

# Tanning Capacity and Nicotine Dependence Among African Americans

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**Abstract: Purpose:** Recent findings suggest a link between facultative melanin and nicotine dependence among African Americans. We hypothesized that tanning capacity is associated with the time to first cigarette (TFC) of the day.

**Methods:** Using a criterion based sample of 150 adult African American current smokers, reflectometer measures of constitutive and facultative melanin, tanning capacity, smoking status and history, saliva cotinine, sociodemographic characteristics, and stress and discrimination scales were recorded.

TFC was categorized as: 1) within the first 5 min versus more than 5 min; and 2) within the first 30 min versus more than 30 min. Descriptive and multivariate analyses were conducted.

**Results:** Analysis revealed significantly higher tanning capacity among individuals who smoked their first cigarette of the day within the first 5 min of awakening (13.5) than among those who smoked after 5 min (10.3,  $p = 0.01$ ) and among those who smoked within the first 30 min (12.8 vs. 9.6,  $p = 0.03$ ) compared to those who initiated after this time point.

Multivariate logistic regression indicated that tanning capacity was significantly and positively related (OR = 1.14, 95% CI = 1.05–1.22) to TFC within the first 5 min and was also significantly related to TFC within the first 30 min (OR = 1.13, CI = 1.03–1.23).

**Conclusion:** Tanning capacity was positively associated with a behavioral measure of nicotine dependence among African American smokers. This association was consistent whether comparing smokers at higher or lower levels of dependence. Future research should examine tanning capacity and other indicators of melanin content with smoking cessation rates and tobacco-attributable health disparities.

**Keywords:** Smoking ■ Nicotine ■ Melanin ■ Tobacco ■ African Americans

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## INTRODUCTION

Cigarette smoking among African Americans continues to be a major public health problem contributing to health disparities in smoking-related diseases and mortality. Smoking is primarily maintained by nicotine dependence,<sup>1</sup> a complex and multifaceted construct that cannot be defined by any single

measure but rather entails biological, behavioral, psychosocial, and sociological factors. Although smoking prevalence rates among African Americans have substantially declined and are virtually identical to those of Whites (16.7% vs. 16.6%), this progress is primarily due to prevention efforts rather than cessation.<sup>2,3</sup> Despite the strong desire of African Americans to quit, studies revealed that they experience more difficulty with cessation than some other racially classified social groups.<sup>4–7</sup>

Melanin, the primary source of skin color, has been demonstrated in biological studies to have an affinity for nicotine.<sup>8</sup> Constitutive melanin is genetically determined and not affected by exposure to UV radiation,<sup>9</sup> whereas facultative melanin is induced by direct exposure to the sun, artificial irradiation, hormonal changes (i.e., stress induced melanocyte-stimulating hormone), or disease.<sup>10,11</sup> Tanning is a physiologic and protective response to sunlight and other sources of UV; thus excessive exposure to ultraviolet radiation (UVA & UVB) stimulates melanocytic activity, resulting in an increase in melanin levels and in tanning or the darkening of the skin.<sup>12</sup> Darker skin is more absorbent and dissipating of UV than lighter pigmented skin. As a result, darker skin serves as a stronger protective mechanism in reducing cellular damage and disease than lighter pigmented skin.<sup>13,14</sup> Tadokoro et al<sup>15</sup> surmised that postinflammatory hyperpigmentation or tanning resulted from three potential processes or mechanisms: 1) redistribution of existing melanin towards the surface of the skin; 2) change in the shape and perhaps the intracellular localization of melanin; and/or 3) de novo melanin synthesis. They also reported that the major mechanism entailed redistribution, which is “more dramatic in dark skin.”

Since the early 1970s, studies of the link between melanin and nicotine have been conducted.<sup>16–19</sup> Hedin<sup>17</sup> coined the phrase “smoker’s melanosis” to describe the darkened gingival pigmentation found in the oral mucosa of smokers. Other studies have reported a positive association between nicotine and melanin content of the hair,<sup>20–22</sup> as well as a possible positive link between melanin and tobacco carcinogens.<sup>16</sup> A paper by Apelberg et al<sup>23</sup> reported 5 times higher concentrations of nicotine among black smokers than whites. Japanese researchers have also found an association between smoking and melanin in comparing women smokers and non-

smokers.<sup>24</sup> The first substantive and comprehensive conceptualization of this relationship was provided by Yerger and Malone<sup>8</sup> who reviewed the literature on the relationship between melanin and nicotine and posed the question: “Does the sequestering of nicotine in melanin-containing tissues [such as the skin] prolong its half-life, thereby leading to chronic exposure to nicotine and increased nicotine dependence ... ?”

In investigating this question, King et al<sup>25</sup> conducted a study of Black smokers to explore the relationships between melanin and nicotine dependence, nicotine exposure, and smoking behavior. Statistically significant associations were found between facultative melanin (though not with constitutive melanin) and the Fagerström Test of Nicotine Dependence (FTND), cigarettes smoked per day (CPD), and cotinine concentrations.<sup>25</sup>

In the present analysis, it is hypothesized that greater tanning capacity (i.e., difference between facultative and constitutive melanin) is associated with greater morning smoking urgency as an index of nicotine dependence. Greater nicotine dependence could lead to lower tobacco cessation rates and more adverse health outcomes among populations such as African Americans,<sup>25</sup> who tend to have higher melanin content and possess greater tanning capacity than Whites.

A commonly used behavioral marker of nicotine dependence and predictor of cessation success is the time to first cigarette of the day (TTFC) upon awakening. TTFC has consistently achieved high item loadings in confirmatory factor analyses.<sup>26–31</sup> TTFC has been recommended or used as an index of nicotine dependence for adults and youths in both clinical<sup>26,32</sup> and population samples.<sup>33,34</sup> TTFC, especially within the first 30 min after waking, was significantly associated with cotinine levels and was more reliably predictive of nicotine exposure or quitting success than other specific measures of the FTND.<sup>26,35</sup> Interestingly, the study by Apelberg et al<sup>23</sup> also found an association between nicotine hair concentrations and cigarettes per day and TTFC.

Thus, the aim of this paper is to present an analysis of the relationship between melanocytic activity (i.e., tanning capacity) and morning smoking urgency as a behavioral measure of nicotine dependence among African American adult daily smokers.

## METHODS

Data were collected in Harrisburg, PA during the summer months of June, July, and August, using a criterion based non-probability sample. Respondents were current daily smokers, self-identified as African American or Black, and 18 years of age or older. This research project was

approved by the Pennsylvania State University Office of Research Compliance (Institutional Review Board approval #24899). Additional information about the study’s methodology is available in another publication.<sup>25</sup>

One hundred and fifty participants (n = 150) were included in the study; however due to misclassification (2 individuals) and duplication (1 person) the final sample was 147. The present analysis was further reduced to 130 participants because those whose constitutive melanin scores exceeded their facultative scores were excluded, as this could indicate an atypical situation (e.g., use of skin lighteners, skin disease). To measure melanin content we used a reflectometer (Derma Spectrometer, Cortex Technology), which provides an objective quantification of skin color that may range from 0 to 112. This instrument is particularly well-suited for measuring melanin-induced pigmentation.<sup>36</sup>

A melanin index, called M, is computed from the intensity of the absorbed and the reflected light. Measures of facultative and constitutive melanin were estimated separately by using a reflectometer to measure skin color at each site (i.e., the forehead and the upper under arm). Three average M values for the forehead (facultative melanin, FM) and the upper under arm (constitutive melanin, CM) were used in all the analyses. Tanning capacity was computed by subtracting constitutive melanin from facultative melanin (FM-CM=Tanning capacity).

Saliva samples (5 cc) were collected from each participant and specimens were frozen until analysis. Cotinine concentrations were determined by enzyme immunoassay (EIA) using commercially available kits (Salimetrics LLC, State College, PA).

Chronological age (18–30, 31–45, >45 years), gender (male, female) and education (non-high school graduate, high school graduate, college or more) were the key socio-demographic variables in this analysis. Cohen’s Perceived Stress Scale (PSS10) was employed to measure stress.<sup>37</sup> The PSS10 was recoded for bivariate analyses to reflect the categories “Low”, “Medium”, “Medium to High” and “High” levels of stress. A Perceived Discrimination Scale measuring racial discrimination was recoded as “High” (1–3), “Medium to High” (4–6), “Low to Medium” (7–9), and “Low” (10–12).<sup>25</sup>

Smoking status and behavioral variables inquired about lifetime smoking (i.e., more than 100 cigarettes in their lifetime) and whether subjects were currently smoking everyday or some days, average number of cigarettes smoked per day (CPD), age they began smoking cigarettes regularly, and whether they had tried to quit within the past year. The “number of years smoked” was calculated as a measure of smoking duration by subtracting the age at which a respondent began smoking from their current age. Data on menthol cigarettes were collected but were not

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