Original Article

Application of classification tree approach to analysis youth marriage age gap

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Abstract

Background: During the last decades, the average gap between attitudinal and behavioral youths' marriage age has increased due to the changes in Iranian society and family patterns. This paper is devoted to studying this increment.

Methods: Classification and Regression Trees (CART) are applied for modeling the marriage age gap (MAG) of 12741 youths selected by a multi-stage cluster sampling method from 31 provinces in Iran.

Results: Classification accuracies of fitted CART for females' and males' MAG were equal to .62 and .60, respectively. The most influential variables on females' and males' MAG were educational level and the number of siblings, respectively. Females with "university education," "diploma and less education with 5 and more siblings", and "employed diploma and less education with 3 or 4 siblings" married later than their desired time. Males with "3 and more siblings", "employed with 2 and fewer siblings and 3 and more ideal number of children", "employed university educated with 2 and fewer siblings and 1 or 2 ideal number of children", and " employed with 2 and fewer siblings and 1 or 2 ideal number of children with a diploma and less education and negative opinion towards childbearing" also married later than their desired time.

Conclusion: If the inevitable experience of modernity doesn't combine with the convenient policy and the economic and socio-cultural conditions of the community don't change, the negative consequences of such developments would be more than its positive achievements on different social issues especially and more importantly youth's marriage age.

Keywords: Attitude; Decision Trees; Iran; Marriage; Youth

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Introduction

Marriage, like any other social phenomenon, has some norms that these norms are different in any society and at any time (1). Iran is in the transition from tradition to modernity and faces a wide range of social changes in all social phenomena like marriage. These changes have led youth to have a new attitude towards marriage. This new world raises the level of social awareness, public education, and simultaneously causes the expectations of youths from their life to become far more than the past (1). Since the beginning of the 20th century, the traditional family pattern in Iran, by accelerating the socio-economic changes, has gradually shifted and these changes have led to changes within the family in the country.

One of the areas of this change is youths' marriage age. According to the results of the Statistical Center of Iran, for 55 years, the average women's age of marriage in Iran increased 5 years from 18.4 to 23.4 years. While the average male's age of marriage in Iran increased gradually 1.7 years from 25 years in the census of 1966 to 26.7 years in the census of 2011. The survey on the marriage age of men and women in Iranian provinces also shows that during 2004-2014, the average men's age of marriage from 26.2 years reached 28.2 years, and the average women's marriage age from 21.8 reached to 23.7 years (2). This trend, after centuries of early marriage experience in Iran, was an important phenomenon in the area of social changes. The increase in the average age of marriage and the development of definite celibacy would disrupt the normal functioning of the family and, as a result, cause disruptions in the community. Moreover, the age of marriage is one of the important indices to assess the physical and mental health of individuals in the society, thus raising its average can affect the health of the community (3). Some of the consequences of this phenomenon are anxiety and nervous pressures, the prevalence of depression and behavioral disorders, changing patterns, and the norms of marriage, and the increasing moral corruption (4).

Various studies about the tendency and intendancy of youths to marriage pointed to cultural variables (religious orientation and rate of using media, gender equality, childbearing style, having older siblings), social variables (educational level, gender, self-esteem, the pleasure of being single, high expectations, tightening of parents) and economic variables (job status, housing status, income, parents' occupation) (5-7).

In the course of the changes that have taken place, it is obvious that the youth marriage age comparing to the past is increasing, and in many parts of the country, the delay in the age of marriage is happening. Though early marriage could result in health risks for mothers and their children, higher rates of divorce, and reducing woman's social participation (8-9), many studies have examined the causes and factors of increasing in youths' average age of marriage in Iran. Habibipour et al. indicated that as society moves out of traditional mode and approaches to the modern situation, the marriage age will increase (10).

The main root of all the causes affecting the increase in the age of marriage is the subject of experiencing modernity and modernization of the Iranian society, which is also acknowledged previous economic, social and demographic theories. The theory of modernization is believed that the transition of societies from traditional order to modern order causes changes among all the groups in the macro, middle, and micro levels, and these changes will alter the values, expectations, and demands (11).

Several theoretical foundations have stated about the effect of modernization and its indices on the increase in the girls' marriage age. William Good, among the most important of these people, believes that the modernization through the expansion of educational opportunities, changes in the workforce, and modern job roles and urbanization, increases the age of marriage. Habibpour et al. showed that girls who married later than their desired age have higher education, and believes that by marriage, the cost of lost opportunities is more than marriage opportunity (10). Nastizaie et al. indicated that if marriage happens at an old age (for women 35 years and more, and men 45 years and more), the possibility of various lesions in children such as mental retardation increases (12). In another study age, gender, residence place, and socioeconomic status were the influential factors creating new ideas and attitudes about marriage (13).

Some of the researchers also studied marriage age by gender. Aghai et al. resulted that there is

not a significant relationship between household income and attitude towards the marriage age for both genders (14). There is a significant relationship between education and attitude toward marriage age in girls opposite to boys. Concerning the person's employment and attitudes toward the age of marriage, there is a meaningful relationship for both girls and boys. Also, there is a relationship between the social status of the family and the attitude towards the girls' age of marriage opposite to boys. The higher the social status of the girls' family is, the higher their marriage age.

Though many studies have been devoted to the actual marriage age, there are a few studies conducted on the ideal marriage age. In the study of Asgari Nadushan et al. on ideal marriage age and its determinants, they resulted that educational level of respondents and their parents, attitude towards gender equality, individualism and cultural capital has direct meaningful conversely effect, and the variables of adherence to religious values have a reverse and significant relationship with ideal marriage age (15). Mehrabani et al. presented an economic model with evidence of decision making for the age of marriage in Tehran. He concluded that the ideal age for marriage for men is higher than women (16).

Up to our knowledge, there are few studies about the gap in youths' marriage age attitude and their behaviors except Hossaini et al. study (6). Their results indicated that there is a gap in women's behavior and attitude about marriage age for girls in Kuhdasht city, Iran. The gap is mainly in a negative direction. Preferred average marriage age for girls of more than 80 % of women was more than their age at the time of marriage. Based on this study, women's socio-economic status, attitude toward marriage, women's independence, and age of respondents had the most significant impact on the gap between the attitudes and behavior of women's marriage age.

Different statistical methods such as logistic regression and multiple regression models were applied for analyzing influential factors on marriage age (6, 11). These traditional methods may counter some problems such as occurring complicated interactions and the difficulty of their studying and handling missing data. To solve the deficiency of these methods, the application of data mining, which is a computational process of discovering patterns in large data sets could be applied. The main aim of this study was to investigate influential factors on youths' marriage age gap by gender by applying one of the most applicable classification trees of CART.

Methods

The application of the Classification and Regression Trees (CART) method is increasing in demographical data recently (17-23). Amongst data mining methods, the decision tree has various advantages of understanding and interpreting simple, requiring little data preparation, handling both numerical and categorical data, the possibility of validation a model using statistical tests, being robust, and performing well with large datasets. The decision tree can be described as a model that predicts the value of a target variable based on several input variables. CART algorithm (24) is one of the most applicable classification trees which extracts binary splits. CART is a non-parametric statistical methodology developed for analyzing classification issues. If the dependent variable is categorical, the CART algorithm produces a classification tree. When the dependent variable is continuous, it produces a regression tree. In both classification and regression trees, CART's primary goal is to produce an accurate set of data classifiers by uncovering the predictive structure of the problem under consideration (24). CART methodology is done in three-phase of construction or building of maximum tree, selection of right tree size, and classification of new data (25).

To fit the CART algorithm, demographics, fertility attitudes, and socio-economic characteristics of 12741 pre-married youths from 31 provinces in Iran in 2014 were used. The following section devoted to introducing briefly CART algorithm and the data set. Section (3) presents the results, and concluding remarks are stated in Section (4).

The data of this study was extracted from a cross-sectional study under the title of "Childbearing Attitudes and Its Social, Economic and Cultural Factors" (26). In this survey, the Cochran formula by considering 5 % error was used to select the number of participants. A sample of 12741 Iranian pre-married youths almost in the same gender (6381 males and 6360 females) was selected by a multi-stage stratified method from those who were referred to public health centers for doing pre-marriage test in 31 Iranian provinces in 2014. Steps of sampling procedure could be summarized as selecting three cities in each province based on the size and distribution of population using probability proportional to size sampling method then filling out a self-reported questionnaire by youth which randomly selected within each center. Careful monitoring system was used during the survey time to reduce the percentages of errors (26). It is important mentioning that in the present study, no intervention was carried out thus there was no requirement to obtain ethical code. However, oral consent has been asked from respondents prior to fill out the questionnaire.

The research variables include independent and dependent variables. Dependent variable rates the gap between women's marriage age behavior and their appropriate age for marriage of girls and boys. This variable indicates the difference between the pattern of marriage observed and experienced by youths and their expected pattern about the marriage age. This index was computed based on their behaviors and attitudes toward marriage age. The respondents' ages, which show their marriage-age was considered as their behavior about marriage age (since they were going to marry in the same year of the study, all of them had the same marriage age as their ages). The respondent's attitude about the convenient marriage age for youths was also questioned. Finally, the difference in the age of youths in their first marriage and their ideal marriage age was calculated as Marriage Age Gap (MAG).

The MAG index consists of two components: the sign and its absolute value. The sign shows the direction of the difference. Its absolute value represents the amount of gap between the youths' attitude and appropriate age for marriage. This value can be zero, positive, and negative values. The zero value (considered as on-time) indicates that the marriage age of youths (their exact ages) is their ideal marriage age. Positive values (considered as sooner) indicate that the youths married sooner than their desired marriage age. On the contrary, the negative value (considered as later) indicates that they married later than their ideal marriage age.

Opinion towards childbearing as dependent variable is measured according to *cultural questions* (1- Families with a child have a greater sense of happiness than childless families, 2- Childbearing strengthens the power of commitment of the people, 3- Life without a child is cold and soulless, 4- Good children are a blessing and God will help for their expenditure, and 5-The existence of a child strengthens the family); *social questions* (1- These days if you have more than two children, 2- These days, if you don't have a child people will blame you, 3- Childbearing spoil mother's body fitting, 4- Spending money for what you may like is better to spend it for childbearing, 5- Childbearing is a difficult task and takes comfort from an individual, 6- Childbearing can spoil women's educational and career progresses which are more important than childbearing for them, and 7- These days many people prefer to delay their childbearing because of distrust to their husbands);

and *economic questions* (1- Children will be parental support in old-age, 2- Concerns and uncertainties about the future make people unwilling for childbearing, 3- If the government protects families especially employed women they will have more children and the parents' reason to prevent from having a child is the cost of raising a child). According to the score of individuals, this variable is categorized to three groups of positive, neutral and negative attitudes.

There are little studies like as (19-20) which considered province divisions in fertility analysis. Since in different studies, the developmental level of different provinces of the country has been effective in their fertility, ignoring the differences between provinces' infertility analysis is preventing the achievement of accurate results (19). In this study, to more precise data analyzes of these provinces; they were divided into two provincial classes based on their TFR. These classes were constructed based on whole provinces TFR in the country from 2009 to 2011, which were calculated in the study of (27) based on the own-children method. According to the values of TFR and replacement level, the province of Iran divided into two categories of TFR≤2 and TFR>2 in this study.

Results

Among 12741 youths, 49.92% of females, and 50.08% of males admitted to public health and treatment centers to receive before marriage consultant in 31 provinces in Iran in 2014 were selected. Mean ±SD ideal marriage age of males (25.24±3.46) and females (21.79±3.34) was less than the average marriage age of males (26.86±5.05) and females (23±5.57) in this study. Figure 1 illustrates the frequency figures of variables in this study by gender. The results of Figure 1 show that 47.9% of females and 52.8% of males thought that they married later than their desired time. 33.9% of females and 27.8% of males thought that they married sooner. 79.6% and 77.1% of females and males had neutral opinions toward childbearing, respectively. The percentages of negative opinions about childbearing for males (14.8%) were more than females (12%). Most females (87.4%) and males (88.6%) lived in urban areas. 24% of females against 86.1% of males were employed. Almost all of the youths had at least one sibling (97.7% of females against 98.3% of males). Only 1.4% of females and 4.1% of males had 5 and more children. More than 40% of females and males were university-educated youths. Almost 80% of females and males lived in provinces with Total Fertility Rate (TFR) less than replacement level.

Table 1 presents the results of MAG for youths crossed by predicted variables. According to the results of Table 1, except for opinion toward childbearing and province categories, the other predicted variables had significant effects on MAG for females (P<0.01). All the selected variables except the place of residence and province category variables were significant in MAG for males (P<0.05). According to the results, most of the youths with different opinions toward childbearing, job status, Ideal Number of Children (INC), and province categories married later than their desired time. 49% and 45.5% of females married later and sooner than their desired age, respectively. While, more than 50% of males, whether they were living in urban (52.4%) or rural areas (55.7%) married later than their desired time. Most of the females with less than 2 (53.7% of no-siblings and 43.3% of 1-2 siblings) comparing to more than 2 siblings married sooner than their desired time. Similar to this group most of the males (39.1%) didn't have siblings. Most females with secondary school and less (45.2%) and university (61.0%) educational levels compared to high school and diploma (33.8%) educated ones married later than their desired time. Most of the males in different educational levels (56.5%of secondary school and less, 50.1% of high school and diploma, and 53.7% university educational levels) are similar to this group.

Table 1. Marriage Age Gap (MAG) Crossed by Predicted Variables

Variables		Female Marriage Age Gap (Response Variable)					Male Marriage Age Gap (Response Variable)				
Name	Value	Sooner	On-time	Later	Total	Test statistic (*P*)	Sooner	On-time	Later	Total	Test statistic (*P*)
Opinion toward Childbearing	Negative	33.2	18.6	48.2	100	3.01* (.56)	26.1	23.4	50.5	100	12.40* (.015)
	Neutral	33.9	18.4	47.6	100		27.9	18.8	53.3	100	
	Positive	34.3	15.6	50.1	100		29.9	17.5	52.6	100	
Place of Residence	Urban	32.6	18.4	49.0	100	31.57* (<.00)	27.9	19.7	52.4	100	3.48* (.175)
	Rural	42.5	16.9	40.5	100		27.1	17.2	55.7	100	
Job Status	Employed	16.2	14.7	69.2	100	391.56* (<.00)	26.0	19.3	54.8	100	76.15* (<.00)
	Unemployed	39.5	19.4	41.2	100		39.1	20.1	40.7	100	
Number of siblings	No siblings	53.7	22.8	23.5	100	347.93** (<.00)	39.1	23.6	37.3	100	175.04** (<.00)
	1-2 siblings	43.3	21.3	35.4	100		36.4	22.4	41.2	100	
	3-4 siblings	31.0	17.0	51.9	100		26.7	18.3	55.0	100	
	≥5 siblings	22.2	14.9	62.9	100		21.3	17.7	61.0	100	
INC	1-2 children	34.9	18.1	47.0	100	10.86** (<.001)	29.5	19.8	50.8	100	32.45** (<.00)
	3-4 children	30.5	18.7	50.8	100		24.2	18.5	57.3	100	
	≥5 children	25.85	20.2	53.9	100		19.7	18.1	62.2	100	
Province category	TFR<2	33.6	18.2	48.2	100	0.981* (.64)	27.9	19.3	52.9	100	.262 (.877)
	TFR≥2	34.9	18.5	46.7	100		27.5	19.9	52.6	100	
Educational Level	Illiterate, Primary and Secondary School	42.3	12.5	45.2	100	524.14* (<.00)	25.3	18.2	56.5	100	14.89* (.005)
	High School/Diploma	46.4	19.8	33.8	100		29.7	20.2	50.1	100	
	University	20.2	18.9	61.0	100		27.2	19.1	53.7	100	
Total		33.9	18.2	47.9	100		27.8	19.4	52.8	100	

*Pearson Chi-Square
**Linear-by-Linear Association
TFR: Total Fertility Rate
INC: Ideal Number of Children

CART algorithm was fitted to classify MAG of youths in Figures 2 and 3 by gender. These figures present the most accurate classification tree of marriage age gap based on predicted variables of opinion toward the childbearing, place of residence, job status, number of siblings, INC, educational level, and province categories.

Table 2 indicates the misclassification matrix for the classification of MAG of male and female youths, separately. This confusion matrix could be used to compute the accuracy of the fitted model. The number of correct predicted categories of the response variable makes the numerator and the total sample size constructs the denominator of the accuracy of the fitted model. The value of accuracy for both fitted CART models will be calculated in the discussion section.

Table 3 shows risks and standard errors of classification tree for females' and males' MAG, which are calculated based on training and learning data. To fit the CART algorithm to data sets, data divided into two different groups of training (to fit the model) and learning data (to confirm the validity of the model), and the model fits these two groups. When the risk of these two data groups is close to each other, it confirms the validity of the fitted model (29).

Table 2. Misclassification Matrix for Classification

	Observed Category	Female				Male			
		Predicted Category			Total	Predicted Category			Total
		Sooner	On-time	later		Sooner	On-time	later	
Sooner	Numbers	1262	0	893	2155	145	0	1429	1574
	Total (%)	19.84	0	14.04	33.88	2.27	0	22.39	24.66
On-time	Numbers	432	0	727	1159	71	0	966	1037
	Total (%)	6.79	0	11.43	18.22	1.11	0	15.14	16.25
Later	Numbers	380	0	2666	3046	73	0	3697	3770
	Total (%)	5.97	0	41.92	47.89	1.14	0	57.94	59.08
Total	Numbers	2074	0	4286	6360	289	0	6092	6381
	Total (%)	32.61	0	67.39	100	4.53	0	95.47	100

Table 3. Risks and Standard Errors of Classification Trees

	Female		Male	
	Risk	Standard error	Risk	Standard error
Learning set	.414	.006	.461	.006
k-fold cross validity of training set	.416	.006	.463	.006

Discussion

Changes in the field of marriage and family patterns, as well as many other aspects of social life, are an irrefutable reality of life in the modern world. Modernization and socio-economic development are the main factors for these changes. Most of the previous studies were related to the study of the influential factors on behaviors or attitudes of MAG, separately. Moreover, most of them focused on females' MAG. However, this study attempted to investigate the effect of socio-economic variables on the youths' MAG in Iran by gender through the application of Classification and Regression Trees (CART).

According to the results, there was a gap in youths' behavior and attitudes towards the appropriate age of marriage. The youth's marriage age of almost 80% of the sample population is different from their age at the time of marriage (sooner or later). The gaps were mainly in a positive direction, which means that youths married later than their desired time.

The accuracy of the classification tree for the fitted CART models can be calculated from the results of Table 2 by equations 3 and 4.

$$Accuracy = \frac{1262+2666}{6360} = 0.62 \quad (3)$$

$$Accuracy = \frac{145+3697}{6381} = 0.60 \quad (4)$$

Classification accuracy equals 0.62, and 0.60 means that MAG of 62 and 60 % of females and males have been correctly classified, respectively (This value indicates that misclassifications of these models are equal to 38 and 40 %).

To fit the CART algorithm to data sets, data divided into two different groups of training (to fit the model) and learning data (to confirm the validity of the model), and the model fits these two groups. When the risk of these two data groups is close to each other, it confirms the validity of the fitted model (29). According to the results of Table 4, these values are almost equal for females and males, which indicate the validity of classification models proposed by classification trees in Figures 2 and 3.

According to Figure 2, the educational level variable was located in the root of the CART algorithm of females' MAG. The other influential variables in this figure were the number of siblings and job status. In Figure 3, the number of sibling variables was located in the root of the CART algorithm of males' MAG. Job-status, educational levels, INC, and opinion also influence this variable too.

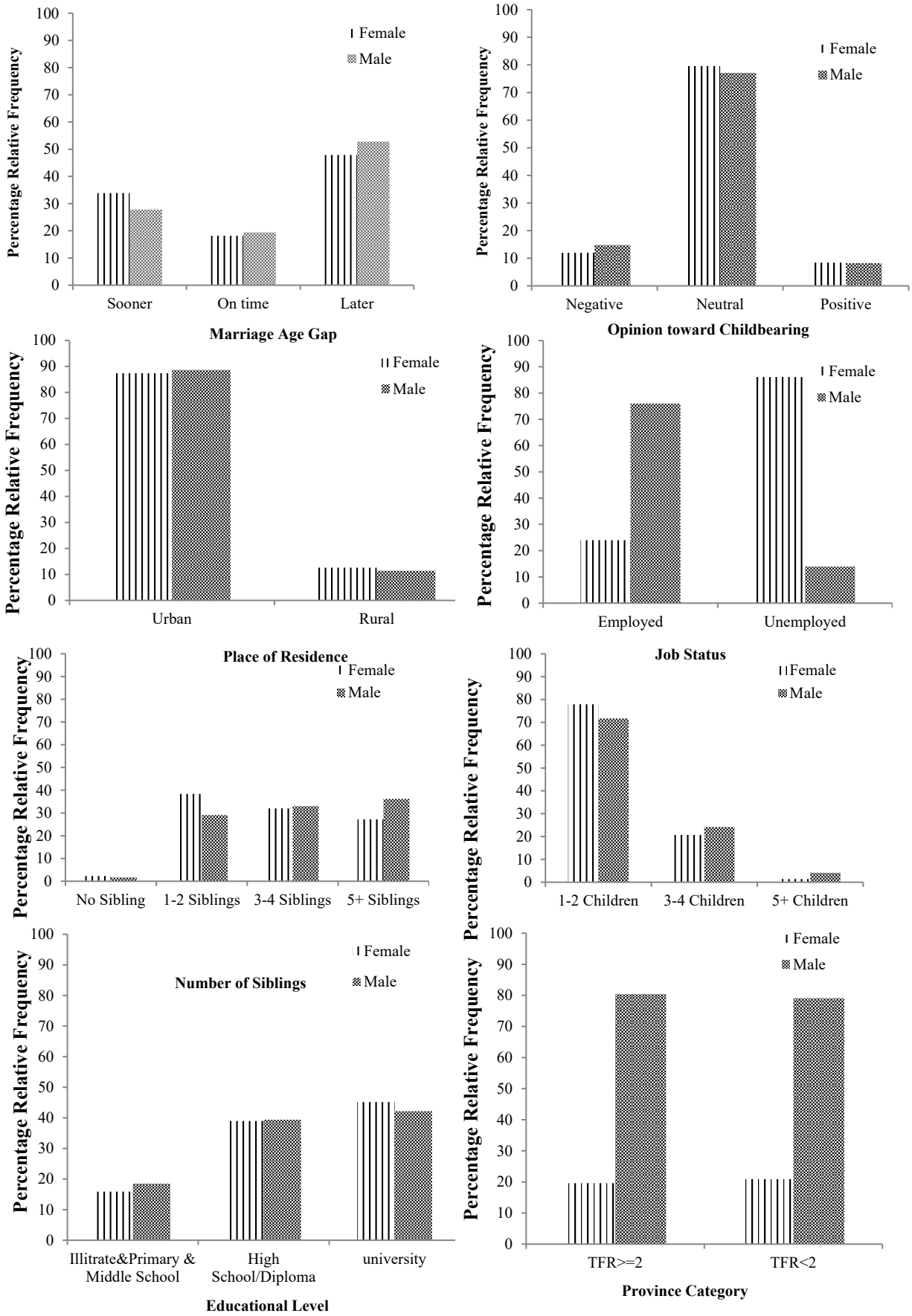

Figure 1. Percentage Relative Frequency figures of variables by gender

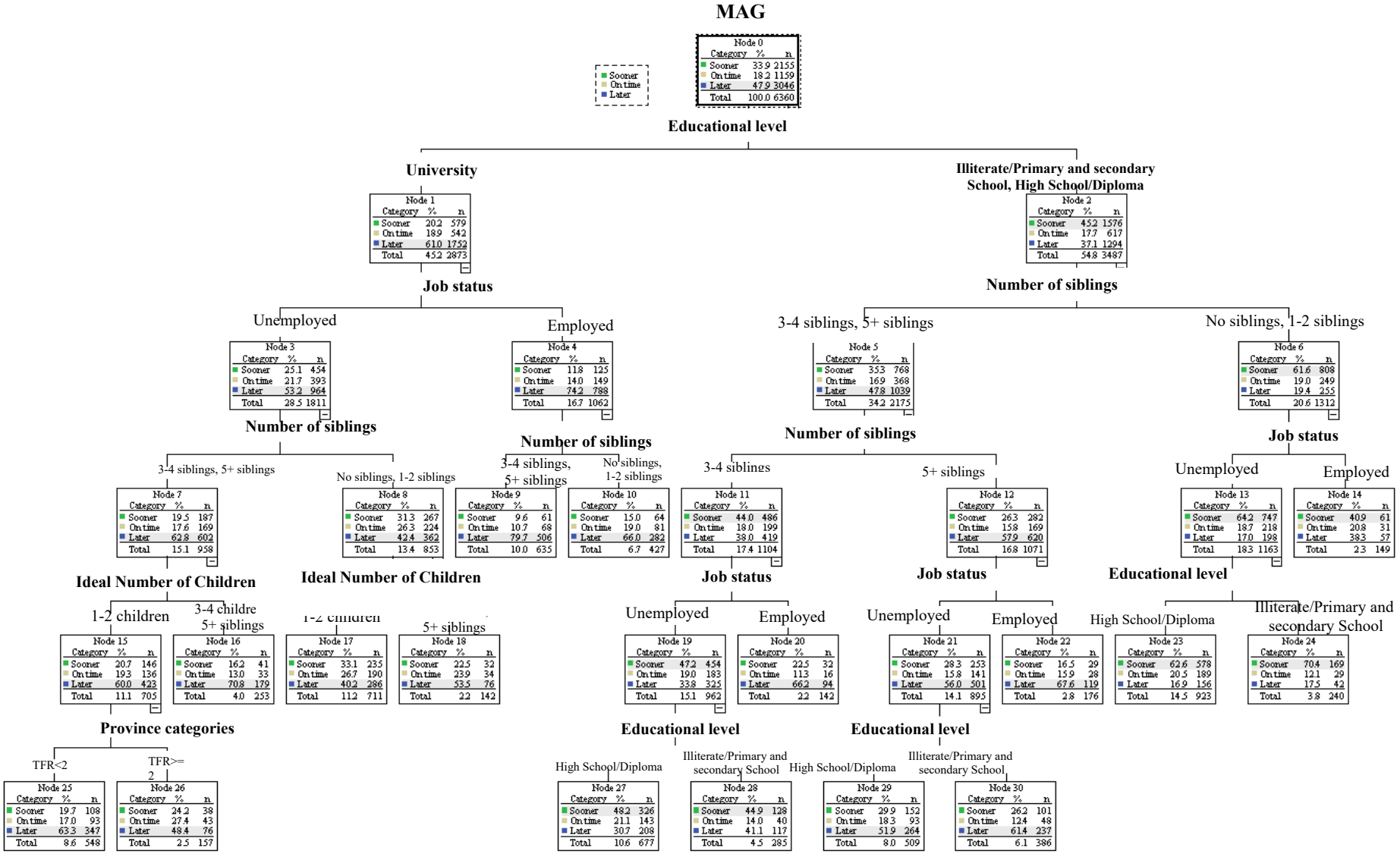

Figure 2. Classification Tree of Female's MAG

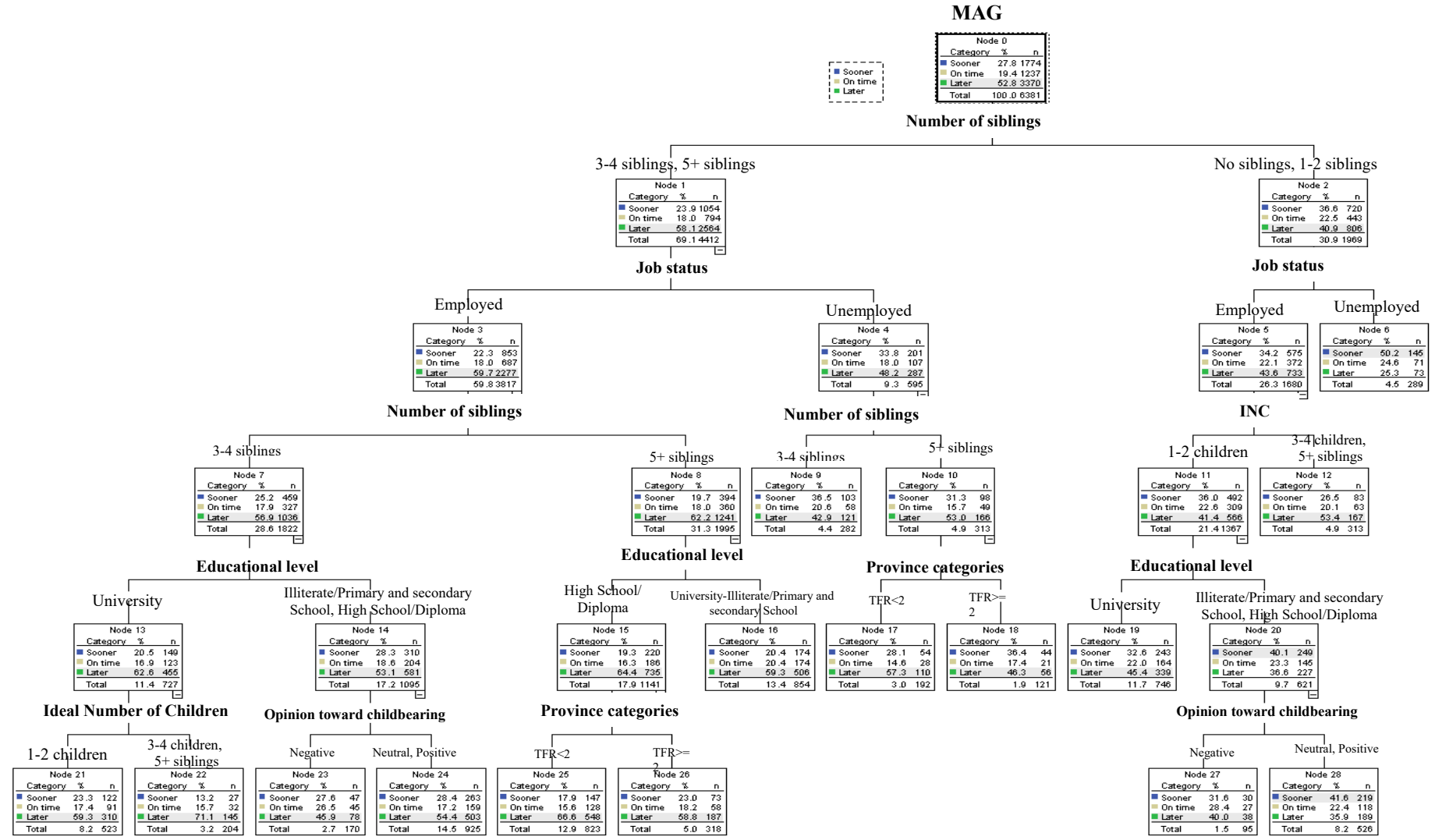

Figure 3. Classification Tree of Male's Marriage Age Gap

Rules 1 to 3 can be extracted from the classification tree of MAG for youth females in Figure 2:

1- University educated females married later than their desired timer.

2- Diploma and less educated females with 2 and fewer siblings opposite to 5 and more siblings married sooner than their desired time.

3- Diploma and less educated females with 3 or 4 siblings who are employed opposite to unemployed married later than their desired time.

The followings are the extracted rules from Figure 3:

1- Males with 3 and more siblings married later than their desired time.
2- Unemployed males with 2 and fewer siblings married sooner than their desired time.
3- Employed males with 2 and fewer siblings and 3 and more INC married later than their desired time.
4- Employed males with 2 and fewer siblings and 1 or 2 INC who are university-educated married later than their desired time.
5- Employed males with 2 and fewer siblings and 1 or 2 INC who are diploma and less educated with neutral and positive opinions married sooner than their desired time.
6- Employed males with 2 and fewer siblings, and 1 or 2 INC who are diploma and less educated with negative opinion married later than their desired time.

Females' educational level was the most important variable in the fitted CART algorithm of females' MAG. However, this variable was also influential in Males' MAG. Youths with higher educational levels married later than their desired marriage age. Some of the other authors are confirmed these results such as (1, 5-7, 10, 28). They stated that increasing educational levels of youths especially females could cause delays in marriage age and as a result, increasing MAG. Kazemipour et al. studied the factors affecting the age of marriage and concluded that educational level, ethnicity, place of residence, and the socio-economic situations of youths affected the age of their marriage (1). Zarrabi et al. examined the factors influencing the marriage age in Iran with an economic approach (5). They studied women's marriage age according to a different range of variables and found that educational level had a negative effect on the marriage age and living in rural areas, in comparison with urban areas, had a positive effect on women's marriage age. The results of them also showed that increasing career opportunities and earnings for men could lead to a sooner marriage age (5). Maitra et al. and Mensch et al. highlighted the impact of education on increasing the age of marriage among girls (29-30). Rezaedost et al., in the study of the marriage age of the employed women in Ahwaz, reached this conclusion that the delay in the marriage of women and variables such as educational level and income are correlated (28).

The number of siblings was the most important variable on males' MAG though this variable also was one of the influential variables on females' MAG. Youths with more siblings married later than their desired time. This result is in the same line as other studies (31-32). These authors reached this conclusion that people with more siblings or who are themselves among the older siblings are likely to marry earlier. Another effective variable on youths' MAG is job status. According to the results of this study, employed youths married was more delayed than their desired time. The results of this study were confirmed by (2, 6, 16, 33). Bohairai et al., to identify the effective factors in increasing the age marriage of female university students, indicated that 80.8% of respondents agree with this statement that unemployment is the most important factor in increasing the age of marriage (34). Zarabi et al. showed that increasing career opportunities and earnings for men could lead to a sooner marriage age (5).

Opinion towards childbearing was also influential in males' marriage age. Those with the negative opposite to positive and neutral attitudes towards childbearing thought that they married later than their desired time. This variable has been studied in Ardebili's et al. study by measuring males' opinions towards marriage and selecting a wife (35). Most probably this result indicates that youths are thinking about marriage and childbearing as two separate phenomena. Marrying is not summarized to childbearing for them (36).

Based on the results of this study, in order to solve a social problem called the marriage age gap, the socio-economic conditions of youth should be improved.

The current study is a kind of research that has used secondary data. There were some important limitations such as lack of information about the time-varying independent variables (the information of independent variables at the time of the respondent's desired marriage time). In the fitted CART algorithm just the data of independent variables at the time of the study which was the same as their real marriage time were included. Changing the socio-economic status of youth could impact their desired marriage time. Moreover, the selected youth in this study didn't experience childbearing which could influence their attitude towards their marriage time. It is recommended that further studies in this area consider these suggestions in the studies.

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Conflict of interest

Authors declare no conflict of interests.

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