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Demography Dynamics: Factors Affecting Number of Offspring and Male to Female Ratio in Greece

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Abstract: *Background*: Population models assume that parents make investment decisions that maximize reproductive success in the face of limited resources. *Aim*: The aim of the current study was to investigate the dynamics of offspring and the patterns of male to female ratio in the urban area of Athens. In addition, the role of socioeconomic factors to their dynamics was examined. The study was conducted in the urban area of Athens. The target group consisted of children in the area's kindergartens. A total of 435 single parents or parent couples were investigated with respect to their socioeconomic background and the number of children. *Result*: The main factors affecting the number of children included the income which was influenced by both education and nationality. At the same time, nationality appeared to play a significant role in the male to female ratio with mixed couples manifesting the largest ratio. *Conclusions*: To the best of our knowledge, this is the first work in the literature examining the dynamics of offspring by calculating the effects of socioeconomic factors such as education, income and nationality. At the same time, such works are extremely important both towards the understanding of population dynamics but also towards policy making, which includes both demographical and fiscal policies.

Keywords: Demography, Greece, Socioeconomics, Number of Offspring, Male to Female Ratio

1. Introduction

Population models assume that parents make investment decisions that maximize reproductive success in the face of limited resources [1]. In other words, when certain constraints are met such as energy, effort or time invested in the provisioning of offspring, then it is difficult to invest in the production of additional offspring [2]. As a consequence, one of the life's most fundamental trade-offs is between the number and the size of offspring [3]. In order to put it more simply, parents produce offspring based on certain criteria, which probably vary on current socioeconomic conditions.

During the time period of 2004-2006, a study was conducted in the urban area of Athens and in particular in the area's kindergartens. The purpose of this study was to investigate the pediculosis rates among children living in that area. As a consequence, the data collected from this study produced information for another report, which included the investigation of patterns in offspring numbers. In other words, it led to an investigation focusing on socioeconomic factors influencing the number of children per family [4].

In the area of population dynamics, there are two main categories to could potentially be investigated. The first is the population growth or decline *per se* and the second is the male to female ratio. In particular, this affords the secondary ratio since the primary one consists of the child's gender at

conception [5]. Both phenomena, despite the simplicity of their nature, can manifest very complicated dynamics, since population growth is tightly linked not only to the availability of resources but also to other social and economic factors. For example, it is of interest that Greece has gone through several recession periods during its history, as well as periods of expansionary fiscal policies, which have influenced the birth rate. At the same time, the mean age of the Greek population tends to rise, indicating a decline in the rate of births, attributed to several socioeconomic factors [6]. It is noteworthy, that the actual numbers, presented further on, are somehow frightening since they manifest a rapid population aging.

2. Materials and Methods

2.1. Study Location

The study has been conducted in the urban area of Athens during the period of 2004-2006. Specifically, the study has been conducted in the kindergartens of the Municipality of Athens, where admittance is free of charge and thus eliminates the bias of income as far as the choice of the kindergarten is concerned (i.e. kindergartens with tuition fees would attract parents with higher incomes and *vice versa*). First, confirm that you have the correct template for your paper size. This template has been tailored for output on the A4 paper size.

2.2. Sample Collection

The target group consisted of families from the area's kindergartens. A total of 435 single parents or parent couples were investigated with respect to their socioeconomic background and the number of offspring. The children's age ranged from 2-6 years. All children were included following written consent from the child's guardian. All kindergartens visited, cooperated and provided access to their sample size of pupils. The sample along with its basic demographic data is presented in summarized in Table 1.

2.3. Data Collection and Ethics

Questionnaires were filled out by a trained health professional. For this purpose, we asked the assistance of the teachers from the kindergartens and primary schools. The study was conducted following special license from the Municipality of Athens conformed to the standards set by the Declaration of Helsinki. Reporting of the study conforms to STROBE statement along with references to STROBE and the broader EQUATOR guidelines [7]. All questionnaires were anonymous and no superfluous personal data were collected ensuring no possibilities for someone to trace back the identity of examined individuals. More specifically, the data collected included gender, age, education of both parents, family yearly income, parents' nationality, and if children were raised in a single parent family.

2.4. External Data

Demographic data were collected from additional sources

[5, 8-13]. In addition, data were collected from Eurostat and in particular from the *Population* section (http://ec.europa.eu/eurostat/web/population-demography-migration-projections/statistics-illustrated) (From "*Population Data*" Table *demo_pjangroup*, from "*Births and Fertility Data*" Tables *demo_fmonth*, *demo_frate* and *demo_fasec*).

2.5. Statistics, Data Analysis and Bias

Data analysis was performed using the non-parametric *Kruskal-Wallis* statistical method, along with chi-square test. In addition, n-way ANOVA was carried out, in order to examine the effect of categorical data to the number of children per family. In particular, two- and three-way ANOVA was performed including all possible combinations of categorical data (e.g. family income, education etc.). Regression analysis, was performed using linear and second degree polynomial functions of the form $y=ax+b$ and $y=ax^2+bx+c$ respectively. Correlation analysis was performed using Pearson's correlation coefficient calculations, which investigates for linear correlations among datasets. Data and statistical analysis were performed with the MATLAB simulation environment (The Mathworks, Inc. Natick MA). Possible bias in the present investigation would be the misinterpretation of the questionnaire. Yet, the questionnaire was self-explanatory and the health professional was trained to overcome any obstacles. Further on, a possible bias would have been the presence of tuition fees in the kindergartens, which was not the case in the present study.

3. Results

3.1. General Remarks on the Demography of Greece

Before examining the particulars of offspring dynamics in Greece during the period of study, it would be interesting to mention some elements of demographic data. The first interesting, but alarming at the same time, fact was that Greek women choose to bear children at a higher age with respect to time. In particular, it appears that the mean mother age has risen exponentially with time and this pattern seems to be irrespective of economic or social factors (Figure 1A). Further on, when examining the number of births in absolute numbers, there was a constant fall, starting from 1960, which is reversed from 2000 to 2008, as a rapid rise in births was observed (Figure 1B). Yet, a sudden drop was observed from 2008 and on, a time that coincides with the fiscal recession and memorandum austerity policies (Figure 1B). Similarly, the same result appears in the fertility factors, measured as number of children per mother (Figure 1C). Interestingly, total births and children per mother follows the pattern of Gross Domestic Product (GDP) *per capita* (Figure 1D). Further on, it is noteworthy that the male/female ratio manifested a decline during austerity years (Figure 1E). In addition, the effect of population aging is confirmed by the population pyramids from 1961 to 2014. This is presented in Figure A1.
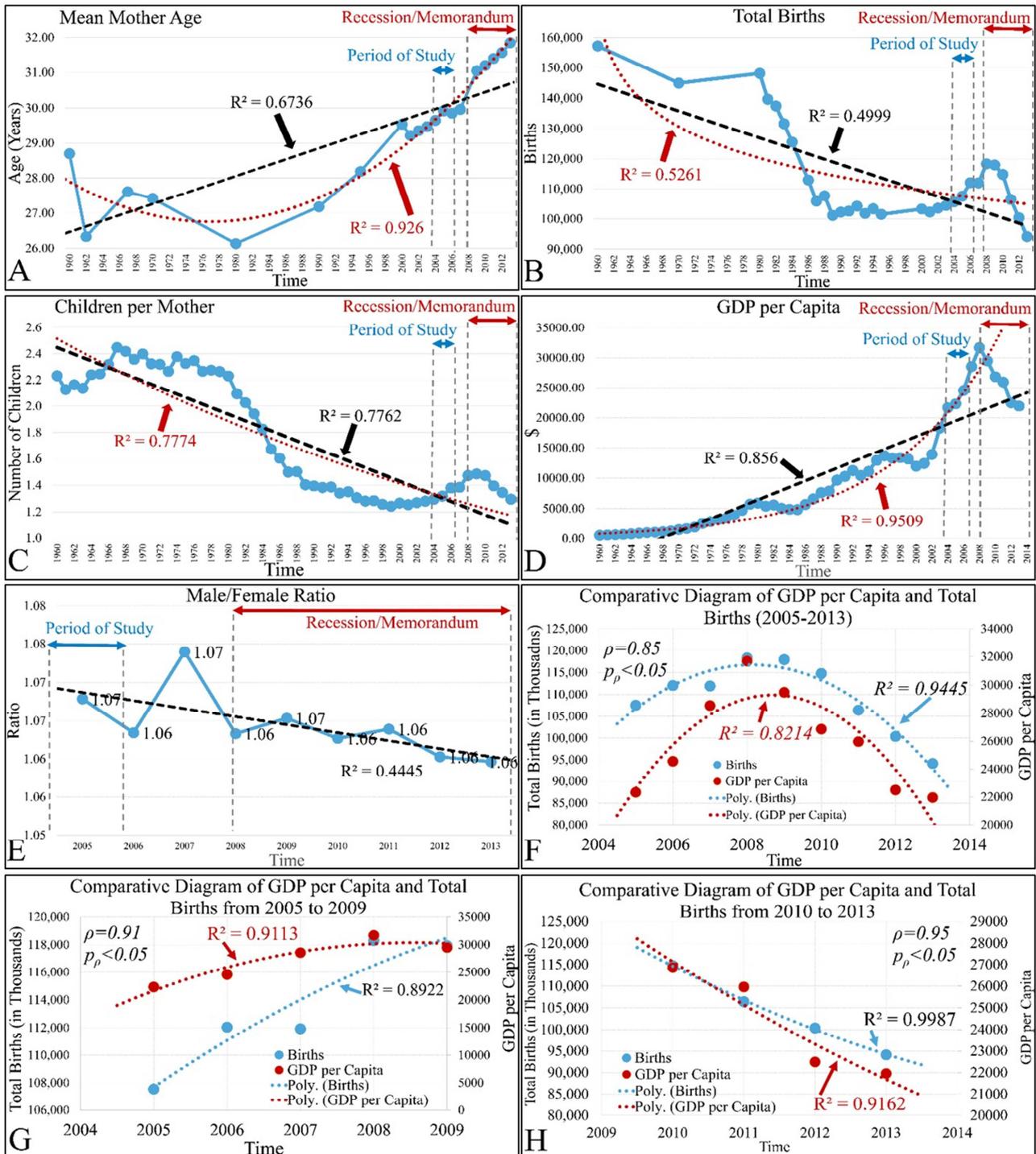
Figure 1. *Elements of demographic and economic statistics of Greece. In particular, following variables are presented: Mean mother age, which states the age of a mother at the time of birth of her first child. Linear (black dashed line) and polynomial (red dotted line) regressions have been performed, in order to investigate the dynamic pattern (A), total births in absolute numbers. Linear (black dashed line) and polynomial (red dotted line) regressions have been performed, in order to investigate the dynamic pattern (B), fertility numbers, expressed as children per mother. Linear (black dashed line) and polynomial (red dotted line) regressions have been performed, in order to investigate the dynamic pattern (C), the Gross Domestic Product (GDP) per capita expressed in thousand dollars. Linear (black dashed line) and polynomial (red dotted line) regressions have been performed, in order to investigate the dynamic pattern (D) and the Male/Female ratio. Linear regression is presented (black dashed line) (E). Analyzing the GDP and total birth data in a common diagram, it appears that indeed they follow similar dynamics. In particular, the rise and fall in GDP and Total Births respectively is similar from 2005 to 2013. This is shown by using second degree polynomial regression, where the blue-dotted line represents the number of births and the red-dotted line represents the GDP per Capita. In the same diagram, calculating the Pearson's correlation coefficient it has been found to be ρ=0.85 (p_ρ<0.05) (F). To analyze this behavior in detail, we present the total curve (from 2005 to 2013 in (F)) from 2005 to 2009 (G) and from 2010 to 2013 (H). The Pearson's correlation coefficient from 2005 to 2009 for GDP and Total Births was found to be ρ=0.91 (H) and from 2010 to 2013 was found to be ρ=0.95 (G). Both variables (GDP and total births) were found to be highly correlated. This does not necessarily implies causality, yet it hints toward such an assumption.*

Table 1. *Demographic and socioeconomic data of sample under investigation.*

		Population (*N*)	TOTAL CHILDREN POPULATION	
			Age (years)	Number of Children
CHILDREN			Mean±StDev	Mean±StDev
	Total (children)	434	4.24±0.91	1.81±0.85
GENDER	Males	219	4.28±0.91	1.76±0.78
	Females	215	4.21±0.91	1.86±0.91
PARENTS				
MOTHERS EDUCATION	MORE THAN 12 YEARS	342	4.26±0.90	1.84±0.86
	BETWEEN 7 AND 12 YEARS	92	4.18±0.95	1.70±0.81
FATHERS EDUCATION	MORE THAN 12 YEARS	360	4.25±0.91	1.84±0.84
	BETWEEN 7 AND 12 YEARS	74	4.22±0.89	1.66±0.86
INCOME	UP TO 10K	96	4.28±0.78	1.79±1.03
	BETWEEN 10K AND 30K	250	4.25±0.96	1.73±0.73
	MORE THAN 30K	88	4.18±0.89	2.06±0.90
FATHER NATIONALITY	GREEK	276	4.32±0.85	1.91±0.89
	OTHER	156	4.11±0.98	1.64±0.73
MOTHER NATIONALITY	GREEK	278	4.32±0.84	1.90±0.90
	OTHER	156	4.10±1.01	1.64±0.73
COUPLE NATIONALITY	GREEK	268	4.33±0.84	1.91±0.90
	OTHER	148	4.11±1.00	1.64±0.74
	MIXED	18	4.02±0.95	1.61±0.61

Table 1. *Continued.*

		MALES		FEMALES		
		Age (years)	Number of Children	Age (years)	Number of Children	Male/Female Ratio
CHILDREN		Mean±StDev	Mean±StDev	Mean±StDev	Mean±StDev	
	Total (children)					1.018
GENDER	Males					
	Females					
PARENTS						
MOTHERS EDUCATION	MORE THAN 12 YEARS	4.25±0.91	1.74±0.76	4.28±0.88	1.94±0.94	1.047
	BETWEEN 7 AND 12 YEARS	4.40±0.88	1.82±0.87	3.97±0.97	1.58±0.74	0.917
FATHERS EDUCATION	MORE THAN 12 YEARS	4.26±0.92	1.74±0.74	4.24±0.91	1.94±0.93	1.046
	BETWEEN 7 AND 12 YEARS	4.39±0.86	1.86±0.97	4.08±0.90	1.49±0.72	0.897
INCOME	UP TO 10K	4.31±0.84	1.76±0.92	4.26±0.73	1.82±1.12	0.920
	BETWEEN 10K AND 30K	4.22±0.96	1.70±0.77	4.29±0.97	1.76±0.70	1.066
	MORE THAN 30K	4.42±0.81	1.93±0.62	3.94±0.90	2.18±1.11	1.000
FATHER NATIONALITY	GREEK	4.36±0.87	1.79±0.79	4.27±0.83	2.04±0.99	1.173
	OTHER	4.10±0.96	1.69±0.75	4.12±1.01	1.60±0.72	0.795
MOTHER NATIONALITY	GREEK	4.37±0.86	1.79±0.81	4.27±0.82	2.02±0.97	1.091
	OTHER	4.10±0.98	1.69±0.72	4.10±1.04	1.60±0.73	0.902
COUPLE NATIONALITY	GREEK	4.38±0.85	1.80±0.80	4.27±0.83	2.04±0.99	1.110
	OTHER	4.12±0.95	1.70±0.74	4.10±1.04	1.60±0.73	0.805
	MIXED	3.88±0.95	1.58±0.74	4.31±1.04	1.67±0.73	2.000

3.2. A Short Analysis of Demography Dynamics

Analyzing the GDP and total birth data, presented in Figures 1B and 1D, in a common diagram, it appeared that indeed they follow similar dynamics. In particular, the rise and fall in GDP and Total Births, respectively was similar from 2005 to 2013. This is shown by using second degree polynomial regression, where the blue-dotted line represents the number of births and the red-dotted line represents the GDP per Capita. In the same diagram, the Pearson's correlation coefficient was found to be ρ=0.85 (p_p<0.05) (Figure 1F). To analyze this patterns in detail, we presented the total curve (from 2005 to 2013 in (Figure 1F)) from 2005 to 2009 (Figure 1G) and from 2010 to 2013 (Figure 1H). The Pearson's correlation coefficient from 2005 to 2009 for GDP and Total Births was found to be $\rho=0.91$ (Figure 1H) and from 2010 to 2013 was found to be $\rho=0.95$ (Figure 1G). Both variables (GDP and total births) were found to be highly correlated. This did not necessarily imply causality, yet it hinted toward such an assumption.

3.3. The Effects of Education, Income and Nationality on the Number of Children

We found differences in the characteristics of the population with respect to each family's number of children. First of all, it was found that the number of children per family was related to the education of the mother (Figure 2A), with mothers with more than 12 years education having more children (*median* 2). At the same time, fathers' nationality, mothers' nationality and couples' nationality played a significant role, with Greek mothers, fathers and couples (*median* 2) having more children than other nationalities (*median* 1) (Figure 2B-2D) (the couples' nationality was defined as follows: *Greek* couples were considered those with both spouses of Greek citizenship, *Other* couples were considered those with both spouses of other citizenship than Greek and *Mixed* couples were considered those that the spouses were of Greek citizenship and the other of another citizenship). Results are summarized in Table 2.

3.4. The Effect of Income Sub-populations and Nationality on the Number of Children

Isolating the sub-population of families with income between 10K and 30K euros per annum, it was found that the number of children was related to fathers', mothers' and couples' nationality, in all cases being higher in Greek families (Figure 3A-3C). Results are also summarized in Table 2.

3.5. The Effect of the Sub-population of Mothers with Education More Than 12 Years and Nationality on the Number of Children

Examining the subpopulations of our sample it appeared

that mother's education played a significant role in the number of offspring. Investigating the sub-population of mothers with education more than 12 years it was observed that Greek fathers had more children (*median* 2) as compared to fathers from other nationalities (*median* 1) (Figure 4A). Similarly, the same effect was observed in Greek mothers when compared to mothers from other nationality (Figure 4B). Finally, Greek couples also manifested similar pattern with Greek couples having more children when compared to other and mixed couples (Figure 4C). Results are summarized in Table 2.

3.6. The Effect of Education and Nationality on Familial Status (Single Parent Families) and the Number of Children

Examining the individual sub-populations of education it was found that within the sub-population of mothers with education between 7 and 12 years there was a significant difference in the number of children with single mothers manifesting higher levels of children (*median* 2) when compared to two-parent families (*median* 1) (Figure 5A). This pattern was reversed in the sub-population of mothers with education more than 12 years where single parent families manifested lower number of children (*median* 1) when compared to two-parent families (*median* 2) (Figure 5B). The same effect was observed in the case of the father sub-population with education more than 12 years (Figure 5C). In particular, single parent families had less children (*median* 1) when compared to two-parent families (*median* 2). The same effect was also observed in the case of Greek mothers (Figure 5D) and fathers (Figure 5E), where both mothers and fathers manifested higher number of children in two-couple families (*median* 1) when compared to single parent families (*median* 2). Results are summarized in Table 2.

Table 2. *Univariate (Kruskal-Wallis) analysis of grouping variables with respect to number of children per family. Populations include the total population, the sub-population of mothers with education (E) between 7 and 12 years, mothers with education (E) more than 12 years, fathers with education (E) more than 12 years and finally family income (I) between 10 thousand (10K) euros per annum and 30 thousand (30K) euros per annum. Average values correspond to average number of children for the respective population and it is presented as Mean±Stdev.*

		Group	Average1	Median	*Group*	Average	StDev
Total Population	Mother's Education	*7<E<12*	1.70±0.81	2.00	*E>12*	1.84±0.86	0.86
	Father's Nationality	*Greek*	1.91±0.89	2.00	*Other*	1.64±0.73	0.73
	Mother's Nationality	*Greek*	1.90±0.90	2.00	*Other*	1.64±0.73	0.73
	Couple Nationality	*Greek*	1.91±0.90	2.00	*Other*	1.64±0.74	0.74
Mothers with 7<E<12	Single Parent Families	*Yes*	1.41±0.62	1.00	*No*	1.90±0.87	0.87
	Father's Nationality	*Greek*	1.91±0.88	2.00	*Other*	1.62±0.73	0.73
	Mother's Nationality	*Greek*	1.91±0.89	2.00	*Other*	1.62±0.71	0.71
Mothers with E>12	Single Parent Families	*Yes*	1.41±0.62	1.00	*No*	1.90±0.87	0.87
	Income	*I<10K*	1.78±1.08	2.00	*10K<I<30K*	1.76±0.75	0.75
	Couple Nationality	*Greek*	1.92±0.89	2.00	*Other*	1.61±0.73	0.73
Fathers with E>12	Father's Nationality	*Greek*	1.90±0.88	2.00	*Other*	1.69±0.71	0.71
	Single Parent Families	*Yes*	1.40±0.63	1.00	*No*	1.90±0.85	0.85
	Father's Nationality	*Greek*	1.83±0.77	2.00	*Other*	1.56±0.63	0.63
Income 10K<I<30K	Mother's Nationality	*Greek*	1.83±0.78	2.00	*Other*	1.56±0.62	0.62
	Couple Nationality	*Greek*	1.83±0.78	2.00	*Other*	1.55±0.62	0.62

Table 2. *Continued.*

|		Median	p	Group	Average	StDev	Median	p
Total Population	Mother's Education	2.00	0.0230					
	Father's Nationality	2.00	0.0018					
	Mother's Nationality	2.00	0.0016					
	Couple Nationality	2.00		*Mixed*	1.61	0.61	2.00	0.0036
Mothers with 7<E<12	Single Parent Families	2.00	0.0066					
	Father's Nationality	1.00	0.0035					
	Mother's Nationality	1.00	0.0054					
Mothers with E>12	Single Parent Families	2.00	0.0000					
	Income	2.00		*I>30K*	2.08	0.89	2.00	0.0034
	Couple Nationality	1.00		*Mixed*	1.69	2.00	0.73	0.013
Fathers with E>12	Father's Nationality	2.00	0.0420					
	Single Parent Families	2.00	0.0000					
	Father's Nationality	1.00	0.0082					
Income 10K<I<30K	Mother's Nationality	1.00	0.0082					
	Couple Nationality	1.00		*Mixed*	1.69	0.62	2.00	0.0243
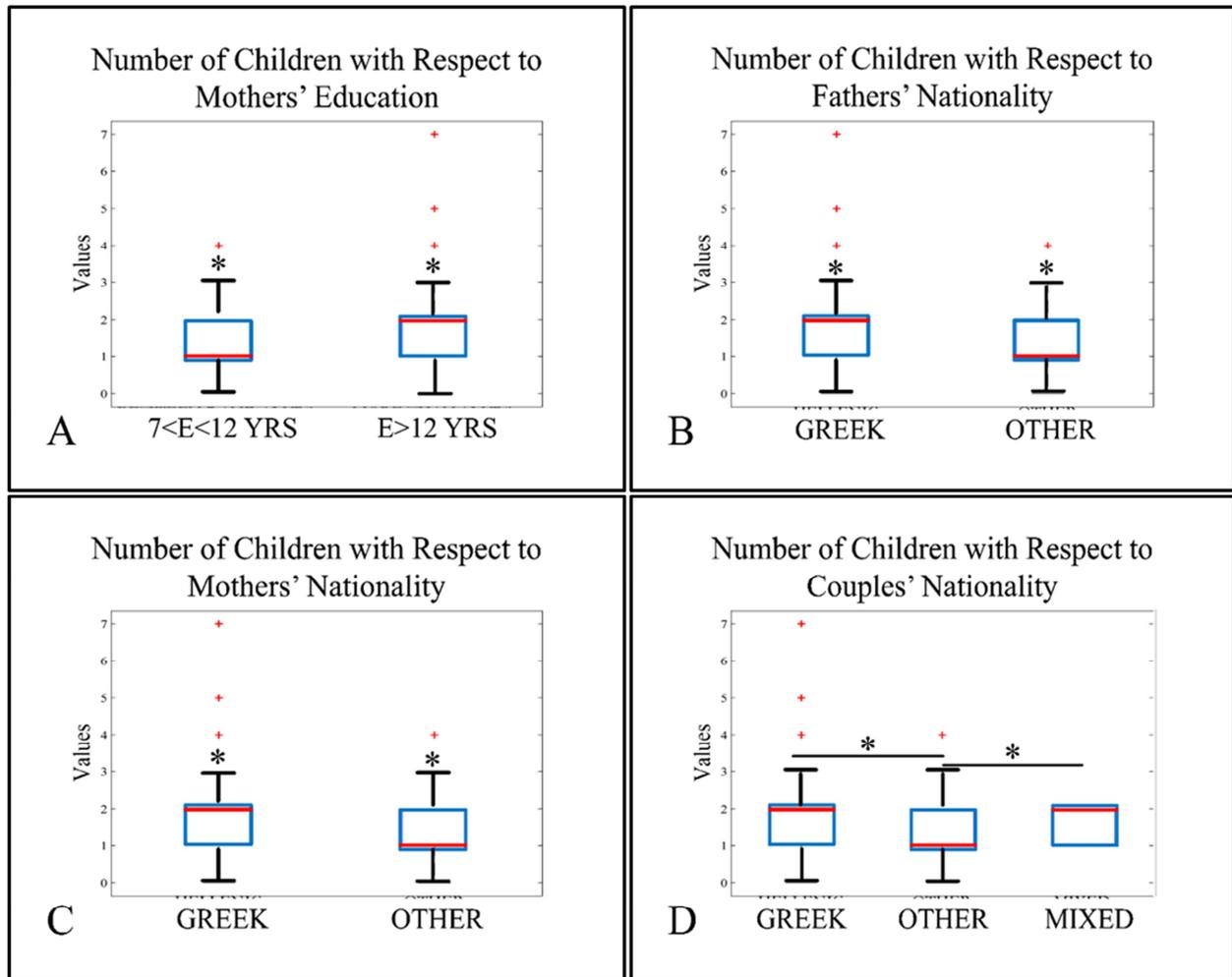
Figure 2. *The effect of mothers' education, fathers', mothers' and couples' nationality on children population. In particular, there was a significant difference between mothers' education (E: Education) and the number of children being higher in mothers with more than 12 years of education (A), there was a significant difference between fathers' nationality and the number of children being higher in Greek fathers (B), there was a significant difference between mothers' nationality and the number of children being higher in Greek mothers (C), there was a significant difference between couples' nationality and the number of children being higher in Greek and mixed couples (D) (In sub-figure D, the couples' nationality is defined as follows: Greek couples are considered those with both spouses of Greek citizenship, Other couples are considered those with both spouses of other citizenship than Greek and Mixed couples are considered those that one of the spouses is of Greek citizenship and the other of an other citizenship). Asterisks depict a difference at the p<0.05 significance level.*
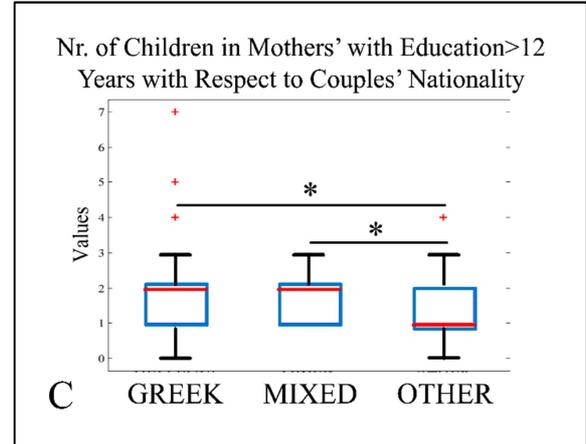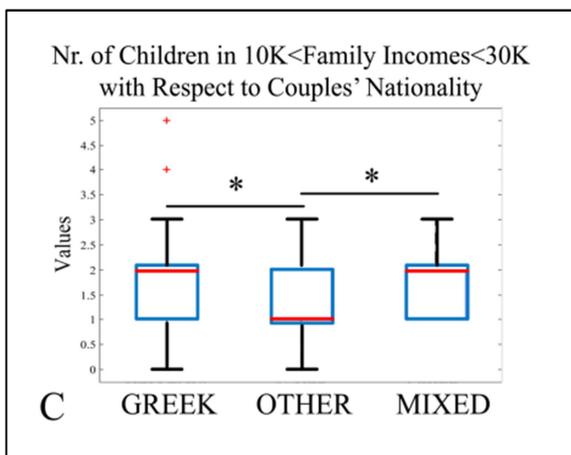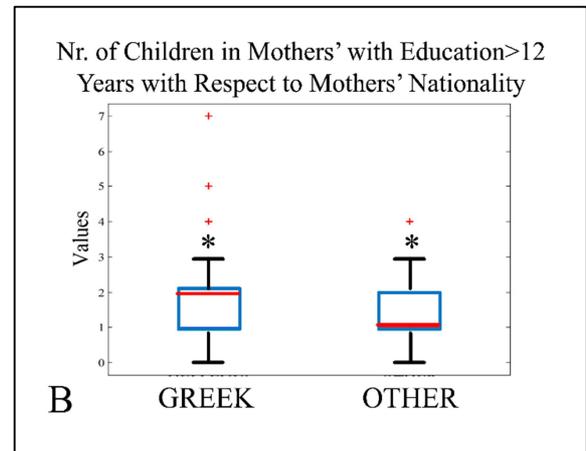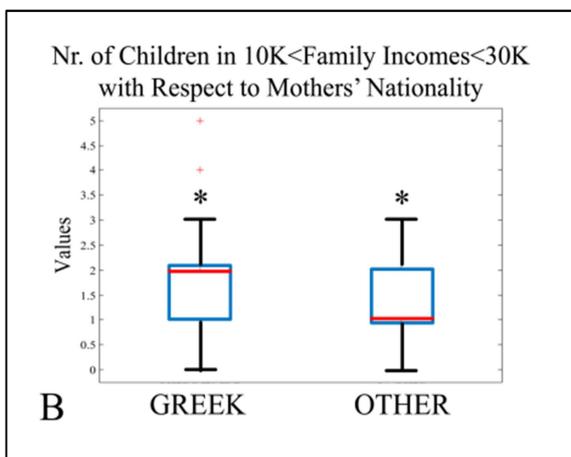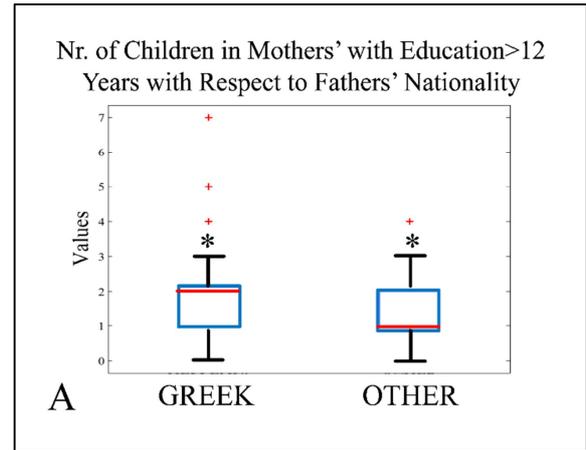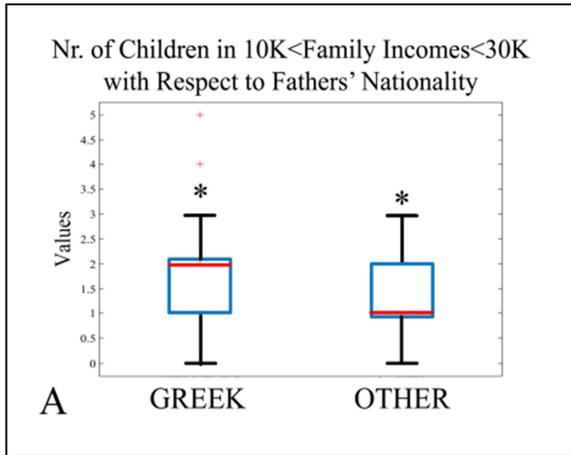
Figure 3. *The relation of nationality to the number of children in families with income between 10K and 30K euros (K symbolizes thousands of euros). In particular, Greek fathers tend to have more children as compared to those fathers of an alternative origin (A), similar correlations were observed for mothers (B) and couples, where Greek and mixed couples tended to have more children than families with alternative origin (C). (the couples' nationality is defined as follows: Greek couples are considered those with both spouses of Greek citizenship, Other couples are considered those with both spouses of other citizenship than Greek and Mixed couples are considered those that one of the spouses is of Greek citizenship and the other of an other citizenship). Asterisks depict a difference at the p<0.05 significance level.*

Figure 4. *The effect of the sub-population of mothers with education more than 12 years and nationality on the number of children. Examining the sub-population of mothers with education more than 12 years it has been found that Greek fathers had more children as compared to other nationalities (A), while the same was true for Greek mothers (B) and Greek couples (C). (In sub-figure C, the couples' nationality is defined as follows: Greek couples are considered those with both spouses of Greek citizenship, Other couples are considered those with both spouses of other citizenship than Greek and Mixed couples are considered those that one of the spouses is of Greek citizenship and the other of an other citizenship). Asterisks depict a difference at the p<0.05 significance level.*
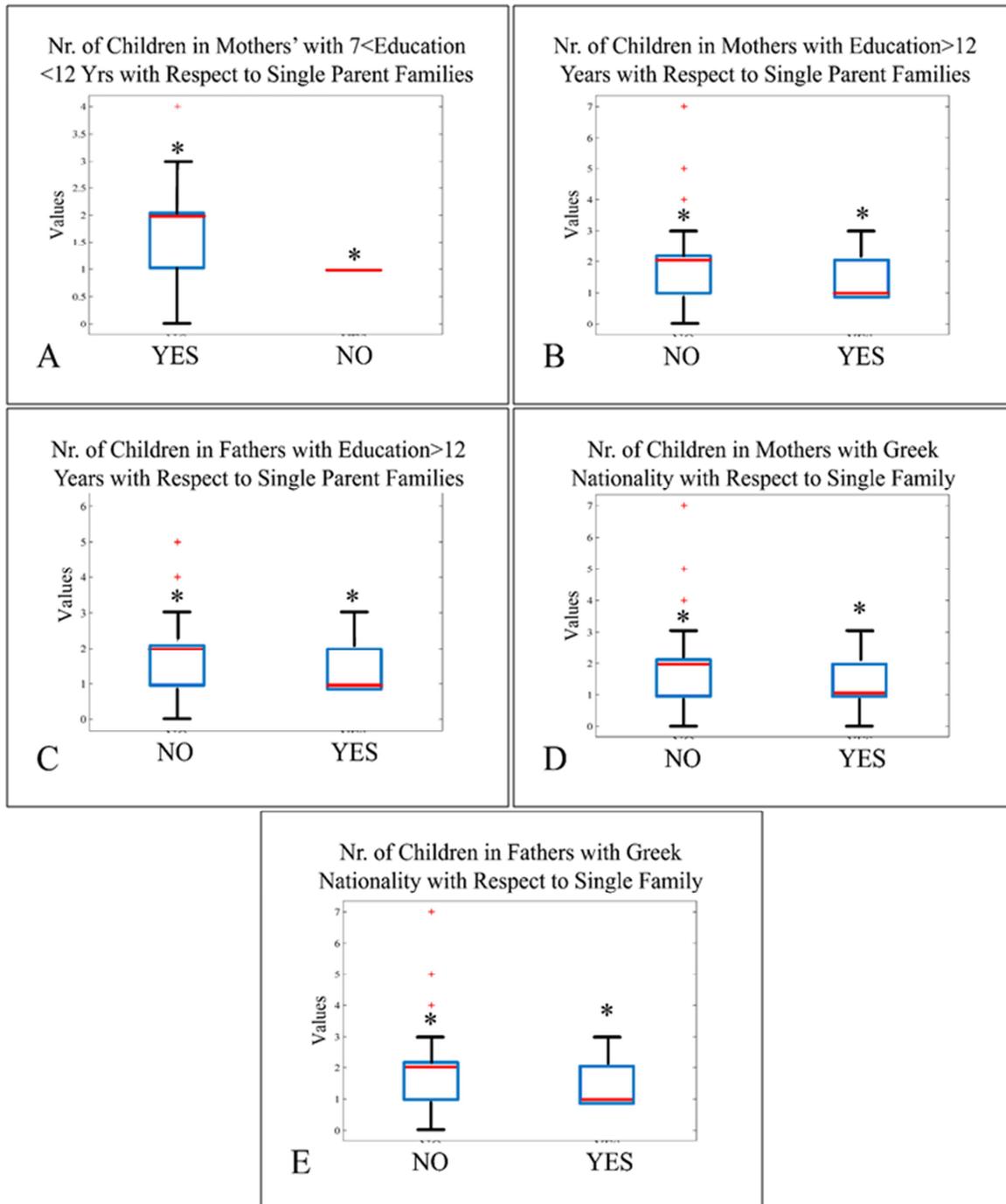
Figure 5. *The effect of education and familial status (single parent family). There was a significant difference with respect to the number of children in single parent families within the sub-population of mothers with education between 7 and 12 years (A). Similarly, there was a significant difference with respect to the number of children in single parent families within the sub-population of mothers with education more than 12 years (B). Finally, there was a significant difference with respect to the number of children in single parent families within the sub-population of fathers with education more than 12 years (C). It also appeared that mother with Greek nationality had the same effect on single parent families with respect to children, with single parent families manifesting lower number of children as compared to two-couple families (D). Finally, it appears that fathers' nationality (Greek) had the same effect on single parent families as mothers' nationality (E). Asterisks depict a difference at the $p<0.05$ significance level.*

3.7. Patterns of Male to Female Ratio

Examining for patterns in male to female ratio, we found that there were differences based on both mothers' (Figure 6A) and fathers' education (Figure 6B). In particular, it appeared

that both mothers and fathers with more than 12 years education manifested a birth gender rate towards boys, while parents with education between seven and twelve years manifested a birth gender rate towards girls. At the same time, it appeared that income also influenced the male to female ratio with middle income families, that was with income

between 10K and 30K had more boys than girls and lower income families have more girls (Figure 6C). Another interesting observation was that both fathers (Figure 6D) and mothers (Figure 6E) from Greek origin had more boys than girls, as compared to parents from other origin (Figure 6D, 6E). Further on, when accounting for couple nationality, a very interesting observation was that mixed couples had an above the average male to female ratio equal to two, followed by Greek couples and couples from other nationalities (Figure 6F). Finally, it appeared that family status, that is whether there was a single-parent family or not, influenced the male to female ratio with single-parent families having more girls when compared to non-single-parent families (Figure 6G). Results are summarized in Table 2.

3.8. Bivariate Analysis of Variables Under Investigation

It was apparent that the studied variables were affecting the number of offspring, which led to the question whether those variables could influence the number of children in a combinatorial way. Bivariate analysis revealed that there was significant difference in the number of children with respect to gender and fathers' education (p=0.04) (Table 3), gender and fathers' nationality (p=0.03) (Table 3) and gender and couple nationality (p=0.03) (Table 3). Similarly, as observed in the univariate analysis mothers' education and fathers' education significantly influenced the number of children (p=0.03) (Table 3). Family income and single parent status also manifested significant differences with respect to the number of children (p=0.03) (Table 3).

4. Discussion

In the present work, we investigated the dynamics of offspring in resident families in Athens and combined it with other socioeconomic factors such as origin of the parents, marital status, income and education. To the best of our knowledge, there are not many works available in the literature focusing on this topic especially for the Greek area. In addition, this must be the first study that combines all aforementioned variables together and in that extent.

In general, as numbers indicated, Greece's population shrinks with time, a phenomenon apparently irrelevant to economic growth, up to 2008. In other words, we saw that from 1980 and on, birth rate fell, with a reversal in that pattern from 2000 and on. Yet, austerity led births almost at the 2000 levels, which signified that birth rate dynamics followed fiscal dynamics. This is in line with other reports, where it was shown that austerity literally "kills" births [6, 14]. The same pattern was followed by fertility indexes, where the mean offspring number per mother started recovering from year 2000 and suddenly dropped at the beginning of austerity. It is also noteworthy that during the 60s' and up to the early 80s', birth rate remained constant, whilst 60s' were marked by great poverty of the general population. Before that time point, the rate of population change was always positive and for the first time since the demographic recordings in history of Greece obtained a negative growth rate of approximately -1.3% in

2011. Exception was noted between 1821 and 1828, where Greece had a decline to its population of -30%, due to the ongoing liberation war with the Turks [12]. It is interesting to mention that based on population data, this austerity devastating effect on births was not even succeeded by the series of wars that Greece has gone through from 1897 to 1944 [12]. There are many responses on the question, regarding the reasons that this austerity affects so much the birth rate in Greece. For certain, it is not a matter of health care issue, or conditions of hospitalization, since infant and mother mortalities are at the lowest levels in Europe. A possible hypothesis, would be that the austerity shock was too big for couples in Greece and at the same time, and most importantly, fear was the greatest enemy. In other words, people on one hand have too much to lose, since almost everybody is indebted to a bank, and thus couples would apply their household cut-offs by avoiding having children.

An additional surprising notification was that the male to female ratio slightly, but markedly, followed the birth dynamics during austerity years. In particular, it appeared that there was a decrease in the number of boys when compared to the number of girls from 2004 up to date. To the best of our knowledge, this is the first time that this 'phenomenon' is presented.

Examining the offspring dynamics of the era under investigation, it appeared that mothers' education influenced positively the number of children. In other words, mothers with education more than 12 years tended to have more children. Similarly, nationality appeared to influence number of offspring with Greek single parents and couples manifesting higher birth rates. Further on, in the sub-population of couples with income between 10K and 30K euros per annum, Greek single parents and couples manifested higher numbers of offspring when compared to other nationalities. Similarly, in the sub-population of mothers' with education more than 12 years, Greek single parents and couples manifested higher numbers of offspring when compared to other nationalities. Finally, single parent families manifested lower numbers of offspring in several sub-populations such as mothers education, mothers' and fathers' nationality. These findings could be interpreted by the fact that during that era, fiscal conditions regulated positively the number of offspring. At the same time, Greek couples tended to have more children than families with other nationality, probably also to better financial position, an observation also verified by the effect of mothers' nationality. Further on, it appeared that this finding was factual also for the number of children in Greek as well as mixed families, where one of the spouses was of Greek origin. Probably, this observation was due to the better financial position of Greek couples or single parents. Worth mentioning is the fact that the examined era is characterized by the entrance of Greece into the Eurozone and the rapid fall in bank loan interest rates.

Although, it is possible that the beneficiary financial condition was not due to the increase of production in Greece, but due to the increase of consumption it had, what so ever, a positive effect on birth rates, a fact that the policy makers should use to the benefit of the Greek society (which they eventually did not).

At this point, we should mention that it is generally believed that couples with other nationalities tend to bear more children, which according to these observations it is not true, at least for those couples whose children attend the kindergartens and primary schools in Athens. This leaves us with the following: Greek parents and mothers tend to have more children, send them in an educational infrastructure on older age, when compared to parents and couples with other nationalities. It also appeared that medium incomes are more influenced with respect to number of offspring, since in lower and higher incomes there was no significant difference observed in the number of offspring.

As it has been already stated, nationality and education had a positive effect on offspring numbers, yet both probably closely linked to financial prosperity. Therefore, it is probable that economics played a positive role in the number of children since we had the first pattern reversal (birth rates kept falling from 1970 and on) since the late 60s'.

In a very interesting work by *Veropoulou* et al (2010), which investigated the patterns of sex ratio in Greece, data from 2006 have been reported [5]. Interestingly, our calculation coincided for the male to female ratio in Greek couples and/or single parents, where we estimated an average of 1.11 for parents of Greek origin in a sample size of 435 couples, while in their report the sex ratio was estimated at the 1.06 level on a sample size of 53 thousand couples [5]. At the same time, our estimation for couples with other nationalities disagrees, as we have an estimation of 0.8 and their report manifested an average of 1.1 [5]. Probable reasons for that difference might be the small sample size of our study or the bias inherently obtained, since we examined families that sent their children to the kindergarten. As a matter of fact, based on our findings, the education and income had an increasing effect on the ratio. At the same time, when accounting for the effect of nationality, we found that mixed couples manifested a high male to female ratio of 2.

To the best of our knowledge, this is the first work in the literature examining the dynamics of offspring by calculating the effects of socioeconomic factors such as education, income and nationality. At the same time, such works are extremely important both towards the understanding of population dynamics but also towards policy making, which includes both the demographical as well as fiscal policies.

Table 3. Bivariate analysis of variables under investigation. Two- and three-way ANOVA was performed in order to test for the combinatorial effect of socioeconomic variables with respect to the number of children.

		Father Education					
		7<E<12 Years			E>12 Years		
		Mean	StDev	Median	Mean	StDev	Median
Gender	Males	1.82	0.87	2.00	1.74	0.76	2.00
	Females	1.49	0.72	1.00	1.94	0.93	2.00
p-values	Father Education	0.01					
	Gender × Father Education	0.04					

		Father Nationality					
		Greek			Other		
		Mean	StDev	Median	Mean	StDev	Median
Gender	Males	1.79	0.79	2.00	1.69	0.75	2.00
	Females	2.04	0.99	2.00	1.60	0.72	1.00
p-values	Father Nationality	0.00					
	Gender × Father Nationality	0.03					

|		Father Education					
		7<E<12 Years			E>12 Years		
		Mean	StDev	Median	Mean	StDev	Median
Mother Education	7<E<12 Years	1.64	0.89	1.00	1.79	0.65	2.00
	E>12 Years	1.73	0.80	2.00	1.84	0.86	2.00
p-value	Mother Education × Father Education	0.03					

		Couple Nationality								
		Greek			Other			Mixed		
		Mean	StDev	Median	Mean	StDev	Median	Mean	StDev	Median
Gender	Males	1.80	0.80	2.00	1.70	0.74	2.00	1.58	0.74	1.00
	Females	2.04	0.99	2.00	1.60	0.73	1.00	1.67	0.73	2.00
p-value	Gender × Couple Nationality	0.03								

		Family Income								
		Up to 10K			Between 10K and 30K			More than 30K		
		Mean	StDev	Median	Mean	StDev	Median	Mean	StDev	Median
Single Parent	YES	1.28	0.45	1.00	1.15	0.38	1.00	1.89	0.93	2.00
	NO	2.01	1.12	2.00	1.76	0.73	2.00	2.08	0.90	2.00
p-value	Income	0.01								
	Family Income × Single Parent	0.03								
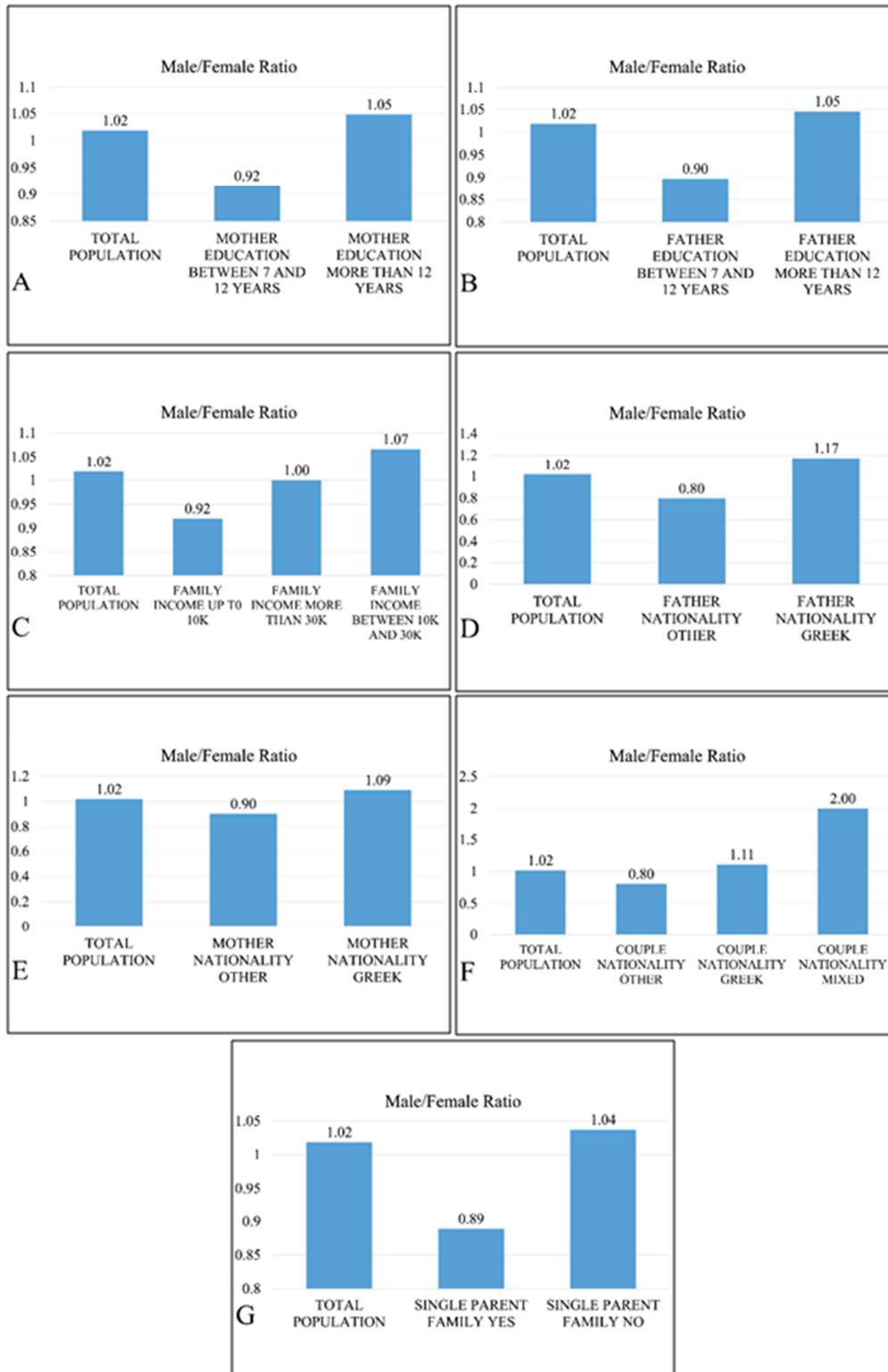
Figure 6. *Maler to Female ratio in the total and subpopulations of our study sample. In particular, male to female ratio is presented for the following variables: mothers' education (A), fathers' education (B), family income (C), fathers' nationality (D), mothers' nationality (E), couples nationality (F) and single-parent status (G).*

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Disclosures and Conflict of Interest

The authors have nothing to disclose and no conflict of interest.

Appendix
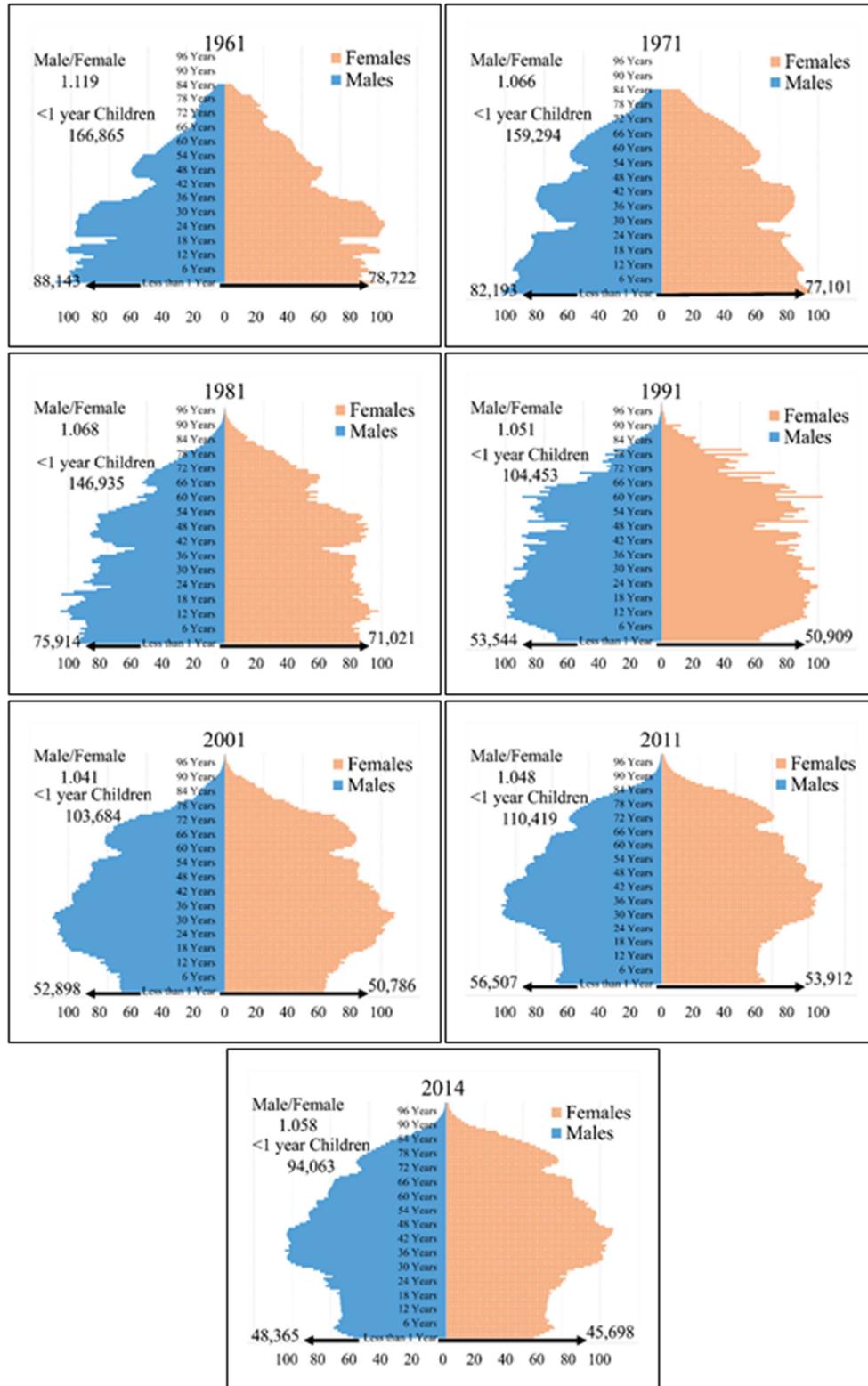
Figure A1. *Population pyramids of Greece from 1961 to 2014. Since 1961 there is a decreasing trend in children less than a year old.*

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