



Racial Differences in Perceptions of Psoriasis Therapies: Implications for Racial Disparities in Psoriasis Treatment

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In the United States, black patients are less likely than white patients to receive biologic treatment for their psoriasis. We conducted a qualitative free-listing study to identify patient-generated factors that may explain this apparent racial disparity in psoriasis treatment by comparing the perceptions of biologics and other psoriasis therapies between white and black adults with psoriasis. Participants included 68 white and black adults with moderate to severe psoriasis who had and had not received biologic treatment. Each participant was asked to list words in response to verbal probes querying five psoriasis treatments: self-injectable biologics, infliximab, methotrexate, apremilast, and phototherapy. Salience scores indicating the relative importance of each word were calculated, and salient words were compared across each race/treatment group. Participants who had experience with biologics generally associated positive words with self-injectable biologics. Among biologic-naïve participants, “apprehension,” “side effects,” and “immune suppression” were most salient. “Unfamiliar” and “dislike needles” were salient only among black participants who were biologic naïve. Participants were generally unfamiliar with the other psoriasis therapies except phototherapy. Unfamiliarity with biologics, particularly among black, biologic-naïve patients, may partly explain the existing racial disparity in biologic treatment for psoriasis and might stem from lack of exposure to or poor understanding of biologics.

Journal of Investigative Dermatology (2019) **139**, 1672–1679; doi:10.1016/j.jid.2018.12.032

INTRODUCTION

Psoriasis is a chronic systemic inflammatory disease, primarily of the skin, that affects approximately 7.5 million Americans (National Psoriasis Foundation, 2018). Moderate to severe psoriasis, in particular, has major negative effects on the physical and psychosocial well-being of those affected (Rapp et al., 1999) and is associated with cardiometabolic (Azfar et al., 2012; Gelfand et al., 2006, 2009; Langan et al., 2012; Mehta et al., 2010; Wan et al., 2018) and other comorbid diseases (Chiesa Fuxench et al., 2016; Grewal et al., 2017; Kurd et al., 2010; Ogdie et al., 2018; Takeshita et al., 2018; Wan et al., 2013; Yeung et al., 2013) that may be modulated by psoriasis treatment (Ahlehoff et al., 2015; Bissonnette et al., 2017a, 2017b; Mehta et al., 2018; Wu et al., 2017, 2018a, 2018b; Yang et al., 2016). Psoriasis is also associated with a large economic burden of up to \$135

billion in total costs (in 2013 dollars), of which up to \$35.4 billion is attributed to indirect costs that are largely due to lost work productivity (Brezinski et al., 2015). Therefore, it is important on both individual and societal levels that patients with psoriasis receive adequate and effective treatment.

Despite a growing number of increasingly efficacious therapeutic options (primarily biologics) for treating moderate to severe psoriasis, most patients remain undertreated with only topical medications or no treatment at all (Lebwohl et al., 2014). Considering that, in the United States, psoriasis may be more severe (Gelfand et al., 2005) and have a greater negative impact on quality of life (Shah et al., 2011) among racial/ethnic minority patients than white patients, undertreatment may disproportionately affect minority and other marginalized or disadvantaged individuals with psoriasis. For example, among Medicare recipients, black beneficiaries with moderate to severe psoriasis are 70% less likely to receive biologic treatment for their psoriasis than white beneficiaries, independent of other demographic and socioeconomic factors, comorbidities, and differences in Medicare plans (Takeshita et al., 2015). A clinic-based study of patients with psoriasis in the United States also found similar racial differences in psoriasis treatment with biologics (Kerr et al., 2015). As biologic therapies increasingly become the mainstay of treatment for patients with more severe psoriasis, it is important to identify why black patients are less likely than white patients to receive highly efficacious biologics for their skin disease and rectify any existing treatment disparity. Thus, our study aimed to understand psoriasis patients' perceptions of biologics and other common or new psoriasis treatments by leveraging qualitative research methods that are aimed at

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Received 8 August 2018; revised 5 December 2018; accepted 18 December 2018; accepted manuscript published online 6 February 2019; corrected proof published online 12 April 2019

generating testable hypotheses for why a racial disparity in biologic treatment for psoriasis exists in the United States.

RESULTS

Participants

The sociodemographic and clinical characteristics of 68 participants with moderate to severe psoriasis according to race/treatment groups are summarized in Table 1. Median age ranged from 48 to 55 years and was similar across race/treatment groups. Participants were predominantly female (70.6% of all participants). Most participants resided in Northeastern US and were affiliated with the University of Pennsylvania Health System. Significantly more black participants were of lower income and education levels than white participants. Differences in primary medical insurance were also seen across race/treatment groups.

Psoriasis history and characteristics, with the exception of treatment history, were similar across all race/treatment groups (Table 2). Compared with participants who had experience with biologics, biologic-naïve participants were more likely to be currently receiving phototherapy or topical therapy only and were less likely to have received oral systemic therapy in the past.

Free-listing results

Self-injectable biologics. Salient words for self-injectable biologics varied across race/treatment groups (Figure 1a). Positive feelings (“positive,” “effective,” “convenient”) were salient only among participants who had experience with biologic treatment, but they were mixed with some negative perceptions, particularly among the white/biologic group. Among biologic-naïve participants, feelings of apprehension and concerns about potential adverse effects and immune suppression were salient. Lack of familiarity with self-injectable biologics, dislike of needles, and concern about side effects were each strongly salient for the black/biologic-naïve group only; “side effects” was also moderately salient for the white/biologic-naïve group. Additionally, only black participants linked “injection,” which included the descriptive terms “shots” and “needles,” with self-injectable biologics.

Considering baseline differences in income and education among the race/treatment groups, we also compared free-list data for self-injectable biologics between higher and lower income and education groups (Table 3). “Unfamiliar” was not salient among any of the four groups. However, for both the lower income and education groups, “injection” was identified as the only salient item, whereas apprehension and concerns about adverse effects and immune suppression were salient for both the higher income and education groups.

Infliximab. The most salient word associated with infliximab was “unfamiliar” across all race/treatment (Figure 1b), income, and education groups (Table 3). Lack of experience with infliximab treatment was also strongly salient for each of the black/biologic and lower education groups.

Methotrexate. “Unfamiliar” was strongly salient for methotrexate across all race/treatment (Figure 1c), income, and education groups (Table 3). Among white/biologic and black/biologic participants, who were also more likely to have been treated with methotrexate in the past, additional strongly

salient items included “side effects” for both groups and “ineffective” for the white/biologic group. Moderately salient items among participants with history of biologic treatment were generally negative in nature among whites and positive among blacks.

Apremilast. Similar to infliximab and methotrexate, “unfamiliar” was also strongly salient for apremilast across all race/treatment (Figure 1d), income, and education groups (Table 3). Specifically, for the white/biologic group, reference to commercials for apremilast was strongly salient. “Commercials” remained strongly salient among whites compared with blacks, regardless of biologic treatment status (data not shown) and was also moderately salient for those in the higher education group.

Phototherapy. “Inconvenient” was the most salient item for phototherapy among white participants, regardless of biologic treatment history, whereas it was the least moderately salient item for the black/biologic group and was not at all salient for the black/biologic-naïve group (Figure 1e). When all white and black participants were compared, “inconvenient” remained a strongly salient item for the former, whereas “light” and “positive” were salient items for the latter (data not shown). Similarly, among participants who had experience with biologic treatment, negative feelings and “inconvenient” were strongly salient compared with biologic-naïve participants, for whom positive feelings and “effective” were strongly salient (data not shown). A comparison of salient items between participants who were currently receiving versus not receiving phototherapy was performed as well and showed a mix of both positive and negative words. The most salient words associated with those currently receiving phototherapy were positive or neutral, whereas negative or neutral items were most salient for those not currently receiving phototherapy (data not shown). “Inconvenience” was also the most and only strongly salient item for the higher income and education groups (Table 3). The term “light,” which included descriptors of phototherapy (e.g., “UV-ray,” “lights,” “sun lamp”) was strongly salient among all black participants and those in the lower income and education groups.

DISCUSSION

In our free-listing study of white and black patients with moderate to severe plaque psoriasis, we identified differences in perceptions and understanding of psoriasis therapies by race and treatment history that show potential reasons for the existing racial disparity in biologic treatment for psoriasis. Most strikingly, we found that for self-injectable biologics, lack of familiarity was a uniquely salient item among black participants who were biologic naïve. Unfamiliarity with self-injectable biologics among this group was unlikely to be due to patients never having been treated with biologics, because “unfamiliar” was not a salient item among white participants who were also biologic naïve. Similarly, in analyses that compared participants by income and education levels, lack of familiarity with self-injectable biologics did not emerge as a salient item, suggesting that neither of these measures of socioeconomic status were primary drivers of our findings among the black/biologic-naïve group. Collectively, these

Table 1. Participant characteristics

Characteristics	White/Biologic (n = 19)	White/No Biologic (n = 17)	Black/Biologic (n = 16)	Black/No Biologic (n = 16)	P-Value
Age in years, median (IQR)	48 (35–66)	50 (36–62)	54 (46.5–62)	55 (46.5–66.5)	0.54
Female, n (%)	12 (63.2)	11 (64.7)	14 (87.5)	11 (68.8)	0.39
Annual household income, n (%)					0.005
<\$50,000	6 (31.6)	3 (17.6)	10 (62.5)	10 (62.5)	
≥\$50,000	12 (63.2)	12 (70.6)	3 (18.7)	3 (18.7)	
Prefer not to answer	1 (5.2)	2 (11.8)	3 (18.7)	3 (18.7)	
Education, n (%)					<0.001
Less than bachelor’s degree	4 (21.0)	3 (17.6)	12 (75.0)	11 (68.8)	
Bachelor’s degree or more	15 (79.0)	14 (82.4)	4 (25.0)	5 (31.2)	
Employment, n (%)					0.14
Unemployed/unable to work	5 (26.3)	0 (0)	4 (25.0)	2 (12.5)	
Part time	2 (10.5)	5 (29.4)	1 (6.2)	1 (6.2)	
Full time	9 (47.4)	9 (52.9)	6 (37.5)	7 (43.8)	
Retired	1 (5.3)	2 (11.8)	5 (31.3)	5 (31.3)	
Other	2 (10.5)	1 (5.9)	0 (0)	1 (6.2)	
Marital status, n (%)					0.08
Single	6 (31.6)	6 (35.3)	5 (31.3)	5 (31.3)	
Married/domestic partner	11 (57.9)	11 (64.7)	6 (37.5)	5 (31.3)	
Divorced/separated/widowed	1 (5.3)	0 (0)	5 (31.3)	5 (31.3)	
Other	1 (5.3)	0 (0)	0 (0)	0 (0)	
Prefer not to answer	0 (0)	0 (0)	0 (0)	1 (6.3)	
Residence in US Northeast, n (%)	14 (73.7)	10 (58.8)	14 (87.5)	15 (93.8)	0.08
Primary medical insurance, n (%)					0.004
Commercial	8 (42.1)	15 (88.2)	9 (56.3)	7 (43.8)	
Medicare/Medicaid	9 (47.4)	1 (5.9)	7 (43.7)	5 (31.3)	
Other	0 (0)	1 (5.9)	0 (0)	1 (6.2)	
None	2 (10.5)	0 (0)	0 (0)	0 (0)	
Prefer not to answer	0 (0)	0 (0)	0 (0)	3 (18.7)	

Abbreviation: IQR, interquartile range.

results indicate that black patients with psoriasis, in particular, are less aware of biologics as therapeutic options despite biologics being highly efficacious treatments for psoriasis. We hypothesize that greater unfamiliarity with biologics among black versus white patients may be an important modifiable cause of the racial disparity in biologic treatment for psoriasis that we have previously observed (Takeshita et al., 2015).

“Dislike needles” and “side effects” were also uniquely strongly salient items for self-injectable biologics among the black/biologic-naïve group. This suggests that preference to avoid needles and greater concern about adverse effects among the black/biologic-naïve group compared with other race/treatment groups for whom these items were not strongly salient may also drive different biologic treatment patterns. The idea that the risk-benefit balance for biologics may be different between whites and blacks is supported by a single study of rheumatoid arthritis patients that found blacks to be more risk averse than whites when considering treatment with disease-modifying antirheumatic drugs (Constantinescu et al., 2009).

Although treatment differences due to patient preferences alone do not constitute a disparity, it is important to remember that patient preferences are not always based on an accurate or adequate comprehension of health care. In fact, preferences that are founded on an inaccurate or inadequate understanding can be a source of disparity (Institute of Medicine, 2003). We cannot definitively determine from our

study if the identified salient themes among race/treatment groups are based on similar levels of understanding of biologics. However, among the salient items for self-injectable biologics, purely descriptive terms, as captured under the item “injection,” were highly salient among black but not white participants and also among participants of lower income and education levels. Among all salient items, a predominance of descriptive terms, some of which were provided in the free-listing prompts, over other words or phrases that express a feeling or represent deeper knowledge may support a hypothesis that the understanding of biologics was less comprehensive among black, lower income, and lower education participants than white, higher income, and higher education participants. A similar pattern of descriptive salient terms (i.e., “light”) among black, lower income, and lower education participants was noted for phototherapy, even though a numerically higher percentage of black participants were currently receiving phototherapy.

Lack of familiarity with treatment was the most or second most salient item for all other psoriasis therapies (methotrexate, apremilast, infliximab), except for phototherapy. In contrast to self-injectable biologics, lack of familiarity with these other treatments was a similar theme across all race/treatment groups and, at least in part, was likely related to the fact that few participants were currently receiving methotrexate, infliximab, or apremilast in our study.

Table 2. Psoriasis history

Characteristics	White/Biologic (n = 19)	White/No Biologic (n = 17)	Black/Biologic (n = 16)	Black/No Biologic (n = 16)	P-Value
Age in years at psoriasis onset, n (%)					0.46
<40	16 (84.2)	11 (64.7)	11 (68.8)	10 (62.5)	
≥40	3 (15.8)	6 (35.3)	5 (31.2)	6 (37.5)	
Psoriasis duration in years, median (IQR)	21 (14–34)	10 (7–22)	8 (5.5–32.5)	9 (2.25–25)	0.83
Current psoriasis severity, n (%)					0.88
None/very little	5 (26.3)	3 (17.7)	3 (18.8)	3 (18.8)	
Mild	5 (26.3)	3 (17.7)	2 (12.5)	3 (18.8)	
Moderate	6 (31.6)	8 (47.1)	7 (43.8)	4 (25.0)	
Severe	3 (15.8)	3 (17.7)	4 (25.0)	6 (37.5)	
Psoriatic arthritis, n (%)	9 (47.4)	4 (23.5)	6 (37.5)	3 (18.8)	0.28
Primary medical provider for psoriasis, n (%)					0.53
Dermatologist	15 (79.0)	16 (94.1)	15 (93.8)	15 (93.8)	
Rheumatologist	3 (15.8)	1 (5.9)	1 (6.3)	0 (0)	
Other	1 (5.3)	0 (0)	0 (0)	1 (6.2)	
Dermatology life quality index, median (IQR)	7 (1–11)	5 (2–9)	9 (2.5–15.5)	5.5 (2–13.5)	0.62
Current treatment, n (%)					
Phototherapy	0 (0)	8 (47.1)	2 (12.5)	8 (50.0)	<0.001
Oral systemic	1 (5.3)	4 (23.5)	1 (6.3)	2 (12.5)	0.44
Biologic	13 (68.4)	0 (0)	12 (75.0)	0 (0)	<0.001
Topicals only	1 (5.3)	7 (41.2)	1 (6.3)	5 (31.3)	0.02
Other	1 (5.3)	0 (0)	1 (6.3)	0 (0)	0.86
None	3 (15.8)	0 (0)	1 (6.3)	1 (6.3)	0.36
Past treatment, n (%)					
Phototherapy	12 (63.2)	10 (58.8)	11 (68.8)	12 (75.0)	0.82
Oral systemic	13 (68.4)	4 (23.5)	9 (56.3)	1 (6.3)	<0.001
Biologic	16 (84.2)	0 (0)	15 (93.8)	0 (0)	<0.001
Topicals only	0 (0)	4 (23.5)	0 (0)	3 (18.8)	0.02
Other	3 (15.8)	1 (5.9)	1 (6.3)	0 (0)	0.46
None	1 (5.3)	2 (11.8)	0 (0)	1 (6.3)	0.73

Abbreviation: IQR, interquartile range.

As with all studies, there are limitations to consider. The main limitation is that most study participants were from Northeastern US and had been seen at a single large, urban academic health center. Because the intent of qualitative research is hypothesis generation rather than generalizability, our findings may not be representative of all patients with psoriasis throughout the United States who may be seen in different medical settings or who may have chosen not to participate in our study. However, many participants had a long history of psoriasis for which they had received care from multiple providers across different locations over their skin disease course. Second, there were differences in income and education level between the white and black participants that may explain our results. However, our additional analyses by income and education level suggest that our findings for the biologics are not entirely due to socioeconomic status differences. Third, our study was designed to identify differences in perceptions of psoriasis therapies by race/treatment groups, primarily for biologics. Therefore, perceptions of other therapies and differences across other group categorizations require further study. Finally, because there are many potential causes of treatment disparities, understanding not only each patient's experiences and perceptions but also the medical provider and health

system factors that may contribute to disparities is important in future work.

In conclusion, we hypothesize that racial disparities in biologic treatment for psoriasis in the United States may be due to a greater level of unfamiliarity with biologics, preference to avoid needles, and fear of side effects among black patients compared with whites. Poor familiarity with biologics may stem from having less exposure to the treatments (e.g., not being offered a biologic by a medical provider or not seeing advertisements for biologics, among other reasons) or from lack of recognition or understanding of biologics as treatments for psoriasis even when patients have been offered treatment with or have received information about them. Therefore, we propose that efforts to improve exposure to and understanding of biologic therapeutic options for psoriasis among black patients may be essential to minimizing existing disparities in treatment for this common and chronic inflammatory skin disease that is associated with major comorbid disease burden. Future studies aimed at testing our hypothesis may involve developing and quantitatively testing, in a randomized controlled trial, treatment decision aids or other educational efforts to improve awareness of psoriasis therapies, especially biologics, among black patients with psoriasis. Such studies are critical to advancing efforts to



Figure 1. Salient items from free-lists for psoriasis therapies by race/treatment groups. For each psoriasis therapy, words are listed in order of salience from most to least salient: (a) self-injectable biologics, (b) infliximab, (c) methotrexate, (d) apremilast, and (e) phototherapy. Words in boldface are strongly salient; words in plain text are moderately salient. Words are listed twice if strongly salient in one group and moderately salient in another.

reduce psoriasis treatment disparities and improve outcomes for all.

MATERIALS AND METHODS
Study overview and design

We designed a qualitative study that used free-listing to understand and compare perceptions of biologics and other common or newer

psoriasis therapies among white and black individuals with moderate to severe plaque psoriasis who have and have not received biologic treatment. Free-listing is a standard, systematic interviewing method that is well established in anthropologic research and has been more recently applied to medical research (Ahmad et al., 2016; Andrew et al., 2003; Barg et al., 2009; Bennett et al., 2006; Fiks et al., 2011; Patterson et al., 2006; Schrauf and Sanchez, 2008).

Table 3. Salient items¹ from free-lists of psoriasis therapies by income and education level

Psoriasis Therapy	Income ²		Education	
	Higher (n = 30)	Lower (n = 29)	Higher (n = 38)	Lower (n = 30)
Self-injectable biologics	side effects	injection	apprehension	injection
	apprehension		side effects	
	negative		immune suppression	
	immune suppression			
Infliximab	unfamiliar	unfamiliar	unfamiliar	unfamiliar inexperienced
Apremilast	unfamiliar	unfamiliar	unfamiliar	unfamiliar
			commercials	
			inexperienced	
Methotrexate	unfamiliar	unfamiliar	unfamiliar	unfamiliar
	side effects	side effects	side effects	side effects
	risk			
	ineffective			
Phototherapy	inconvenient	light	inconvenient	light
		positive	negative	positive
			light	effective
			side effects	booth
				unfamiliar
				side effects
				ineffective

¹Words in boldface are strongly salient; words in plain text are moderately salient.

²Participants who did not provide income information (n = 9) were excluded from analysis.

Free-listing allows one to identify how people with shared experiences (e.g., a disease such as psoriasis) perceive or define a topic (e.g., psoriasis treatments) (Dongre et al., 2009; Weller and Romney, 1988). This method involves asking respondents (e.g., individuals with psoriasis) to list all words that come to mind when they think of a specific word or phrase (e.g., biologics) (Dongre et al., 2009). Through free-listing, salient or important words and phrases are identified and considered to define a topic or domain (i.e., a set of items or things that are of the same category) of interest based on the principles that the most relevant items will be mentioned more frequently and earlier than less important or relevant items (Bernard et al., 1986; Borgatti, 1999a; Handwerker and Borgatti, 1988; Weller and Romney, 1988). Salient words identified from free-lists can also be compared among different groups of people. The free-listing study was embedded within a longer, in-depth, semi-structured interview study aimed at understanding the experience of psoriasis and its treatments from the patient perspective. This study was conducted in accordance with the Declaration of Helsinki and approved by the institutional review board of the University of Pennsylvania. Every participant provided informed consent; written consent was obtained for in-person interviews, and verbal consent was obtained for telephone interviews.

Study sample

Study participants were recruited both locally and nationally. Local recruitment was primarily from dermatologist referrals from outpatient clinics affiliated with and/or patient responses to study advertisements within the University of Pennsylvania Health System. National recruitment was primarily from individual responses to study advertisements sent to members of the National Psoriasis Foundation, with select additional recruitment by dermatologists of psoriasis patients seen at the University of California—San Francisco, Johns Hopkins University, Howard University, and Cooper

University dermatology clinics. Inclusion criteria were as follows: (i) at least 18 years of age, (ii) self-report of current or prior diagnosis of moderate to severe plaque psoriasis from a dermatologist for at least 6 months, (iii) self-identified race as either white or black, (iv) resides in the United States, and (v) is or has been under the care of a dermatologist or rheumatologist for psoriasis. Moderate to severe psoriasis was defined by at least one of the following: (i) study referral from a dermatologist who confirmed a history of moderate to severe psoriasis or (ii) self-report of current or prior treatment with or recommendation by a dermatologist to be treated with phototherapy, oral systemic, or biologic therapy for psoriasis. Individuals were excluded if they did not speak English. Participants were interviewed either in person or via telephone; interview mode has not been shown to affect semi-structured interview responses (Gravlee et al., 2013; Vogl, 2013).

As is standard for qualitative studies, we used a purposive sampling strategy in selecting consecutive study participants who indicated interest in participating in our study. Considering the study objective to understand racial disparities in the biologic treatment of psoriasis, we aimed to achieve an approximately equal number of white and black participants who have and have not received biologic treatment for their psoriasis. Sampling in qualitative research is continued until data saturation is reached, which indicates that no new information or important themes arise (Dongre et al., 2009). We evaluated for saturation by analyzing the free-list data when 80% and 100% of the data had been collected. No new salient words were identified between the two analyses, and the sample was considered to be sufficient. Each participant was provided \$40 for his/her study participation.

Data collection

The research team developed a free-list interview guide (see [Supplementary Appendix S1](#) online) based on their expertise and

input from clinical experts in psoriasis. The guide included an initial description of the study, instructions for free-listing, and an example exercise to allow study participants to practice with a question unrelated to the study. The guide included a written script for the interviewer to maintain consistency across interviews. Participants were asked to provide a verbal list of words in response to five questions about specific psoriasis therapies (self-injectable biologics, infliximab, methotrexate, apremilast, and phototherapy) by asking, “What words come to mind when you think of ‘X’ as a psoriasis treatment?” where X represents each of the psoriasis therapies of interest. Infliximab was queried separately from the other biologics due to being administered intravenously rather than being self-injectable. The brand names for self-injectable biologics, infliximab, and apremilast were used. An optional prompt with a short description of each therapy was provided to those who expressed initial unfamiliarity. The questions were designed to identify perceptions and understanding of biologics and other commonly used or newer therapies for moderate to severe psoriasis among individuals with the disease.

Interviews were conducted from May 2017 through January 2018. All interviews were performed by one of two members of the research team (WTE or VTR) who were trained in conducting semi-structured interviews. The free-listing portion of the interview typically lasted up to 10 minutes. The interviewers met regularly with the principal investigator (JT) and anthropologist qualitative methods expert (FKB) to address any questions regarding the interview process. Interviews also included questions about participants’ sociodemographic characteristics, psoriasis history, and skin disease-related quality of life as measured by the Dermatology Life Quality Index (Bronsard et al., 2010; Finlay and Khan, 1994).

Data management and analysis

Each study participant’s word lists were transcribed and evaluated independently by three research team members (WTE, CB, and LH) to group similar ideas into standardized single words or phrases while maintaining the order in which words were mentioned. For example, in response to biologics, the single standard word “injection” was used to represent each mention of “needle,” “needles,” and “shot.” Standardized and ordered word lists were reviewed and validated by the principal investigator, revised as necessary, and entered as text files into Anthropac 4.98 (Analytic Technologies, Lexington, KY). For the primary analysis, a text file of word lists was created for each of the five questions about psoriasis treatments and each race/treatment group, indicating the participant’s combination of race and treatment history with biologics (white/biologic, white/no biologic, black/biologic, and black/no biologic), for a total of 20 text files. In additional analyses, text files of word lists for each of the five psoriasis treatments and each of the following race, education, and income groups were also created: white and black race, higher ($\geq \$50,000$) and lower ($< \$50,000$) annual household income, and higher (bachelor’s degree or higher) and lower (less than a bachelor’s degree) education level.

A salience index (Smith S) for each item (i.e., word or theme) in each list was calculated in Anthropac using the following formula: $S = \{\sum [(L - R_j + 1)/L]\}/n$, where L is the length of each list, R_j is the rank of item j in the list, and n is the number of lists in the sample (Borgatti, 1999b; Smith and Borgatti, 1997). The Smith S is a numeric measure of item importance that identifies salient items that represent those that are most important for defining a domain of interest (e.g., biologics) among members of a group (e.g., individuals with

psoriasis). Salience values theoretically range from 0.0 (an item that is never mentioned in any list) to 1.0 (the first item on every list). Salience scores remained linked to their corresponding items and were sorted from high to low and plotted as scree plots, with the y-axis representing Smith S values. The plots were examined to identify the elbow that indicates the transition from a steep to a flattened slope. All items linked to salience scores greater than or equal to the elbow value were considered salient (Borgatti, 1999b). Among salient items, those with the highest S values and largest spatial separation from words with lower values were considered strongly salient, and the remaining words were considered moderately salient. The primary analysis compared salient items among participants in the white/biologic, white/no biologic, black/biologic, and black/no biologic race/treatment groups. In additional analyses, we also compared salient words between the following participant groups: white and black race, higher and lower annual household income, and higher and lower education level.

CONFLICT OF INTEREST

JT receives research grants from Pfizer (to the Trustees of the University of Pennsylvania) and has received payment for continuing medical education work related to psoriasis that was supported indirectly by Eli Lilly and Novartis. JMG served as a consultant for BMS, Boehringer Ingelheim, GSK, Janssen Biologics, Novartis, Regeneron, UCB (DSMB), Sanofi, and Pfizer, receiving honoraria; receives research grants (to the Trustees of the University of Pennsylvania) from AbbVie, Janssen, Novartis, Sanofi, Celgene, Ortho Dermatologics, and Pfizer; and received payment for continuing medical education work related to psoriasis that was supported indirectly by Eli Lilly and Ortho Dermatologics. JMG is a co-patent holder of resiquimod for the treatment of cutaneous T-cell lymphoma. The other authors state no conflict of interest.

ACKNOWLEDGMENTS

This study was supported by a grant from the National Institute of Arthritis and Musculoskeletal and Skin Diseases K23-AR068433 (to JT). Funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

We are grateful to Warren R. Heymann, Wilson Liao, and Ginette A. Okoye for their assistance with study recruitment and to our study participants for sharing their time and thoughts with us.

An abstract of the data contained in this article was presented at the International Investigative Dermatology 2018 Meeting (May 2018) and the American Public Health Association 2018 Annual Meeting (November 2018).

SUPPLEMENTARY MATERIAL

Supplementary material is linked to the online version of the paper at www.jidonline.org, and at <https://doi.org/10.1016/j.jid.2018.12.032>.

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SUPPLEMENTARY MATERIALS

Supplementary Appendix S1. Free-listing interview guide¹

I'd like to start with a word association exercise about different psoriasis therapies. I will name a psoriasis treatment, and I'd like you to tell me any and all words that come to your mind about that treatment. If you can, please try to use single words. If you are not familiar with the treatment, you can say, "I don't know." Before we begin, let's try a practice exercise together.

What words come to mind when you think of the beach? Now, let's do the same exercise with psoriasis treatments.

Q1: What words come to mind when you think of phototherapy as a psoriasis treatment?

Reminder: Phototherapy is a form of artificial sunlight that is usually administered 2–3 times a week (not a tanning bed).

Q2: What words come to mind when you think of methotrexate as a psoriasis treatment?

Reminder: Methotrexate is an oral pill. Methotrexate is often taken as multiple pills once a week at home.

Q3: What words come to mind when you think of Otezla (apremilast)?

Reminder: Otezla is an oral pill that is taken twice a day at home.

Q4: What words come to mind when you think of self-injectable medications or biologics, for example, Enbrel, Humira, Stelara, Cosentyx, Taltz, Siliq, and Tremfya?

Reminder: These medications are shots that you can give yourself at home anywhere from 2 times a week to every 3 months depending on the specific medication.

Q5: What words come to mind when you think of Remicade (infliximab)?

Reminder: This is a medication (biologic) that is administered as an infusion through your vein in the doctor's office about every 8 weeks.

¹ Cosentyx: Novartis, East Hanover, NJ; Enbrel: Amgen, Thousand Oaks, CA; Humira: AbbVie, North Chicago, IL; Otezla: Celgene, Summit, NJ; Remicade: Janssen Biotech, Horsham, PA; Siliq: Ortho Dermatologics, Bridgewater, NJ; Stelara: Janssen Biotech, Horsham, PA; Taltz: Eli Lilly, Indianapolis, IN; Tremfya: Janssen Biotech, Horsham, PA.