



The effect of social norms messaging regarding skin carotenoid concentrations among college students



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ARTICLE INFO

Article history:

Received 3 November 2016

Received in revised form

14 April 2017

Accepted 24 April 2017

Available online 25 April 2017

ABSTRACT

Descriptive social-normative messaging positively influences short-term dietary choices and healthy food intake. The purpose of this study was to evaluate the effects of descriptive normative messages on college students' skin carotenoid concentrations (a biomarker of carotenoid-containing fruit and vegetable [FV] intake) over an 8-week period. 251 college students consented to participate and 74% completed the study. Students were randomly assigned to groups who, following a baseline evaluation of skin-carotenoid levels, were told how their score ranked within a peer group of college students attending the same university (Individualized Normative group), that their score was in the lower 20th percentile of the peer group (Manipulated Normative group), or were given no information about their score or the peer group (Control group). Skin carotenoid concentrations were reassessed 8 weeks after the normative messages were presented or withheld. Skin carotenoid levels of those in the Manipulated Normative group increased significantly more than did scores of those in the Control group ($t(126) = 3.74, p < 0.001; d = 0.67$), but these students' self-reported FV intake did not increase. This finding suggests normative messaging can influence behavior for up to 8 weeks, but future research must better evaluate if the increase in skin carotenoids reflects increased FV consumption, increased consumption of carotenoid-containing FV (with decreased consumption of other FV), or is accounted for by some other behavior change (e.g., increased use of supplements). These findings support further exploration of normative messaging as a technique for producing the long-term behavior change needed to impact public health.

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1. Introduction

The transition from adolescence to adulthood is a critical period for developing habits that impact health and risk for disease later in life (Blondin et al., 2015; Wengreen & Moncur, 2009). College students may be especially vulnerable to social and environmental conditions that encourage less healthy behaviors (Butler, Black, Blue, & Gretebeck, 2004). For example, few college students consume the recommended amounts of fruits and vegetables (FV; Franko et al., 2008; Kang et al., 2014; Lowry et al., 2000; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005) and students new to a college campus may follow their peers' lead in making unhealthy dietary decisions. Doing so allows them to avoid standing out, avoid unfamiliar bad-tasting foods, or may serve to integrate them into the local culture (Cialdini, Reno, & Kallgren, 1990).

Perceived descriptive norms are informal knowledge about modal patterns of behavior occurring within a group or society (Lapinski & Rimal, 2005). Because perceived descriptive norms can influence behavior (see Chung & Rimal, 2016 for review), interventions designed to alter these norms may lead to behavior change. In some cases, providing information about descriptive social norms (e.g., "Did you know that only 15% of your peers eat the recommended amounts of fruits and vegetables") is contraindicated (Stok, De Ridder, De Vet, & De Wit, 2012) as it may encourage a change in an otherwise healthy baseline pattern of eating; a so-called boomerang effect (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). In other cases, provision of accurate descriptive normative information can have a positive impact when the perceived descriptive norm over-estimates the actual prevalence of a maladaptive behavior (e.g., "67% of students at this university have three or fewer drinks when they party;" Scribner et al., 2011).

A growing body of evidence from human intervention studies

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demonstrates that descriptive normative messages can promote greater consumption of fruits or vegetables among college students. For example, when students were informed that their peers typically consume three or more servings of vegetables per day, the recipient of this message increased vegetable consumption in a putatively unrelated brief-duration study examining food selection and consumption (Robinson, Fleming, & Higgs, 2014). Similar outcomes have been reported in studies using non-objective (self-report) measures of dietary intake assessed after normative messaging (Stok, Ridder, Vet, & Wit, 2014; Stok, Verkooijen, Ridder, Wit, & Vet, 2014, 2012). While the latter data are encouraging, self-reports of dietary behavior are prone to social-desirability and social-approval biases, such that participants generally under-report their consumption of calories and fat, and over-report healthy food consumption such as FV (Archer, Hand, & Blair, 2013; Heitmann, Lissner, & Osler, 2000; Hébert, 2016; Miller, Abdel-Maksoud, Crane, Marcus, & Byers, 2008). As an experimental manipulation, descriptive social norms may be particularly susceptible to these biases, as normative information may specify what behavior is socially desirable/condoned, motivating prevarication in self-reports if not validated with objective measures of FV consumption. Thus, at present it is unknown if providing descriptive normative information can establish an objectively measured, improved pattern of FV consumption beyond a single meal. Such a long-term pattern of healthy eating is necessary to realize the health benefits of eating FV (Peterkin, 1990).

The present study was conducted to fill this gap in the literature. Addressing the issue of objective measurement of FV consumption, participants' skin carotenoid levels were assessed prior to and eight weeks after providing descriptive normative information (Beccarelli et al., 2017). Tissue concentrations of carotenoids are a biomarker of carotenoid containing FV intake. Carotenoids are fat-soluble pigments found in red, orange, purple, and green vegetables and some fruits. Dietary carotenoids provide health benefits by inhibiting inflammation, oxidation, and platelet aggregation contributing to many chronic conditions in humans (Krinsky, 1989; Milani, Basirnejad, Shahbazi, & Bolhassani, 2016; Thies, Mills, Moir, & Masson, 2016). Resonance Raman spectroscopy provides a noninvasive method of measuring carotenoid concentrations in the skin, which correlate with serum concentrations of carotenoids (Aguilar, Wengreen, Lefevre, Madden, & Gast, 2014; Mayne et al., 2010; Shive & Morris, 2006; Smidt & Shieh, 2003) and increase when children consume a carotenoid-rich juice (Aguilar, Wengreen, & Dew, 2015).

For the present experiment, two varieties of descriptive normative information were provided (or not provided in the Control group). One group of students was provided accurate information about their skin carotenoid score compared to the distribution of skin carotenoid scores of their peers. A second group was told that their carotenoid levels were below the norm, regardless of their actual carotenoid level. Robinson et al. (2014) informed their college-student participants that their peers typically consume three or more servings of vegetables per day. This normative information was not designed to be deceptive because it was based on self-reported vegetable consumption among college students. However, the message may have been inadvertently deceptive because national surveys of college students suggest they consume less than this amount of vegetables (e.g., Lowry et al., 2000; ACHA, 2015) and, as noted above, because people tend to over-report healthy behaviors and under-report unhealthy behavior in self-report surveys (Archer et al., 2013; Heitmann et al., 2000; Hébert, 2016; Miller et al., 2008). If deceptive normative information about skin carotenoid levels proves effective in increasing long-term patterns of FV consumption, it would encourage the exploration of less deceptive normative information

that may improve long-term eating habits.

2. Methods

2.1. Participants

The Institutional Review Board at Utah State University reviewed and approved this study. At the beginning of the 2014 spring semester, all students enrolled in three sections of a first-year human nutrition course (NDFS 1020 "Science and Application of Human Nutrition") were invited to participate ($N = 344$) in a study related to skin carotenoid assessments collected as a curricular component of the course. The letter of information indicated that the study was about students' food choices and deception was a possible component of the study. Seventy-three percent (251) of students agreed to participate in the study and 74% of these participants (185) completed the pre- and post-intervention skin carotenoid assessments and are included for analysis. Drop-outs occurred because of student absences from the class period in which follow-up data were collected.

Of the participants who completed the study, the average age was 20 (± 3.6), 69.7% were female, and 94% identified themselves as white, with 3% identifying as Hispanic. Black, Native American, Asian, middle-eastern, and pacific islanders made up the remainder of the sample. Participants reported being in good health with no known chronic conditions.

2.2. Procedures

After consenting to participate, students completed an online assessment of their usual dietary intake of FV over the past month, and were randomly assigned to the Individualized Normative Feedback group ($n = 57$), Manipulated Normative Feedback group ($n = 62$), or the Control group ($n = 66$). Group assignment was not disclosed to participants. As part of the course curriculum, all students were informed about the validity of skin carotenoids as a biomarker of carotenoid-containing FV consumption. Participants' skin carotenoid levels were measured in the second week of the class (January 2014). As part of this assessment, all participants were given a printed message that included the sentence, "Eating more vegetables and fruits that are red, orange, yellow, green, or purple will help to increase your skin carotenoid score."

Additional information provided after the skin carotenoid assessment depended on the group to which participants were assigned. Control group participants were told, "You will receive your skin carotenoid score in approximately 7 weeks." Participants in the Manipulated Normative group were given a printed message that did not indicate their score, but instead said, "Your skin carotenoid score is in the 20th percentile of skin carotenoid scores for college students attending Utah State University. 80% of college students have a higher skin carotenoid score than you. Students who eat the recommended amount of fruits and vegetables have skin carotenoid scores of 35,000 or higher." Of the 62 students who were randomized to the Manipulated Normative group 47 (76%) were deceived by the message communicated to them (i.e., their skin carotenoid level was not in the bottom 20% of scores among college students).

Participants in the Individualized Normative group were given a printed message that included their skin carotenoid score, a visual representation of the distribution of scores measured in a reference population of "college students attending Utah State University," and their percentile ranking within that reference distribution. The reference distribution was obtained from 344 students enrolled in the same course during the previous year (mean = 24,172, SD = 8697; range: 5820–52,050). For example, "Your skin

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