

HEATED PRODUCTS

Puffing Topography of PULZE Heated Tobacco and Heated Herbal Products Reveals Consistent Use Patterns that Support Tobacco Harm Reduction

CORESTA PSPT 2025 | 19-23 October 2025

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INTRODUCTION

Puffing topography describes how consumers use inhaled nicotine or tobacco products. It provides insights into user behaviour and potential exposure to aerosol constituents. Key puffing parameters such as puff count, volume, duration, and inter-puff interval are informative for understanding potential exposure patterns. While cigarette topography is well characterised [1,2], data for heated products remains comparatively limited. Heated products represent a relatively new category of tobacco and nicotine products that deliver nicotine without burning tobacco [3]. The aim of this analysis was to characterise puffing behaviour among adult smokers during the *ad libitum* use of PULZE heating system variants (iD heated tobacco variants and iSENZIA heated herbal sticks), evaluate their potential for tobacco harm reduction (THR) - strategies designed to reduce the health risks associated with tobacco smoking [4] - and determine if it aligns with the new ISO standard [5].

METHODS

Puffing topography data were collected during two separate nicotine pharmacokinetic (PK) studies, evaluating a total of eight nicotine and tobacco products. Seven PULZE heating system stick variants were studied and compared to subjects' own brand cigarettes (OBC). Each PK study used a different PULZE device version (Figure 1).

Study Products

The PULZE 1.1 device was used with three variants of iD tobacco sticks, Intense American Blend, Regular American Blend, and Regular Menthol. While the PULZE 2.0 device was used with two variants of iSENZIA heated herbal stick, Summer Watermelon and Forest Berry, and two variants of iD heated tobacco stick, Balanced Blue and Rich Bronze. Subject's OBC was used as a comparator.

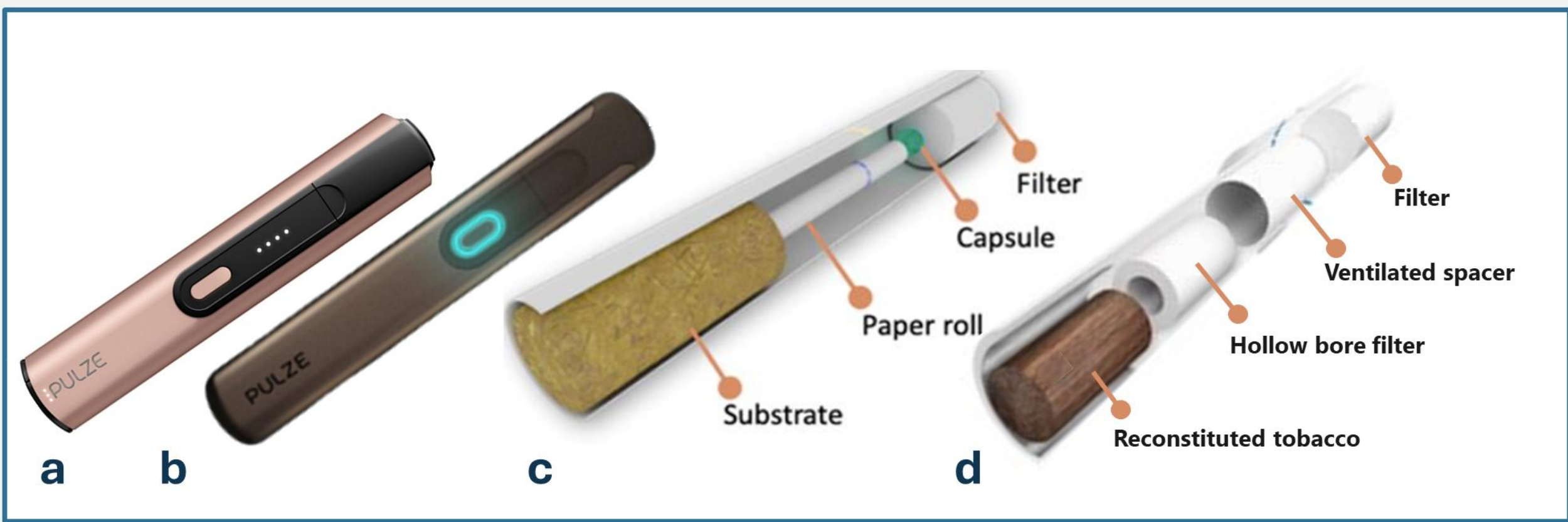


Figure 1. Study products. a PULZE 1.1 device; b PULZE 2.0 device; c iSENZIA heated herbal stick constructions; d iD heated tobacco stick constructions.

Study Design

In each PK study, adult smokers (aged 21 and older) used a randomly assigned heated stick or their OBC during a 4-hour *ad libitum* use session, with puff topography recorded over the final 2-hour period, using a SODIM Smoking Puff Analyser Mobile (SPA-M) device (Figure 2). For standardised assessment, ten puffs were taken from each stick assigned randomly at 30-second intervals and of 3-second duration [6,7].

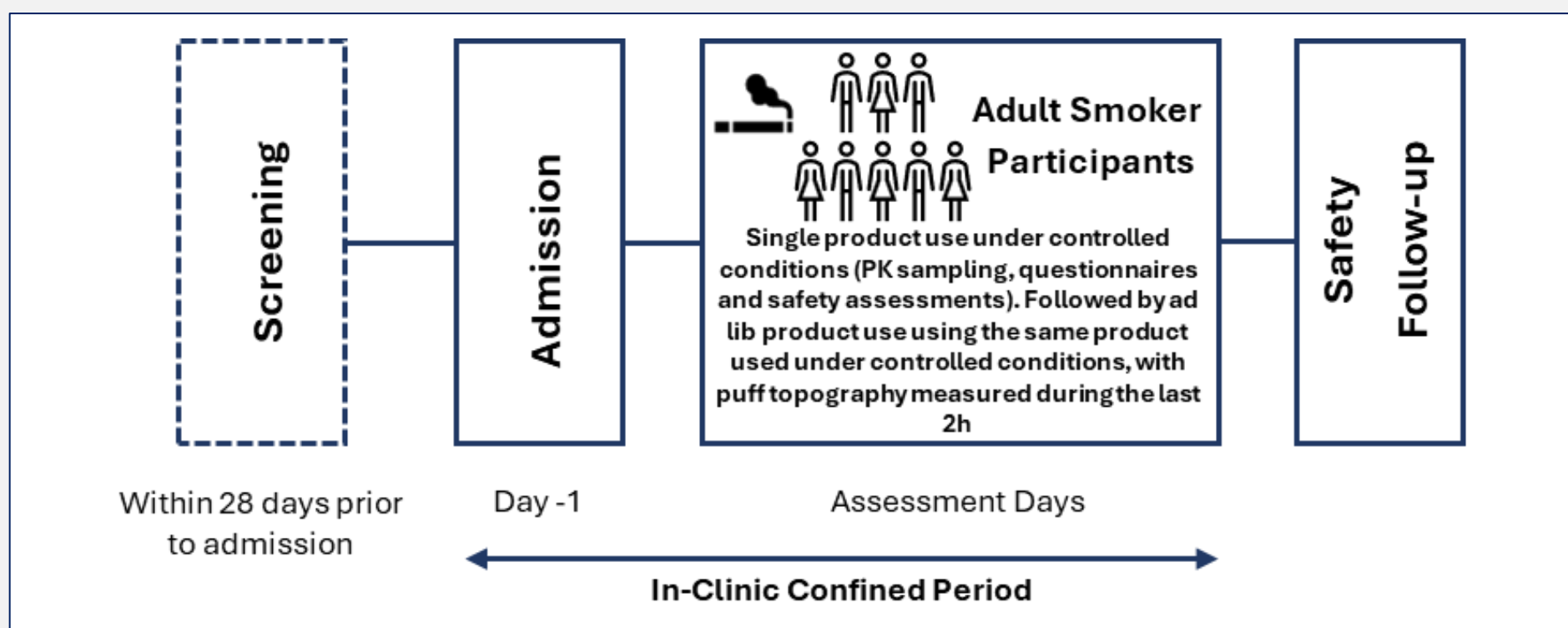


Figure 2. Study procedure for the two PK studies.

RESULTS

- Puffing topography was characterised by calculating means and standard deviations (SD) of key parameters across participants' OBC and heated stick variants (Table 1).
- Parameters included: puff count, puff duration, inter puff interval, puff volume, peak flow, and average flow, providing insights into product use patterns and variability.

Table 1. Puffing topography recorded during the two PK studies. The table reports mean and SD for average puff count, puff duration, inter-puff interval, puff volume, peak puff flow rate, average puff flow rate, and the number of subjects across the eight assessed products.

Parameter	PULZE 1.1						PULZE 2.0								OBC	
	iD Intense American Blend		iD Regular American Blend		iD Regular Menthol		iD Balanced Blue		iD Rich Bronze		iSENZIA Forest Berry		iSENZIA Summer Watermelon			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Puff Count/Stick	6.0	1.6	6.62	2.5	5.8	2.6	12.4	2.6	16.6	5.1	21.3	8.4	21.3	7.1	12.4	2.6
Puff Duration (s)	2.3	1.4	3.2	1.7	2.7	1.2	2.8	1.0	2.5	1.4	3.3	1.6	2.4	0.9	2.4	0.8
Inter-puff Interval (s)	14.1	6.7	12.2	7.7	11.0	4.8	14.3	6.1	16.0	4.9	11.7	7.9	11.5	5.0	20.4	7.3
Puff Volume (mL)	51.8	27.0	78.8	39.0	57.0	19.1	60.7	19.3	63.5	43.0	67.9	32.4	42.2	31.0	74.4	17.9
Peak Flow (mL/s)	39.5	14.6	46.1	11.5	43.4	16.1	46.1	13.6	43.8	21.8	41.3	14.7	42.9	18.2	59.9	17.8
Avg. Flow (mL/s)	25.2	10.0	27.0	7.0	23.8	6.5	23.9	7.5	26.4	12.0	22.1	7.8	18.7	11.4	34.8	8.3
Number of Subjects	11		11		11		12		9		9		11		18	

- To compare puffing behaviour across the two PK studies, visualisation of iD sticks compared to cigarette parameter are presented in Figures 3-4.

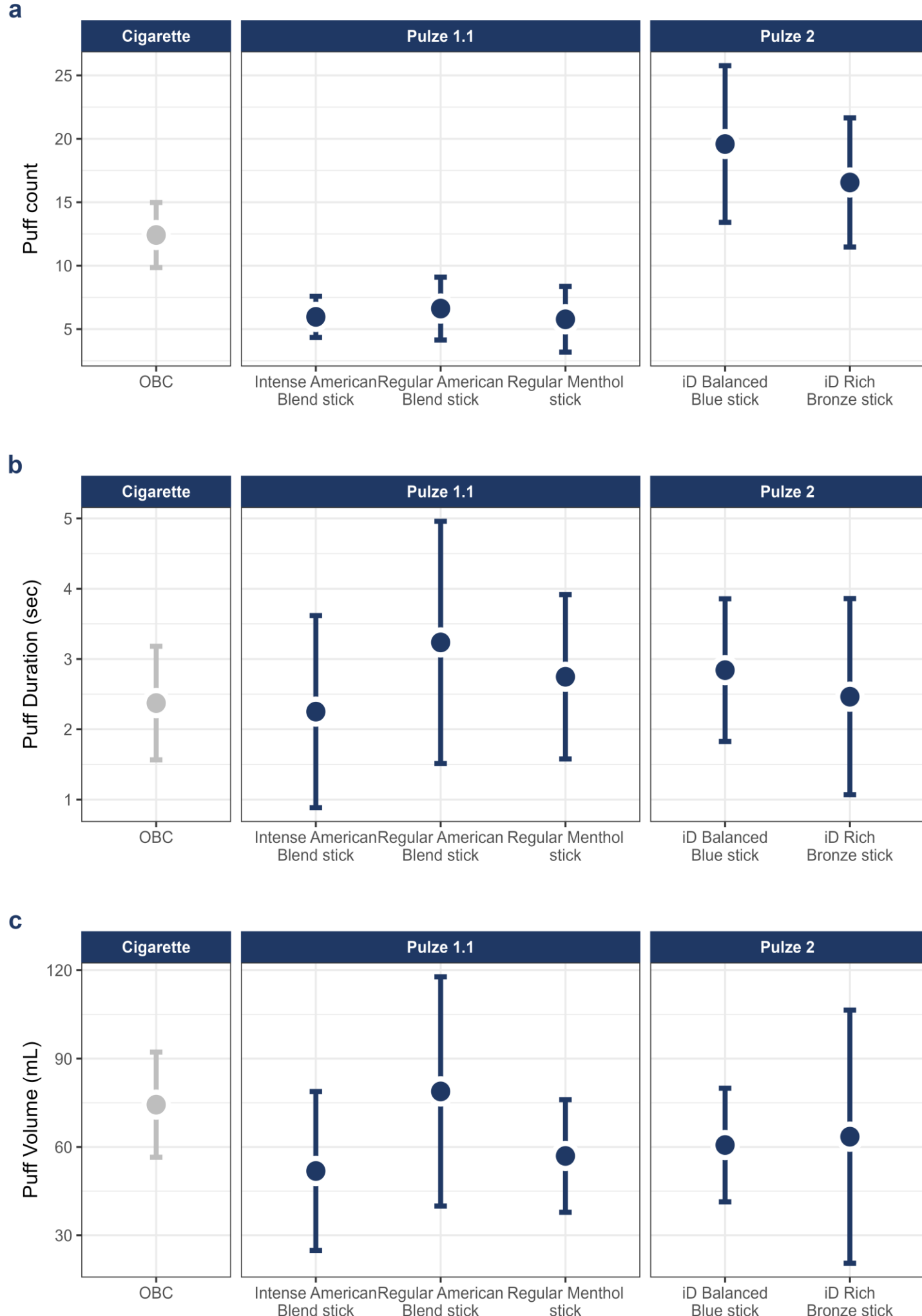


Figure 3. Visual comparison of average (a) puff count (b) puff duration (c) puff volume between the two PK studies each carried out with a different PULZE device version (PULZE 2.0 and PULZE 1.1) with iD variants, compared with cigarette.

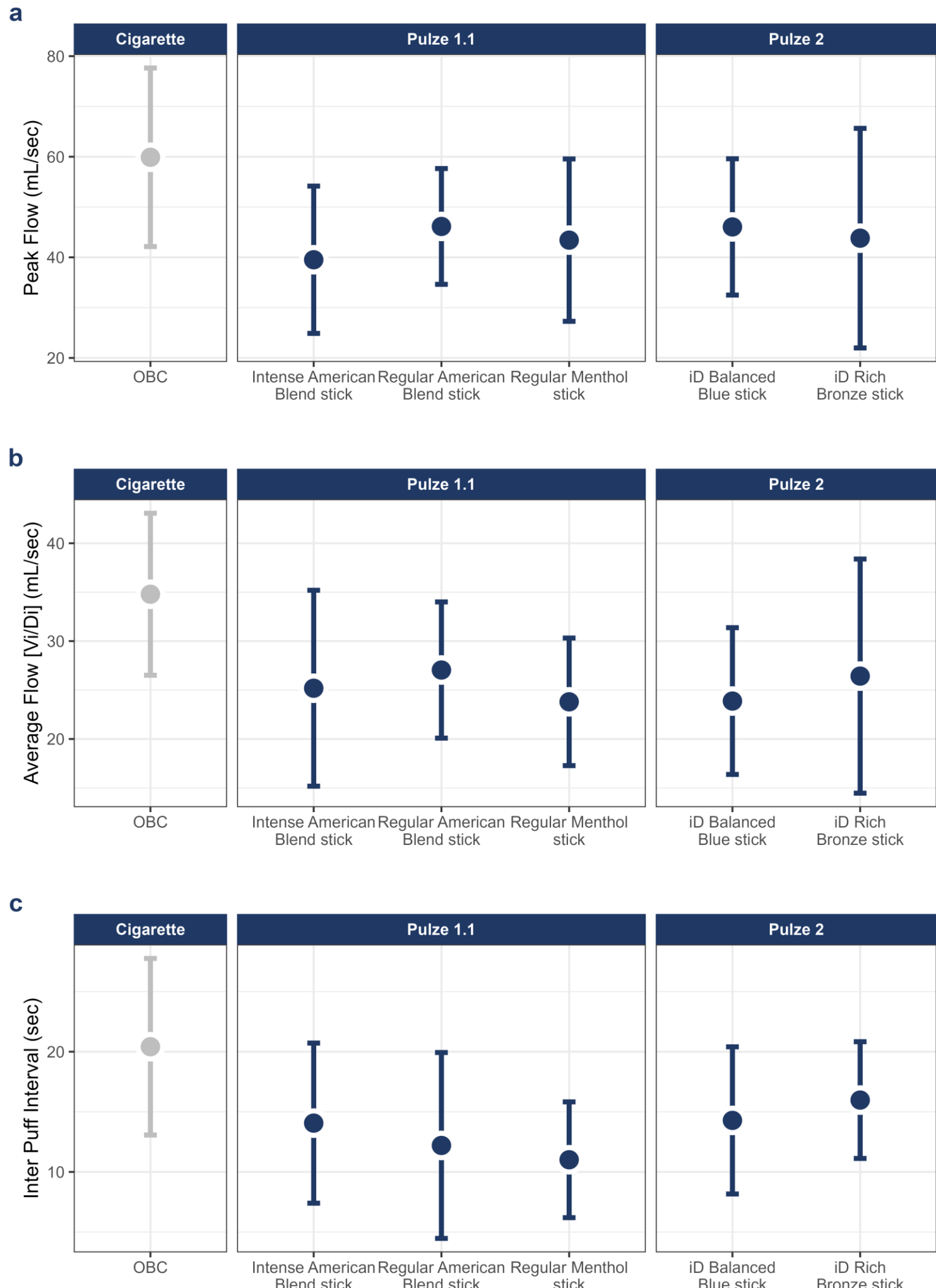


Figure 4. Visual comparison of average (a) peak flow (b) puff flow rate (c) inter puff interval between the two PK studies each carried out with a different PULZE device version (PULZE 2.0 and PULZE 1.1) with iD variants, compared with cigarette.

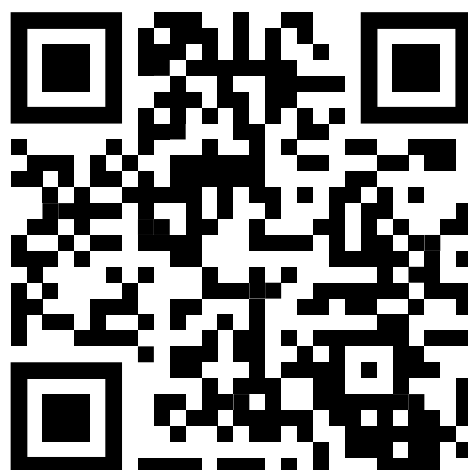
- There were no significant differences in puffing topography parameters between flavours, within and in between each of the two product categories (heated tobacco and heated herbal products).
- Puffing topography was broadly consistent across both PK studies and PULZE variants, with exception of puff count, which showed some variation (Table 2).
- Summarised topography data is broadly in line with the ISO standard (55 mL puff over 2 sec every 30 sec).

Table 2. Summary of key puffing topography parameters for iD/PULZE 1.1, iD/PULZE 2.0 and iSENZIA/PULZE 2.0 obtained from two PK studies.

	Puff Volume (mL)		Puff Duration (s)		Inter-puff-Interval (s)		Puff Count/Stick	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PULZE 1.1/iD	62.54	30.92	2.74	1.45	12.42	6.44	6.12	2.2
PULZE 2.0/iD	61.87	30.74	2.68	1.17	15.01	5.55	18.3	5.8
PULZE 2.0/iSENZIA	53.73	33.44	2.80	1.33	11.56	6.29	21.3	7.5

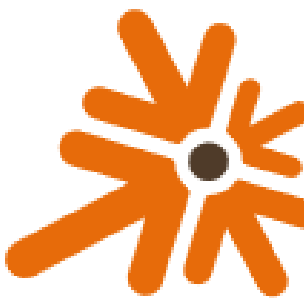
CONCLUSIONS

- No significant differences were observed between PULZE heating system used with any of the iD variants, suggesting similar user behaviour, except for puff count.
- Similarly, no significant differences observed between PULZE device used with iD and iSENZIA variants, suggesting similar user behaviour across both heated tobacco and heated herbal formats, except for puff count.
- These findings suggest that, overall, flavours did not substantially influence puffing behaviour.
- Puff count was lower in the earlier version of PULZE (PULZE 1.1), likely due to difference in device efficiency, airflow, or user experience, which were improved in the new version (PULZE 2.0) rather than changes in the aerosol composition. Given both versions deliver aerosol with substantially fewer and lower levels of harmful and potentially harmful constituents compared to cigarettes [7,8], this observed difference does not alter the products' overall THR potential.
- Overall, subjects' puffing behaviour with PULZE heating systems was broadly consistent with the ISO standard, further supporting the applicability of this standard for the generation and collection of heated product aerosols.



FIND OUT MORE

REFERENCES
[1] ISO 3308:2012. Routine analytical cigarette-smoking machine — Definitions and standard conditions
[2] ISO 20778:2018. Cigarettes — Routine analytical cigarette smoking machine — Definitions and standard conditions with an intense smoking regime
[3] Upadhyay S, Rahman M, Johanson G, Palmberg L, Ganguly K. Heated Tobacco Products: Insights into Composition and Toxicity. Toxics. 2023 Aug 2;11(8):667. doi: 10.3390/toxics11080667. PMID: 37624172; PMCID: PMC10459283.
[4] Institute of Medicine (US) Committee to Assess the Science Base for Tobacco Harm Reduction. Clearing the Smoke: Assessing the Science Base for Tobacco Harm Reduction. Stratton K, Shetty P, Wallace R, Bondurant S, editors. Washington (DC): National Academies Press (US); 2001. PMID: 25057541.
[5] ISO 5901-1:2024 standard Tobacco heating systems — Definitions and standard conditions for aerosol generation and collection — Part 1: Electrically heated tobacco products (eHTPs), Health Canada Intense regimen, supporting evidence of reduced HPHC exposure relative to cigarettes.
[6] McDermott S, Reichmann K, Mason E, Fearon IM, O'Connell G, Nahde T. An assessment of nicotine pharmacokinetics and subjective effects of the pulze heated tobacco system compared with cigarettes. Sci Rep. 2023 Jun 3;13(1):9037. doi: 10.1038/s41598-023-36259-1. PMID: 37270650; PMCID: PMC1028516.
[7] Marinas-Lacasta AF, Fearon IM, Stevenson M, Abusaleem T, Chapman F, Trellis Sticken E, Wiecek R, Pour SJ, Dethloff O, Komini O, Brown M, Simms L, Nahde T. Assessment of heated herbal products' tobacco harm reduction potential: pre-clinical and clinical studies. Front Toxicol. 2025 Aug 11;7:1589480. doi: 10.3389/ftox.2025.1589480. PMID: 40861931; PMCID: PMC12375587.
[8] Chapman F, Sticken ET, Wiecek R, Pour SJ, Dethloff O, Budde J, Rudd K, Mason E, Czekala L, Yu F, Simms L, Nahde T, O'Connell G, Stevenson M. Multiple endpoint in vitro toxicity assessment of a prototype heated tobacco product indicates substantially reduced effects compared to those of combustible cigarette. Toxicol In Vitro. 2023 Feb;86:105510. doi: 10.1016/j.tiv.2022.105510. Epub 2022 Nov 11. PMID: 36372310.



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