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Comparison of effectiveness in smoking cessation using nicotine replacement therapy and electronic cigarettes

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Abstract

Nicotine, a potent psychoactive alkaloid found in tobacco leaves, is recognized for its high addictive potential, contributing to over 8 million deaths annually according to the World Health Organization. This article explores the complexities of nicotine addiction, highlighting its dual nature as both a learned behavior and a physical dependence. Despite approximately 70% of smokers expressing a desire to quit, achieving long-term cessation often requires multiple attempts, typically around six. Nicotine replacement therapy has been shown to enhance cessation success rates significantly, with various forms available, including skin patches, chewing gum, nasal and oral sprays, inhalers, lozenges, and tablets. Personalized dosing and combined pharmacotherapy with behavioral support are recommended for optimal outcomes. However, the rise of electronic cigarettes (e-cigarettes) as an alternative to traditional smoking has introduced new opportunities in smoking cessation efforts. While e-cigarettes are marketed as safer alternatives, their effectiveness in promoting long-term abstinence remains contentious, with studies indicating that they may aid short-term cessation but not necessarily improve long-term quitting rates. The impact of electronic cigarettes on smoking cessation also remains controversial, taking into consideration how little today's medicine does know about the long-term side effects of using e-cigarettes. This article emphasizes the importance of a comprehensive approach to treating nicotine addiction, combining pharmacotherapy with behavioral support, and highlights the need for further research to evaluate the long-term safety and efficacy of e-cigarettes as cessation tools.

Keywords: Nicotine withdrawal syndrome, Nicotine replacement therapy, Electronic cigarettes for smoking cessation, Smoking cessation.

The aim of the study:

The aim of this study is to review the literature from the last 10 years regarding the effectiveness of smoking cessation in tobacco smoking. We focus only on the usage of nicotine replacement therapy and electronic cigarettes. Based on the analysis of available research and data, we will attempt to answer the question of which is a more successful method for smoking cessation.

Introduction

Nicotine is the psychoactive agent found in tobacco leaves, where this alkaloid serves as an insecticide. According to the World Health Organisation, nicotine is highly addictive and makes every year more than 8 million people die from its use[1]. Among flavorings and non-nicotine compounds, nicotine is only one of a few substances contained in cigarettes, that can influence the addictive potential of tobacco[2,3]. Tobacco smoking is a learned behavior and also a physical nicotine dependence. Around 70% of people suffering from this chronic disorder want to quit smoking. Unfortunately, it usually takes approximately 6 attempts before achieving cessation for a long time [4]. Nicotine replacement therapy can help smokers quit, but it is becoming more popular that people use electronic cigarettes instead, for smoking cessation [5,6]. Much research addresses the subject because e-cigarettes are relatively new and the outcomes of their use are still proceeding.

Nicotine withdrawal syndrome

Quitting smoking after chronic tobacco use results in a well-described withdrawal syndrome. The intensity of these withdrawal symptoms is greatly influenced by the method of nicotine consumption. A withdrawal syndrome occurs 4 to 24 hours after stopping the use of nicotine products, particularly for those who have been using them regularly. Symptoms typically reach their highest intensity around the third day and gradually diminish over the next three to four weeks. We can distinguish 3 main groups of nicotine withdrawal symptoms: affective, somatic, and cognitive. The diagram below presents the mentioned classification [7,8].

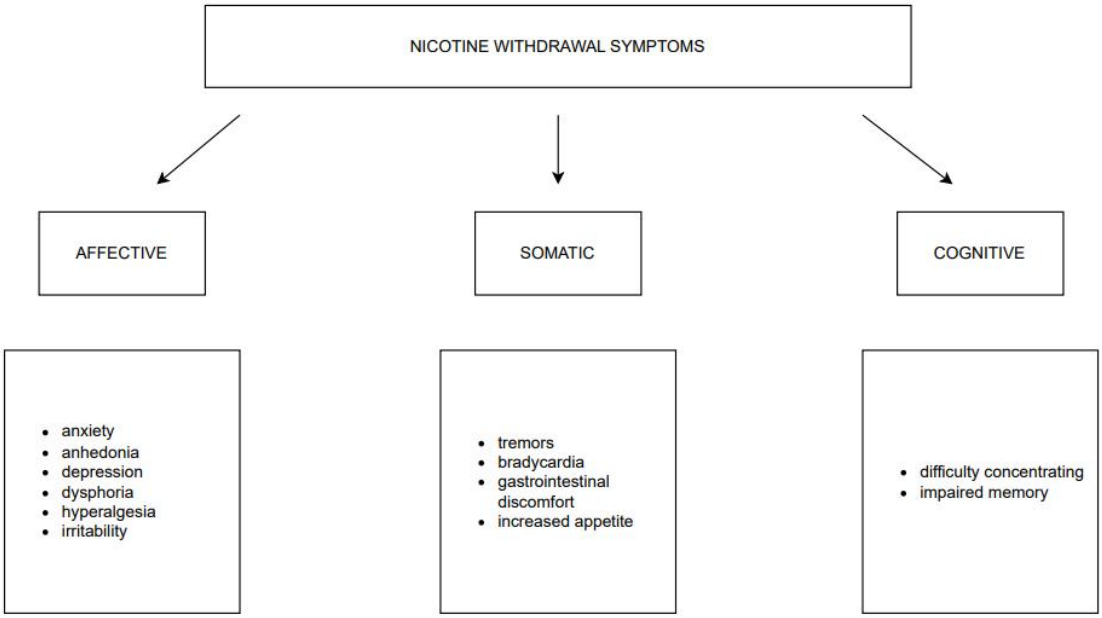

Figure 1. The above diagram presents nicotine withdrawal symptomes divided into 3 groups : affective, somatic and cognitive.

Nicotine replacement therapy

Nicotine replacement therapy (NRT) aims to simplify the transition from smoking cigarettes to complete, long-term cessation. Among NRT forms, many products can be listed, such as skin patches, chewing gum, nasal and oral sprays, inhalers, lozenges, and tablets [9]. The variety of NRT forms is wide. According to the newest research, all of the commercially available forms can increase the probability of successful smoking cessation. Some authors even claim that NRTs increase the rate of quitting by 50 to 70% [10]. The first product available to customers was transmucosal-delivered nicotine polacrilex (nicotine gum). After some time (weeks, months) the number of daily doses is reduced gradually and finally no longer required. This approach may come with patients' compliance troubles. When nicotine replacement therapy systems control withdrawal symptoms, many people are more likely to stop the use of NRT, because of the conviction that treatment is no longer needed [10]. Some research emphasizes that the effectiveness of NRT can highly depend on the personalized dosage of the used products [11]. Additionally, one research claimed that 4 mg nicotine gum is more effective than 2 mg, but also suggests that lower-dose nicotine patches and gum may be less effective than higher doses. Important is also a fact that starting NRT before quitting may enhance success rates compared to starting on the quit date [12].

The most successful method described in the literature to quit smoking is a combination of a few methods [4,9,12]. The authors underline, that the first-line therapy should be a combination of NRT (pharmacotherapy) and also a behavioral support [4]. Taking into consideration the fact that the mechanism of tobacco addiction consists of physical nicotine dependence as well as learned behavior it seems to be natural to focus in treatment both on pharmacotherapy and behavioral support.

Electronic cigarettes

Electronic cigarettes (e-cigarettes) are battery-powered devices that produce vapor containing many substances for users to inhale, and simulate the habit of smoking. Due to the great effort of the tobacco industry and their marketing, they are seen as a safe alternative to smoking [13]. Some authors even call the tobacco/e-cigarette companies the only winners and millions of addicted people the losers [14]. Therefore over the past years, the most widely used method for delivering tobacco and nicotine among teenagers in the United States has become e-cigarettes containing nicotine [15]. Moreover, the research on adolescents in Los Angeles high schools revealed that the students who had ever used e-cigarettes were more likely to start using tobacco over the next year [16]. They are often the first step to the smoking habit, and are also usually seen as a better way than NRT to quit smoking [17]. According to some research [18], e-cigarettes resulted in greater cessation of tobacco use than counseling alone. However many of the people who abstained from smoking tobacco were still using electronic cigarettes. It is also confirmed in results from the research [19] that tobacco smokers using e-cigarettes were more likely to reduce tobacco intake or even quit smoking. Another research describes very similar consequences. Participants in a reported group even though they ceased smoking tobacco cigarettes, continued using electronic cigarettes [20].

On the other hand, one author clearly emphasizes the advantage of the e-cigarettes over the placebo group and even claims that they have similar effectiveness to the nicotine patches. Described patients reached better goals in halving their usage of tobacco cigarettes using e-cigarettes with nicotine than placebo or nicotine patches. The author underlines that the long-term safety of e-cigarettes is unknown [21]. Furthermore, another article describes moderate-certainty evidence of the advantage of e-cigarettes with nicotine over NRT and also compared to e-cigarettes without nicotine [22]. The use of e-cigarettes for smoking cessation did not lead to higher rates of abstinence at 12 months or longer, which aligns with other findings described in the article, in which, researchers noted a cessation benefit for e-cigarettes at 6

months, but not at 12 or 18 months [23]. It is claimed that e-cigarettes may help quitting cigarettes, but only in the short term [23].

E-cigarettes remain controversial among medical and public health communities. Worries regarding the long-term effects of e-cigarette aerosol components fuel much of the discussion surrounding their use as smoking cessation aids. Evaluating the exposure of long-term users to inhaled vapor could provide more clarity on this risk [20].

Health effects of e-cigarettes

Even though we have a high awareness of smoking tobacco's side effects, we do not consider e-cigarettes in the same way. Many efforts worldwide to stop any form of smoking, ended up not being the optimal way. The number of tobacco smoking cessations is lower than the number of new e-cigarette users[24]. Since e-cigarettes entered the United States markets in 2006[25], an increasing number of research has been conducted to examine their influence on different organs and systems. The described in vitro study regarding oral health side effects found a range of cellular effects, but less substantial than after exposure to tobacco smoke[26]. The correlation between tobacco smoking and cardiovascular diseases has been well-known for a long time. The data describing the correlation in e-cigarettes is still limited. The authors point to cardiovascular harm through the mechanism increasing the risk of thrombosis and aterosclerosis[27]. Research shows that e-cigarettes lead to blood pressure and heart rate increase through consumption of e-cigarettes—furthermore oxidative stress, endothelial dysfunction, changes in vascular tone as well as increased platelet aggregation[24]. Focusing on lung-associated side effects, the conclusions are similar to the ones drawn regarding the cardiovascular system, namely research indicates cellular changes, including heightened oxidative stress, endothelial dysfunction, and compromised immune responses involving macrophages and neutrophils. Notably, vaping has been linked to significant lung injuries, although the long-term consequences of such exposure are still unclear. Further studies are needed to explore the intricate mechanisms of lung injury and the interactions between harmful inhalants and the host immune system concerning using of e-cigarettes-associated illnesses[28]. Many aspects of the long-term use of e-cigarettes remain uncertain. Among others, cancer risk demands more research to understand the full threat of using e-cigarettes[29].

Conclusion

The main aim of this study was to review the literature from the last 10 years regarding the effectiveness of smoking cessation in tobacco smoking and attempt to answer the question of which method focusing on NRT and e-cigarettes is more successful for smoking cessation. Nicotine addiction remains a significant public health challenge, with millions of people struggling to overcome and fight addiction each year. While nicotine replacement therapy (NRT) has proven effective in aiding cessation efforts, the rise of electronic cigarettes presents both opportunities and challenges in the realm of smoking cessation. A multifaceted approach that combines NRT, with behavioral support appears to be the most effective strategy for achieving sustained cessation. Easy access to e-cigarettes remains very disturbing, especially among adolescents, who at the same time believe they are completely harmless. Although e-cigarettes may offer a potential pathway for some smokers to reduce or quit their tobacco use, their long-term safety and efficacy remain uncertain. Additionally, it is essential to underline, that many people would have never tried traditional tobacco smoking, but they more willingly reach out for e-cigarettes, which seem to be much safer, but the actual long-term effects of using them are still unclear and not enough investigated.

Furthermore, ongoing research is essential to fully understand the implications of e-cigarette use, particularly among younger populations, who may be at risk of developing lifelong nicotine dependence. Evaluating the exposure of long-term users of e-cigarettes and substances contained in the inhaled vapor could provide more clarity on this risk. We want to underline the essence of promoting effective prevention and treatment strategies for nicotine addiction, ultimately reducing the burden of tobacco-related diseases and improving public health outcomes.

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References:

[1]- World Health Organization. [Internet] [cited 2024 Nov. 17]. Available from: https://www.who.int/health-topics/tobacco#tab=tab_1
[2]- Wittenberg RE, Wolfman SL, De Biasi M, Dani JA. Nicotinic acetylcholine receptors and nicotine addiction: A brief introduction. Neuropharmacology. 2020 Oct 15;177:108256. doi: 10.1016/j.neuropharm.2020.108256. Epub 2020 Jul 29. PMID: 32738308; PMCID: PMC7554201.
[3]- Sansone L, Milani F, Fabrizi R, Belli M, Cristina M, Zagà V, de Iure A, Cicconi L, Bonassi S, Russo P. Nicotine: From Discovery to Biological Effects. Int J Mol Sci. 2023 Sep 26;24(19):14570. doi: 10.3390/ijms241914570. PMID: 37834017; PMCID: PMC10572882.
[4]- Rigotti NA, Kruse GR, Livingstone-Banks J, Hartmann-Boyce J. Treatment of Tobacco Smoking: A Review. JAMA. 2022 Feb 8;327(6):566-577. doi: 10.1001/jama.2022.0395. PMID: 35133411.
[5]- Hartmann-Boyce J, McRobbie H, Lindson N, Bullen C, Begh R, Theodoulou A, Notley C, Rigotti NA, Turner T, Butler AR, Fanshawe TR, Hajek P. Electronic cigarettes for smoking cessation. Cochrane Database Syst Rev. 2021 Apr 29;4(4):CD010216. doi: 10.1002/14651858.CD010216.pub5. Update in: Cochrane Database Syst Rev. 2021 Sep 14;9:CD010216. doi: 10.1002/14651858.CD010216.pub6. PMID: 33913154; PMCID: PMC8092424.
[6]- Cook R, Davidson P, Martin R; NIHR Dissemination Centre. E-cigarettes helped more smokers quit than nicotine replacement therapy. BMJ. 2019 May 10;365:l2036. doi: 10.1136/bmj.l2036. PMID: 31076461.
[7]- McLaughlin I, Dani JA, De Biasi M. Nicotine withdrawal. Curr Top Behav Neurosci. 2015;24:99-123. doi: 10.1007/978-3-319-13482-6_4. PMID: 25638335; PMCID: PMC4542051.
[8]- Jackson KJ, Muldoon PP, De Biasi M, Damaj MI. New mechanisms and perspectives in nicotine withdrawal. Neuropharmacology. 2015 Sep;96(Pt B):223-34. doi: 10.1016/j.neuropharm.2014.11.009. Epub 2014 Nov 26. PMID: 25433149; PMCID: PMC4444410.
[9]- Theodoulou A, Chepkin SC, Ye W, Fanshawe TR, Bullen C, Hartmann-Boyce J, Livingstone-Banks J, Hajizadeh A, Lindson N. Different doses, durations and modes of delivery of nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev. 2023 Jun 19;6(6):CD013308. doi: 10.1002/14651858.CD013308.pub2. PMID: 37335995; PMCID: PMC10278922.

[10]- Wadgave U, Nagesh L. Nicotine Replacement Therapy: An Overview. Int J Health Sci (Qassim). 2016 Jul;10(3):425-35. PMID: 27610066; PMCID: PMC5003586.
[11]- Zawertailo L, Hendershot CS, Tyndale RF, Le Foll B, Samokhvalov AV, Thorpe KE, Pipe A, Reid RD, Selby P. Personalized dosing of nicotine replacement therapy versus standard dosing for the treatment of individuals with tobacco dependence: study protocol for a randomized placebo-controlled trial. Trials. 2020 Jun 29;21(1):592. doi: 10.1186/s13063-020-04532-7. PMID: 32600406; PMCID: PMC7325031.
[12]- Theodoulou A, Chepkin SC, Ye W, Fanshawe TR, Bullen C, Hartmann-Boyce J, Livingstone-Banks J, Hajizadeh A, Lindson N. Different doses, durations and modes of delivery of nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev. 2023 Jun 19;6(6):CD013308. doi: 10.1002/14651858.CD013308.pub2. PMID: 37335995; PMCID: PMC10278922.
[13]- Kanniah G, Kumar S, Prasad S. E-cigarettes and vaping - a panacea or a bane to smoking in current times? Australas Psychiatry. 2021 Feb;29(1):7-9. doi: 10.1177/1039856220950095. Epub 2020 Aug 24. PMID: 32838540.
[14]- Bernhard D, Messner B. Vaping Versus Smoking: Are Electronic-Cigarettes the Savior? Arterioscler Thromb Vasc Biol. 2024 May;44(5):1012-1015. doi: 10.1161/ATVBAHA.123.319575. Epub 2024 Apr 24. PMID: 38657033.
[15]- Hamberger ES, Halpern-Felsher B. Vaping in adolescents: epidemiology and respiratory harm. Curr Opin Pediatr. 2020 Jun;32(3):378-383. doi: 10.1097/MOP.0000000000000896. PMID: 32332328; PMCID: PMC7285995.
[16]- Leventhal AM, Strong DR, Kirkpatrick MG, Unger JB, Sussman S, Riggs NR, Stone MD, Khoddam R, Samet JM, Audrain-McGovern J. Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence. JAMA. 2015 Aug 18;314(7):700-7. doi: 10.1001/jama.2015.8950. PMID: 26284721; PMCID: PMC4771179.
[17]- Jerry JM, Collins GB, Streem D. E-cigarettes: Safe to recommend to patients? Cleve Clin J Med. 2015 Aug;82(8):521-6. doi: 10.3949/ccjm.82a.14054. PMID: 26270431.
[18]- Auer R, Schoeni A, Humair JP, Jacot-Sadowski I, Berlin I, Stuber MJ, Haller ML, Tango RC, Frei A, Strassmann A, Bruggmann P, Baty F, Brutsche M, Tal K, Baggio S, Jakob J, Sambiagio N, Hopf NB, Feller M, Rodondi N, Berthet A. Electronic Nicotine-Delivery Systems for Smoking Cessation. N Engl J Med. 2024 Feb 15;390(7):601-610. doi: 10.1056/NEJMoa2308815. PMID: 38354139.
[19]- Ronchetti J, Terriau A. Help me quit smoking but don't make me sick! The controversial effects of electronic cigarettes on tobacco smokers. Soc Sci Med. 2021 Apr;274:113770. doi: 10.1016/j.socscimed.2021.113770. Epub 2021 Feb 24. PMID: 33667743.
[20]- Rigotti NA. Electronic Cigarettes for Smoking Cessation - Have We Reached a Tipping Point? N Engl J Med. 2024 Feb 15;390(7):664-665. doi: 10.1056/NEJMe2314977. PMID: 38354147.
[21]- Bui Q. Electronic Cigarettes for Smoking Cessation. Am Fam Physician. 2016 Feb 1;93(3):178-9. PMID: 26926611.
[22]- Hartmann-Boyce J, McRobbie H, Butler AR, Lindson N, Bullen C, Begh R, Theodoulou A, Notley C, Rigotti NA, Turner T, Fanshawe TR, Hajek P. Electronic cigarettes for smoking cessation. Cochrane Database Syst Rev. 2021 Sep 14;9(9):CD010216. doi: 10.1002/14651858.CD010216.pub6. Update in: Cochrane Database Syst Rev. 2022 Nov 17;11:CD010216. doi: 10.1002/14651858.CD010216.pub7. PMID: 34519354; PMCID: PMC8438601.
[23]- Chen R, Pierce JP, Leas EC, White MM, Kealey S, Strong DR, Trinidad DR, Benmarhnia T, Messer K. Use of Electronic Cigarettes to Aid Long-Term Smoking Cessation in the United States: Prospective Evidence From the PATH Cohort Study. Am J Epidemiol.

2020 Dec 1;189(12):1529-1537. doi: 10.1093/aje/kwaa161. Erratum in: Am J Epidemiol. 2020 Dec 1;189(12):1640. doi: 10.1093/aje/kwaa193. PMID: 32715314; PMCID: PMC7705599.
[24]- Krabbe B, Espinola-Klein C, Malyar N, Brodmann M, Mazzolai L, Belch JJF, Müller OJ, Heiss C; DGA-German Society of Angiology Board; ESVM-European Society of Vascular Medicine Board. Health effects of e-cigarettes and their use for smoking cessation from a vascular perspective. Vasa. 2023 Mar;52(2):81-85. doi: 10.1024/0301-1526/a001056. Epub 2023 Feb 3. PMID: 36734252.
[25]- Eltorai AE, Choi AR, Eltorai AS. Impact of Electronic Cigarettes on Various Organ Systems. Respir Care. 2019 Mar;64(3):328-336. doi: 10.4187/respcare.06300. Epub 2018 Nov 6. PMID: 30401756.
[26]- Holliday R, Chaffee BW, Jakubovics NS, Kist R, Preshaw PM. Electronic Cigarettes and Oral Health. J Dent Res. 2021 Aug;100(9):906-913. doi: 10.1177/00220345211002116. Epub 2021 Mar 25. PMID: 33764176; PMCID: PMC8293737.
[27]- Kennedy CD, van Schalkwyk MCI, McKee M, Pisinger C. The cardiovascular effects of electronic cigarettes: A systematic review of experimental studies. Prev Med. 2019 Oct;127:105770. doi: 10.1016/j.ypmed.2019.105770. Epub 2019 Jul 22. PMID: 31344384.
[28]- O'Callaghan M, Boyle N, Fabre A, Keane MP, McCarthy C. Vaping-Associated Lung Injury: A Review. Medicina (Kaunas). 2022 Mar 10;58(3):412. doi: 10.3390/medicina58030412. PMID: 35334588; PMCID: PMC8949983.
[29]- Sahu R, Shah K, Malviya R, Paliwal D, Sagar S, Singh S, Prajapati BG, Bhattacharya S. E-Cigarettes and Associated Health Risks: An Update on Cancer Potential. Adv Respir Med. 2023 Nov 14;91(6):516-531. doi: 10.3390/arm91060038. PMID: 37987300; PMCID: PMC10660480.