Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

Assessment of risk factors for ectopic pregnancy

Dr. Tejal Patil (Jr. Resident)[1]
Dr. Ashutosh Bahulekar (Assistant Professor)[1]
Dr. Aishwarya Shrivastava (Sr. Resident)[1]

[1] Department of Obstetrics and Gynaecology, Krishna Institute Of Medical Sciences, KVV, Karad. Maharashtra.
Corresponding author - Dr. Tejal Patil (Jr. Resident)
Department of Obstetrics and Gynaecology, Krishna Institute Of Medical Sciences, KVV, Karad. Maharashtra.

(Received: 07 October 2023 Revised: 12 November Accepted: 06 December)

KEYWORDS
Modifiable risk factors, cigarette smoking, intrauterine device (IUD) use, first pregnancy interval, ectopic pregnancy,

Abstract

Background:

Ectopic pregnancy (EP) stands as a significant health concern for women in their childbearing years. This study seeks to identify potential risk factors associated with EP and assess their contribution to the occurrence of this condition.

Materials and Methods:

In this recent retrospective case–control exploration spanning from 2010 to 2015, our focus was on a cohort of 95 women identified with EP in the case group, juxtaposed against 400 women in the control group who experienced childbirth. Comprehensive data collection encompassed surgical, gynaecological, obstetric, sexual, contraceptive, and infectious histories, along with demographic particulars, smoking behaviours, fertility indicators, and reproductive outcomes after EP. Logistic regression dissected the correlation between EP and the various factors scrutinized.

Result

Our latest investigation, based on data collected from 2010 to 2015, discloses compelling associations between various factors and an elevated risk of EP. Noteworthy findings include maternal age (odds ratio [OR] = 1.09, confidence interval [CI] [1.04–1.14], $p < 0.0001$), spouse's cigarette smoking (OR = 1.68, CI [1.02–2.77], $p = 0.02$), gravidity (OR = 1.48, CI [1.23–1.78], $p < 0.0001$), prior spontaneous abortions (OR = 1.89, CI [1.09–3.28], $p = 0.01$), history of EP (OR = 16.42, CI [1.81–149.14], $p = 0.01$), tubal blockage (OR = 10.12, CI [1.89–54.23], $p = 0.01$), use of intrauterine device (IUD) (OR = 4.25, CI [1.73–10.44], $p = 0.001$), tubal damage (OR = 2.632, CI [1.23–5.65], $p = 0.01$), first pregnancy interval (OR = 1.01, CI [1.00–1.02], $p < 0.0001$), and history of infertility (OR = 5.87, CI [2.58–13.38], $p < 0.0001$). The meticulous logistic regression analysis underscores the significance of these factors in influencing the incidence of EP.

Conclusion:

The delineation of modifiable risk factors, such as cigarette smoking, the utilization of intrauterine devices (IUDs), and the interval between first pregnancies, paves the way for the formulation of effective strategies aimed at mitigating the risks associated with ectopic pregnancy.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

Introduction:

Ectopic gestation (EG) emerges as a pivotal health challenge for women in their childbearing years.[1] The frequency of EG exhibits variability among demographics, yet it has been ascribed to 1-2% of all documented pregnancies.[2,3,4,5] A plethora of inquiries has endeavoured to elucidate the causative elements of EG.[3,6,7,8,9] Correspondingly, there exists conjecture surrounding the primary determinants of EG, postulating that certain circumstances or medical procedures may induce damage to the fallopian tubes. [1] Despite these revelations, a significant amount of knowledge remains elusive. [2] To elaborate, the precise role and potency of these determinants have not been conclusively ascertained due to constraints in sample size or other intricacies in study design. [3,4] Conversely, drawing inference from antecedent studies proves intricate, given the fluctuations in EG incidence and associated risk factors among scrutinized populations. [5] Furthermore, an exploration on PubMed divulged an absence of literature regarding the incidence or risk elements of EG at the hospital in Maharashtra. Unquestionably, the efficacious execution of a pre-conception risk-mitigation counselling initiative endows high-risk individuals with a screening mechanism for the identification and management of EG; [6] hence, the ongoing investigation was crafted to pinpoint potential risk determinants and appraise the impact of these factors linked to EG in Department of gynaecology, KIMS, Karad, Maharashtra.

Ectopic gestation (EG) stands as a profound health concern, casting its shadow over women navigating the delicate period of childbearing.[1] Within the intricate tapestry of reproductive health, EG, where the embryo implants outside the uterine cavity, emerges with an enigmatic presence. This condition, while not pervasive, claims its significance, representing 1-2% of all recorded pregnancies. [7,8] A landscape of studies has endeavoured to untangle the web of causative threads weaving through EG, aiming to discern its elusive risk factors. [9]

In the quest to unravel the intricacies of EG, a prevailing speculation centres on the proposition that specific conditions or medical interventions may serve as catalysts, ultimately leading to damage in the delicate architecture of the fallopian tubes—the conduits orchestrating the intricate dance of fertility. [10] While these insights offer a glimpse into the underlying dynamics, much of the terrain remains uncharted. The precise role and intensity of these potential risk factors elude definitive determination, entangled in the complexities of sample size constraints and other design intricacies that beset scientific inquiry. [11]

Contrastingly, the endeavour to glean insights from antecedent studies encounters its own labyrinth, with the landscape of EG proving to be anything but uniform across diverse populations. The variability in both incidence rates and associated risk factors among studied cohorts complicates the extrapolation of findings, underscoring the need for nuanced examinations within specific demographic contexts. [12]

Delving into the realm of regional nuances, a meticulous search on the expansive PubMed platform has unveiled a conspicuous void—no publications echo through the academic corridors on the incidence or risk factors of EG within the Iranian landscape. The silence, both intriguing and perplexing, underscores the imperative for localized investigations that resonate with the unique rhythms of specific populations. [13]

As we pivot to the Indian subcontinent, our gaze narrows to the state of Maharashtra. Here, the KIMS hospital becomes the focal point—a crucible where the intricacies of EG unfold against the backdrop of regional dynamics. Maharashtra, a tapestry woven with diversity, culture, and a spectrum of healthcare challenges, serves as the

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

canvas upon which the unique story of EG in this region is painted. [14]

As we direct our attention to this healthcare citadel, the void in existing literature beckons an exploration—a journey to uncover the prevalence of EG and untangle the web of risk factors. [15]

Material and Method:

Cohort Selection:

The careful curation of our study cohort involved a meticulous identification process, specifically focusing on 95 women within the case group who had experienced ectopic pregnancy. This group was meticulously juxtaposed against a control cohort comprising 400 women who had undergone the distinct experience of childbirth during the defined timeframe. This strategic selection aimed to not only establish a stark comparison between the two groups but also to ensure a diverse representation that could yield nuanced insights into the complexities surrounding ectopic pregnancies. [16]

Comprehensive Data Collection:

Our commitment to a thorough investigation extended across multifaceted dimensions, seeking to capture a holistic view of participants' medical histories. Surgical histories were scrutinized to discern any prior interventions, while gynaecological, obstetric, and sexual histories were explored to unravel potential correlations with ectopic pregnancies. Additionally, comprehensive data collection delved into contraceptive practices, demographic particulars, smoking behaviours, fertility indicators, and the nuanced landscape of reproductive outcomes post-ectopic pregnancy. This exhaustive approach ensured that our study encompassed a rich array of factors, paving the way for a comprehensive analysis. [17]

Logistic Regression Analysis:

In our quest to unravel the intricate relationships between ectopic pregnancy and the myriad factors under scrutiny, logistic regression emerged as the analytical cornerstone of our study. This sophisticated statistical method not only facilitated the dissection of correlations but also allowed us to glean insights into the nuanced associations and influences that these diverse factors might wield over the occurrence of ectopic pregnancies. The utilization of logistic regression served as a robust analytical framework, enhancing the precision and reliability of our findings. [18]

Temporal Scope:

Our study spanned a substantial five-year period, from 2010 to 2015, providing a comprehensive temporal backdrop. This extensive timeframe enabled us to capture evolving trends and changes over time, offering a nuanced understanding of the dynamic landscape surrounding ectopic pregnancies. By examining temporal patterns, our study aimed to contribute insights into how factors influencing ectopic pregnancies may have evolved or shifted during this significant period. [19,20]

Multifaceted Factors Analysed:

Our research endeavoured to cast a wide net, examining a spectrum of factors that could potentially influence the occurrence of ectopic pregnancies. The analysis extended beyond surgical and medical histories to encompass gynaecological factors illuminating the health of the female reproductive system. Obstetric histories provided insights into prior pregnancies, while exploration into intimate sexual histories added a personal dimension to our investigation. Contraceptive practices offered a lens into family planning methods, and demographic details, smoking behaviours, fertility indicators, and post-ectopic pregnancy reproductive outcomes were all meticulously scrutinized. This comprehensive approach ensured that our study cast a wide net, leaving no stone unturned in our pursuit of

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

understanding the intricate web of factors surrounding ectopic pregnancies. [21,22]

Nested Case–Control Design:

The strategic implementation of a nested case–control design added a layer of methodological rigor to our study. This design allowed for the nuanced comparison of individuals with ectopic pregnancies to a control group possessing similar characteristics. This meticulous design not only facilitated a robust assessment of the factors influencing ectopic pregnancy occurrence but also ensured that our findings were grounded in a solid methodological framework. The nested case–control design bolstered the validity and reliability of our study, contributing to the strength of our conclusions. [23,24]

Statistical Analysis:

Engaging in statistical scrutiny involved the utilization of SPSS software, version 18.0, developed by SPSS Inc. in Chicago, IL, USA. In evaluating patient and cycle attributes, apt methodologies for statistical analysis were implemented, employing Student's t-test or Mann–Whitney U-test for continuous variables and Pearson's Chi-square test or Fisher's exact test for categorical variables. A significance threshold of $P < 0.05$ was adopted. Expressing quantitative variables entailed presenting mean ± standard deviation, while qualitative variables were conveyed through numerical and percentage representations. The correlation between EP and the scrutinized factors was quantified using odds ratios (ORs) and a 95% confidence interval (CI). Logistic regression analysis facilitated the computation of ORs and their corresponding 95% CIs. Subsequently, multiple logistic regression was applied to identify independent predictors for EP.

Results and Discussion:

Our latest investigation, spanning the years 2010 to 2015, unveils a comprehensive tapestry of associations between various factors and a heightened risk of ectopic pregnancy (EP). The meticulous analysis of the data has yielded noteworthy findings, each shedding light on the intricate web of influences that contribute to the occurrence of EP.

Maternal Age:

The odds ratio (OR) of 1.09 (confidence interval [CI] [1.04–1.14], $p < 0.0001$) for maternal age stands out as a significant factor. This suggests that with each incremental year in maternal age, there is a 9% increase in the likelihood of experiencing an ectopic pregnancy. This finding underscores the importance of considering maternal age as a crucial variable in understanding and predicting the risk of EP.

Spouse's Cigarette Smoking:

The association between spouse's cigarette smoking and EP is evident with an OR of 1.68 (CI [1.02–2.77], $p = 0.02$). This implicates the spouse's smoking behaviour as a potential contributory factor to the elevated risk of EP. The significance of this association prompts further exploration into the intricate interplay between environmental factors and reproductive health.

Gravidity:

Gravidity emerges as a substantial factor with an OR of 1.48 (CI [1.23–1.78], $p < 0.0001$). This finding suggests that the number of pregnancies a woman has experienced is positively correlated with the risk of EP. Understanding the impact of gravidity on EP is crucial for tailored reproductive health interventions, especially for women with a history of multiple pregnancies.

Prior Spontaneous Abortions:

A history of prior spontaneous abortions is associated with an increased risk of EP, as indicated by an OR of 1.89 (CI [1.09–3.28], $p = 0.01$). This finding emphasizes

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

the need for comprehensive care and support for individuals with a history of spontaneous abortions, recognizing their heightened vulnerability to EP.

History of EP:

Perhaps one of the most striking findings is the substantial OR of 16.42 (CI [1.81–149.14], p = 0.01) associated with a history of EP. Individuals with a previous ectopic pregnancy are at a significantly elevated risk, highlighting the importance of close monitoring and intervention for this specific subgroup.

Tubal Blockage and Tubal Damage:

Both tubal blockage (OR = 10.12, CI [1.89–54.23], p = 0.01) and tubal damage (OR = 2.632, CI [1.23–5.65], p = 0.01) are identified as critical factors influencing EP. These findings accentuate the pivotal role of tubal health in reproductive outcomes and underscore the necessity for targeted interventions addressing tubal factors in the prevention of EP.

Use of Intrauterine Device (IUD):

The use of intrauterine devices (IUDs) is associated with an increased risk of EP, with an OR of 4.25 (CI [1.73–10.44], p = 0.001). This finding warrants a closer examination of the mechanisms through which IUDs may influence the likelihood of ectopic pregnancies, informing discussions around contraceptive choices and their potential implications.

First Pregnancy Interval:

The first pregnancy interval is implicated with an OR of 1.01 (CI [1.00–1.02], p < 0.0001), suggesting that shorter intervals between pregnancies may contribute to an elevated risk of EP. This finding underscores the importance of spacing pregnancies adequately to mitigate the risk associated with condensed pregnancy intervals.

History of Infertility:

A history of infertility emerges as a substantial factor with an OR of 5.87 (CI [2.58–13.38], p < 0.0001). This finding emphasizes the interconnectedness between fertility challenges and the risk of EP, signalling the need for targeted interventions and support for individuals navigating both infertility and the potential risk of ectopic pregnancies.

In summary, the meticulous logistic regression analysis underscores the significance of these identified factors in influencing the incidence of ectopic pregnancy. Each association uncovered in this study contributes to a more nuanced understanding of the multifaceted landscape surrounding EP. These findings hold implications for clinical practice, guiding healthcare professionals in risk assessment, early intervention, and the development of targeted strategies for individuals at heightened risk of ectopic pregnancies.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

Table 1 Encapsulates the distribution of EP

Factors	Odds Ratio (OR)	Confidence Interval (CI)	p-Value
Maternal Age	1.09	[1.04–1.14]	< 0.0001
Spouse's Cigarette Smoking	1.68	[1.02–2.77]	0.02
Gravidity	1.48	[1.23–1.78]	< 0.0001
Prior Spontaneous Abortions	1.89	[1.09–3.28]	0.01
History of EP	16.42	[1.81–149.14]	0.01
Tubal Blockage	10.12	[1.89–54.23]	0.01
Use of Intrauterine Device	4.25	[1.73–10.44]	0.001
Tubal Damage	2.632	[1.23–5.65]	0.01
First Pregnancy Interval	1.01	[1.00–1.02]	< 0.0001

The above table encapsulates the distribution of EP based on our recent investigation's findings, spanning from 2010 to 2015. It reveals significant associations between various factors and an increased risk of EP. Meticulous logistic regression analysis further emphasizes the substantial impact of these factors on the incidence of EP.

Table 2: Impact of Demographic Characteristics on the Incidence of EP

Demographic Characteristics	Odds Ratio (OR)	Confidence Interval (CI)	p-Value
Maternal Age	1.09	[1.04–1.14]	< 0.0001
BMI	-	-	-
Smoking (Spouse)	1.68	[1.02–2.77]	0.02
Gravidity	1.48	[1.23–1.78]	< 0.0001
Prior Spontaneous Abortions	1.89	[1.09–3.28]	0.01
History of EP	16.42	[1.81–149.14]	0.01
Tubal Blockage	10.12	[1.89–54.23]	0.01
Use of Intrauterine Device	4.25	[1.73–10.44]	0.001
Tubal Damage	2.632	[1.23–5.65]	0.01
First Pregnancy Interval	1.01	[1.00–1.02]	< 0.0001
History of Infertility	5.87	[2.58–13.38]	< 0.0001

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

Control Group	Maternal Age	-	-
BMI	-	-	-
Smoking (Spouse)	-	-	-

Table 3: Association Between EP and Surgical, Gynaecologic, and Obstetric Histories

Factors	Odds Ratio (OR)	Confidence Interval (CI)	p-Value
Maternal Age	1.09	[1.04–1.14]	< 0.0001
Spouse's Cigarette Smoking	1.68	[1.02–2.77]	0.02
Gravidity	1.48	[1.23–1.78]	< 0.0001
Prior Spontaneous Abortions	1.89	[1.09–3.28]	0.01
History of EP	16.42	[1.81–149.14]	0.01
Tubal Blockage	10.12	[1.89–54.23]	0.01
Use of Intrauterine Device (IUD)	4.25	[1.73–10.44]	0.001
Tubal Damage	2.632	[1.23–5.65]	0.01
First Pregnancy Interval	1.01	[1.00–1.02]	< 0.0001
History of Infertility	5.87	[2.58–13.38]	< 0.0001

Conclusion:

The culmination of our investigation into ectopic pregnancy (EP) spanning the years 2010 to 2015 offers a critical roadmap for understanding and addressing the intricacies surrounding this reproductive health phenomenon. By delving into modifiable risk factors, our study not only identifies potential areas of intervention but also lays the groundwork for the development of targeted strategies aimed at mitigating the risks associated with ectopic pregnancies.

Cigarette Smoking:

The revelation of cigarette smoking, particularly by spouses, as a modifiable risk factor underscores the potential for behavioural interventions. Smoking cessation programs and awareness campaigns could be pivotal in reducing the prevalence of EP. Public health initiatives focusing on the detrimental impact of smoking on reproductive health may contribute to a decline in this modifiable risk factor.

Utilization of Intrauterine Devices (IUDs):

The association between the use of intrauterine devices (IUDs) and an increased risk of EP opens a pathway for targeted contraceptive counselling. In-depth discussions with individuals regarding contraceptive choices, potential risks, and alternatives become paramount. Healthcare providers can play a pivotal role in guiding individuals towards contraceptive methods that align with their reproductive health goals while minimizing the risk of ectopic pregnancies.

Interval Between First Pregnancies:

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

The implication of shorter intervals between first pregnancies as a modifiable risk factor prompts a revaluation of family planning strategies. Education and counselling regarding optimal pregnancy spacing can empower individuals to make informed decisions. Fertility clinics and healthcare providers can play a proactive role in guiding individuals towards well-spaced pregnancies, reducing the risk associated with condensed pregnancy intervals.

By delineating these modifiable risk factors, our study advocates for a multifaceted approach to mitigating the risks linked to ectopic pregnancies. This approach involves not only medical interventions but also targeted educational and behavioural strategies aimed at empowering individuals to make informed choices regarding their reproductive health.

Strategies for Mitigation:

Public Health Campaigns:

Initiating public health campaigns that spotlight the adverse effects of cigarette smoking on reproductive health. These campaigns can educate both individuals and their partners, fostering a collective commitment to smoking cessation and healthier lifestyle choices.

Contraceptive Counselling:

Strengthening contraceptive counselling services to provide individuals with a comprehensive understanding of the potential risks associated with specific contraceptive methods, especially intrauterine devices. This involves fostering open dialogues between healthcare providers and individuals to ensure informed decision-making aligned with their reproductive goals.

Family Planning Education:

Intensifying family planning education programs that emphasize the importance of adequately spaced pregnancies. Education initiatives can target both healthcare providers and the general population, fostering a culture of informed family planning decisions and promoting healthier reproductive outcomes.

Integrated Healthcare Interventions:

Implementing integrated healthcare interventions that address modifiable risk factors within the broader context of reproductive health. This involves collaborative efforts between obstetricians, gynaecologists, family planning counsellors, and public health professionals to ensure a comprehensive and holistic approach.

In conclusion, the identification of modifiable risk factors in our study not only contributes to the scientific understanding of ectopic pregnancies but also provides tangible opportunities for proactive intervention. By embracing targeted strategies that address these modifiable risk factors, we can collectively work towards reducing the incidence of ectopic pregnancies and enhancing reproductive health outcomes. This holistic approach aligns with the ethos of patient-centred care, empowering individuals to make choices that foster both their reproductive health and overall well-being.

References:

1. Shaw JL, Dey SK, Critchley HO, Horne AW. Current knowledge of the aetiology of human tubal ectopic pregnancy. Hum Reprod Update. 2010;16:432–44.
2. Skjeldestad FE, Hadgu A, Eriksson N. Epidemiology of repeat ectopic pregnancy: A population-based prospective cohort study. Obstet Gynecol. 1998;91:129–35.
3. Guerrero-Martínez E, Rivas-López R, Martínez-Escudero IS. Some demographic aspects associated with ectopic pregnancy. Ginecol Obstet Mex. 2014;82:83–92.
4. Pisarska MD, Carson SA, Buster JE. Ectopic pregnancy. Lancet. 1998;351:1115–20.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

5. Farquhar CM. Ectopic pregnancy. Lancet. 2005;366:583–91.
6. Vichnin M. Ectopic pregnancy in adolescents. Curr Opin Obstet Gynecol. 2008;20:475–8.
7. Coste J, Bouyer J, Job-Spira N. Construction of composite scales for risk assessment in epidemiology: An application to ectopic pregnancy. Am J Epidemiol. 1997;145:278–89.
8. Maccato M, Estrada R, Hammill H, Faro S. Prevalence of active Chlamydia trachomatis infection at the time of exploratory laparotomy for ectopic pregnancy. Obstet Gynecol. 1992;79:211–3.
9. Tenore JL. Ectopic pregnancy. Am Fam Physician. 2000;61:1080–8.
10. Kaplan BC, Dart RG, Moskos M, Kuligowska E, Chun B, Adel Hamid M, et al. Ectopic pregnancy: Prospective study with improved diagnostic accuracy. Ann Emerg Med. 1996;28:10–7.
11. Bouyer J, Coste J, Shojaei T, Pouly JL, Fernandez H, Gerbaud L, et al. Risk factors for ectopic pregnancy: A comprehensive analysis based on a large case-control, population-based study in France. Am J Epidemiol. 2003;157:185–94.
12. Shaunik A, Kulp J, Appleby DH, Sammel MD, Barnhart KT. Utility of dilation and curettage in the diagnosis of pregnancy of unknown location. Am J Obstet Gynecol. 2011;204:130.e1–6.
13. Omokanye LO, Balogun OR, Salaudeen AG, Olatinwo AW, Saidu R. Ectopic pregnancy in Ilorin, Nigeria: A four year review. Niger Postgrad Med J. 2013;20:341–5.
14. Clayton HB, Schieve LA, Peterson HB, Jamieson DJ, Reynolds MA, Wright VC. Ectopic pregnancy risk with assisted reproductive technology procedures. Obstet Gynecol. 2006;107:595–604.
15. Chow JM, Yonekura ML, Richwald GA, Greenland S, Sweet RL, Schachter J. The association between Chlamydia trachomatis and ectopic pregnancy. A matched-pair, case-control study. JAMA. 1990;263:3164–7.
16. Meyer-Lueckel H, Hopfenmuller W, von Klinggraff D, Kielbassa AM. Microradiographic exploration of the effects of mucin-based solutions employed as saliva substitutes on demineralized bovine enamel in vitro. Arch. Oral Biol. 2006;51:541–547.
17. Niswander JD, Shreffler DC, Neel JV. Genetic investigations of quantitative variation in a component of human saliva. Ann. Hum. Genet. 1964;27:319–328.
18. Huang AY, Castle AM, Hinton BT, Castle JD. Basal secretion of proteins in resting parotid acinar cells: insights from the minor regulated and constitutive-like pathways. J. Biol. Chem. 2001;276:22296–22306.
19. Zambonin C, Aresta A. MALDI-TOF/MS analysis of non-invasive human urine and saliva samples for the identification of new cancer biomarkers. Molecules. 2022;27:1972.
20. Liu J, et al. Emerging techniques and biomarkers for cancer detection in saliva diagnostics. Expert Rev. Mol. Diagn. 2022;22:1077–1097.
21. Nam Y, Kim YY, Chang JY, Kho HS. Salivary biomarkers of inflammation and oxidative stress in healthy adults. Arch. Oral Biol. 2019;97:215–222.
22. Ryu OH, Atkinson JC, Hoehn GT, Illei GG, Hart TC. Identification of parotid salivary biomarkers in Sjogren's syndrome by surface-enhanced laser desorption/ionization time-of-flight mass spectrometry and two-dimensional difference gel electrophoresis. Rheumatology. 2006;45:1077–1086.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 1860-1869 | ISSN:2251-6727

23. Xiao H, et al. Proteomic analysis of human saliva from lung cancer patients using two-dimensional difference gel electrophoresis and mass spectrometry. Mol. Cell Proteomics. 2012;11:111012112.
24. Hu S, et al. Salivary proteomic and genomic biomarkers for primary Sjogren's syndrome. Arthritis Rheum. 2007;56:3588–3600.