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Teenage Induced Abortions Trends in New Zealand Between the Period 2000-2019

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ABSTRACT

Teenage pregnancies and related induced abortions always reveal an important women health issue. Anybody between the ages of 13 and 19 years old is considered a teenager. The current article aims to derive the number of induced abortions trends of the girls in New Zealand up to age 19 years old between the period 2000 to 2019. Teenage girls are grouped into two age groups such as 11-14 years and 15-19 years old. For each age group, mean and variance trend equations are derived herein. For both the age groups, mean trend is a non-linear polynomial of fourth degree, while variance trend is a third degree polynomial in time. Both the trends of the teenage number of induced abortions are declining, concluding that teenage induced abortions are decreasing over the time. The derived models can forecast the number of induced abortions in future. Some educational plan is necessary at school levels to impart the knowledge of adverse effects of induced abortions to women health, which may reduce the teenage induced abortions. More efforts are required to impart necessary education on useful contraception and family planning.

Keywords:

Adolescents, Joint generalized linear models (JGLMs), Induced abortion, Non-constant variance, Teenagers, Trends

Introduction

Teenage pregnancies and related induced abortions reveal a major public health issue [1,2]. In many countries such as USA, Australia, New Zealand, Sweden, abortion of a previable fetus is legal, while it is illegal in many countries over the world. In the USA, there are many state-specific restrictions such as gestational age restrictions, mandatory waiting periods exist, and there are 50% pregnancies are unintended, while around 40% unintended pregnancies end in induced abortion, about 90% of procedures are done during the 1st trimester [3,4]. In countries where abortion is legal, it is commonly safe with rare complications, while it is very dangerous for women's health issues for the countries where abortion is illegal [3-5].

Induced abortions are highly associated with major health issues. An induced abortion is one of the primary usual gynecological procedures. Despite highly developed abortion methods, there are many known adverse effects and risks that must be considered in public health issues. Completion of an induced abortion can be verified by directly watching removal of uterine contents through ultrasonography used during the procedure. Over the world, 13% of maternal deaths are secondary due to induced abortion, while majority of these deaths take place in countries where abortion is illegal [5-7]. Potential complications associated with induced abortions include bleeding, pain, an infection in the upper genital tract, or an incomplete abortion that causes oophoritis, endometritis, salpingitis, and parametritis [6-9].

Teenage induced abortions trends are very little studied in the previous articles [1,2,10]. In fact in women's health studies abortions trends are not studied properly. The word "Trend" is related to a data set for a long period of time, known as time series data. Trend is defined as the persevering and gradual movement of the series for a long period of time. Thus, the long term variation of a time series data for smooth downward decrease or upward increase is known as trend [11,12]. Actually the trend problem is one of statistical statements, we have by no means converted the problem to a mathematical basis, nor have we done away with the requisite for necessary investigation of the characteristics of the original data. Very little abortions trends are studied based on statistical modeling [2,10].

The current article aims to derive teenage induced abortions trends based on statistical approach Joint Generalized Linear Models (JGLMs), which are very little studied in the women's health literature. The article is ordered as follows. The next section presents materials and methods which are used in the article. The following sections are statistical analysis and results, and discussions and conclusions.

Materials and Statistical Methods

Materials

The article considers the teenage (for the girls of age group 11 to 19 years old) induced abortions data of New Zealand from the period 2000 to 2019. The data set is given in the website link source: https://catalogue.data.govt.nz/dataset/abortion-statistics The data set contains for the age groups from 11 year to more than 45 years, and it has three columns which describe the period of data collection, age of women, induced abortions numbers. For ready reference, the data set for the age groups (11-14) and (15-19) are given in Table 3, which are used in the current study.

Statistical methods

The present study considers the teenage induced abortions trends of New Zealand from 2000 to 2019, where the data set is given in the Appendix. It is noted that the response number of abortions over the time for different age groups is positive, heterogeneous and non-normally distributed. We fit both the gamma and lognormal distributions under JGLMs which is clearly described in the book by Lee, Nelder and Pawitan [13] and by Das [14]. For ready reference, it is very shortly given herein.

JGLMs under lognormal distribution: For a positive response random variable Y_i's with unequal variance (σ_i^2), if $E(Y_i) = \mu_i$ (mean) and $Var(Y_i) = \sigma_i^2 \mu_i^2 = \sigma_i^2 V(\mu_i)$ say, where V (.) represents the dispersion function, the log transformation $Z_i = \log(Y_i)$ is commonly used to stabilize the variance $Var(Z_i) \approx \sigma_i^2$, but the variance may not be stabilized always. For deriving a better model, JGLMs for the mean and dispersion can be considered. For log-normal distribution, JGLM of the mean and dispersion (with $Z_i = \log Y_i$) are given by

$E(Z_i) = \mu_{zi}$ and $Var(Z_i) = \sigma_{zi}^2$,

$\mu_{zi} = x_i^t \beta$ and $\log(\sigma_{zi}^2) = g_i^t \gamma$,

where x_i^t and g_i^t are the vectors of independent variables associated with the regression coefficients β and γ, respectively.

JGLMs under gamma distribution: For the above Y_i's, the variance has two parts such as σ_i^2 (free of μ_i's) and $V(\mu_i)$ (depending on the mean parameters). The dispersion function presents the GLM family distributions. For instance, if $V(\mu) = \mu$, it is Poisson, normal if $V(\mu) = 1$, and Gamma if $V(\mu) = \mu^2$, etc. Gamma JGLMs mean and dispersion models are

$\eta_i = g(\mu_i) = x_i' \beta$ and $\varepsilon_i = h(\sigma_i^2) = w_i' \gamma$,

where *g(.)* and *h(.)* are the GLM link functions for the mean and dispersion linear predictors respectively, and x_i^t, w_i^t are the independent variables vectors related with the mean and dispersion parameters respectively. Maximum likelihood (ML) method is adopted to estimate mean parameters, while the restricted ML (REML) method is applied to estimate dispersion parameters, which are clearly described in the book by Lee, Nelder and Pawitan [13].

Statistical Analysis and Results

Statistical analysis

The response teenage induced abortions of New Zealand from 2000 to 2019 has been modeled by JGLMs under both the gamma and lognormal distributions based on the transformed time t (=Year-2009), as the response teenage induced abortion is heteroscedatic. Final model is received based on the lowest Akaike information criterion (AIC) value (within each class) that minimizes both the squared error loss and predicted additive errors [15; p. 203-204]. For the age group (11-14 years old), based on AIC criterion, JGLMs gamma (AIC=123.464) and lognormal (AIC=123.1) fits (Table 1) are almost identical, while for the age group (15-19 years old), JGLMs gamma (AIC=236.290) and lognormal (AIC=236.5) fits (Table 2) are also almost identical. For both the age groups, in the mean model t, t^2, t^3 and t^4 are included as they are all significant, while in the variance model t, t^2 and t^3 are included due to functional marginality rule (i.e., if higher degree term is significant, then all its lower degree should be included) by McCullacgh and Nelder [16]. Both the lognormal and gamma JGLMs analysis results are presented in Table 1 for the age group (11-14 years old), while for the age group (15-19 years old) these results are presented in Table 2. Both the models show very similar analysis for each age group.

Table 1: JGLMs gamma and lognormal fitted trends for induced abortions for the age group 11-14 years.

Model	Variables	Gamma fit				Lognormal fit			
Mean		Estimate	s.e.	t(15)	P-value	Estimate	s.e.	t(15)	P-value
	constant	4.46300	0.04356	102.43	<0.0001	4.455700	0.04314	103.30	<0.0001
	t^1	-0.08444	0.01075	-7.86	<0.0001	-0.08609	0.01063	-8.09	<0.0001
	t^2	-0.01557	0.00270	-5.75	<0.0001	-0.01556	0.00267	-5.81	<0.0001
	t^3	0.000324	0.00017	1.97	0.0676	0.0003455	0.00016	2.09	0.0541
	t^4	0.00007419	0.00003	2.40	0.0298	0.00007423	0.00003	2.44	0.0276
Dispersion	Constant	-4.528389	0.5423	-8.343	<0.0001	-4.54947	0.5409	-8.401	<0.0001
	t^1	0.333883	0.1603	2.093	0.0538	0.327492	0.1601	2.054	0.0578
	t^2	0.001253	0.0144	0.078	0.9389	0.001454	0.0143	0.090	0.9295
	t^3	-0.004509	0.0027	-1.661	0.1175	-0.004453	0.0027	-1.640	0.1218
AIC		123.464				123.1			

The derived teenage induced abortions gamma model for the age group (11-14 years old) in Table 1 is a data obtained model that is accepted based on diagnostic checking plots in Figure 1. In Figure 1(a), absolute residuals for the gamma fitted of teenage induced abortions for the age group (11-14 years old) are plotted against the fitted value, which is a closely flat straight line, concluding that variance is constant with the running means. Figure 1(b) presents normal probability plot of the residuals of gamma fitted mean model for teenage induced abortions (Table 1), which does not indicate any lack of fit. Both these plots in Figure 1 show that the derived gamma fitted trend is almost correct.

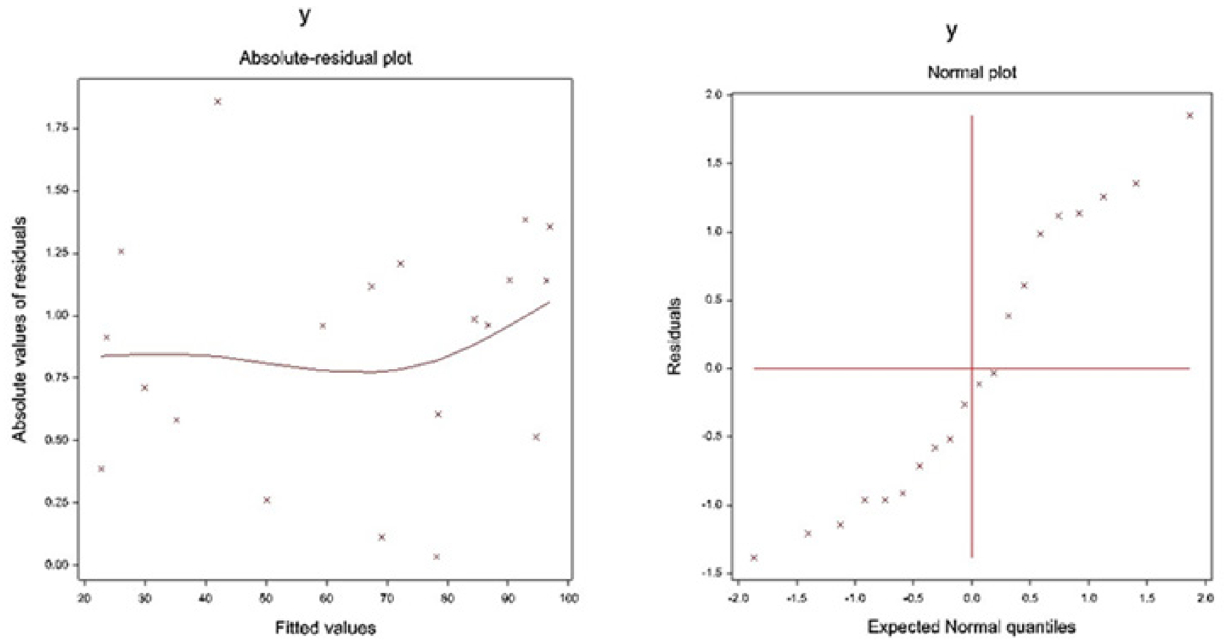

Figure 1(a) Figure 1(b)

Figure 1: For the joint gamma fitted of teenage induced abortions for the age group (11-14 years old) models of (Table 1), the (a): absolute student residuals plot with the fitted values; and (b): the normal probability plot for the mean model.

Table 2: JGLMs gamma and lognormal fitted trends for induced abortions for the age group 15-19 years.

Model	**Variables**	**Gamma fit**				**Lognormal fit**			
Mean		Estimate	s.e.	t(15)	P-value	Estimate	s.e.	t(15)	P-value
	constant	8.191000	0.0168	489.5	<0.0001	8.191000	0.0169	486.3	<0.0001
	t^1	-0.08667	0.0039	-24.4	<0.0001	-0.08671	0.0039	-24.2	<0.0001
	t^2	-0.01366	0.0010	-15.9	<0.0001	-0.01370	0.0010	-15.8	<0.0001
	t^3	0.0004682	0.0001	8.2	<0.0001	0.000468	0.0001	8.0	<0.0001
	t^4	0.00007879	0.0001	8.2	<0.0001	0.00007931	0.0001	8.1	<0.0001
Dispersion	constant	-5.93941	0.6291	-10.19	<0.0001	-5.944415	0.6353	-10.07	<0.0001
	t^1	-0.236568	0.1831	-2.49	0.0252	-0.241958	0.1897	-2.40	0.0299
	t^2	-0.017534	0.0196	-0.56	0.5824	-0.017498	0.0196	-0.56	0.5811
	t^3	0.006012	0.0034	2.85	0.0123	0.006122	0.0036	2.76	0.0145
AIC		236.290				236.5			

Similarly, for the teenage induced abortions gamma model for the age group (15-19 years old) in Table 2, diagnostic checking plots are given in Figure 2. In Figure 2(a), absolute residuals for the gamma fitted of teenage induced abortions for the age group (15-19 years old) are plotted against the fitted value, which is a flat straight line, concluding that variance is constant with the running means. Figure 2(b) presents normal probability plot of the residuals of gamma fitted mean model for teenage induced abortions (Table 2), which does not indicate any lack of fit. Both these plots in Figure 2 show that the derived gamma fitted trend is almost correct.

Analysis results

Table 1 shows the summarized results of the teenage induced abortions for the age group (11-14 years old) under both lognormal and gamma model analysis. Gamma fitted mean model shows that the mean response of the teenage induced abortions is a fourth degree function of time "t". Note that time "t" is the transformed time, where t=(Period – 2009) (shown in Table 3). In the mean model, t ($P<0.0001$), t^2 ($P<0.0001$), t^3 ($P=0.0676$) and t^4 ($P=0.0298$) are significant. In the variance model, t ($P=0.0538$) is significant, while t^3 ($P=0.1175$) is partially significant, but t^2 ($P=0.9389$) is not significant. Lognormal fit gives similar results (Table 1).

Gamma fitted teenage induced abortions for the age group (11-14 years old) mean ($\hat{\mu}$(11-14)) model (Table 1) is

$\hat{\mu}(11\text{-}14)=\exp(4.463-0.08444t-0.01557t^2+0.000324t^3+0.00007419t^4)$, and the fitted mean trend values are given in Table 3.

The gamma fitted teenage induced abortions for the age group (11-14 years old) dispersion ($\hat{\sigma}^2$(11-14)) model is

$\hat{\sigma}^2(11\text{-}14)=\exp(-4.528389 +0.333883t+0.001253t^2 -0.004509t^3)$.

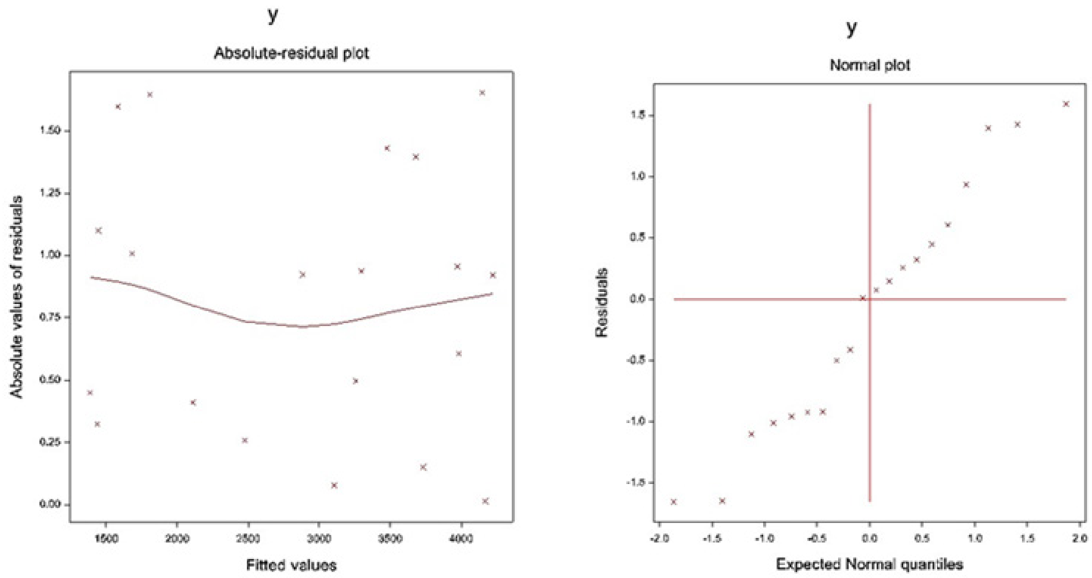

Figure 2(a) Figure 2(b)

Figure 2: For the joint gamma fitted of teenage induced abortions for the age group (15-19 years old) models of (Table 2), the (a) absolute student residuals plot with the fitted values, and (b) the normal probability plot for the mean model.

Also, Table 2 shows the summarized results of the teenage induced abortions for the age group (15-19 years old) under both lognormal and gamma model analysis. Gamma fitted mean model shows that the mean response of the teenage induced abortions is a fourth degree function of time "t". Note that time "t" is the transformed time, where t=(Period–2009) (shown in Table 3). In the mean model, t (P<0.0001), t^2 (P<0.0001), t^3 (P<0.0001) and t^4 (P<0.0001) are significant. In the variance model, t (P=0.0252) and t^3 (P=0.0123) are significant, but t^2(P=0.5824) is not significant. Lognormal fit gives similar results (Table 2).

Gamma fitted teenage induced abortions for the age group (15-19 years old) mean ($\hat{\mu}$(15-19)) model (Table 2) is

$\hat{\mu}(15\text{-}19)=\exp(8.191-0.08667t-0.01366\,t^2+0.0004682t^3+0.00007879t^4)$, and the fitted mean trend values are given in Table 3.

The gamma fitted teenage induced abortions for the age group (15-19 years old) dispersion ($\hat{\sigma}^2$(15-19)) model is

$\hat{\sigma}^2(15\text{-}19)=\exp(-5.93941-0.236568\,t-0.017534\,t^2+0.006012\,t^3)$.

Table 3: Original and fitted induced abortions data for the age groups (11-14) and (15-19) .

Year	Age	Abortions (11-14)	t	Fitted abortions (11-14)	Age	Abortions (15-19)	Fitted abortions (15-19)
2000	11-14	74	-9	67.51532	15-19	3107	3103.213
2001	11-14	66	-8	72.24291	15-19	3240	3271.898
2002	11-14	78	-7	78.11235	15-19	3602	3487.471
2003	11-14	89	-6	84.37627	15-19	3757	3715.396
2004	11-14	85	-5	90.18100	15-19	3758	3918.910
2005	11-14	92	-4	94.62263	15-19	3718	4061.572
2006	11-14	105	-3	96.87790	15-19	3978	4112.600
2007	11-14	104	-2	96.37001	15-19	4173	4053.010
2008	11-14	83	-1	92.90897	15-19	4097	3880.117
2009	11-14	79	0	86.74736	15-19	3873	3608.329
2010	11-14	84	1	78.52273	15-19	3389	3265.659
2011	11-14	68	2	69.10444	15-19	2822	2887.153
2012	11-14	51	3	59.40078	15-19	2489	2507.580
2013	11-14	48	4	50.19165	15-19	2096	2155.752
2014	11-14	57	5	42.03148	15-19	1758	1851.810

2015	11-14	32	6	35.23269	15-19	1635	1607.544
2016	11-14	27	7	29.91177	15-19	1451	1429.010
2017	11-14	30	8	26.06961	15-19	1414	1320.601
2018	11-14	22	9	23.68464	15-19	1289	1290.479
2019	11-14	23	10	22.81687	15-19	1215	1358.858

Discussions and Conclusions

The article has derived teenage induced abortions trends of New Zealand for the period 2000 to 2019 using statistical JGLMs under both the gamma and lognormal distributions. Generally trend equations are derived assuming variance is constant [11, 12]. If the variance is non-constant, it is necessary to derive both the mean and variance trends jointly, which are very little studied in time series analysis. Best of our knowledge, teenage induced abortions trends are very little studied in the women's health literature based on statistical methods [2,10]. Here the response teenage induced abortions variance in non-constant that should be modeled using JGLMs. It is the first article in the context of teenage induced abortion literature that has attempted to study the teenage induced abortions trends using advanced statistical models. In addition, models are selected based on graphical diagnosis (Figure 1 and Figure 2), lowest AIC value, comparing two probability distributions of the response (Table 1 and Table 2), and the estimates are very stable as their standard errors are very small (Table 1 and Table 2). The research should have a greater faith on the current developed results.

From Table 3, it is found that the teenage induced abortions trends of New Zealand for the period 2000 to 2019 are declining. For both the age groups (11 -14 years old) and (15 -19 years old) fitted trend values are very close to the original data (Table 3 and Figure 3). The trend curves for both the age groups are shown in Figure 3, which also show that the teenage induced abortions trends of New Zealand for the period 2000 to 2019 are declining. It implies that the impacts of contraception use and family planning education are effective in New Zealand. But this scenario may not be observed in many developing, or under developing countries. Several research studies are to be conducted for such countries.

There is no similar study for the teenage induced abortions trends of New Zealand, so the present results can not be compared with the previous studies. The present derived results and models are clearly verified by Figures 1, 2 and 3. Here it is observed that the fitted values are very close to the original data. The preset results will help the researchers and the Government for predicting the future teenage induced abortions. Accordingly, the Government can take necessary actions. The family planning education is to be continued in New Zealand, and other developing, or under developing countries.

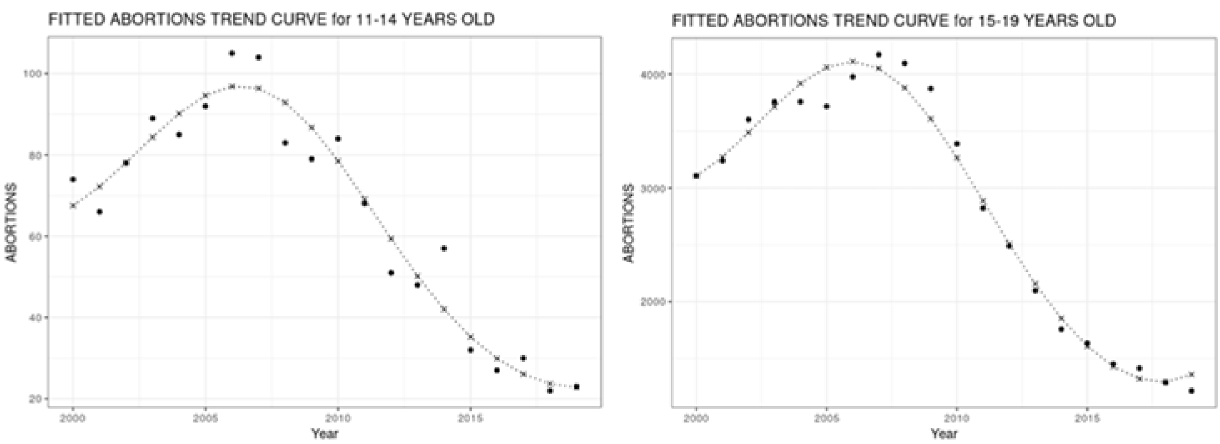

Figure 3(a) Figure 3(b)

Figure 3: Scattered plot of the original observations, fitted values and the smooth fitted mean trend curves for the age group (a): 11-14 years old; (b): 15-19 years old.

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References

1. Kapp N, Eckersberger E, Lavelanet A, et al. (2016) Medical abortion in the late first trimester: A systematic review. MMWR Recomm Rep 65(4): pp. 1-66.

2. Ioannis T, Apostolos M, Apostolos A, et al. (2020) Trends in Induced Abortions in Greece: A Cross-sectional Study. J Pediatr Adolesc Gynecol 33(2): pp. 149-152.

3. Niinimaki M, Suhonen S, Mentula M, et al. (2011) Comparison of rates of adverse events in adolescent and adult women undergoing medical abortion: population register based study. BMJ (Clinical research ed) d2111: pp. 342.

4. Bjartling C, Osser S, Persson K (2010) The association between mycoplasma genitalium and pelvic inflammatory disease after termination of pregnancy. BJOG 117(3): pp. 361-364.

5. Larsson PG, Platz-Christensen JJ, Thejls H, et al. (1992) Incidence of pelvic inflammatory disease after first-trimester legal abortion in women with bacterial vaginosis after treatment with metronidazole: a double-blind, randomized study. Am J Obstet Gynecol 166(1): pp. 100-103.

6. Carlsson I, Breding K, Larsson PG (2018) Complications related to induced abortion: a combined retrospective and longitudinal follow-up study. BMC Women's Health 18(1): pp. 158.

7. World Health Organization DoRHaR. Safe abortion: technical and policy guidance for health systems. Second edition 2012.

https://www.who.int/reproductivehealth/publications/unsafe_abortion/9789241548434/en/

8. Bell BG, Schellevis F, Stobberingh E, et al. (2014) A systematic review and meta-analysis of the effects of antibiotic consumption on antibiotic resistance. BMC Infect Dis 14: pp. 13.

9. Penney GC TM, Norman J, McKenzie H, et al. (1998) A randomised comparison of strategies for reducing infective complications of induced abortion. Br J Obstet Gynaecol 105(6): pp. 599-604.

10. Jones RK, Kost K, Singh S, et al. (2009) Trends in abortion in the United States. Clin Obstet Gynecol 52(2): pp. 119-129.

11. Montgomery DC, Jennings CL, Kulachi M (2016) Introduction to Time Series Analysis and Forecasting, John Wiley and Sons Inc., New Jersey.

12. Shumway RH, Stoffer DS. Time Series Analysis and Its Applications: With R Examples, 4th Edition, Springer International Publishing AG, Switzerland, 2017.

13. Lee Book, Lee Y, Nelder JA, et al. (2017) Generalized Linear Models with Random Effects (Unified Analysis via H–likelihood) (Second Edition). Chapman and Hall, London.

14. Das RN. Robust response surfaces, regression and positive data analyses. Chapman and Hall, London, 2014

15. Hastie T, Tibshirani R, Friedman J. The Elements of Statistical Learning (Second edition). Springer-Verlag, New York, 2009.

16. McCullagh, P. and Nelder, JA. Generalized linear models. Chapman and Hall, London, 1989.