Nicotine Pharmacokinetics and Puffing Behaviors of Large Cigar Smokers

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Conflict of Interest:

- No conflict of interest to report

Background

- Cigar smoking is associated with nicotine addiction and adverse health effects including mouth and throat cancer as cigar smoke contains toxicants similar to those found in cigarette smoke (Hoffman & Hoffman, 1998).
- Unlike cigarettes that are quite uniform in size and composition, there is a wide range of cigar sizes, flavors, and designs.
- Because there are no naming standards, manufacturers are free to label cigars as they wish and typically define cigars as little cigars, cigarillos, large cigars, or premium cigars.
- Subset of cigar smokers (large / premium cigar users) tends to not inhale smoke which may differentiate these product use behavior from other combustible tobacco product use.

Research Objectives

- **STUDY1:** To compare large cigar and cigarette smoking for use patterns, smoking topography, and toxicant exposure; ad lib use
- **STUDY 2:** To investigate the impact of cigar tobacco pH (low and high) on nicotine pharmacokinetics, pharmacodynamics, and subjective measures after buccal (mouth) absorption by experimentally controlling smoking behavior to limit smoke inhalation (modeled after the subset of cigar smokers that tend to not inhale smoke)

Study 1: Ad libitum Large Cigars Smoking
Study Design

- Dual users (*n* = 17, 94% men, 77% African American) smoked *ad libitum* either their usual cigarette brand or a study large cigar (Phillies Blunt) in two laboratory sessions.
- Plasma nicotine and exhaled carbon monoxide were collected before and after smoking.
- Smoking topography measures of puff volume, puff duration, puff velocity, and interpuff interval were also collected.

Study 1: Ad libitum Large Cigars Smoking
Toxicant Exposure

Outcome measure	Mean (SD)		Product		Time		Product × time interaction	
	Cigarette smoking	Large cigar smoking	F value	p value	F value	p value	F value	p value
Plasma nicotine (ng/mL)			<0.1	.98	32.2	<0.001*	0.7	0.42
Pre-smoking	18.0 (11.9)	20.7 (15.3)						
Post-smoking	38.8 (15.3)	36.3 (23.0)						
COex (ppm)[a]			4.3	.04*	36.2	<0.001*	3.2	0.08
Pre-smoking	21 (12)	22 (14)						
Post-smoking	30 (12)	47 (26)						

[a]COex = exhaled carbon monoxide

- Both cigarettes and large cigars significantly increased plasma nicotine and carbon monoxide and significantly decreased the urge to smoke.
- Cigarettes delivered more nicotine per gram of tobacco smoked and per 1000 mL of puff volume.

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Study 1: Ad libitum Large Cigars Smoking
Topography

Outcome measures	Mean (SD)		Product F value[a]	Product p value[a]
	Cigarette smoking	Large cigar smoking		
Number of puffs[a]	12 (4)	23 (11)	54.2	<.001*
Total puff volume (mL)[a]	658 (215)	1660 (1060)	72.1	<.001*
Time to smoke (s)	252 (89)	371 (207)	8.0	.01*
Average puff volume (mL)	57.8 (20.4)	73.9 (20.0)	10.6	<.01*
Puff velocity (mL/s)[a]	23.6 (5.1)	34.3 (13.0)	20.6	<.001*
Puff duration (s)	2.6 (0.7)	2.5 (0.6)	0.8	.38
Interpuff interval (s)[a]	21.9 (9.8)	16.6 (9.6)	9.0	.01*

[a]Log-transformed variable included in the rANOVA model

- Number of puffs, time to smoke, puff volume, and puff velocity were significantly larger and interpuff interval was significantly shorter in large cigar smoking.

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Study 1: Ad libitum Large Cigars Smoking
Conclusions & Implications

- People who regularly use both large cigars and cigarettes adapt their smoking pattern such that they are exposed to similar levels of nicotine from each product.
- The immediate increase in plasma nicotine and carbon monoxide suggest significant inhalation of large cigar smoke.
- These data call into question the assumption that cigar smoking is less toxic than cigarette smoking. By smoking large cigars, dual users expose themselves to toxic components that have been linked with the addiction risk, morbidity, and mortality of cigarette smoking.

Study 2: Directed Large Cigars Smoking
Study Design

- The clinical study was a single-center, randomized, single-blinded, cross-over study in 36 adult small (n=18) and large (n=18) cigar smokers.
- The study was designed to evaluate the relationship between tobacco pH, salivary pH, and nicotine exposure in non-inhaling cigar smokers.
- Assignment into the groups was based on participant report of the type of cigars they smoked and staff confirmation of the cigar size when participants brought their product to the laboratory for the in-person screening visit.
- An important methodological consideration of the study was to limit cigar smoke exposure to buccal tissue - largely the mouth and upper pharynx. To do so, participants complied to specific instructions given before and during the directed smoking sessions to not inhale the smoke. Furthermore, if exhaled CO levels increased by more than 5 ppm, the participant's data was not used, and they were rescheduled.

Study 2: Directed Large Cigars Smoking

Study Design: Study Products and Targeted Smoking Amounts

	Cigar	Nicotine content [mg/cigar]	Targeted Smoking Amount		
			Minimum (%)	Target (%)	Maximum (%)
Large Cigars	Dutch Master's Palma	71.5	15	18	20
	White Owl NY Ranger	41.8	26	30	35
Small Cigars	Royal Comfort Black	23.5	43	50	58
	Middleton's Black & Mild	25.7	39	46	53

pH = 5.34

pH = 6.71

pH = 6.30

pH = 6.72

Note: From top to bottom: Middleton's Black & Mild (low pH small cigar), Royal Comfort Black (high pH small cigar), Dutch Master's Palma (low pH large cigar), White Owl NY Ranger (high pH large cigar) Silver markings show the targeted smoking amount for each cigar product. Additional markings show the ±15% smoking margin

Limitation: The free base nicotine calculations based on cigar tobacco pH measurements may fundamentally differ from the tobacco smoke pH generated from these tobacco products.

Study 2: Directed Large Cigars Smoking
Results and Conclusions

- All the participants in the large cigar group were male, mean age of 46.1 years (range 22-64 years) Fifty percent of participants in the large cigar group identified as white.
- Large cigar participants reported using their products for a mean of 8.3 years and in the past 30 days, smoked an average of 16.5 large cigars
- Only few participants had measurable post-smoking nicotine concentrations.
  - Most of the nicotine concentrations were either below the quantitation limit or below the detection limit. Even when plasma nicotine could be quantified, the measured increases were small.
- After correcting for creatinine all measured urinary biomarkers tended to be higher in large compared to small cigar users. However, no formal statistical comparisons were conducted.

Overall Conclusions

- Dual users of large cigars and cigarettes inhale significant quantities of carbon monoxide, nicotine, and presumably other components of mainstream smoke when they smoke large cigars.
- Buccal absorption plays little role in nicotine exposure from large cigar smoking which mean that increases in plasma nicotine levels result from smoke inhalation.
- Large cigar smoke exposure may lead to or sustain nicotine addiction.
- Exclusive large (premium) cigar users are a challenging population to study; most large cigar users in our studies were poly-users of tobacco products; “Non inhalers” of cigar smoke were almost nonexistent.
- Due to the wide variety of large cigar sizes and design features (e.g. tobacco pH), selecting representative study products for clinical research is also challenging.

Additional Information, Questions, Contact

Additional Information on Cigars:

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