ORIGINAL ARTICLE

Incidence of and Maternal-fetal Risk Factors Associated with Therapeutic Abortion: A Nested Case-control Design Based on a Population-based Historical Cohort

Zahra Maleki[1], PhD; Haleh Ghaem[2], PhD; Mozhgan Seif[3], PhD; Sedigheh Foruhari[4], PhD

[1]Student in Epidemiology, Student Research committee, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Non-Communicable Diseases Research Center, Research Center for Health Sciences, Institute of Health, Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran
[3]Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran
[4]Infertility Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

Correspondence:
Haleh Ghaem, PhD;
Non-Communicable Diseases Research Center, Research Center for Health Sciences, Institute of Health, Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran
Tel: +98 71 37256007
Email: ghaemh@sums.ac.ir
Received: 12 October 2021
Revised: 14 November 2021
Accepted: 24 December 2021

Abstract

Background: Therapeutic Abortion (TA) has been defined as termination of pregnancy before the 20th week of gestation in order to save the mother's life and prevent birth defects. The present study aimed to investigate the incidence of TA and its related maternal-fetal risk factors.

Methods: This historical cohort study reviewed 11000 birth records. Among these reviewed records, 83 cases of TA were identified. Then, for each case, three controls of live infants born in the same hospital on the same day were selected and matched for gestational age. We used a researcher-made questionnaire for data collection.

Results: The cumulative incidence of TA was computed 7.54 per 1000 live births. The results of multiple Cox regression model revealed that four risk factors including male gender; parental consanguinity; maternal diseases including gestational hypertension, gestational diabetes mellitus, hypothyroidism, infertility, the use of in Vitro Fertilization (IVF) and urinary tract infection; and maternal medication consumption increased the risk of TA (all hazard ratios > 1: $P<0.05$).

Conclusion: For the first time, we assessed the incidence of TA through this population-based cohort study in Iran. Importantly, parental consanguinity was one of the predictors of TA revealed in this study. Identification of the causes of TA would prevent the birth of infants with congenital anomalies.

Please cite this article as: Maleki Z, Ghaem H, Seif M, Foruhari S. Incidence of and Maternal-fetal Risk Factors Associated with Therapeutic Abortion: A Nested Case-control Design Based on a Population-based Historical Cohort. J Health Sci Surveillance Sys. 2022;10(1):71-77.

Keywords: Pregnancy, Cohort, Abortion, Therapeutic, Risk factors

Introduction

Approximately 210 million women become pregnant annually worldwide, out of whom, 63% give live births, 22% experience abortion, and 15% are victims of pregnancy failure. According to the current estimates, abortion rates showed an increasing trend in most developing countries.[1-3] In Africa, one out of every seven pregnancies leads to abortion.[4, 5] In Iran, married women of reproductive ages annually undergo about 73,000 abortions, imposing post-abortion costs on the government.[6-9] In medical terms, Therapeutic abortion (TA) has been defined as removal of an embryo or fetus from the uterus before the 20th week of gestation.[10] TA is a deliberate termination of pregnancy that is performed by a physician to maintain maternal health.[1] In Iran, TA conditions have been divided into two main categories: 1) termination of pregnancy to save mother's life or in emergency cases that severely threaten the mother's life, and 2) when the continuation of pregnancy may lead to the birth of an abnormal or mentally retarded infant based on medical documentation and approval of

three specialists.[11, 12] The conditions for TA depend on both maternal and fetal factors, 49 of which have been approved by the Islamic Republic of Iran (see Appendix).[13] After enactment of this legislation (in June 2005), TA rate has significantly increased due to embryonic anomalies.[1] TA prevents the birth of infants with physical or mental disabilities or those with mental retardation and metabolic problems.[14] A number of other legal conditions for abortion in other countries are maternal health, rape-related pregnancy, and fetal defects.[15, 16] A meta-analysis showed that the incidence of TA was 8.9 per 1,000 women aged 15-44 years and 5.34 per 100 live births.[17] In a study by Hosseini et al., women aged 15-44 years reported a 3.8% rate of induced abortion.[18]

Neural tube defects, organ malformations, fetal hydrops, hydrocephalus, and chromosomal anomalies such as Down syndrome accounted for approximately 65% of therapeutic abortions in Iran.[14] In another study, the rate of pregnancy termination due to fetal death was reported as 30.1%.[19] Some risk factors associated with TA include parental consanguinity, family history of some diseases such as thalassemia, intellectual retardation, abnormal infants, and history of abortion.[20]

To date, no single study has assessed the incidence and associated risk factors of TA using statistical modeling techniques, and the majority of previous studies have focused on the prevalence of TA with small sample sizes.[1, 14] Although a limited number of studies have determined the risk factors for TA, neither maternal nor fetal variables have been assessed simultaneously.[14, 18] Furthermore, the irreversible effects that therapeutic abortion has on the mother and her subsequent pregnancies, both psychologically and physically, should be considered. Thus, the present study aimed to determine the population-based incidence of TA with a large sample size, using a nested case-control design by Cox regression model in order to identify the risk factors for TA based on both maternal and fetal causes.

Methods

Study Procedure

This study was performed in two phases: historical cohort and nested case-control.

Phase 1: Historical Cohort

A total of 11000 medical records were reviewed from five major delivery hospitals in Shiraz city, capital of Fars province, Iran (three public and two private hospitals) by using census method from March 2016 to March 2017. The study cohort constituted of all cases of pregnant women referring to the mentioned hospitals for pregnancy termination, consisting of vaginal delivery, cesarean section, and abortion. We must note that all the Ministry of Health standard forms were entailed in the patients' medical records; they were distributed among the midwives and nurses in the operating room.

Phase 2: Nested Case-control Cohort

Once a TA was detected, three controls were singled out from the women who had never experienced the intended event (TA) and had hospital live births in the same hospital on the same day. Either in case or control groups, the week of gestation was considered as a time-matched variable, and a researcher-made questionnaire was applied to collect the required data. TA was the dependent variable.

Study independent variables included 1) maternal characteristics, such as age, parental consanguinity, gestational age, mother's blood group, mother's blood RH, number of labors, mode of delivery, maternal disease during pregnancy (having at least one of the following diseases: urinary tract infection, gestational diabetes mellitus, gestational hypertension (blood pressure≥140/90 mm Hg), hypothyroidism and infertility and the use of In Vitro Fertilization (IVF), taking medications, and 2) fetal characteristics, such as gender and multiple births. All women living in Shiraz with Iranian nationality were eligible for study participation. Quality assurance was performed by supervision on the data collection, data extraction, data entry into the software, and data analysis.

Statistical Analysis

Cox regression model was employed to evaluate the factors for TA. Positive Hazard Ratio (HR) implied an increase in the occurrence of TA. The univariate analysis examined the relationship between each independent variable and TA. For data modelling, those variables with $p<0.25$ were entered in multivariate Cox regression model to control confounding variables. The dependent variable examined in this study was "having TA or not". The study variables were analyzed by STATA, version 13.0. Descriptive statistics were expressed as mean and Standard Deviation (±SD) for continuous variables and number (%) for categorical variables. The subgroup differences were compared through independent-sample t-test and Chi-square test. All quantitative variables were assessed for normal distribution by using Kolmogorov-Smirnov test and appropriate graphs, such as histogram and box-plot. Univariate and multivariate Cox regression analyses were employed and reported independently for either the maternal or fetal variables.

Ethical Considerations

After admission by the medical staff, verbal consent was obtained from each patient. Ethical approval has been obtained from the ethics committee of Shiraz University of Medical Sciences (IR.SUMS.REC.1397.912).

Results

Maternal Risk Factors

The mean age of the participants was 28.44±6.35 years, ranging from 13 to 45 years. The demographic and clinical characteristics of the study participants are shown in detail in Table 1.

The cumulative incidence of TA was estimated as 7.54 per 1000 live births (95% Confidence Interval (CI) 6.00-9.00). Considering the age groups, the incidence rates were 11.19 (95% CI 2.00-32.00), 7.81 (95% CI 6.00-9.00), and 4.73 (95% CI 1.00-10.00) per 1000 live births in mothers aged under 18, 18-35, and above 35 years, respectively.

Among maternal variables, consanguineous parents, maternal age, blood group, blood RH, maternal diseases (e.g. gestational hypertension, gestational diabetes mellitus, hypothyroidism, infertility and the use of IVF, and urinary tract infection), and maternal medication use were

Table 1: Maternal and fetal demographic/clinical characteristics

Characteristics		Case (n=83) N (%)	Control (n=249) N (%)	P value
Maternal age (year)	>18	3 (3.6)	9 (3.6)	0.284
	18-35	74 (89.2)	206 (82.7)	
	<35	6 (7.2)	34 (13.7)	
Consanguineous parents	No	25 (30.1)	223 (89.6)	0.001
	Yes	58 (69.9)	26 (10.4)	
Maternal diseases	No	59 (71.1)	245 (98.4)	0.001
	Yes	24 (28.9)	4 (1.6)	
Mother's Blood group	AB	7 (8.4)	22 (8.8)	0.667
	A	27 (32.5)	72 (28.9)	
	B	15 (18.1)	52 (20.9)	
	O	34 (41)	103 (41.4)	
Mother's Blood RH	Positive	77 (92.8)	237 (95.2)	0.534
	Negative	6 (7.2)	12 (4.8)	
Taking medications by the mother	No	41 (49.4)	232 (93.2)	0.001
	Yes	42 (50.6)	17 (6.8)	
Gender	Female	13 (15.7)	122 (49)	0.001
	Male	70 (84.3)	127 (51)	
Multiple births*	1	80 (96.4)	245 (98.4)	0.141
	2	2 (2.4)	4 (1.6)	
	3	1 (1.2)	0 (0)	
Mode of delivery	Cesarean	4 (4.8)	128 (51.4)	0.001
	Vaginal	79 (95.2)	121 (48.6)	

*Number of babies

Table 2: Simple analysis on the relationship between the study factors and therapeutic abortion

Variables		Multiple Cox model		
		n	HR (95% CI)	P value
Maternal age (year)	<18 (reference)	12	1	-
	18-35	280	1.10 (0.34-3.50)	0.866
	>35	40	0.51 (0.12-2.07)	0.351
Fetus gender	Female (reference)	140	1	0.001
	Male	192	3.94 (2.17-7.13)	
Consanguineous parents	No (reference)	248	1	0.001
	Yes	84	6.14 (3.84-9.83)	
Multiple births	1	325	1	-
	2	6	1.33 (0.32-5.42)	0.689
	3	1	11.74 (1.59-86.70)	0.016
Mother's Blood group	AB (reference)	29	1	-
	A	99	1.18 (0.51-2.72)	0.687
	B	67	1.04 (0.42-2.57)	0.919
	O	137	1.07 (0.47-2.43)	0.858
Mother's Blood RH	Positive (reference)	314	1	0.435
	Negative	18	1.39 (0.60-3.20)	
Maternal diseases	No (reference)	304	1	0.001
	Yes	28	5.37 (3.340-8.640)	
Taking medications by the mother	No (reference)	273	1	0.001
	Yes	59	5.27 (3.42-8.11)	

Table 3: Modelling the predictors of the risk of therapeutic abortion

Variables		Multiple Cox model		
		n	HR (95% CI)	P value
Fetus gender	Female (reference)	140	1	0.020
	Male	192	2.10 (1.12-3.94)	
Consanguineous parents	No (reference)	248	1	0.001
	Yes	84	3.91 (2.36-6.47)	
Maternal diseases	No (reference)	304	1	0.005
	Yes	28	2.19 (1.26-3.83)	
Taking medications by the mother	No (reference)	273	1	0.003
	Yes	59	2.20 (1.29-3.73)	

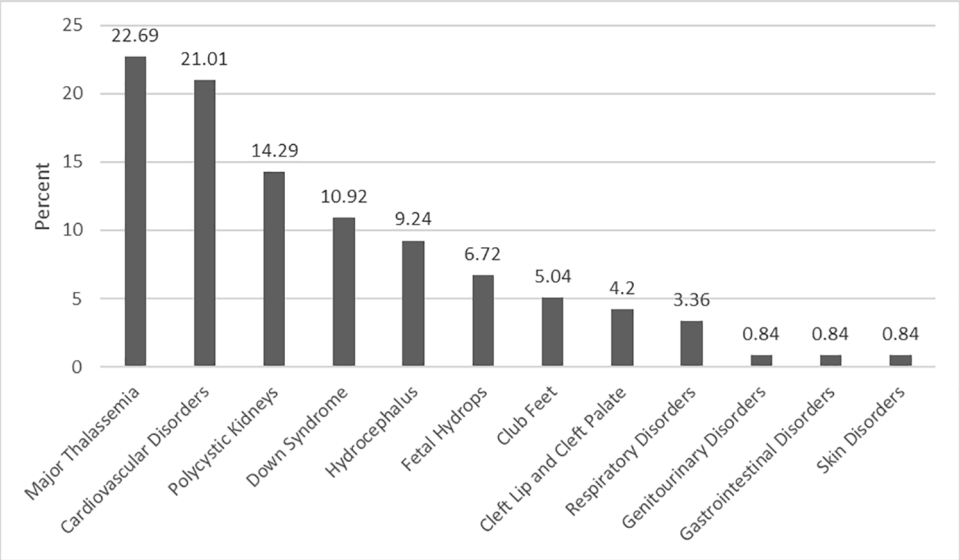

Figure 1: Distribution of the causes of therapeutic abortion

shown to be associated with TA in simple analysis (Table 2). In multiple Cox regression modelling, three maternal variables remained as the major predictors of TA: consanguineous parents (HR=3.91; 95% CI 2.36-6.47; P=0.001), maternal diseases (e.g. gestational hypertension, gestational diabetes mellitus, hypothyroidism, infertility and IVF use, and urinary tract infection) (HR=2.19; 95% CI 1.26-3.83; P=0.005), and taking medications by mothers (HR=2.20; 95% CI 1.29-3.73; P=0.003) (Table 3). Thus, consanguineous parents, maternal diseases, and taking medications by mothers increased the risk of TA by 9.3, 1.2, and 2.2 times, respectively.

Fetal Risk Factors

According to the findings, the most and least common causes of TA were major thalassemia (22.69%) and skin disorders (0.84%), respectively (Figure 1). The cumulative incidence of TA in male and female fetuses was calculated as 12.00 (95% CI 9.00-15.00) and 2.51 (95% CI 1.00-4.00), respectively, per 1000 live births. Amongst fetal-related variables, fetus gender and multiple births were linked with TA in univariate analysis (Table 2). In the final modelling through multivariate Cox regression, only one fetal variable, male gender (HR=2.10; 95% CI 1.12-3.94; P=0.020), remained as the most important predictor of TA (Table 3). Therefore, for the male gender, the risk of TA was 2.1 times higher than in the female gender. According to univariate Cox regression analysis, the variables shown to be significantly associated with TA were entered into multivariate Cox regression model (Tables 2 and 3).

Discussion

Maternal Risk Factors

The results of this historical cohort study revealed the cumulative incidence rate of TA as 7.54 per 1000 live births, which was disclosed for the first time in Iran. Therefore, Polis and Sully reported the incidence of TA as 38.0, and 17.8 per 1000 women at ages of 15-49 years, respectively. These rates were much higher compared to those reported in the present study, which might be due to cultural, religious, environmental, and social differences across countries.[21, 22] However, two studies in Iran reported the prevalence of TA as 3.8%.[14, 18]

In the current study, the participants' mean age was 28 years, which is consistent with the previous studies conducted in Iran (29.4 and 28.6 years).[23] In the United States, most induced abortions were performed under the age of 14 and over the age of 40 years, with a two-fold higher rate in individuals aged 25-29 years.[4]

Another study in the United States showed that 51% of all abortions were done under the age of 24 years.[24]

The mean gestational age for doing TA was 16 weeks in the present study. In Iran, due to specific rules, TA is only allowed before 18-20 weeks of gestation. However, Bazmi et al. showed an average gestational age of 10 weeks. It is clear that there is a huge difference between Iran and other countries, especially non-Muslim ones, regarding religious beliefs.[13] In another study in Iran, the mean gestational age was reported to be 12.8 weeks.[18]

A number of previous studies showed that maternal disease during pregnancy, such as hypertension, hypothyroidism, and diabetes would lead to congenital anomalies, chromosomal abnormalities, and intrauterine growth retardation.[18, 25] Indeed, gestational diabetes mellitus was reported to be one of the risk factors associated with the occurrence of TA and spontaneous abortions due to congenital anomalies.[26] As mentioned above, the study results showed hypothyroidism as a risk factor for TA, which might be due to the high prevalence of endocrine diseases (thyroid dysfunction) and thyroid disorders in women (11.4%) in Shiraz.[27] These findings were supported by those obtained by Azizi et al., which indicated that maternal hypothyroidism led to intrauterine growth retardation, congenital malformation, abortion, and stillbirth.[28] Levy et al. also concluded that urinary tract infection during pregnancy was associated with fetal injury and abortion.[29] Moreover, various studies have shown that the use of assisted reproductive techniques increased the incidence of congenital malformations by 25-40%.[30, 31] Govaerts et al. also found that TA would be one of the inappropriate consequences of using assisted reproductive tools, such as IVF.[32] Many of these abnormalities would be treated by abortion if detected at early stages.

Fetal Risk Factors

According to the results of this study, the risk of TA was two times higher in male fetuses than in females, which was supported by the results of studies by Bazyar et al., Golalipour et al., and Vatankhah et al.[33-35] This might be attributed to the increased susceptibility and weakness of the male gender in the embryonic period as well as the higher rate of male births.[33, 36]

The present study findings showed that the main reasons for TA were major thalassemia, cardiac disorders, renal disease, and Down syndrome, which was in line with the results of Ghodrati et al.[19] Vatankhah et al. stated that musculoskeletal disorders were the major cause of TA.[34] This is due to the higher prevalence of thalassemia gene (8-10%) in Fars province.[37, 38]

This study had several strengths. The population-based design and large sample size of the study provided generalizability as well as adequate power to detect a reduction in composite maternal and fetal outcomes. Another strength of the study was its cost-effectiveness from an economic point of view. One other strong point of the study was that the two groups were matched with respect to gestational age. However, the study limitations included non-registration of the parents' smoking status and mother's education level, which caused these variables not to be examined.

Conclusion

The incidence of TA in this population-based historical cohort study was determined for the first time in Iran to be 7.54 per 1000 live births. In fact, maternal and fetal TA predictors include fetal sex, parental kinship, maternal diseases (e.g. gestational hypertension, gestational diabetes, hypothyroidism, infertility and IVF use, and urinary tract infections) and medications taken by mothers. In addition, maternal hypothyroidism and parental kinship were the most important risk factors associated with TA.

Financial Support and Sponsorship

This study was financially supported by Shiraz University of Medical Sciences (grant No. 97-01-04-18095).

Suggestions for Future Studies

This study suggests that a prospective study should be conducted on this issue by considering more factors including socio-economic factors.

Acknowledgment

The authors would like to thank all staff working in the Medical Records Department of Obstetrics and Gynecology wards of Shiraz hospitals for their cooperation.

Conflicts of interest*:* None declared.

References

1 Mahdavi SA, Jafari A, Azimi K, Dehghanizadeh N, Barzegar A. Therapeutic abortion in Iran: an epidemiologic study of legal abortion in 2 years. BMC Research Notes. 2020 Dec;13:1-6.

2 Dawson AJ, Nicolls R, Bateson D, Doab A, Estoesta J, Brassil A, Sullivan EA. Medical termination of pregnancy in general practice in Australia: a descriptive-interpretive qualitative study. Reproductive health. 2017 Dec;14(1):1-3.

3 Lamichhane P, Harken T, Puri M, Darney PD, Blum M, Harper CC, Henderson JT. Sex-selective abortion in Nepal: a qualitative study of health workers' perspectives. Women's Health Issues. 2011 May 1;21(3):S37-41.

4 Chan A, Keane RJ. Prevalence of induced abortion in a reproductive lifetime. American journal of epidemiology. 2004 Mar 1;159(5):475-80.

5 Daskalakis GJ, Mesogitis SA, Papantoniou NE, Moulopoulos GG, Papapanagiotou AA, Antsaklis AJ. Misoprostol for second trimester pregnancy termination in women with prior caesarean section. BJOG: An International Journal of Obstetrics & Gynaecology. 2005 Jan;112(1):97-9.

6 Erfani A, McQuillan K. Rates of induced abortion in Iran: the roles of contraceptive use and religiosity. Studies in family planning. 2008 Jun;39(2):111-22.

7 Singh S. Hospital admissions resulting from unsafe abortion: estimates from 13 developing countries. The Lancet. 2006 Nov 25;368(9550):1887-92.

8 Solymanpour A, Magharehzadeh M, Pourbakhteyar M, Mehmandoust M, J. k (2017) Investigation congenital anomaly in legal abortion in esfahan.The Journal of Obstetrics and Gynecology of India. 2014;20 (4):25-33

9 du Toit-Prinsloo L, Pickles C, Smith Z, Jordaan J, Saayman G. The medico-legal investigation of abandoned fetuses and newborns—a review of cases admitted to the Pretoria Medico-Legal Laboratory, South Africa. International journal of legal medicine. 2016 Mar 1;130(2):569-74.

10 Finer L, Fine JB. Abortion law around the world: progress and pushback. American journal of public health. 2013 Apr;103(4):585-9.

11 Sharifi A, Janatolmakan M, Khatony A. The prevalence and the reasons of issuing permission for therapeutic abortion in department of forensic medicine, Kermanshah, Iran, during 2005 to 2010. BMC research notes. 2019 Dec;12(1):1-5.

12 Tofighi H, Mousavipour F, Barooni S. Investigation of patients requesting permission for abortion to the legal medicine center from June 1999 to the end of May 2000. Journal Forensic Medecin. 2000;7(22):21-7.

13 Bazmi S, Behnoush B, Kiani M, Bazmi E. Comparative study of therapeutic abortion permissions in central clinical department of Tehran Legal Medicine Organization before and after approval of law on abortion in Iran. 2008:315-322.

14 Sharifi A, Janatolmakan M, Khatony A. The prevalence and the reasons of issuing permission for therapeutic abortion in department of forensic medicine, Kermanshah, Iran, during 2005 to 2010. BMC research notes. 2019 Dec;12(1):1-5.

15 Madeiro AP, Diniz D. Legal abortion services in Brazil–a national study. Ciencia & saude coletiva. 2016;21:563-72.

16 dos Santos Mutta D, Angerame Yela D. Sociodemographic characteristics of women in a public hospital in Campinas who underwent legal abortion due to sexual violence: cross-sectional study. Sao Paulo Medical Journal. 2017 Jul 31;135:363-8.

17 Motaghi Z, Poorolajal J, Keramat A, Shariati M, Yunesian M, Masoumi SZ. Induced abortion rate in Iran: a meta-analysis. Archives of Iranian medicine. 2013 Oct 1;16(10):594-598.

18 Hosseini H, Erfani A, Nojomi M. Factors associated with incidence of induced abortion in Hamedan Iran. Arch Iran Med. 2017;20(5):282.

19 Godrati F, Saadatmand N, Dinpazhoh M, Akbarzadeh M. Epidemiological study of legal abortion due to fetal defects in the files referred to Fars province forensic medicine centers from 2007 to 2013. Shiraz E-Medical Journal. 2016 Nov 1;17(11).

20 Naeeji H, Mirtorabi SD, Shojamoradi MH, A. K. The Requests for Therapeutic Abortion in Legal Medicine Organization of Tehran: Indications for Acceptance and Rejection. Journal Forensic Medecin. 2011:17 (61):41-47.

21 Polis CB, Mhango C, Philbin J, Chimwaza W, Chipeta E, Msusa A. Incidence of induced abortion in Malawi, 2015. PLOS one. 2017 Apr 3;12(4):e0173639.

22 Sully EA, Madziyire MG, Riley T, Moore AM, Crowell M, Nyandoro MT, Madzima B, Chipato T. Abortion in Zimbabwe: a national study of the incidence of induced abortion, unintended pregnancy and post-abortion care in 2016. PloS one. 2018 Oct 24;13(10):e0205239.

23 Sully E, Giorgio M, Anjur-Dietrich S. Estimating abortion incidence using the network scale-up method. Demographic Research. 2020 Jul 1;43:1651-84.

24 Koonin LM, Smith JC, M. R. Abortion surveillance. Morbidity and Mortality Weekly Report.1992: 41 (1):1-33

25 Berhan Y, Berhan A. Meta-analysis of selected maternal and fetal factors for perinatal mortality. Ethiop Journal Health Science. 2014: 24:55-68

26 Hadden D. Diabetes in pregnancy 1985. Diabetologia.1986: 29 (1):1-9

27 Karamizadeh Z, Saneifard H, Amirhakimi G, Karamifar H, Alavi M. Evaluation of Congenital Hypothyroidism in Fars Province, Iran. Iran J Pediat. 2012;22(1):107-112.

28 Azizi F. Hypothyroidism after treatment with Bamethasemol in Iran, Comparison of the Effect of Methimazol in Tehran and Boston. Research in Medicine.1985;9(1):1-7.

29 Levy M, Read SE. Erythema infectiosum and pregnancy-related complications. CMAJ: Canadian Medical Association Journal. 1990:143 (9):849

30 Sommerhäuser G, Borgmann-Staudt A, Astrahantseff K, Baust K, Calaminus G, Dittrich R, Fernández-González MJ, Hölling H, König CJ, Schilling R, Schuster T. Health outcomes in offspring born to survivors of childhood cancers following assisted reproductive technologies. Journal of Cancer Survivorship. 2021 Apr;15(2):259-72.

31 Dieamant F, Petersen CG, Vagnini LD, Renzi A, Petersen B, Massaro F, Zamara C, Nicoletti A, Ricci

J, Oliani AH, Oliveira JB. Impact of Intracytoplasmic Morphologically Selected Sperm Injection (IMSI) on Birth Defects: A Systematic Review and Meta-Analysis. JBRA Assisted Reproduction. 2021 Jul;25(3):466.

32 Lemardeley G, Pirrello O, Dieterlé S, Zebina A, Astrugue C, Jonveaux P, Lucas-Samuel S, Couchoud C. Overview of hospitalizations in women undergoing oocyte retrieval for ART in the French national health data system. Human Reproduction. 2021 Oct;36(10):2769-81.

33 Bazyar J, Daliri S, Sayehmiri K, Karimi A, Delpisheh A. Assessing the relationship between maternal and neonatal factors and low birth weight in Iran; a systematic review and meta-analysis. Journal of medicine and life.2015;(4):23:1-8.

34 Vatankhah S, Jalilvand M, Sarkhosh S, Azarmi M, Mohseni M. Prevalence of congenital anomalies in Iran: A review article. Iran J Public Health. 2017; 46 (6):733-736.

35 Golalipour MJ, Mirfazeli A, Mobasheri E (2013) Incidence and pattern of congenital malformations in Gorgan-north of Iran. Journal Medecine Science (Faisalabad, Pakistan).2013; 13 (8):834-838.

36 Daliri S, Safarpour H, Bazyar J, Sayehmiri K, Karimi A, Anvary R. The relationship between some neonatal and maternal factors during pregnancy with the prevalence of congenital malformations in Iran: a systematic review and meta-analysis. Journal Matern Fetal Medecine. 2018;1-9

37 Ghadipasha M, Z. A. The Study of Abortion Licences Being Issued by Legal Medicine office of Kerman in 2005 and a Short Comparison with Last Years Issued Licences. Journal Kerman University Medecal Science. 2008;14 (2):147-152. [Persian].

38 Maleki Z, Ghaem H, Seif M, Foruhari S. Incidence and maternal-fetal risk factors of stillbirth. A population-based historical cohort and a nested casecontrol study. Ann Ig. 2021;33(3):231-241. https://doi.org/10.7416/ai.2021.2430