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Evaluating Factors Affecting Reproductive Success by Intrauterine Fertilization: The Cases in Qom University Jihad Center, 2018-2019

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ABSTRACT

The aim of this study was to investigate the factors affecting the success of the IUI method in couples who referred to the Jihad University Infertility Center in Qom province. Classification of groups and their comparison was done through descriptive statistics, t-test and ANOVA tests through SPSS software version 23 and $p < 0.05$ was considered as a significant level. In terms of age and male age variables, endometrial thickness and serum FSH level on the third day did not show a significant difference between the two groups with successful IUI and those with unsuccessful IUI. There was a significant difference between the two groups of successful IUI and unsuccessful IUI in terms of follicle number above 14 mm, normal sperm morphology and sperm count in men. Both successful IUI and unsuccessful IUI groups were similar in terms of history of premature ejaculation, history of male testicular disorders and type of infertility, and no significant difference was observed between the two groups. It is effective in the success of fertility with intrauterine insemination and has a significant role in increasing the rate of pregnancy with intrauterine insemination.

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GRAPHICAL ABSTRACT

Introduction

Until three decades ago, infertility for each couple may have been considered impossible and intermittent, but since the late twentieth century we have seen significant advances in reproductive medicine. Every year, a large number of children are born in different countries through assisted reproductive techniques [1]. For example, between 1990 and 2010, about 480 children were born through assisted reproductive techniques in a single clinic in the United Kingdom. These technologies include: IVF (in vitro fertilization) and ICSI (intracytoplasmic sperm injection). Reproductive method of intrauterine sperm insemination or IUI is one of the most common and well-known methods of artificial insemination today due to its ease of use, lower cost than other methods and non-invasive method. In the past, small amounts of unprepared semen were used for intrauterine insemination, but due to the possibility of reacting to proteins and prostaglandins and bacteria in the semen and the very low success of this insemination method, now only it is a historical topic and today, instead of semen, washed sperm in the form of spermatozoa are used [2].The first written IUI procedure dates back to 1962, when it was very simple, but since then the method has changed a lot and many preparations have been made before, such as sperm preparation, ovulation evaluation. HCG injections and clomiphene citrate or letrozole are administered, according to the European IVF Evaluation Agency. In 2004, 93388 IUI procedures were performed in 19 countries [3]. Of this number, 12081 cases resulted in 12.9% of births, of which 87% were singles and 13% were twins. Today, intrauterine insemination of sperm is usedin the treatment of infertility due to cervical factor, lack of ovulation, mild endometriosis, immunological factor, male-oriented causes such as mild oligospermia and unknown causes. This method is usually used as an intermediate stage as and easier than other methods of infertility treatment such as in vitro fertilization (IVF) or intracytoplasmic injection of sperm (ICSI) which reduces erosion. The sperm is secured during the ascent from the reproductive system and the presence of a large number of sperm capacity in the place of fertilization, i.e., the end of the fallopian tube

ampule, and by leaving aside the cervical mucus and other effective factors in reducing the number of sperms involved in fertilization completely eliminate these factors as factors of infertility [4-6]. The probability of pregnancy in IUI method based on studies has been between 11.4% and 12.6% depending on the presence or absence of success factors, which has been accepted by many experts in this field due to the amount of payment and the simplicity of the procedure.Many factors can increase the rate of pregnancy and childbirth by using this method in infertile candidates. Predictors of male success include motility, sperm shape, and number of inoculated sperm, and predictors of success in women include age over 38, adequate egg storage, and egg maturity [7-9].

Materials and Methods

This study was a retrospective-analytical study and was performed on 200 infertile couples who were treated with IUI by referring to Jihad Daneshgahi Infertility Center. First, we referred to the Jihad University Center of Qom province. Then, couples who were treated with IUI during the period of April 2017 to March 2017 were identified and the subjects were divided into two groups: 100 successful IUI couples and 100 unsuccessful IUI couples. Next, their files in terms of the following variables were formed: Female age - type of infertility - duration of infertility - serum FSH level on the third day of female - number of follicles above 14 mm female - female endometrial thickness - male age - number of male sperm - male sperm motility - rate Normal morphology of male sperm - History of premature ejaculation in men - History of testicular disorders in men. Subsequently, the required information was recorded in a researcher-made questionnaire. In this study, IUI was defined as a positive BHCG test on the 12th and 14th postoperative days, as well as observation of the gestational sac. Also, BHCG positive number above 50 and negative number below 50 were considered. IUI failure meant that at least one of the two BHCG tests was negative or that the pregnancy sac was not observed [10-12]. Then, this information was fed into SPSS software and the relationships between the variables were examined using descriptive statistics, ANOVA and t-test. Significance level of the test was considered $P < 0.05$.

Findings

In order to get more acquainted with the population of the study in this section, some of the individual characteristics collected in four different sections of the questionnaire is presented. First, their demographic (identity) characteristics and cultural, social and economic status in the form of 12 questions were elicited, followed by their midwifery characteristics and medical records in 12 questions, then the level of adequacy of their care in 2 questions and finally the extent of the effect of factors preventing proper care were asked. Pregnancy is measured in 15 questions with yes and no answers, which will be described using tables.

Based on the findings of the above table, according to the independent t-test in the variables of female age ($P = 0.413$), male age ($P = 0.844$), female endometrial thickness ($P = 0.156$), serum FSH level on the third day of female ($P = 0.125$), male sperm motility ($P = 0.251$), duration of couple infertility ($P = 0.463$), no significant difference was observed between the two groups. In other words, both successful IUI and unsuccessful IUI groups were similar in terms of these variables. However, the number of female follicles above 14 mm ($P = 0.023$), the normal morphology of male sperm ($P = 0.001$) and the number of male sperm ($P = 0.036$) were significantly different between the two groups. In other words, the number of female follicles above 14 mm, the normal morphology of male sperm and the number of male sperm in the successful IUI group were higher than those of the unsuccessful group.

Table 1. Comparison of continuous research variables in two groups with successful and unsuccessful IUI

P Value	Df	t	Successful100=n	Unsuccessful100=n	group
			Average ±Standard deviation	Average ±Standard deviation	Variable
0.413	198	0.821	5.61 ± 28.5	5.42 ± 29.2	Female age (years)
0.844	198	-0.197	6.01 ± 33.3	6.21 ± 33.2	Male age (years)
0.156	198	1.426	1.71 ± 7.1	1.4 ± 7.4	Female endometrial thickness (mm)
0.023	198	-2.289	1.25 ± 2.2	1.16 ± 1.8	Number of follicles above 14 mm female
0.125	197	1.541	2.24 ± 6.2	2.34 ± 6.7	Serum FSH level on the third day (MIU / ml)
0.001	198	-3.320	3.96 ± 5.3	2.41 ± 3.8	Normal morphology of male sperm (percentage)
0.251	198	-1.152	14.1 ± 30.5	11.14 ± 28.4	Male sperm motility A + B (percentage)
0.036	198	-2.107	34.06 ± 95.1	39.55 ± 84.1	Male sperm count (million / ml)
0.463	198	0.736	2.59 ± 3.5	2.79 ± 3.8	Duration of couple infertility (years)

Based on the findings of Table 2, according to the chi-square test, there was a significant difference between the two variables: history of male preterm birth (P = 0.355), history of male testicular disorders (P = 0.063) and type of couple infertility (P = 0.174). However, both successful and unsuccessful IUI groups are similar in terms of these variables.

Table 2. Comparison of research discrete variables in two groups with successful and unsuccessful IUI

P Value	Successful100=n		Unsuccessful 100=n		group	Variable
	Percentage	Abundance	Percentage	Abundance		
0.355	%67	67	%73	73	does not have	Premature history of male
	%33	33	%27	27	has it	
0.063	%83	83	%72	72	does not have	History of male testicular disorders
	%17	17	%28	28	has it	
0.174	%63	63	%72	72	Secondary	Type of couple infertility
	%37	37	%28	28	primitive	

Table 3: Frequency table of respondents' age characteristics Property

Valid percentage	Frequency percentage	Abundance	Property
8.1	8.0	21	Age
21.7	21.5	56	
28.3	28.0	73	
25.2	24.9	65	
12.0	11.9	31	
4.7	4.6	12	
100.0	98.9	258	
	1.1	3	
	100.0	261	
5.6	5.4	14	The age of wife and husband
31.0	29.9	78	
29.8	28.7	75	
19.4	18.8	49	
14.3	13.8	36	
100.0	96.6	252	
	3.4	9	
	100.0	261	
7.4	7.3	19	Marriage Age
51.4	50.6	132	
28.0	27.6	72	
11.3	11.1	29	
1.9	1.9	5	
100.0	98.5	257	
	1.5	4	
	100.0	261	

Regarding the level of education, the answers were as follows: About 72% of the respondents (1.9% illiterate and 70% with primary education up to diploma) had no university or seminary education. This means that only 28% of the respondents had university and seminary education. 1 respondent did not answer this question. Although the percentage of illiterate people among the respondents 'spouses was more than that of the respondents, the percentage of respondents' wives with university and seminary education was also higher than

that of the respondents in this section. Regarding the level of education of the respondents' spouses, 58.8% have primary education up to diploma, 29.2% had university education and 6.5% had seminary education. Also, 5.4% of the respondents' spouses were illiterate. 1 person also left this question unanswered.

Table 4: Frequency table of respondents' educational characteristics

Valid percentage	Frequency percentage	Abundance	Property
1.9	1.9	5	Level of Education
70.0	69.7	182	
25.0	24.9	65	
3.1	3.1	8	
100.0	99.6	260	
	0.4	1	
	100.0	261	
5.4	5.4	14	Level of Education (Wife & Husband)
58.8	58.6	153	
29.2	29.1	76	
6.5	6.5	17	
100.0	99.6	260	
	0.4	1	
	100.0	261	

Regarding the employment status of the respondents and their husbands, among women, only 6.9% of them were employed and 93.1% of them were housewives. 48% of the respondents' spouses were self-employed, 19.9% were employees and 9.5% were workers. Unfortunately, 1.4% of these married people who were also having children were unemployed. Finally, 21.3% of these spouses were clerics and did not engage in any particular profession. 5 people did not answer this question properly. The results obtained regarding the racial and residential status of the respondents show that 89.7% of the women in this study were Iranian and 10.3% were non-Iranian. Among 261 respondents, 86.6% were born in the city and 13.4% were born in the village. Most of the pregnant women participating in this study lived in the city. Thus, 98.5% of them lived in cities and 1.5% in rural areas. 54.8% of the respondents had rented properties and the other 43.7% owned personal properties. 13 people did not answer the question, which is valid in the table below in the percentage column. It should be noted that regarding the variables of race, place of birth and place of residence, according to the response of all respondents, the values of the frequency percentage column have been equated with the valid percentage column; the frequency column values have been used.

Table 5: Frequency table of respondents' job characteristics

Frequency percentage	Abundance	Property
93.1	243	Job
6.9	18	
100.0	261	
21.1	55	Job (Wife & Husband)
22.2	58	
46.0	120	
1.1	3	
0.8	2	
1.1	3	
7.3	19	
0.4	1	
100.0	261	

Table 6: Frequency table of racial and residential characteristics of the respondents

Valid percentage	Frequency percentage	Abundance	Property
	89.7	234	Race
	10.3	27	
	100.0	261	
	86.6	226	place of birth
	13.4	35	
	100.0	261	
	98.5	257	Location
	1.5	4	
	100.0	261	
55.6	54.8	143	Location type
44.4	43.7	114	
100.0	98.5	257	
	1.5	4	
	100.0	261	

Discussion

1- **Female age:** In the present study, no significant difference was observed between the age of women in the two successful IUI groups and in the unsuccessful IUI group. In the study of Korian et al.(2019), the pregnancy rate in women under 30 years old was about 35%, which was not significantly different from 32% in the group over 30 years old. In the Smoon Khah's(2019), study, 217 patients were divided into 4 age groups: under 30 years, 30 to 34 years, 35 to 39 years and over 40 years. Of these, 36 (18%)

had successful pregnancies. The highest number of people was in the age group of 35-39 years (41.5%). Accordingly, the highest pregnancy rate was equal to 33.3% of the group under 30 years old, which was significantly different from other groups (p = 0.006) [13-15]. According to this study, the younger the women at the time of referral, the higher the probability of successful pregnancy.In the current study, the highest fertility rate with 10 numbers was related to the age group of 34-30 years, followed by the age group of 29-25 years and 39-35 years with 7 pregnancies. From this study, it was concluded that the younger the couple at the time of referral, the higher the success rate of IUI. In the study by Khamka et al.(2017), 8 pregnancies under the age of 30 years and 3 pregnancies over the age of 30 years occurred with a significant difference (p = 0.003). The overall result of this study is that the age of under 30 years enhances the success rate of use. IUI method has a positive effect. This study was consistent with the studies of Kourian et al. (2019). But did not agree with the studies of Smonkhah, Ani and Khumka(2019). In this study, individuals were randomly selected and the age range for the study was not determined.The lack of significant differences between the two groups is the evidence of sampling with appropriate dispersion for the study [16-18].

2- **Male age:** In the present study, there was no significant difference between the age of men in the two successful IUI groups and in the unsuccessful IUI group. Studies recorded in the Danforth book [19] show that men over 35 are twice as likely to be infertile as men under 25. Among infertile couples, the time required for pregnancy to increase significantly increases with age (when women are similar in age). This study was inconsistent with studies recorded in the Danforth book and found that aging had no effect on the success of IUI surgery. In this study, individuals were randomly selected and the age range for the study was not determined and the lack of significant differences between the two groups is the evidence of sampling with appropriate dispersion for the study [20-23].

3- **Type of infertility of couples:** In the present study based on the type of infertility, among couples with primary causes, 20 people and with secondary causes, 14 people became pregnant. From this study, it was concluded that in infertility of primary type, the rate the success of IUI surgery is higher. The present study found that the primary or secondary type of infertility is not a predictor of the success of IUI surgery [24-27].

4- **Duration of infertility of couples:** In the study of Korian and his colleagues, the duration of infertility was divided into under 5 years and over 5 years, in which 102 people, equivalent to 52% of people, had an infertility period of less than 5 years.32% of the population in this group did not become pregnant, but in the infertility group over 5 years, this rate was 55%, which was a significant difference between the two groups. As a result, the duration of infertility was involved in pregnancy and the best response to this method is people, having duration of infertility equal to 4 years [28-30]. In the Smunkhah study, the duration of infertility varied from 1 to 17 years, which was 3.5 years in the under 30 age group, 4 years in the 30-to-34-year group, 7 years in the 35-to-39-year group, and 9 years in the over 40 age group. According to this study, the shorter the infertility period of women (under 4 years), and the higher the probability of successful pregnancy by IUI. In the study of Khamka et al., Couples who were infertile for 4 to 6 years had the

highest pregnancy success rates with 5 pregnancies and 56.3%, as well as 2 pregnancies in people with infertility 1-3 with 18.1% and 2 pregnancies in people with 9 There was 7 years of infertility with 18.1% and 1 pregnancy occurred in couples with 10 years of infertility, the difference between the first group and other groups was significant (P = 0.032). The overall result of this study was that the infertility period was short. It has a positive effect on the success rate of using the IUI method. In the current study, regarding the infertility duration variable, the highest success rate was related to people with a history of infertility 1-4 years with 19 pregnancies (33%) and then 5-9 years with a history of infertility with 12 pregnancies. It was found that the shorter the infertility period (under 3 years), the higher the success rate of IUI surgery. In the present study, there was no significant relationship between the duration of infertility and the success of IUI and it was not consistent with any of the studies. This result may be due to the small number of samples in the study, and it is likely that examining the relationship between this variable and the success of the IUI with a larger number of samples will provide more documented and accurate results [31-33].

5- **The number of male sperm:** In the study of Khomka and his colleagues, based on the results obtained from pregnant women, 7 of their wives had sperm count above 20 million and 4 less than 20 million with a significant level (p = 0.01)had a significant difference. The overall result of this study was that high sperm count has a positive effect on the success rate of IUI. In this study, the positive effect of high sperm count on the success of IUI was obtained, which is consistent with the previousstudies.

6- **Male sperm motility rate:** In this study, it was concluded that if the number of motile sperms used is more (more than 50% of the total sample), the success rate of IUI operation is higher. In the present study, there was a relationship between sperm motility rate and IUI success. This finding is against the previous findings.

7- **Normal morphology of male sperm:** The results of the study of Esmailzadeh et al. Showed that the normal morphology of sperm more than 5% can be a determining and influential factor on IUI results and normal morphology of sperm with normal number and motility plays an important role. According to the results of this study, the normal morphology of male sperm in the successful IUI group is higher than the unsuccessful group and is consistent with the studies of Ismailzadeh et al.

8- **History of male testicular disorders:** Based on the results of this study, no significant difference was observed in the history of testicular disorders in the studied men (P = 0.063) in the two groups. In other words, both successful and unsuccessful IUI groups were similar in terms of this variable.

9- **History of premature ejaculation in men:** Based on the results of this study, no significant difference was observed in the history of premature ejaculation in the studied men (P = 0.355), in the two groups. In other words, both successful and unsuccessful IUI groups were similar in terms of this variable.

10- **Serum FSH level on the third day of woman:** Ahmadpour et al. (2019)reported that with increasing FSH level, the number and quality of oocytes, fertile oocytes and pregnancy increase and the most positive effect is FSH = 10-15 miu / ml. According to the findings of this study, both successful IUI

and unsuccessful IUI groups are similar in terms of serum FSH level on the third day and the results are not consistent with those of Ahmadpour et al.

11- **Number of follicles over 14 mm female:** In the study of Corian et al., people who used one follicle, the pregnancy rate was 9.5% and the group that used more than one follicle for their fertility with a pregnancy rate of 18.1% was significantly different from the first group had. The final result of this study was that more follicles increase the probability of successful pregnancy. In a study by Esmailzadeh et al., the rate of pregnancy in cycles with only one follicle before ovulation was significantly lower than in cycles with three follicles. The results of the present study are consistent with those of Kourian et al., and Esmailzadeh et al., confirming that the higher the number of follicles above 14 mm in women, the greater the success of IUI.

12- **Female endometrial thickness:** In the study of Korian et al., endometrial thickness of more than 1 mm increased the probability of successful pregnancy. In the study of Khomka et al., 7 pregnancies with endometrial thickness above 10 mm and 4 pregnancies with thickness of 6-10 mm happened but no significant difference was observed.The study was consistent with the studies of Khumka et al., but did not agree with the studies of Korian et al. According to the present study, the thickness of the female endometrium is not a factor influencing the success of IUI [40].

Conclusion

The results of this study showed that the number of follicles above 14 mm female, the normal morphology of male sperm and the number of male sperm affect the success of fertility by intrauterine insemination and play an important role in increasing the rate of pregnancy by intrauterine insemination. Endometrial thickness and serum FSH level on the third day of female, male sperm motility and duration of male infertility are not predictive factors in the success rate of intrauterine insemination.

References

[1]. T. Moccetti, A. Busjahn, C. Schmidlin, A. Schmidt, B. Bradl, aydoganfood. Supplementation with an olive (Olea europaea L.) leaf extract reduces blood pressure in borderline hypertensive monozygotic twins. Phytotherapy *Research 2008*; 22 (2008) 1239–1242.

[2]. H. Sahraei, Z. Faghih-Monzavi, SM. Fatemi, S. Pashaei-Rad, SH. Salimi, et al. Effects of Papaver rhoeas extract on the acquisition and expression of morphine induced behavioral sensitization in mice. *Phototherapy Research*, 20 (2006) 737-741.

[3]. SE. Hosseini, S. Hamzavi, H. Aghababa, The effects of alcoholic extract of red poppy (Papaver rhoeas) on anxiety induced by elevated plus maze and the plasma corticosterone levels in adult male wistar rats. *Bimonthly Sabzevar University of Medical Sciences*, 22 (2015) 4-14

[4]. N. Osanloo, A. Najafi-Abedi, F. Jafari, F. Javid, M. Pirpiran, MRM. Jafari, et al. Papaver Rhoeas L. Hydro alcoholic Extract Exacerbates Forced Swimming Test-Induced Depression in Mice. *Basic and clinical neuroscience* 7 (2016) 195.

[5]. A. Jennings, AA. Welch, SJ. Fairweather-Tait, C. Kay, AM. Minihane, P. Chowienczyk, et al. Higher anthocyanin intake is associated with lower arterial stiffness and central blood pressure in women**.** *The American journal of clinical nutrition*, 96 (2012) 781-788.

[6]. K. Kent, KE. Charlton, A. Jenner, S. Roodenrys, Acute reduction in blood pressure following consumption of anthocyanin-rich cherry juice may be dose-interval dependant: a pilot cross-

over study. *International journal of food sciences and nutrition*, 67 (2016) 47-52.

[7]. R. Torres, Access Barriers to Prenatal Care in Emerging Adult Latinas. *journal of the National Association of Hispanic Nurses* 14(1) (2016) 6-10

[8]. MK. Reddy, HD. Schultz, H. Zheng, KP. Patel, altered nitric oxide mechanism within the paraventricular nucleus contributes to the augmented carotid body chemoreflex in heart failure. *American Journal of Physiology-Heart and Circulatory Physiology*, 292 (2007) 149-157

[9]. E. Farrokhi, M. Shafei, A. Khajavirad, M. Hosseini, ARE. Bideskan, Role of the Nitrergic System of the Cuneiform Nucleus in Cardiovascular Responses in Urethane-Anesthetized Male Rats. *Iranian Journal of Medical Sciences* 41 (2017) 41-52

[10]. G. Gargiulo, D. Capodanno, G. Longo, P. Capranzano, C. Tamburino, Updates on NSAIDs in patients with and without coronary artery disease: pitfalls, interactions and cardiovascular outcomes. *Expert review of cardiovascular therapy*, 12(10) (2014) 1185-1203.

[11]. Z. Wang, BC. Martorell, T. Wälchli, O. Vogel, J. Fischer, W. Born, J. Vogel, Calcitonin gene-related peptide (CGRP) receptors are important to maintain cerebrovascular reactivity in chronic hypertension. *PloS one*, 10(4) (2015) 123.

[12]. P. Agnieszka, K. Magdalena, M. Natalia, M. Korostynski, K. Starowicz. Expression of matrix metalloproteinases and components of the endocannabinoid system in the knee joint are associated with biphasic pain progression in a rat model of osteoarthritis, *Journal of Pain Res,* 10 (2017) 1973–1989.

[13]. X. Qiang, Z. Zhang, W. Suna. Effect of Naringin on Monosodium Iodoacetate-Induced Osteoarthritis Pain in Rats. *Med Sci Monit* 23 (2017) 3746–3751.

[14]. E. Farrokhi, MN. Shafei, A. Khajavirad, M. Hosseini, ARE. Bideskan, Role of the Nitrergic System of the Cuneiform Nucleus in Cardiovascular Responses in Urethane-Anesthetized Male Rats. *Iranian Journal of Medical Sciences* 41(2) (2017) 12-25

[15]. L. Marcocci, JJ. Maguire, MT. Droylefaix, L. Packer, Nitric oxide scavenging properties of Ginkgo biloba extract EGB 761. *Biochem. Biophys. Res. Commun*, 201 (1994) 748–757

[16]. P. Karimian, G. Kavoosi, Z. Amirghofran, Anti-inflammatory effect of Mentha longifolia in lipopolysaccharide-stimulated macrophages: reduction of nitric oxide production through inhibition of inducible nitric oxide syntha ,*J Immunotoxicol,* 4 (2013) 393

[17]. A. Samimi, M. Samimi, Investigating the Strategic Concept of Risk Management in the Stock Market and Investing, *Journal of Engineering in Industrial Research* 2 (1) (2021) 1-6.

[18]. A. Samimi, M. Samimi, Investigation of Risk Management in Food Industry, *Int. J. Adv. Stu. Hum. Soc. Sci.* 9 (3) (2020) 195-204.

[19]. A. Samimi, Risk Management in the Laboratory based on the 17025 Standards, *Journal of Exploratory Studies in Law and Management,* 7 (3) (2020) 114-119.

[20]. RE. Guzman, MG. Evans, S. Bove, B. Morenko, K. Kilgore, Mono-iodoacetate-induced histologic changes in subchondral bone and articular cartilage of rat femorotibial joints: an animal model of osteoarthritis. Toxicologic Pathology 31(6) (2003) 619-624.

[21]. H. Wang, J. Bai, B. He, X. Hu, D. Liu, Osteoarthritis and the risk of cardiovascular disease: a meta-analysis of observational studies. *Scientific reports*. 6 (2016) 396-72.

[22]. JM. Huston, KJ. Tracey, The pulse of inflammation: heart rate variability, the cholinergic anti-inflammatory pathway and implications for therapy. *Journal of internal medicine*; 269(1) (2011) 45-53

[23]. JM. Sankhari, MC. Thounaojam, RN. Jadeja, RV. Devkar, A V Ramachandran. Anthocyanin rich red cabbage (Brassica oleracea L.) extract attenuates cardiac and hepatic oxidative stress in rats fed an atherogenic, *diet* 92(8) (2012) 14

[24]. L. Chen, J. Huang, Y. Ji, X. Zhang, P. Wang, K. Deng, M. Jiang, G. Ma, H. Li, Tripartite motif 32 prevents pathological cardiac hypertrophy. *Clin Sci (Lond),* 130(10) (2016) 813-28.

[25]. Y. Huang, X. Cai, W. Mai, M. Li, Y. Hu. Association between prediabetes and risk of cardiovascular disease and all-cause mortality, *systematic review and meta-analysis*, 22 (2016) 355

[26]. S. Moncada, Sir John Robert Vane: 29 March 1927 - 19 November 2004. Biogr Mem *Fellows R Soc*, 52 (2006) 401-11.

[27]. A. Cassidy, G. Rogers, JJ. Peterson, JT. Dwyer, H. Lin, PF. Jacques, Higher dietary anthocyanin and flavonol intakes are associated with anti-inflammatory effects in a population of US adults. *Am J Clin Nutr*. 102 (1) (2015) 172-81.

[28]. O. Valenti, FA. Di Prima, E. Renda, M. Faraci, E. Hyseni, R. De Domenico, S. Monte, E. Giorgio, Fetal cardiac function during the first trimester of pregnancy. *J Prenat Med.* 5(3) (2011) 59-62.

[29]. N. Veronese, B. Stubbs, SE. Jackson, A. Koyanagi, V. Noventa, et al. Prospective associations of cardiovascular disease with physical performance and disability : A longitudinal cohort study in the Osteoarthritis Initiative. *Wien Klin Wochenschr* 5 (2019) 5. 21-36

[30]. Y. Raziani, S. Raziani .The Effect of Air Pollution on Myocardial Infarction, *Journal of Chemical Reviews* 3 (1) (2021) 83-96.

[31]. Y. Raziani, S. Raziani .Investigating the Predictors of Overweight and Obesity in Children, *International Journal of Advanced Studies in Humanities and Social Science* 9 (4) (2020) 262-280.

[32]. KK. Dolisgan, Y. Razisni, a review of child abuses and its management in Iran, *Journal of Critical Reviews* 7 (19) (2020) 9899-9906

[33]. G Mohamadi, A Kavosi, Y Raziani, AMP Nasab, Rhinocerebral mucormycosis and treatment: Report of two cases, *J. Neyshabur Univ. Med. Sci*, 2 (2) (2011), 10-13.

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