Tobacco in Australia
Facts & Issues

Relevant news and research
18B.5 Exposure to chemicals from heated tobacco products

Last updated December 2024

Research: 3

18B.5 Exposure to chemicals from heated tobacco products 3

18B.5.1 What are the emissions from heated tobacco products? 3

18B.5.1.1 Aerosols from heated tobacco products 3

18B.5.1.2 Mainstream emissions, sidestream emissions and secondhand emissions from heated tobacco products 3

18B.5.1.3 Do heated tobacco products produce smoke? 4

18B.5.2 Measuring the chemicals in heated tobacco product emissions 4

18B.5.3 Chemicals in the emissions from heated tobacco products 6

18B.5.3.1 Nicotine 7

18B.5.3.2 Toxic substances 7

18B.5.3.3 Other chemicals 8

18B.5.4 Heated tobacco product emissions compared to cigarettes and e-cigarettes 8

18B.5.5 Secondhand emissions from heated tobacco products 9

18B.5.6 Biomarkers of exposure to chemicals from heated tobacco products 10

News: 12

18B.5 Exposure to chemicals from heated tobacco products 12

18B.5.1 What are the emissions from heated tobacco products? 12

18B.5.1.1 Aerosols from heated tobacco products 12

18B.5.1.2 Mainstream emissions, sidestream emissions and secondhand emissions from heated tobacco products 12

18B.5.1.3 Do heated tobacco products produce smoke? 12
18B.5.2 Measuring the chemicals in heated tobacco product emissions 12
18B.5.3 Chemicals in the emissions from heated tobacco products 12
18B.5.3.1 Nicotine 12
18B.5.3.2 Toxic substances 13
18B.5.3.3 Other chemicals 13
18B.5.4 Heated tobacco product emissions compared to cigarettes and e-cigarettes 13
18B.5.5 Secondhand emissions from heated tobacco products 13
18B.5.6 Biomarkers of exposure to chemicals from heated tobacco products 13

Research:

18B.5 Exposure to chemicals from heated tobacco products

Szarlowicz, K, & Wojcik, S. (2024). New insights in tobacco radiotoxicity: on the research of (210)Po in modern heated tobacco product-radioactivity, distribution, and dose assessment. *Environ Sci Pollut Res Int*.Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/39576440

Dempsey R, Rodrigo G, Vonmoos F, Gunduz I, Belushkin M, et al. Preliminary toxicological assessment of heated tobacco products: A review of the literature and proposed strategy. Toxicol Rep, 2023; 10:195-205. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36748021

Hirano T, Shobayashi T, Takei T, and Wakao F. Exposure assessment of environmental tobacco aerosol from heated tobacco products: Nicotine and PM exposures under two limited conditions. International Journal of Environmental Research and Public Health, 2020; 17(22). Available from: https://www.ncbi.nlm.nih.gov/pubmed/33217889

Bosilkovska M, Tran CT, de La Bourdonnaye G, Taranu B, Benzimra M, et al. Exposure to harmful and potentially harmful constituents decreased in smokers switching to Carbon-Heated Tobacco Product. Toxicol Lett, 2020; 330:30-40. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32380119

Boue S, Schlage WK, Page D, Hoeng J, and Peitsch MC. Toxicological assessment of Tobacco Heating System 2.2: Findings from an independent peer review. Regulatory Toxicology and Pharmacology, 2019; 104:115-27. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30878573

18B.5.1 What are the emissions from heated tobacco products?

Sussman RA, Sipala F, Emma R, and Ronsisvalle S. Aerosol Emissions from Heated Tobacco Products: A Review Focusing on Carbonyls, Analytical Methods, and Experimental Quality. Toxics, 2023; 11(12). Available from: https://pubmed.ncbi.nlm.nih.gov/38133348/

Pacitto A, Stabile L, Scungio M, Rizza V, and Buonanno G. Characterization of airborne particles emitted by an electrically heated tobacco smoking system. Environ Pollut, 2018; 240:248-54. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29747109

18B.5.1.1 Aerosols from heated tobacco products

18B.5.1.2 Mainstream emissions, sidestream emissions and secondhand emissions from heated tobacco products

El-Kaassamani M, Yen M, Talih S, and El-Hellani A. Analysis of mainstream emissions, secondhand emissions and the environmental impact of IQOS waste: a systematic review on IQOS that accounts for data source. Tobacco Control, 2022. Available from: https://www.ncbi.nlm.nih.gov/pubmed/35568394

St.Helen G, Jacob P, Nardone N, and Benowitz NL. Because PMI application did not report the full range of HPHCs in IQOS aerosol, characterize HPHCs in sidestream emissions, include a non -targeted analysis of chemicals in emissions, or conduct clinical studies to describe exposure to toxicants during dual use with other tobacco products, FDA must deny PMI's application. University of California San Francisco 2017. Available from:

https://tobacco.ucsf.edu/sites/tobacco.ucsf.edu/files/u9/Gideon-ClinPharm_Comments%20on%20aerosol%20and%20exposure_IQOS_11292017-FINAL.pdf.

O'Connell G, Wilkinson P, Burseg KMM, Stotesbury SJ, and Pritchard JD. Heated tobacco products create side-stream emissions: Implications for regulation. Journal of Environmental Analytical Chemistry, 2015; 2(5):1000163. Available from: https://www.hilarispublisher.com/open-access/heated-tobacco-products-create-sidestream-emissions-implications-forregulation-2380-2391-1000163.pdf

18B.5.1.3 Do heated tobacco products produce smoke?

Uguna CN and Snape CE. Should IQOS emissions be considered as smoke and harmful to health? A review of the chemical evidence. ACS Omega, 2022; 7(26):22111-24. Available from: https://www.ncbi.nlm.nih.gov/pubmed/35811880

Auer R, Concha-Lozano N, Jacot-Sadowski I, Cornuz J, and Berthet A. Heat-not-burn tobacco cigarettes: Smoke by any other name. JAMA Internal Medicine, 2017; 177(7):1050-2. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28531246

World Health Organization. Guidelines for implementation Article 8. Geneva, Switzerland: WHO, 2013. Available from: https://fctc.who.int/publications/m/item/protection-from-exposure-to-tobacco-smoke.

18B.5.2 Measuring the chemicals in heated tobacco product emissions

Shi, J, Yang, Y, Zhang, T, Liang, K, Guo, L, Deng, R et al. (2024). Multiple analyses of main flavor components in reconstituted tobacco and transfer behavior of their key substances during heating. *J Sep Sci, 47*(14), e2400250. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/39034833

Zhang X, Sun Y, Cheung YTD, Wang MP, Wu YS, et al. Cigarettes, heated tobacco products and dual use: exhaled carbon monoxide, saliva cotinine and total tobacco consumed by Hong Kong tobacco users. Tobacco Control, 2023. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36693724

Kim YH and Kim SH. Development and validation of a method for preparing heated tobacco product aerosol condensate (HTPAC) for large-scale toxicity data acquisition. Ecotoxicol Environ Saf, 2023; 267:115621. Available from: https://www.ncbi.nlm.nih.gov/pubmed/37879201

Wen Z, Gu X, Tang X, Li X, Pang Y, et al. Time-resolved online analysis of the gas- and particulate-phase of cigarette smoke generated by a heated tobacco product using vacuum ultraviolet photoionization mass spectrometry. Talanta, 2022; 238(Pt 2):123062. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34801915

Chen AX, Akmam Morsed F, and Cheah NP. A simple method to simultaneously determine the level of nicotine, glycerol, propylene glycol, and triacetin in heated tobacco products by gas chromatography-flame-ionization detection. Journal of AOAC International, 2022; 105(1):46-53. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34648035

Wang H, Chen H, Huang L, Han S, Wang L, et al. Novel Solvent-Free Extraction Method for Analyzing Tobacco Heating Product Aerosols: An Analytical and In Vitro Toxicological Five-Way Product

Comparison. Chem Res Toxicol, 2021. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34747590

Kim YH and An YJ. Development of a standardized new cigarette smoke generating (SNCSG) system for the assessment of chemicals in the smoke of new cigarette types (heat-not-burn (HNB) tobacco and electronic cigarettes (E-Cigs)). Environmental Research, 2020; 185:109413. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32224342

Ilies BD, Moosakutty S, Kharbatia N, and Sarathy M. Identification of volatile constituents released from IQOS heat-not-burn tobacco HeatSticks using a direct sampling method. Tobacco Control, 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32457207

Bentley MC, Almstetter M, Arndt D, Knorr A, Martin E, et al. Comprehensive chemical characterization of the aerosol generated by a heated tobacco product by untargeted screening. Analytical and Bioanalytical Chemistry, 2020; 412(11):2675-85. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32072212

Savareear B, Escobar-Arnanz J, Brokl M, Saxton MJ, Wright C, et al. Non-targeted analysis of the particulate phase of heated tobacco product aerosol and cigarette mainstream tobacco smoke by thermal desorption comprehensive two-dimensional gas chromatography with dual flame ionisation and mass spectrometric detection. J Chromatogr A, 2019. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31266643

Meisutovic-Akhtarieva M, Prasauskas T, Ciuzas D, Krugly E, Kerairyte K, et al. Impacts of exhaled aerosol from the usage of the tobacco heating system to indoor air quality: A chamber study. Chemosphere, 2019; 223:474-82. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30784754

McAdam K, Davis P, Ashmore L, Eaton D, Jakaj B, et al. Influence of machine-based puffing parameters on aerosol and smoke yields from next generation nicotine inhalation products. Regulatory Toxicology and Pharmacology, 2018. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30445136

Gasparyan H, Mariner D, Wright C, Nicol J, Murphy J, et al. Accurate measurement of main aerosol constituents from heated tobacco products (HTPs): Implications for a fundamentally different aerosol. Regulatory Toxicology and Pharmacology, 2018; 99:131-41. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30244041

Savareear B, Lizak R, Brokl M, Wright C, Liu C, et al. Headspace solid-phase microextraction coupled to comprehensive two-dimensional gas chromatography-time-of-flight mass spectrometry for the analysis of aerosol from tobacco heating product. J Chromatogr A, 2017; 1520:135-42. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28911941

Tobacco Laboratory Network. Standard operating procedure for method: Intense smoking of cigarettes. WHO TobLabNet Official Method SOP 01.Geneva: WHO, 2012. Available from: http://apps.who.int/iris/bitstream/handle/10665/75261/9789241503891_eng.pdf.

International Organization for Standardization. Tobacco heating systems — Definitions and standard conditions for aerosol generation and collection — Part 1: Electrically Heated Tobacco Products (eHTPs). Available from: https://www.iso.org/obp/ui/en/#iso:std:iso:5501:-1:dis:ed-1:v1:en

18B.5.3 Chemicals in the emissions from heated tobacco products

Zervas EN, Matsouki N, Tsipa CF, and Katsaounou PA. Particle emissions from heated tobacco products. Tob Prev Cessat, 2024; 10. Available from: https://www.ncbi.nlm.nih.gov/pubmed/38566785

Leigh NJ, Page MK, Robinson DL, Heldwein SD, O'Connor RJ, et al. Nicotine, Humectants, and Tobacco-Specific Nitrosamines (TSNAs) in IQOS Heated Tobacco Products (HTPs): A Cross-Country Study. Toxics, 2024; 12(3). Available from: https://www.ncbi.nlm.nih.gov/pubmed/38535913

Zhao X, Zhao S, Xu Y, Xu H, Zhang Z, et al. Preparation of tobacco pyrolysis liquids in subcritical/supercritical ethanol and their application in the aroma enhancement of heated cigarettes. Front Chem, 2023; 11:1347215. Available from: https://www.ncbi.nlm.nih.gov/pubmed/38274898

Sussman RA, Sipala F, Emma R, and Ronsisvalle S. Aerosol Emissions from Heated Tobacco Products: A Review Focusing on Carbonyls, Analytical Methods, and Experimental Quality. Toxics, 2023; 11(12). Available from: https://www.ncbi.nlm.nih.gov/pubmed/38133348

Lim DH, Ahmadi Y, Kim YH, and Kim KH. The extent of harmful volatile organic compounds released when smoking after breaking the flavor capsules of heat-not-burn (HNB) cigarette products. Environmental Research, 2023; 216(Pt 1):114501. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36220443

Li X, Wang X, Cui P, Liu G, Zhang H, et al. Comparison of Biomarkers of Exposure in a Controlled Study of Smokers Switched from Conventional Cigarettes to Heated Tobacco Products. Toxics, 2023; 11(10). Available from: https://www.ncbi.nlm.nih.gov/pubmed/37888667

Ardati O, Adeniji A, El Hage R, Salman R, El-Kaassamani M, et al. Impact of smoking intensity and device cleaning on IQOS emissions: comparison with an array of cigarettes. Tobacco Control, 2023. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36609493

Bekki K, Uchiyama S, Inaba Y, and Ushiyama A. Analysis of furans and pyridines from new generation heated tobacco product in Japan. Environmental Health and Preventive Medicine, 2021; 26(1):89. Available from: https://www.ncbi.nlm.nih.gov/pubmed/3451781

Cancelada L, Sleiman M, Tang X, Russell ML, Montesinos VN, et al. Heated tobacco products: Volatile emissions and their predicted impact on indoor air quality. Environmental Science & Technology, 2019; 53(13):7866-76. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31150216

Uchiyama S, Noguchi M, Takagi N, Hayashida H, Inaba Y, et al. Simple Determination of Gaseous and Particulate Compounds Generated from Heated Tobacco Products. Chem Res Toxicol, 2018. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29863851

Mallock N, Boss L, Burk R, Danziger M, Welsch T, 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(6):2145–9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29730817

Leigh NJ, Palumbo MN, Marino AM, O'Connor RJ, and Goniewicz ML. Tobacco-specific nitrosamines (TSNA) in heated tobacco product IQOS. Tobacco Control, 2018; 27(Suppl 1):s37-s8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30242043

Forster M, Fiebelkorn S, Yurteri C, Mariner D, Liu C, et al. Assessment of novel tobacco heating product THP1.0. Part 3: Comprehensive chemical characterisation of harmful and potentially harmful aerosol emissions. Regulatory Toxicology and Pharmacology, 2018; 93:14-33. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29080848

18B.5.3.1 Nicotine

18B.5.3.2 Toxic substances

Kauneliene, V, Bagdonas, E, Aldonyte, R, Raudoniute, J, Ciuzas, D, Bagdoniene, L et al. (2024). Cytotoxicity of the exhaled aerosol particles from the usage of conventional cigarette and heated tobacco product as determined by a novel "Cells-on-Particles" exposure model in vitro. *Environ Pollut, 361*, 124870. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/39218201

Kim YH and An YJ. Development of a standardized new cigarette smoke generating (SNCSG) system for the assessment of chemicals in the smoke of new cigarette types (heat-not-burn (HNB) tobacco and electronic cigarettes (E-Cigs)). Environmental Research, 2020; 185:109413. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32224342

International Agency for Research on Cancer. IARC monographs on the identification of carcinogenic hazards to humans: Preamble. Lyon, France: IARC, 2019. Available from: https://monographs.iarc.who.int/wp-content/uploads/2019/07/Preamble-2019.pdf.

Caponnetto P, Maglia M, Prosperini G, Busa B, and Polosa R. Carbon monoxide levels after inhalation from new generation heated tobacco products. Respiratory Research, 2018; 19(1):164. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30170593

Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). Final opinion on additives used in tobacco products. European Commission, Health & Food Safety, Directorate C: Public Health 2016. Available from: http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_051.pdf.

International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans: some non-heterocyclic polycyclic aromatic hydrocarbons and some related exposures. Monographs on the Evaluation of Carcinogenic Risks to Human 92 Lyon, France: IARC, 2010. Available from: https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Some-Non-heterocyclic-Polycyclic-Aromatic-Hydrocarbons-And-Some-Related-Exposures-2010.

18B.5.3.3 Other chemicals

Davigo M, Klerx WNM, van Schooten FJ, Opperhuizen A, Remels AHV, et al. Impact of more intense smoking parameters and flavor variety on toxicant levels in emissions of a Heated Tobacco Product. Nicotine & Tobacco Research, 2023. Available from: https://www.ncbi.nlm.nih.gov/pubmed/38035623

18B.5.4 Heated tobacco product emissions compared to cigarettes and e-cigarettes

Distefano, A, Orlando, L, Partsinevelos, K, Longhitano, L, Emma, R, Caruso, M et al. (2024). Comparative evaluation of cigarette smoke and a heated tobacco product on microglial toxicity, oxidative stress and inflammatory response. *J Transl Med, 22*(1), 876. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/39350202

Tane, EG, Martinez-Gomez, L, Amoros-Perez, A, Roman-Martinez, MC, & Lillo-Rodenas, MA. (2024). A novel approach to the quantitative analysis of the particulate matter in conventional cigarette smoke and heated tobacco product aerosols. *Heliyon, 10*(15), e35028. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/39170206

Lang G, Henao C, Almstetter M, Arndt D, Goujon C, et al. Non-targeted analytical comparison of a heated tobacco product aerosol against mainstream cigarette smoke: does heating tobacco produce an inherently different set of aerosol constituents? Analytical and Bioanalytical Chemistry, 2024. Available from: https://www.ncbi.nlm.nih.gov/pubmed/38217698

An YJ and Kim YH. Assessment of toxicological validity using tobacco emission condensates: A comparative analysis of emissions and condensates from 3R4F reference cigarettes and heated tobacco products. Environment International, 2024; 185:108502. Available from: https://www.ncbi.nlm.nih.gov/pubmed/38368717

Hashizume T, Ishikawa S, Matsumura K, Ito S, and Fukushima T. Chemical and in vitro toxicological comparison of emissions from a heated tobacco product and the 1R6F reference cigarette. Toxicol Rep, 2023; 10:281-92. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36876026

Ardati O, Adeniji A, El Hage R, Salman R, El-Kaassamani M, et al. Impact of smoking intensity and device cleaning on IQOS emissions: comparison with an array of cigarettes. Tobacco Control, 2023. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36609493

Karkela T, Tapper U, and Kajolinna T. Comparison of 3R4F cigarette smoke and IQOS heated tobacco product aerosol emissions. Environmental Science and Pollution Research, 2022; 29(18):27051-69. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34935111

Esposito F, Squillante J, Nolasco A, Montuori P, Macri PG, et al. Acrylamide levels in smoke from conventional cigarettes and heated tobacco products and exposure assessment in habitual smokers. Environmental Research, 2022; 208:112659. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34990604

Berthet A, Butty A, Rossier J, Sadowski IJ, and Froidevaux P. (210)Po and (210)Pb content in the smoke of Heated Tobacco Products versus Conventional Cigarette smoking. Scientific Reports, 2022; 12(1):10314. Available from: https://www.ncbi.nlm.nih.gov/pubmed/35725999

Hirn C, Kanemaru Y, Stedeford T, Paschke T, and Baskerville-Abraham I. Comparative and cumulative quantitative risk assessments on a novel heated tobacco product versus the 3R4F reference cigarette. Toxicol Rep, 2020; 7:1502-13. Available from: https://www.ncbi.nlm.nih.gov/pubmed/33209587

Li X, Luo Y, Jiang X, Zhang H, Zhu F, et al. Chemical analysis and simulated pyrolysis of Tobacco Heating System 2.2 Compared to conventional cigarettes. Nicotine & Tobacco Research, 2019; 21(1):111-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29319815

Jeong WT, Cho HK, Lee HR, Song KH, and Lim HB. Comparison of the content of tobacco alkaloids and tobacco-specific nitrosamines in 'heat-not-burn' tobacco products before and after aerosol generation. Inhal Toxicol, 2019:1-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30741569

Davis B, To V, and Talbot P. Comparison of cytotoxicity of IQOS aerosols to smoke from marlboro Red and 3R4F reference cigarettes. Toxicol In Vitro, 2019:104652. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31526836

Takahashi Y, Kanemaru Y, Fukushima T, Eguchi K, Yoshida S, et al. Chemical analysis and in vitro toxicological evaluation of aerosol from a novel tobacco vapor product: A comparison with cigarette smoke. Regulatory Toxicology and Pharmacology, 2018; 92:94-103. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29158044

St Helen G, Jacob Iii P, Nardone N, and Benowitz NL. IQOS: examination of Philip Morris International's claim of reduced exposure. Tobacco Control, 2018; 27(Suppl 1):s30-s6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30158205

Savareear B, Escobar-Arnanz J, Brokl M, Saxton MJ, Wright C, et al. Comprehensive comparative compositional study of the vapour phase of cigarette mainstream tobacco smoke and tobacco heating product aerosol. J Chromatogr A, 2018. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30455053

Farsalinos KE, Yannovits N, Sarri T, Voudris V, Poulas K, et al. Carbonyl emissions from a novel heated tobacco product (IQOS): comparison with an e-cigarette and a tobacco cigarette. Addiction, 2018; 113(11):2099-106. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29920842

Murphy J, Liu C, McAdam K, Gaca M, Prasad K, et al. Assessment of tobacco heating product THP1.0. Part 9: The placement of a range of next-generation products on an emissions continuum relative to cigarettes via pre-clinical assessment studies. Regulatory Toxicology and Pharmacology, 2017. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29080852

Bekki K, Inaba Y, Uchiyama S, and Kunugita N. Comparison of chemicals in mainstream smoke in heat-not-burn tobacco and combustion cigarettes. Journal of UOEH, 2017; 39(3):201-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28904270

18B.5.5 Secondhand emissions from heated tobacco products

Ludovichetti, FS, Zuccon, A, Di Fiore, A, Zambon, G, Bargan, A, Stellini, E, & Mazzoleni, S. (2024). Perception of the oral health risks of passive smoking from traditional cigarettes, electronic

cigarettes, and heated tobacco products: A cross-sectional study. *Tob Induc Dis, 22*. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/38699220

Loupa G, Karali D, and Rapsomanikis S. The trace of airborne particulate matter from smoking e-cigarette, tobacco heating system, conventional and hand-rolled cigarettes in a residential environment. Air Quality, Atmosphere & Health, 2019; 12(12):1449-57. Available from: https://doi.org/10.1007/s11869-019-00760-2

18B.5.6 Biomarkers of exposure to chemicals from heated tobacco products

Swiatkowska B, Jankowski M, and Kaleta D. Comparative evaluation of ten blood biomarkers of inflammation in regular heated tobacco users and non-smoking healthy males-a pilot study. Scientific Reports, 2024; 14(1):8779. Available from: https://www.ncbi.nlm.nih.gov/pubmed/38627440

Braznell S, Campbell J, and Gilmore AB. What can current biomarker data tell us about the risks of lung cancer posed by heated tobacco products? Nicotine & Tobacco Research, 2024; 26(3):270-80. Available from: https://www.ncbi.nlm.nih.gov/pubmed/37210693

Kawasaki Y, Li YS, Ootsuyama Y, Fujisawa K, Omori H, et al. Assessment of exposure and DNA damage from second-hand smoke using potential biomarker in urine: cigarettes and heated tobacco products. J Clin Biochem Nutr, 2023; 72(3):242-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/37251967

Giebe S, Brux M, Hofmann A, Lowe F, Breheny D, et al. Comparative study of the effects of cigarette smoke versus next-generation tobacco and nicotine product extracts on inflammatory biomarkers of human monocytes. Pflugers Arch, 2023. Available from: https://www.ncbi.nlm.nih.gov/pubmed/37081240

Yuki D, Kikuchi A, Suzuki T, Sakaguchi C, Huangfu D, et al. Assessment of the exposure to selected smoke constituents in adult smokers using in-market heated tobacco products: a randomized, controlled study. Scientific Reports, 2022; 12(1):18167. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36307514

Gale N, McEwan M, Hardie G, Proctor CJ, and Murphy J. Changes in biomarkers of exposure and biomarkers of potential harm after 360 days in smokers who either continue to smoke, switch to a tobacco heating product or quit smoking. Intern Emerg Med, 2022. Available from: https://www.ncbi.nlm.nih.gov/pubmed/36036342

Svendsen C, James A, Matulewicz RS, Moreton E, Sosnowski R, et al. Carcinogenic biomarkers of exposure in the urine of heated tobacco product users associated with bladder cancer: A systematic review. Urologic Oncology, 2021. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34920944

Kawasaki Y, Li YS, Watanabe S, Ootsuyama Y, and Kawai K. Urinary biomarkers for secondhand smoke and heated tobacco products exposure. J Clin Biochem Nutr, 2021; 69(1):37-43. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34376912

Gale N, McEwan M, Camacho OM, Hardie G, Proctor CJ, et al. Changes in biomarkers after 180 days of tobacco heating product use: a randomised trial. Intern Emerg Med, 2021. Available from: https://www.ncbi.nlm.nih.gov/pubmed/34196886

van der Plas A, Pouly S, Blanc N, Haziza C, de La Bourdonnaye G, et al. Impact of switching to a heat-not-burn tobacco product on CYP1A2 activity. Toxicol Rep, 2020; 7:1480-6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/33204648

Tran CT, Bosilkovska M, de La Bourdonnaye G, Blanc N, and Haziza C. Reduced levels of biomarkers of exposure in smokers switching to the Carbon-Heated Tobacco Product 1.0: a controlled, randomized, open-label 5-day exposure trial. Scientific Reports, 2020; 10(1):19227. Available from: https://www.ncbi.nlm.nih.gov/pubmed/33154508

Gale N, McEwan M, Camacho OM, Hardie G, Murphy J, et al. Changes in Biomarkers of Exposure on Switching From a Conventional Cigarette to the glo Tobacco Heating Product: A Randomized, Controlled Ambulatory Study. Nicotine & Tobacco Research, 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32776101

Drovandi A, Salem S, Barker D, Booth D, and Kairuz T. Human biomarker exposure from cigarettes versus novel heat-not-burn devices: A systematic review and meta-analysis. Nicotine & Tobacco Research, 2020; 22(7):1077-85. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31641752

van der Toorn M, Koshibu K, Schlage WK, Majeed S, Pospisil P, et al. Comparison of monoamine oxidase inhibition by cigarettes and modified risk tobacco products. Toxicol Rep, 2019; 6:1206-15. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31768332

Haziza C, de La Bourdonnaye G, Donelli A, Skiada D, Poux V, et al. Favorable Changes in Biomarkers of Potential Harm to Reduce the Adverse Health Effects of Smoking in Smokers Switching to the Menthol Tobacco Heating System 2.2 for Three Months (Part 2). Nicotine & Tobacco Research, 2019. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31125079

Glantz SA. PMI's own in vivo clinical data on biomarkers of potential harm in Americans show that IQOS is not detectably different from conventional cigarettes. Tobacco Control, 2018. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30131374

Gale N, McEwan M, Eldridge AC, Fearon IM, Sherwood N, 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 & Tobacco Research, 2018. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29912406

News:

18B.5 Exposure to chemicals from heated tobacco products

18B.5.1 What are the emissions from heated tobacco products?

18B.5.1.1 Aerosols from heated tobacco products

18B.5.1.2 Mainstream emissions, sidestream emissions and secondhand emissions from heated tobacco products

18B.5.1.3 Do heated tobacco products produce smoke?

Campaign for Tobacco-Free Kids. Heated tobacco products. 2021. Available from: https://www.tobaccofreekids.org/what-we-do/global/heated-tobacco-products.

Rodgman A and Perfetti TA, The chemical components of tobacco and tobacco smoke. 2nd edFlorida, USA: CRC Press, Taylor and Francis Group; 2013. Available from: https://www.taylorfrancis.com/books/mono/10.1201/b13973/chemical-components-tobacco-tobacco-smoke-thomas-perfetti-alan-rodgman.

18B.5.2 Measuring the chemicals in heated tobacco product emissions

18B.5.3 Chemicals in the emissions from heated tobacco products

No authors listed. Statement on the toxicological evaluation of novel heat-not-burn tobacco products. Committee on toxicity,. 2019. Available from: https://cot.food.gov.uk/sites/default/files/heat_not_burn_tobacco_statement.pdf.

No authors listed. Tobacco hybrid emits low-toxicant, e-cig-like vapour with enhanced flavour. British American Tobacco. 2018. Available from: http://www.bat-science.com/groupms/sites/BAT_9GVJXS.nsf/vwPagesWebLive/DOAMULJY.

No authors listed. Toxicological evaluation of novel heat-not-burn tobacco products –non-technical summary. Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) (UK). 2017. Available from: https://cot.food.gov.uk/sites/default/files/heat_not_burn_tobacco_summary.pdf.

18B.5.3.1 Nicotine

Margottini L and Chapman M. Philip Morris misleading the public about nicotine in heated tobacco. The Bureau of Investigative Journalism. 2022. Available from: https://www.thebureauinvestigates.com/stories/2022-08-28/philip-morris-misleading-public-about-nicotine-in-heated-tobacco.

18B.5.3.2 Toxic substances

International Agency for Research on Cancer. List of classifications. Agents classified by the IARC Monographs, Volumes 1–135. IARC. Available from: https://monographs.iarc.who.int/list-of-classifications.

18B.5.3.3 Other chemicals

18B.5.4 Heated tobacco product emissions compared to cigarettes and e-cigarettes

No authors listed. Clinical study reveals smokers who switch to glo had significantly reduced exposure to toxicants. British American Tobacco. 2018. Available from: http://bat-science.com/groupms/sites/BAT_9GVJXS.nsf/vwPagesWebLive/DOAW6FS2?opendocument

18B.5.5 Secondhand emissions from heated tobacco products

18B.5.6 Biomarkers of exposure to chemicals from heated tobacco products

British American Tobacco. Smokers Who Switch to Glo had Significantly Reduced Exposure to Toxicants. Technology Networks. 2018. Available from: https://www.technologynetworks.com/tn/news/smokers-who-switch-to-glo-had-significantly-reduced-exposure-to-toxicants-297939.