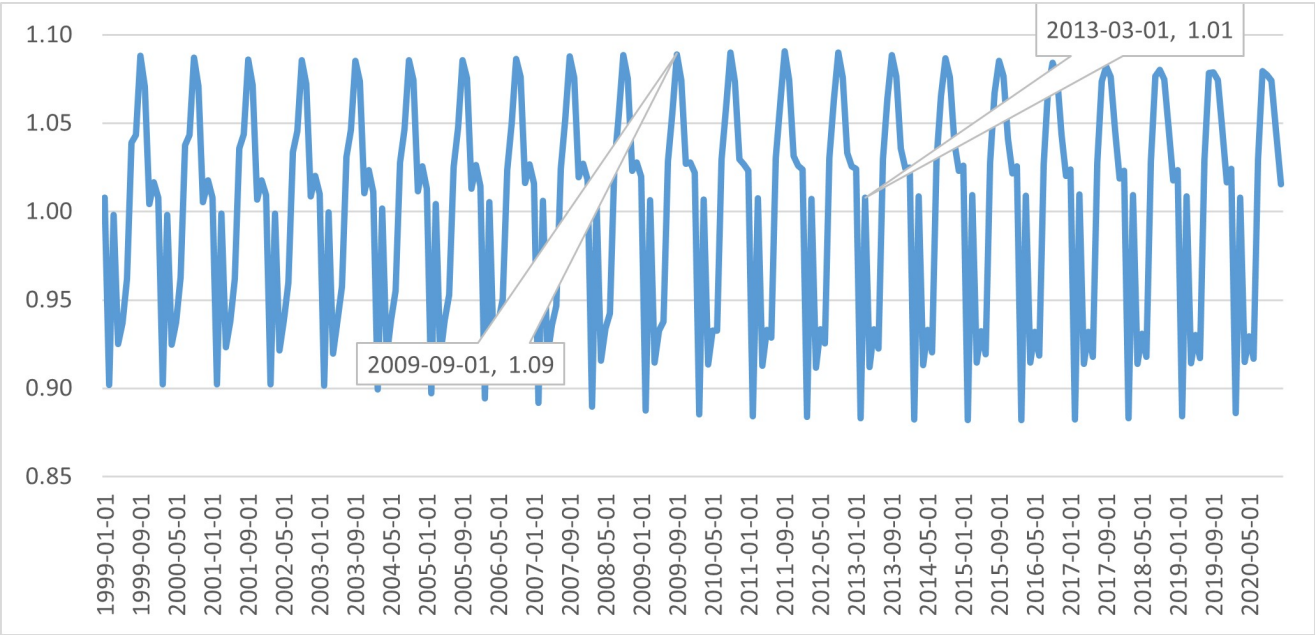

Figure 2 *Seasonal patterns for Malta 1999-2020: First Pregnancies*

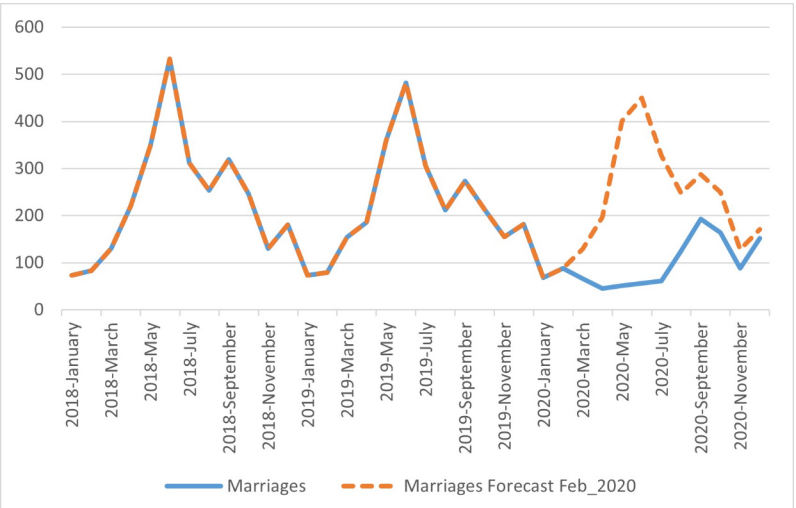

Figure 3 *Observed data for Marriages 1999-2020 and forecasted values for March-December 2020*

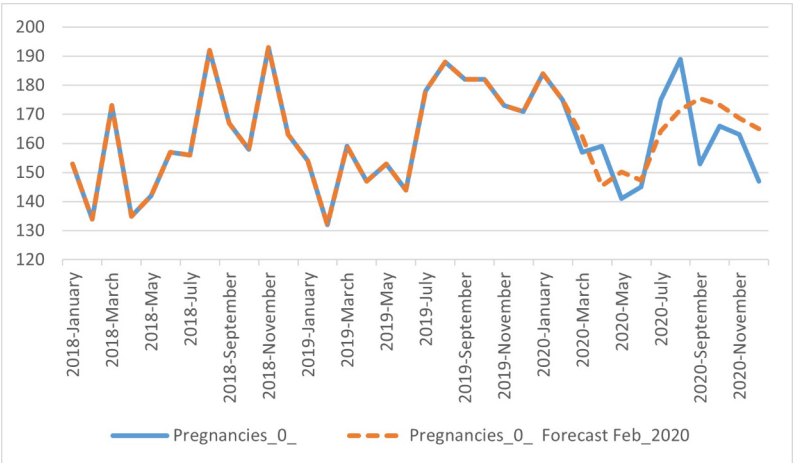

Figure 4 *Observed data for First Pregnancies 1999-2020 and forecasted values for March-December 2020*

Marriages in Malta dropped 72% during March-August 2020, compared to the expected forecasted values. Similarly, First pregnancies dropped by 8% during September-December 2020. In December, the decrease reached 11% for First pregnancies.

DISCUSSION

The drop in marriages and first pregnancies was temporally associated with the brunt of the COVID-19 pandemic, implying a negative impact on both.[4,5]

Seasonal patterns in births occur almost universally due to cultural and/or biometeorological factors.

Examples of cultural factors have included festivals, such as a September birth spike probably due to an increase in coital activity in the Christmas period.[6] Biometeorological factors include agricultural cycles which have been implicated due to potential swings in maternal nutritional status.[7] Fluctuations may also be due to changes in hours of sunlight and/or temperature.[8] The best known seasonal patterns occur in the southern United States, with a birth decline in April and May, and in northern Europe with a birth peak in March/April.[1,9]

A previous paper based on Maltese data had shown a late summer peak in first births only, lagging behind marriages by approximately 10 months,[3] an effect that was similarly noted in Japan.[10] Indeed, seasonal birth patterns have been noted in many countries including birth peaks in Portugal in May and September,[11] and July–September peaks in Croatia,[12] The absence of such seasonality is rare and notable.[13] The Maltese peak had been linked with marriages,[3] a link that was also described in other countries.[14–16]

The Maltese peak may potentially be attributed to conscious family planning with abstention or contraception prior to marriage, and this may be due to a residual Roman-Catholic ethos.[17] Alternatively, this may be due to simple economics with couples preferring to start families once they have formally settled down contractually in wedlock.[17] Furthermore, marriages in Malta are often large-scale, and are considered important family and social occasions. Naturally, an outdoor venue is generally preferred in clement Mediterranean weather.[18] Thus, a socio-cultural bias to Spring weddings influences first pregnancies and births in Malta.

Marriages in Malta correlate with first pregnancies, resulting in seasonal patterns for both. The COVID-19 pandemic has reduced marriages and first pregnancies, implying that the global events which appeared in March 2020 also affected the decisions of having first pregnancies.

REFERENCES

1. Lam DA, Miron JA. Seasonality of births in human populations. Soc Biol. 1991;38(1–2):51–78.
2. Grech V, Gatt M. Assisted reproductive technology and multiple pregnancy in Malta: a population-based study. Early Hum Dev. 2021;157:105378.
3. Grech V, Savona-Ventura C, Agius-Muscat H, Janulova L. Seasonality of births is associated with seasonality of marriages in Malta. J Biosoc Sci. 2002;35:(1)95–105.
4. Velavan TP, Meyer CG. The COVID-19 epidemic. Trop Med Int Health. 2020;25:278–80.
5. Cuschieri S, Calleja N, Devleesschauwer B, Wyper GMA. Estimating the direct COVID-19 disability-adjusted life years impact on the Malta population for the first full year. BMC Public Health. 2021;21.(1)
6. Cowgill UM. Season of birth in man: contemporary situation with special reference to Europe and the Southern Hemisphere. Ecology. 1966;47:(4)614–23.
7. Mosher SW. Birth seasonality among peasant cultivators: the interrelationship of workload, diet, and fertility. Hum Ecol. 1979;7:(2)151–81.

8. Roenneberg T, Aschoff J. Annual rhythm of human reproduction: I. Biology, sociology, or both? J Biol Rhythms. 1990;5:(3)195–216.
9. Russell D, Douglas AS, Allan TM. Changing seasonality of birth: a possible environmental effect. J Epidemiol Community Health. 1993;47:(5)362–7.
10. Matsuda S, Kahyo H. Geographical differences and time trends in the seasonality of birth in Japan. Int J Epidemiol. 1994;23:(1)107–18.
11. Caleiro A. Exploring the peaks and valleys in the number of births in Portugal. Hum Ecol. 2010;38:(1)137–45.
12. Polašek O, Kolčić I, Vorko-Jović A, Kern J, Rudan I. Seasonality of births in Croatia. Coll Antropol. 2005;29:(1)249–55.
13. Pascual J, García-Moro C, Hernández M. Non-seasonality of births in Tierra del Fuego (Chile). Ann Hum Biol. 2000;27:(5)517–24.
14. Stoeckel J, Choudhury AK. Seasonal variation in births in rural East Pakistan. J Biosoc Sci. 1972;4:(1)107–16.
15. Malina RM, Himes JH. Seasonality of births in a rural Zapotec municipio, 1945–1970. Hum Biol. 1977;49:(2)125–37.
16. Holland B. Seasonality of births: stability and change in a developing country. Hum Biol. 1989;61:(4)591–8.
17. Savona-Ventura C. Family planning in a Roman Catholic community. Plan Parent Eur. 1995;24:(1)20–2.
18. Chetcuti D. The climate of the Maltese Islands: a review. Msida: University of Malta; 1992.