Melanoma Literacy among the General Population of three Western US states

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Melanoma literacy among the general population of three western US states

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Abstract

Melanoma is a significant cause of cancer death, despite being detectable without specialized or invasive technologies. Understanding barriers to preventive behaviors such as skin self-examination (SSE) could help to define interventions for increasing the frequency of early detection. To determine melanoma knowledge and beliefs across three high-incidence US states, 15,000 surveys were sent to a population-representative sample. We aimed to assess (1) melanoma literacy (i.e., knowledge about melanoma risks, attitudes, and preventive behaviors) and (2) self-reported SSE and its association with melanoma literacy, self-efficacy, and belief in the benefits of SSE. Of 2326 respondents, only 21.2% provided responses indicating high knowledge of melanoma, and 62.8% reported performing an SSE at any time in their lives. Only 38.3% and 7.3% reported being "fairly" or "very" confident about doing SSE, respectively. SSE performance among respondents was most strongly associated with higher melanoma knowledge, higher self-efficacy, and personal history of melanoma. Melanoma literacy among survey respondents was modest, with greater literacy associated with a higher likelihood of reported preventive behavior. This assessment establishes a baseline and provides guidance for public health campaigns designed to increase prevention and early detection of this lethal cancer.

1 | INTRODUCTION

Melanoma is a major cause of cancer death in the USA and worldwide (American Cancer Society, 2022). Melanomas detected at earlier stages have substantially better survival rates and lower associated costs of care, (Alexandrescu, 2009; Bencina et al., 2017; Buja et al., 2018; da Veiga et al., 2021; Dranitsaris et al., 2018; Elliott et al., 2017; Gogebakan et al., 2021; Keung & Gershenwald, 2018; Leeneman et al., 2021; Lyth et al., 2016; Serra-Arbeloa et al., 2017; Tsao et al., 1998) but general-population–based screening for melanoma has been controversial (Kulkarni et al., 2022; Swerlick, 2022). For example, although the vast majority of melanomas are readily observable on the skin, the value of provider-based melanoma screening has been challenged, (Janda et al., 2020; Welch et al., 2021) and the United States Preventive Services Task Force has concluded that there is insufficient evidence to support general population screening in asymptomatic adults (US Preventive Services Task Force, 2016).

An alternative to provider-based screening of the general population is self-screening, which has been shown in a recent meta-analysis to have reasonable sensitivity (25%–93%) and relatively high specificity (83%–97%) (Hamidi et al., 2010; Reilly et al., 2021; Yagerman & Marghoob, 2013). Currently, most melanomas are first detected by patients, friends, or family members, (De Giorgi et al., 2012; Swetter et al., 2012) but such melanomas are also more advanced at the time of diagnosis than those detected by a provider, suggesting that self-screening may be less effective than provider-based screening (De Giorgi et al., 2012).

However, various studies have shown that interventions can enhance the efficacy of self-screening. Skin self-examination (SSE) has been associated with better detection of atypical nevi and melanoma in a randomized controlled trial when telehealth support was provided as part of the protocol (Robinson et al., 2021). Web-based promotion of self-screening with telehealth support has been shown in Switzerland to enhance prevention behaviors and result in the detection of melanoma and non-melanoma skin cancers (Meyer et al., 2021). These data suggest that population efforts to improve the performance of self-screening could lead to earlier melanoma detection and reduce morbidity and mortality. However, little data exists about melanoma literacy levels of the general population, whether targetable knowledge gaps exist, or whether educational intervention could improve self-screening behaviors.

The health belief model (Hochbaum, 1958) and Bandura's social cognitive theory (Bandura, 1986) provide a general framework for understanding people's likelihood of performing health behaviors such as SSE. These theoretical frameworks emphasize individuals' knowledge of a health concern, perceptions that the concern is a threat to their well-being, beliefs that the benefits of performing a recommended health behavior outweigh the associated barriers and

Significance

We confirmed and extended existing literature demonstrating an association between beliefs about melanoma and preventive behaviors. We also identified deficits in melanoma knowledge and confidence in performing skin self-examination (SSE) within the populations of these three states. Evidence suggests that a public health campaign aimed at addressing these deficits in knowledge and confidence has the potential to increase the performance of SSE and the early detection of melanoma, thereby decreasing melanoma morbidity and mortality.

costs, and confidence in their ability to carry out the health behavior (i.e., perceived self-efficacy) (Bandura, 1986, 1997). Accordingly, any campaign to improve melanoma self-screening must be based on a clear understanding of a population's existing behaviors, knowledge, perceptions, beliefs, and self-efficacy in conducting SSE. Yet the relationship between SSE and the levels of self-efficacy and melanoma literacy (i.e., knowledge, attitudes, beliefs, and/or barriers about melanoma and/or skin exams) in the US population is poorly understood. Also unknown is whether targetable gaps in literacy and self-efficacy exist or if education aimed at reducing gaps in knowledge about melanoma and the value of self-detection can influence the propensity to perform SSE (Atkins et al., 2021; Petrie et al., 2019).

To understand the current levels of melanoma literacy and determine which literacy characteristics best correlate with self-detection behaviors, a survey was designed and sent to representative urban and rural populations from Oregon, Washington, and Utah—3 states with similar demographics and melanoma incidence and mortality rates. To our knowledge, this survey is unique, and it establishes a baseline for assessing the effectiveness of future melanoma detection efforts (Nelson et al., 2022).

2 | MATERIALS AND METHODS

2.1 | Survey development and content

Survey development was a collaborative effort between dermatologists, health psychologists, public health scientists, population scientists, biostatisticians, and questionnaire evaluators. Survey items were designed to assess melanoma literacy, including respondents' knowledge, attitudes, and behaviors around skin cancer and screening. We conducted a review of skin-cancer surveys and published phenotypic risk factors and meta-analyses (Arlinghaus & Johnston, 2018;

Aspinwall et al., 2009; Azoury & Lange, 2014; Baxter et al., 2008; Branstrom, Chang, et al., 2010b; Branstrom, Kasparian, et al., 2010a; Buller et al., 2011; Caini et al., 2009, 2014; Cust et al., 2015; Dodd et al., 2007; Elwood & Jopson, 1997; Fitzpatrick, 1988; Gandini, Sera, Cattaruzza, Pasquini, Abeni, et al., 2005; Gandini, Sera, Cattaruzza, Pasquini, Picconi, et al., 2005; Gandini, Sera, Cattaruzza, Pasquini, Zanetti, et al., 2005; Glanz et al., 2003; Gordon, 2013; MacKie et al., 1989; Morze et al., 2012; Olsen et al., 2012; Penn et al., 2014; Robinson et al., 1997; Siskind et al., 2011; Stump et al., 2018; Taylor et al., 2016, 2017; Watts et al., 2015; Weinstock, 1992; Whiteman et al., 2005) to establish a list of preliminary item domains and specific items. The domains were reviewed by the authors, and items were iteratively refined to enhance clarity, eliminate redundancy, and reduce length. Each potential item was reviewed for both construct and face validity based on the literature review. The final survey was piloted in two communities (rural and urban) in Oregon. The revised survey was also taken by cancer patient advocates, medical students, and dermatology faculty members, and additional revisions were made based on their thoughts about the instructions, question order, and survey completion time. Demographic questions (e.g., age, gender, education, income) were used to calibrate survey weights to obtain population estimates. These questions, together with additional items related to skin cancer risk (e.g., skin and hair color, sun sensitivity), permitted us to confirm expected relationships. Several questions assessed internal validity. For example, two separate questions about insurance coverage were asked, with 99.8% agreement in the answers.

The final survey contained 34 questions to assess knowledge about melanoma, risk factors, and warning signs; performance and perceptions of SSE; self-efficacy in the ability to perform SSE and identify concerning lesions during SSE; and intent to act on suspicious findings from SSE. (Supplemental Information A).

2.2 | Sampling plan and administration

Fifteen thousand households across Oregon (50%; 7536), Washington (30%; 4498), and Utah (20%; 2966) were randomly selected using a stratified 2-stage sample of zip codes and households within zip codes.

The design consisted of six strata: three states divided into urban and rural sectors. Each zip code was designated as either urban or rural. To assure adequate rural representation, zip codes were selected intentionally to result in an oversampling of rural households (i.e., only 10% of households in the three states are rural, but 33.2% of the surveys were sent to rural households). Within each of the six strata, zip codes were sampled with replacement using probabilities proportional to the number of households in the zip code (zip codes, but not households, could be sampled more than once). Within a given zip code, households were sampled randomly without replacement at a fixed rate of 30 households each time the zip code was sampled. This sampling strategy design performed as if it were a simple random sample of households within the six strata. A single survey was mailed to each sampled household, and the instructions requested that only one adult from the household respond.

A $5 incentive was provided to increase participation rates (Supplemental Information A). Respondents were given the option of completing the survey on paper and returning it by mail, or completing the survey online. The survey also contained Spanish-language instructions, and respondents could elect to complete an online version of the survey in Spanish.

Survey responses were received between May 17, 2019, and January 14, 2020. The overall response rate was 15.5%, with 21.3% of responses completed online (3.3% of total surveys), and 78.7% of responses completed on paper (12.2% of total surveys). Response rate was highest for Oregon (18.6%); response rates for Washington (12.7%) and Utah (11.9%) were similar to one another. Data were entered directly by respondents (online survey) or by research team members trained in data entry (paper surveys). All data were stored securely in a REDCap database (IRB #19372). For quality control, 10% of the paper surveys were randomly chosen for double data entry. Discrepancies were resolved by having 2–3 team members review and discuss the contents of the paper form, and the consensus response was retained. The discrepancies were minor (e.g., inadvertently failing to enter a response), and none were concerning for systematic error.

2.3 | Statistical methods

We determined relationships between knowledge, self-efficacy, and self-reported SSE behavior among respondents using a multivariable logistic regression modeling strategy that aligns with components of the health belief model (Hochbaum, 1958) and Bandura's social cognitive theory (Bandura, 1986, 1997). See supplemental material for complete statistical methods, including calculation of survey weights, adjustments for non-response, descriptive analyses, and the logistic regression models of melanoma knowledge, self-efficacy, and SSE (Supplemental Information B).

3 | RESULTS

3.1 | Respondent characteristics

We received 2326 responses to the survey: 60.3% from Oregon, 24.5% from Washington, and 15.2% from Utah. The majority were returned via mail (78.7%) versus online (21.3%), and these percentages were similar across states (78.2%, 80.5%, and 77.6% mail from OR, WA, and UT, respectively).

With few exceptions, demographic, health care, and personal characteristics of the survey respondents were similar across states. Notably, Utahn respondents were younger and more likely to be privately insured and married or in domestic partnerships. Tables 1–5 display response counts, response percentages, and weighted population percentages (and 95% CI) by state and overall. Most respondents, based on unweighted percentages, lived in urban areas (65.8%); had exposure to at least some college or vocational training (80.7%); were female (66.5%); were married or in a domestic

TABLE 1 Demographic characteristics–Population survey.

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
Age								
Less than 18–29 years	78 (5.6%)	20.5 (9.4%–31.6%)	29 (5.1%)	19.7 (13.8%–25.5%)	32 (9.1%)	29.5 (15.5%–43.4%)	139 (6.0%)	22.0 (21.3%–22.7%)
30–39 years	141 (10.0%)	15.4 (9.9%–20.9%)	66 (11.6%)	16.7 (13.1%–20.2%)	54 (15.3%)	19.7 (14.1%–25.2%)	261 (11.2%)	16.9 (16.9%–16.9%)
40–49 years	165 (11.8%)	14.8 (9.6%–20.1%)	66 (11.6%)	17.0 (13.7%–20.3%)	44 (12.5%)	13.2 (8.3%–18.1%)	275 (11.8%)	15.6 (15.2%–15.9%)
50–59 years	227 (16.2%)	20.6 (14.4%–26.9%)	100 (17.5%)	16.0 (12.4%–19.5%)	50 (14.2%)	13.5 (8.0%–19.0%)	377 (16.2%)	16.7 (16.6%–16.8%)
60–69 years	366 (26.1%)	14.6 (10.1%–19.2%)	156 (27.4%)	15.9 (13.1%–18.7%)	75 (21.2%)	11.2 (7.7%–14.8%)	597 (25.7%)	14.6 (14.5%–14.6%)
70 or more years	411 (29.3%)	12.9 (8.6%–17.2%)	150 (26.3%)	14.2 (11.6%–16.7%)	92 (26.1%)	10.7 (7.2%–14.2%)	653 (28.1%)	13.1 (12.8%–13.4%)
Prefer not to answer/(Missing)	15 (1.1%)	1.1 (0.2%–2.0%)	3 (0.5%)	0.7 (0.0%–1.4%)	6 (1.7%)	2.3 (0.0%–5.3%)	24 (1.0%)	1.1 (0.3%–1.9%)
Gender								
Male	447 (31.9%)	48.7 (40.7%–56.6%)	194 (34.0%)	48.1% (43.1%–53.1%)	115 (32.6%)	48.3 (42.3%–54.2%)	756 (32.5%)	48.3 (47.6%–49.0%)
Female	941 (67.1%)	49.8 (41.7%–57.9%)	372 (65.3%)	50.6% (45.9%–55.3%)	234 (66.3%)	49.7 (43.6%–55.8%)	1547 (66.5%)	50.2 (49.4%–51.0%)
Non-binary/(Missing)/Prefer not to answer	15 (1.1%)	1.6 (0.5%–2.6%)	4 (0.7%)	1.3% (0.0%–2.9%)	4 (1.1%)	2.0 (0.0%–5.0%)	23 (1.0%)	1.5 (0.5%–2.6%)
Highest level of education								
Less than high school	31 (2.2%)	2.0 (0.6%–3.3%)	11 (1.9%)	1.8 (0.1%–3.5%)	5 (1.4%)	0.7 (0.1%–1.3%)	47 (2.0%)	1.6 (0.6%–2.5%)
High school diploma	165 (11.8%)	11.6 (8.6%–14.6%)	73 (12.8%)	9.5 (6.6%–12.4%)	59 (16.7%)	11.4 (7.0%–15.7%)	297 (12.8%)	10.5 (8.6%–12.4%)
GED or a high school equivalent	45 (3.2%)	3.6 (2.1%–5.0%)	13 (2.3%)	1.1 (0.3%–1.9%)	7 (2.0%)	0.6 (0.0%–1.2%)	65 (2.8%)	1.7 (1.0%–2.3%)
Some college	295 (21.0%)	18.0 (14.8%–21.3%)	125 (21.9%)	18.3 (14.3%–22.2%)	79 (22.4%)	21.4 (11.9%–31.0%)	499 (21.5%)	18.9 (15.9%–21.8%)
Vocational training or 2-year degree	209 (14.9%)	13.7 (9.8%–17.5%)	102 (17.9%)	16.0 (10.8%–21.1%)	56 (15.9%)	16.0 (9.8%–22.3%)	367 (15.8%)	15.4 (12.2%–18.5%)
A 4-year college degree or more	630 (44.9%)	49.5 (43.3%–55.6%)	240 (42.1%)	52.3 (44.0%–60.6%)	140 (39.7%)	47.6 (39.7%–55.4%)	1010 (43.4%)	50.5 (45.9%–55.1%)
Prefer not to answer	14 (1.0%)	0.6 (0.1%–1.2%)	5 (0.9%)	0.9 (0.0%–1.8%)	4 (1.1%)	0.4 (0.0%–0.8%)	23 (1.0%)	0.7 (0.2%–1.2%)
(Missing)	14 (1.0%)	1.1 (0.2%–1.9%)	1 (0.2%)	0.1 (0.0%–0.4%)	3 (0.8%)	1.9 (0.0%–5.0%)	18 (0.8%)	0.8 (0.1%–1.5%)
Ethnicity								
Yes, Hispanic or Latino/a	53 (3.8%)	6.9 (4.1%–9.7%)	12 (2.1%)	3.6 (0.9%–6.4%)	14 (4.0%)	6.9 (2.9%–11.0%)	79 (3.4%)	5.2 (3.4%–7.0%)
No, not Hispanic or Latino/a	1289 (91.9%)	88.5 (85.4%–91.5%)	533 (93.5%)	92.7 (89.5%–96.0%)	329 (93.2%)	91.7 (87.5%–95.9%)	2151 (92.5%)	91.3 (89.3%–93.4%)
Prefer not to answer	37 (2.6%)	2.7 (1.4%–3.9%)	16 (2.8%)	2.5 (0.9%–4.2%)	6 (1.7%)	1.0 (0.0%–1.9%)	59 (2.5%)	2.2 (1.3%–3.2%)
(Missing)	24 (1.7%)	2.0 (0.9%–3.0%)	9 (1.6%)	1.1 (0.0%–2.2%)	4 (1.1%)	0.4 (0.0%–0.8%)	37 (1.6%)	1.2 (0.6%–1.8%)

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TABLE 1 (Continued)

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
Race								
White	1272 (90.7%)	85.7 (82.6%-88.8%)	504 (88.4%)	80.0 (73.2%-86.9%)	337 (95.5%)	90.7 (85.1%-96.4%)	2113 (90.8%)	83.9 (80.1%-87.6%)
Black or African-American	23 (1.6%)	1.8 (0.7%-2.9%)	8 (1.4%)	3.7 (0.3%-7.1%)	3 (0.8%)	2.8 (0.0%-6.7%)	34 (1.5%)	3.0 (1.0%-5.0%)
American Indian or Alaska Native	48 (3.4%)	3.8 (2.4%-5.2%)	12 (2.1%)	1.5 (0.5%-2.5%)	5 (1.4%)	1.4 (0.0%-2.8%)	65 (2.8%)	2.1 (1.3%-2.8%)
Asian	36 (2.6%)	6.3 (2.7%-9.9%)	30 (5.3%)	13.8 (7.0%-20.7%)	9 (2.5%)	6.0 (1.8%-10.2%)	75 (3.2%)	10.1 (6.3%-13.9%)
Native Hawaiian or Pacific Islander	7 (0.5%)	1.5 (0.4%-2.7%)	5 (0.9%)	1.0 (0.1%-2.0%)	-	-	12 (0.5%)	0.9 (0.4%-1.5%)
Other	47 (3.3%)	5.0 (2.9%-7.1%)	13 (2.3%)	3.7 (0.0%-7.7%)	7 (2.0%)	3.7 (0.0%-7.8%)	67 (2.9%)	4.0 (1.8%-6.3%)
Prefer not to answer	31 (2.2%)	2.5 (1.1%-4.0%)	14 (2.5%)	3.1 (1.0%-5.1%)	2 (0.6%)	0.5 (0.0%-1.2%)	47 (2.0%)	2.4 (1.2%-3.5%)
Preferred language								
English	1399 (99.7%)	99.5 (98.7%-100.3%)	567 (99.5%)	99.2 (98.1%-100.2%)	352 (99.7%)	99.4 (98.2%-100.6%)	2318 (99.7%)	99.3 (98.7%-99.9%)
Spanish	3 (0.2%)	0.5 (0.0%-1.2%)	3 (0.5%)	0.8 (0.0%-1.9%)	1 (0.3%)	0.6 (0.0%-1.8%)	7 (0.3%)	0.7 (0.1%-1.3%)
(Missing)	1 (0.1%)	0.0 (0.0%-0.1%)	-	-	-	-	1 (0.0%)	0.0 (0.0%-0.0%)
Household income (before taxes, 2018)								
Less than $20,000	170 (12.1%)	15.5 (11.5%-19.6%)	59 (10.4%)	9.4 (5.6%-13.2%)	25 (7.1%)	12.6 (3.8%-21.4%)	254 (10.9%)	11.8 (9.0%-14.6%)
$20,000-$34,999	171 (12.2%)	10.5 (7.6%-13.4%)	48 (8.4%)	10.7 (6.3%-15.0%)	37 (10.5%)	7.2 (3.9%-10.5%)	256 (11.0%)	9.9 (7.5%-12.3%)
$35,000-$49,999	159 (11.3%)	10.0 (7.6%-12.5%)	63 (11.1%)	8.4 (5.5%-11.3%)	51 (14.4%)	15.5 (10.2%-20.8%)	273 (11.7%)	10.4 (8.3%-12.4%)
$50,000-$74,999	254 (18.1%)	16.2 (13.1%-19.4%)	100 (17.5%)	18.1 (13.1%-23.1%)	76 (21.5%)	22.0 (14.9%-29.0%)	430 (18.5%)	18.4 (15.3%-21.5%)
$75,000-$99,999	155 (11.0%)	12.3 (9.2%-15.5%)	72 (12.6%)	11.2 (7.9%-14.6%)	47 (13.3%)	13.0 (7.4%-18.7%)	274 (11.8%)	11.9 (9.6%-14.2%)
$100,000 or more	265 (18.9%)	22.1 (17.4%-26.8%)	124 (21.8%)	27.7 (20.6%-34.7%)	49 (13.9%)	18.0 (11.0%-24.9%)	438 (18.8%)	24.1 (20.1%-28.0%)
Prefer not to answer	217 (15.5%)	12.6 (9.8%-15.3%)	100 (17.5%)	13.7 (9.7%-17.6%)	66 (18.7%)	11.0 (6.9%-15.1%)	383 (16.5%)	12.8 (10.5%-15.1%)
(Missing)	12 (0.9%)	0.7 (0.2%-1.2%)	4 (0.7%)	0.9 (0.0%-2.0%)	2 (0.6%)	0.8 (0.0%-2.0%)	18 (0.8%)	0.8 (0.2%-1.5%)
Marital status								
Single (never married)	186 (13.3%)	26.8 (18.6%-34.9%)	70 (12.3%)	28.2 (20.6%-35.8%)	21 (5.9%)	10.3 (4.2%-16.4%)	277 (11.9%)	24.0 (19.4%-28.6%)
Married or in a domestic partnership	810 (57.7%)	51.3 (44.6%-58.0%)	347 (60.9%)	53.1 (45.8%-60.4%)	252 (71.4%)	74.1 (68.0%-80.3%)	1409 (60.6%)	57.1 (52.5%-61.7%)
Widowed	134 (9.6%)	4.0 (2.4%-5.7%)	59 (10.4%)	5.4 (3.5%-7.2%)	34 (9.6%)	5.0 (2.8%-7.1%)	227 (9.8%)	4.9 (3.9%-6.0%)
Divorced	210 (15.0%)	12.9 (10.1%-15.7%)	70 (12.3%)	9.3 (6.9%-11.8%)	33 (9.3%)	7.7 (4.1%-11.3%)	313 (13.5%)	10.0 (8.4%-11.5%)
Separated	16 (1.1%)	1.3 (0.0%-2.6%)	9 (1.6%)	1.8 (0.0%-3.6%)	5 (1.4%)	1.3 (0.0%-3.0%)	30 (1.3%)	1.6 (0.5%-2.6%)

(Continues)

TABLE 1 (Continued)

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
Prefer not to answer	39 (2.8%)	3.1 (1.7%–4.4%)	14 (2.5%)	2.0 (0.8%–3.2%)	7 (2.0%)	1.4 (0.2%–2.6%)	60 (2.6%)	2.2 (1.4%–2.9%)
(Missing)	8 (0.6%)	0.6 (0.1%–1.1%)	1 (0.2%)	0.2 (0.0%–0.6%)	1 (0.3%)	0.2 (0.0%–0.6%)	10 (0.4%)	0.3 (0.1%–0.6%)
Urban/rural								
Urban	930 (66.3%)	90.8 (86.1%–95.4%)	355 (62.3%)	91.4 (89.0%–93.7%)	245 (69.4%)	93.8 (90.7%–97.0%)	1530 (65.8%)	91.7 (89.1%–94.4%)
Rural	473 (33.7%)	9.2 (4.6%–13.9%)	215 (37.7%)	8.6 (6.3%–11.0%)	108 (30.6%)	6.2 (3.0%–9.3%)	796 (34.2%)	8.3 (5.6%–10.9%)

partnership (60.6%); and were age 60 or older (50.8%; Table 1). By applying survey weights, all subsequent percentages were adjusted to approximate the population distributions of the three participating states at the time the survey was administered.

Lightly pigmented skin and hair are established independent risk factors for melanoma (Johnson et al., 2017). Approximately 20% of respondents had blond or strawberry blond hair, while another 2% had red hair. Over 30% of respondents reported they would moderately or severely burn if exposed to the sun for 1 h without sun protection, while 25% reported they would turn darker without burning or that nothing would happen to their skin (Table 3).

Rural respondents more often reported personal history of melanoma (16.2%) compared to urban participants (9.9%). Across all respondents, 10.4% reported personal history of melanoma.

3.2 | Melanoma knowledge

Of the 34 survey questions, 24 had correct and incorrect answers from which to choose. Respondents' scores ranged from 5/24 (21%) to 24/24 (100%) correct; on average, 17/24 questions (71.0%) were correctly answered (Figure S1). Respondents from the three states scored similarly.

Some questions drew on common knowledge. For example, too much sun exposure and a family history of melanoma were correctly identified as risk factors by 96.1% and 86.7% of respondents, respectively, and 91.3% knew that a mole changing size, shape, or color was a warning sign. However, other items, such as "Having a lot of moles is a risk factor for melanoma" (27%), and "Melanoma on my skin is as likely to be detected by me as it is by a doctor" (36%) were answered correctly less often. There was also a modest frequency of correct responses on the true/false item "Melanoma is the deadliest form of skin cancer" (55%). Figure 1 summarizes the percentage of respondents that scored in the "high" range (≥20/24 correct) stratified by respondent characteristics. Overall, only 21.2% of respondents fell into the high knowledge category (95% CI: 18.2%–24.2%).

High melanoma knowledge correlated significantly with self-report of risk factors including skin UVR vulnerability and light hair color. This suggests that those with personal risk factors are more likely to have higher melanoma knowledge overall (Figure 2). There were no statistically significant differences by rural/urban status or state of residence, although there was a trend toward more respondents from Utah having high knowledge as compared to those from Washington and Oregon.

3.3 | Beliefs in benefit of SSE and confidence in ability to perform SSE

The majority of respondents (84.8%) endorsed a belief in the efficacy of SSE in detecting skin cancer, somewhat or strongly agreeing that "Checking my skin for signs of skin cancer will help me detect skin

TABLE 2 Health insurance and health care–Population survey.

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
Current health insurance								
I dont have any insurance now	49 (3.5%)	6.9 (4.3%–9.5%)	18 (3.2%)	3.6 (0.6%–6.6%)	11 (3.1%)	3.1 (0.3%–5.9%)	78 (3.4%)	4.4 (2.6%–6.2%)
Private coverage from an employer or family members employer	545 (38.8%)	50.2 (44.8%–55.6%)	252 (44.2%)	51.0 (44.2%–57.7%)	176 (49.9%)	60.3 (51.4%–69.2%)	973 (41.8%)	52.7 (48.5%–56.9%)
A private plan I pay for myself	222 (15.8%)	10.3 (8.0%–12.6%)	83 (14.6%)	13.1 (8.1%–18.1%)	59 (16.7%)	12.7 (7.7%–17.7%)	364 (15.6%)	12.2 (9.4%–15.1%)
Medicaid or Oregon Health Plan	184 (13.1%)	15.6 (12.3%–18.8%)	61 (10.7%)	15.0 (9.0%–21.0%)	10 (2.8%)	2.1 (0.6%–3.6%)	255 (11.0%)	12.4 (9.1%–15.7%)
Medicare	560 (39.9%)	20.4 (15.3%–25.5%)	219 (38.4%)	23.0 (18.9%–27.1%)	133 (37.7%)	18.0 (13.1%–22.8%)	912 (39.2%)	21.2 (19.6%–22.9%)
VA, TRICARE or other military health care	92 (6.6%)	5.2 (3.4%–7.1%)	34 (6.0%)	6.0 (3.0%–9.1%)	20 (5.7%)	8.1 (1.0%–15.3%)	146 (6.3%)	6.3 (4.0%–8.6%)
Indian Health Service	14 (1.0%)	1.1 (0.3%–1.8%)	3 (0.5%)	0.5 (0.0%–1.2%)	1 (0.3%)	0.0 (0.0%–0.1%)	18 (0.8%)	0.6 (0.2%–1.0%)
Other	88 (6.3%)	3.3 (2.1%–4.6%)	29 (5.1%)	3.3 (1.9%–4.8%)	13 (3.7%)	2.8 (0.6%–4.9%)	130 (5.6%)	3.2 (2.3%–4.1%)
I am not sure	8 (0.6%)	1.9 (0.3%–3.5%)	3 (0.5%)	0.5 (0.0%–1.1%)	4 (1.1%)	0.6 (0.0%–1.2%)	15 (0.6%)	0.9 (0.3%–1.5%)
Location for routine medical care								
I dont have a usual place	63 (4.5%)	10.1 (6.4%–13.9%)	23 (4.0%)	5.2 (1.0%–9.3%)	27 (7.6%)	14.3 (8.2%–20.3%)	113 (4.9%)	8.5 (5.9%–11.0%)
A doctors office, clinic, or health center	1225 (87.3%)	82.0 (77.0%–86.9%)	517 (90.7%)	89.0 (83.3%–94.6%)	305 (86.4%)	76.8 (69.3%–84.3%)	2047 (88.0%)	84.5 (81.0%–87.9%)
A hospital emergency room	2 (0.1%)	0.1 (0.0%–0.2%)	2 (0.4%)	0.1 (0.0%–0.1%)	–	–	4 (0.2%)	0.0 (0.0%–0.1%)
An urgent care facility	12 (0.9%)	1.7 (0.3%–3.1%)	6 (1.1%)	2.1 (0.0%–5.0%)	5 (1.4%)	3.7 (0.0%–7.5%)	23 (1.0%)	2.4 (0.7%–4.0%)
A tribal health facility	14 (1.0%)	1.0 (0.3%–1.7%)	2 (0.4%)	0.3 (0.0%–0.7%)	3 (0.8%)	0.7 (0.0%–1.9%)	19 (0.8%)	0.6 (0.2%–1.0%)
A VA facility	59 (4.2%)	3.2 (1.9%–4.4%)	9 (1.6%)	1.2 (0.0%–2.5%)	6 (1.7%)	2.2 (0.0%–5.1%)	74 (3.2%)	2.0 (1.0%–3.0%)
Some other place	22 (1.6%)	1.6 (0.6%–2.6%)	8 (1.4%)	1.7 (0.1%–3.2%)	5 (1.4%)	2.1 (0.0%–4.8%)	35 (1.5%)	1.7 (0.7%–2.8%)
(Missing)	6 (0.4%)	0.4 (0.0%–0.8%)	2 (0.4%)	0.2 (0.0%–0.4%)	1 (0.3%)	0.1 (0.0%–0.2%)	9 (0.4%)	0.2 (0.0%–0.4%)
I am not sure	–	–	1 (0.2%)	0.3 (0.0%–0.9%)	1 (0.3%)	0.1 (0.0%–0.4%)	2 (0.1%)	0.2 (0.0%–0.5%)
Last time went to a doctor or other health care provider for routine care, such as a regular check-up								
I have not gone to a doctor or clinic for a regular check-up	29 (2.1%)	2.9 (1.4%–4.4%)	6 (1.1%)	1.5 (0.2%–2.8%)	15 (4.2%)	3.9 (1.6%–6.2%)	50 (2.1%)	2.4 (1.5%–3.3%)
0–6 months ago	834 (59.4%)	52.9 (47.2%–58.5%)	363 (63.7%)	61.5 (55.0%–68.1%)	205 (58.1%)	50.1 (40.9%–59.3%)	1402 (60.3%)	56.7 (52.6%–60.9%)

(Continues)

TABLE 2 (Continued)

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
7–12 months ago	325 (23.2%)	21.3 (18.2%–24.5%)	114 (20.0%)	19.3 (14.5%–24.0%)	59 (16.7%)	20.9 (14.5%–27.0%)	498 (21.4%)	20.2 (17.3%–23.1%)
13–24 months ago	107 (7.6%)	9.9 (7.2%–12.6%)	38 (6.7%)	7.8 (3.6%–12.0%)	30 (8.5%)	7.7 (3.4%–12.1%)	175 (7.5%)	8.4 (5.9%–10.8%)
More than 2 years ago	93 (6.6%)	12.0 (7.7%–16.4%)	41 (7.2%)	7.6 (4.9%–10.2%)	32 (9.1%)	15.0 (7.1%–22.9%)	166 (7.1%)	10.4 (7.9%–12.8%)
I am not sure	10 (0.7%)	0.7 (0.1%–1.3%)	4 (0.7%)	1.4 (0.0%–3.0%)	8 (2.3%)	1.9 (0.1%–3.6%)	22 (0.9%)	1.3 (0.4%–2.2%)
(Missing)	5 (0.4%)	0.3 (0.0%–0.6%)	4 (0.7%)	0.9 (0.0%–1.8%)	4 (1.1%)	0.5 (0.0%–1.0%)	13 (0.6%)	0.7 (0.1%–1.2%)

cancer in its early stages" (Table 5). However, confidence in SSE performance was low. Only 7.3% of respondents reported feeling "very confident" in their ability to check their skin for signs of skin cancer, while 38.3% felt "fairly confident" in doing so, and confidence varied by respondent characteristics (Figure S2). Multivariable logistic regression revealed that for both female and male respondents, higher confidence was associated with increasing age and knowledge level (Figure 3). Those with high melanoma knowledge were 2.7 times more likely to report being "fairly" or "very" confident in their ability to perform SSE (95% CI: 1.8–4.2) compared to those with low knowledge; those with medium knowledge were 1.7 (95% CI: 1.2–2.5) times more likely (Figure 3).

3.4 | Self-Reported SSE behavior and its association with melanoma knowledge, Self-Efficacy, belief in the benefit of SSE, and personal history of melanoma

The majority (62.8%) of respondents reported that they or their partner had examined their skin for signs of skin cancer (24.6% performed SSE within the last 2 months, 24.4% between 2 months and 1 year ago, and 13.8% more than 1 year ago). SSE performance was most strongly associated with higher melanoma knowledge and more self-efficacy (Figure 4 and Figure S3). The high-knowledge group reported performing SSE at 3.0 times higher odds than of those with low knowledge (95% CI: 1.7–5.3). Individuals with high self-efficacy ("fairly" or "very" confident) had 4.2 (95% CI: 2.7–6.5) times the odds of performing SSE relative to those with low self-efficacy ("not very confident" or "no confidence"). Some melanoma risk factors were also associated with performance of SSE in the multivariable model. For example, respondents who reported blistering or peeling sunburn were also more likely to report performing SSE than those who did not report sunburn (OR = 2.2 95% CI: 1.5–3.3).

Additionally, although personal history of melanoma was not associated with increased knowledge (OR = 1.0, CI: 0.7–1.6) or confidence (OR = 1.0, CI: 0.6–1.4), respondents reporting personal history of melanoma were more likely to perform SSE (OR = 3.0, CI: 1.5–5.8). Also, belief that SSE helps detect skin cancer early was not associated with higher knowledge, self-efficacy, or increased SSE performance.

4 | DISCUSSION

4.1 | Significance of melanoma knowledge and self-efficacy in the context of SSE performance

To our knowledge, this represents the first population-based survey of melanoma literacy in the United States, providing a unique snapshot of population knowledge, attitudes, and beliefs that might be targetable in future interventions to increase early detection behaviors such as SSE. Higher levels of melanoma

TABLE 3 Skin/hair characteristics–Population survey.

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
Color of the skin on the inside of upper arm (that is, skin color without any tanning)								
Very fair (very light skin or slightly pink)	177 (12.6%)	13.7 (10.7%–16.8%)	71 (12.5%)	12.7 (8.7%–16.7%)	48 (13.6%)	11.9 (7.6%–16.2%)	296 (12.7%)	12.8 (10.4%–15.2%)
Fair (pale or white skin)	796 (56.7%)	52.1 (48.2%–55.9%)	332 (58.2%)	55.9 (49.4%–62.4%)	206 (58.4%)	59.7 (53.8%–65.7%)	1334 (57.4%)	55.7 (52.0%–59.3%)
Olive (cream white to olive skin)	329 (23.4%)	24.9 (21.4%–28.4%)	123 (21.6%)	20.0 (14.4%–25.6%)	82 (23.2%)	22.7 (17.3%–28.2%)	534 (23.0%)	21.9 (18.7%–25.2%)
Light brown (dark olive to moderate brown)	75 (5.3%)	7.5 (5.3%–9.7%)	32 (5.6%)	8.4 (3.6%–13.2%)	11 (3.1%)	2.6 (0.6%–4.6%)	118 (5.1%)	6.9 (4.3%–9.5%)
Dark brown (moderate to dark brown skin)	14 (1.0%)	1.2 (0.2%–2.1%)	4 (0.7%)	2.1 (0.0%–4.9%)	1 (0.3%)	0.4 (0.0%–1.3%)	19 (0.8%)	1.5 (0.0%–3.0%)
Very dark (very dark brown to black)	3 (0.2%)	0.3 (0.0%–0.7%)	–	–	3 (0.8%)	2.5 (0.0%–5.9%)	6 (0.3%)	0.6 (0.0%–1.3%)
(Missing)	9 (0.6%)	0.3 (0.1%–0.6%)	8 (1.4%)	0.9 (0.0%–1.9%)	2 (0.6%)	0.1 (0.0%–0.3%)	19 (0.8%)	0.6 (0.1%–1.1%)
After several months of not being in the sun very much, if you went out in the sun for an hour without sunscreen, a hat, or protective clothing, which of the following best describes what would happen to your skin?								
Get a severe sunburn with blisters	61 (4.3%)	4.3 (2.7%–5.8%)	18 (3.2%)	2.1 (0.0%–4.3%)	22 (6.2%)	3.9 (1.6%–6.2%)	101 (4.3%)	3.1 (1.8%–4.4%)
Have a moderate sunburn with peeling	403 (28.7%)	29.4 (25.8%–33.0%)	148 (26.0%)	28.3 (21.7%–34.9%)	121 (34.3%)	37.1 (26.7%–47.5%)	672 (28.9%)	30.5 (26.4%–34.6%)
Burn mildly with little darkening or tanning	552 (39.3%)	37.5 (33.1%–41.8%)	256 (44.9%)	41.9 (34.8%–49.0%)	134 (38.0%)	36.8 (28.7%–45.0%)	942 (40.5%)	39.6 (35.5%–43.7%)
Turn darker without sunburn	315 (22.5%)	23.4 (19.6%–27.3%)	112 (19.6%)	20.8 (15.1%–26.5%)	56 (15.9%)	16.7 (9.4%–24.0%)	483 (20.8%)	20.6 (17.3%–24.0%)

(Continues)

TABLE 3 (Continued)

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
Nothing would happen to my skin	60 (4.3%)	4.6 (2.7%–6.6%)	34 (6.0%)	6.7 (3.9%–9.5%)	16 (4.5%)	5.0 (1.2%–8.7%)	110 (4.7%)	5.8 (4.0%–7.5%)
(Missing)	12 (0.9%)	0.8 (0.2%–1.4%)	2 (0.4%)	0.2 (0.0%–0.4%)	4 (1.1%)	0.5 (0.0%–1.1%)	18 (0.8%)	0.4 (0.2%–0.7%)
Best represents natural hair color at age 18								
Blonde	233 (16.6%)	12.8 (10.3%–15.3%)	87 (15.3%)	12.2 (8.3%–16.0%)	76 (21.5%)	17.7 (10.1%–25.2%)	396 (17.0%)	13.5 (11.0%–16.0%)
Strawberry blonde	83 (5.9%)	5.4 (3.8%–7.0%)	33 (5.8%)	5.4 (2.8%–8.0%)	24 (6.8%)	7.7 (3.7%–11.7%)	140 (6.0%)	5.9 (4.2%–7.6%)
Red	29 (2.1%)	1.9 (0.8%–2.9%)	13 (2.3%)	2.5 (0.4%–4.7%)	7 (2.0%)	1.0 (0.0%–2.2%)	49 (2.1%)	2.0 (0.9%–3.2%)
Auburn	75 (5.3%)	4.5 (3.1%–5.9%)	23 (4.0%)	4.7 (2.1%–7.4%)	16 (4.5%)	2.0 (0.9%–3.1%)	114 (4.9%)	4.1 (2.7%–5.5%)
Light brown	446 (31.8%)	29.9 (26.5%–33.3%)	193 (33.9%)	28.1 (23.5%–32.7%)	131 (37.1%)	38.6 (31.4%–45.9%)	770 (33.1%)	30.8 (27.8%–33.9%)
Dark brown	445 (31.7%)	36.2 (32.0%–40.4%)	173 (30.4%)	30.8 (25.4%–36.2%)	83 (23.5%)	23.5 (18.5%–28.6%)	701 (30.1%)	30.7 (27.5%–34.0%)
Black	74 (5.3%)	8.7 (5.3%–12.1%)	45 (7.9%)	15.9 (9.1%–22.8%)	14 (4.0%)	9.3 (4.4%–14.2%)	133 (5.7%)	12.5 (8.8%–16.2%)
(Missing)	18 (1.3%)	0.7 (0.3%–1.1%)	3 (0.5%)	0.3 (0.0%–0.8%)	2 (0.6%)	0.2 (0.0%–0.5%)	23 (1.0%)	0.4 (0.1%–0.7%)

knowledge and higher levels of confidence in performing SSE (i.e., self-efficacy) had the strongest associations with the performance of SSE, suggesting that interventions that improve knowledge and self-efficacy may increase the frequency of SSE and earlier detection of melanoma. This implication of our findings is consistent with the robust theory and evidence across domains relating knowledge and self-efficacy to behavior change in the performance of health and other psychosocial behaviors (Arlinghaus & Johnston, 2018; Westmaas et al., 2007).

Our study confirmed previous findings regarding the association of knowledge and confidence with higher reported SSE performance. In a 2002 study, melanoma knowledge and confidence in SSE performance were identified as significant predictors of high-risk individuals' actual performance of SSE (Robinson et al., 2002). Similarly, a 2012 multinational study also demonstrated that confidence in one's ability to perform SSE was a major factor in engagement in SSE (Kasparian et al., 2012). Our survey revealed the population possesses suboptimal melanoma knowledge levels, with 78.8% at "low" or "medium" levels of knowledge, as well as low self-efficacy levels overall, with only 7.3% reporting they were "very confident" in performing SSE.

4.2 | Correlation between risk factors and SSE performance

Respondents' self-reporting of risk factors (including skin UVR vulnerability and light hair color) was associated with higher melanoma knowledge and increased performance of SSE. Similarly, in multivariable analysis adjusting for knowledge and confidence, personal history of melanoma was strongly associated with performance of SSE. These findings make intuitive sense given that those whose skin is more vulnerable to burning might be more likely to learn about skin cancer and more vigilant of their skin in general. However, the risk factor association does not completely explain differences observed in performance of SSE. Interestingly, neither self-reporting of risk factors nor belief in the benefits of SSE was associated with confidence in conducting SSE. This suggests a gap exists between respondents' understanding that they should monitor their skin and their belief that they *can* successfully do so. Together, these findings suggest that interventions focused on increasing both knowledge and self-efficacy in the population would be beneficial.

4.3 | Increasing SSE through knowledge and confidence may decrease mortality

SSE has been promoted for years by the American Academy of Dermatology and the American Cancer Society as a promising way to potentially reduce morbidity and mortality of skin cancer and melanoma (American Academy of Dermatology, 2022; American Cancer Society, 2017). It is known that skin self-awareness and regular SSE performance are strongly related to decreased tumor thickness

TABLE 4 Skin/melanoma awareness–Population survey.

	Oregon		Washington		Utah		Total	
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)
Do you ever think about whether there are any changes to your skin or whether there are any abnormal marks on your skin?								
Yes	1138 (81.1%)	77.4 (74.0%–80.7%)	457 (80.2%)	71.7 (64.1%–79.4%)	282 (79.9%)	79.0 (72.2%–85.8%)	1877 (80.7%)	74.8 (70.6%–79.1%)
No	202 (14.4%)	19.1 (15.5%–22.6%)	90 (15.8%)	25.8 (17.9%–33.7%)	52 (14.7%)	18.1 (11.8%–24.4%)	344 (14.8%)	22.3 (18.1%–26.6%)
(Missing)	63 (4.5%)	3.6 (2.3%–4.9%)	23 (4.0%)	2.5 (0.9%–4.0%)	19 (5.4%)	2.9 (1.1%–4.7%)	105 (4.5%)	2.9 (2.0%–3.8%)
Have you ever seen a media advertisement about melanoma?								
Yes	758 (54.0%)	51.4 (47.3%–55.5%)	305 (53.5%)	49.4 (42.8%–56.0%)	190 (53.8%)	56.3 (49.3%–63.3%)	1253 (53.9%)	51.4 (47.5%–55.3%)
No	358 (25.5%)	27.5 (23.4%–31.5%)	164 (28.8%)	33.5 (26.6%–40.4%)	81 (22.9%)	26.3 (20.2%–32.5%)	603 (25.9%)	30.3 (26.5%–34.1%)
I am not sure	275 (19.6%)	20.2 (17.3%–23.1%)	100 (17.5%)	17.1 (12.6%–21.6%)	79 (22.4%)	15.5 (12.0%–19.0%)	454 (19.5%)	17.6 (15.0%–20.2%)
(Missing)	12 (0.9%)	1.0 (0.1%–1.8%)	1 (0.2%)	0.0 (0.0%–0.1%)	3 (0.8%)	1.9 (0.0%–4.9%)	16 (0.7%)	0.7 (0.0%–1.4%)
Have you ever looked online for information about melanoma?								
Yes	443 (31.6%)	32.6 (28.4%–36.8%)	170 (29.8%)	28.5 (23.2%–33.8%)	102 (28.9%)	34.2 (25.0%–43.4%)	715 (30.7%)	30.8 (27.2%–34.4%)
No	915 (65.2%)	63.7 (59.7%–67.6%)	386 (67.7%)	69.3 (63.9%–74.8%)	232 (65.7%)	60.6 (50.8%–70.4%)	1533 (65.9%)	65.9 (62.2%–69.7%)
I am not sure	31 (2.2%)	2.6 (0.8%–4.4%)	12 (2.1%)	1.8 (0.6%–3.1%)	13 (3.7%)	2.8 (1.0%–4.5%)	56 (2.4%)	2.3 (1.4%–3.2%)
(Missing)	14 (1.0%)	1.1 (0.2%–2.0%)	2 (0.4%)	0.3 (0.0%–0.9%)	6 (1.7%)	2.4 (0.0%–5.4%)	22 (0.9%)	1.0 (0.3%–1.8%)

TABLE 5 Skin exam behavior, self-efficacy (confidence) and melanoma knowledge–Population survey.

	Oregon		Washington		Utah		Total		p-value
	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	# Respondents (unwt %)	Wtd population % (95% CI)	
Have you or a partner ever examined your skin for signs of skin cancer?									0.519
No	344 (24.5%)	31.2% (26.7%–35.8%)	154 (27.0%)	34.3% (28.2%–40.3%)	80 (22.7%)	28.7% (20.5%–36.9%)	578 (24.8%)	32.2% (28.8%–35.7%)	
Yes, within the last 2 months	417 (29.7%)	26.9% (23.3%–30.5%)	157 (27.5%)	22.3% (17.1%–27.5%)	118 (33.4%)	27.3% (20.0%–34.7%)	692 (29.8%)	24.6% (21.6%–27.7%)	
Yes, between 2 months and 1 year ago	416 (29.7%)	24.9% (21.4%–28.5%)	152 (26.7%)	23.1% (17.2%–28.9%)	97 (27.5%)	27.1% (20.7%–33.4%)	665 (28.6%)	24.4% (21.0%–27.9%)	
Yes, more than 1 year ago	179 (12.8%)	12.7% (10.5%–15.0%)	86 (15.1%)	15.2% (10.5%–20.0%)	42 (11.9%)	11.8% (7.4%–16.2%)	307 (13.2%)	13.8% (11.2%–16.4%)	
I am not sure	42 (3.0%)	4.0% (2.0%–6.0%)	19 (3.3%)	4.9% (1.0%–8.7%)	15 (4.2%)	5.0% (2.3%–7.7%)	76 (3.3%)	4.7% (2.6%–6.7%)	
(Missing)	5 (0.4%)	0.2% (0.0%–0.4%)	2 (0.4%)	0.3% (0.0%–0.8%)	1 (0.3%)	0.1% (0.0%–0.2%)	8 (0.3%)	0.2% (0.0%–0.5%)	
How confident are you that you are able to check your skin for signs of skin cancer?									0.759
Not at all confident	157 (11.2%)	14.9 (11.5%–18.3%)	62 (10.9%)	14.2 (9.8%–18.6%)	42 (11.9%)	12.8 (6.7%–19.0%)	261 (11.2%)	14.1 (11.5%–16.7%)	
Not very confident	499 (35.6%)	36.7 (32.6%–40.8%)	209 (36.7%)	40.7 (35.2%–46.3%)	118 (33.4%)	40.7 (33.7%–47.7%)	826 (35.5%)	39.6 (36.2%–43.0%)	
Fairly confident	625 (44.5%)	40.2 (35.8%–44.6%)	243 (42.6%)	37.0 (31.7%–42.3%)	166 (47.0%)	39.1 (32.2%–46.0%)	1034 (44.5%)	38.3 (35.1%–41.6%)	
Very confident	110 (7.8%)	7.4 (5.1%–9.7%)	56 (9.8%)	8.1 (4.9%–11.3%)	24 (6.8%)	5.5 (2.6%–8.4%)	190 (8.2%)	7.3 (5.5%–9.2%)	
(Missing)	12 (0.9%)	0.8 (0.0%–1.7%)	–	–	3 (0.8%)	1.9 (0.0%–4.9%)	15 (0.6%)	0.6 (0.0%–1.3%)	
Melanoma knowledge									0.181
Low	474 (33.8%)	37.8 (33.7%–42.0%)	197 (34.6%)	41.9 (35.0%–48.7%)	116 (32.9%)	34.4 (27.5%–41.2%)	787 (33.8%)	39.1 (35.2%–43.1%)	
Medium	590 (42.1%)	40.3 (36.4%–44.2%)	250 (43.9%)	39.5 (33.7%–45.3%)	145 (41.1%)	39.2 (32.3%–46.1%)	985 (42.3%)	39.7 (36.1%–43.2%)	
High	339 (24.2%)	21.9 (18.3%–25.4%)	123 (21.6%)	18.7 (14.2%–23.1%)	92 (26.1%)	26.5 (19.3%–33.6%)	554 (23.8%)	21.2 (18.2%–24.2%)	
Believe checking skin for signs of skin cancer will help detect skin cancer in its early stages.									0.141
Strongly disagree	134 (9.6%)	10.7 (8.5%–13.0%)	41 (7.2%)	6.0 (3.6%–8.4%)	38 (10.8%)	7.4 (3.9%–10.9%)	213 (9.2%)	7.6 (6.0%–9.2%)	
Somewhat disagree	35 (2.5%)	3.6 (1.7%–5.5%)	20 (3.5%)	3.9 (1.8%–5.9%)	9 (2.5%)	2.1 (0.4%–3.7%)	64 (2.8%)	3.4 (2.2%–4.6%)	
Somewhat agree	352 (25.1%)	26.2 (22.8%–29.6%)	136 (23.9%)	25.2 (19.3%–31.1%)	100 (28.3%)	32.4 (26.3%–38.4%)	588 (25.3%)	27.0 (23.6%–30.4%)	
Strongly agree	829 (59.1%)	56.0 (52.2%–59.7%)	352 (61.8%)	60.1 (54.7%–65.6%)	184 (52.1%)	54.6 (47.4%–61.8%)	1365 (58.7%)	57.8 (54.5%–61.2%)	
I am not sure	46 (3.3%)	3.0 (1.7%–4.3%)	20 (3.5%)	4.5 (1.8%–7.2%)	20 (5.7%)	1.9 (0.9%–2.9%)	86 (3.7%)	3.5 (2.1%–5.0%)	
(Missing)	7 (0.5%)	0.5 (0.0%–1.3%)	1 (0.2%)	0.2 (0.0%–0.7%)	2 (0.6%)	1.6 (0.0%–4.6%)	10 (0.4%)	0.6 (0.0%–1.3%)	

Gender
Female — 24%
Male — 19

Age
< 18 - 29 years — 18
30 - 39 years — 23
40 - 49 years — 15
50 - 59 years — 27
60 - 69 years — 28
70+ years — 19

Highest level of education completed
Some high school, diploma, or equivalent — 14
Some college — 16
Vocational training or 2-year degree — 25
A 4-year college degree or more — 24

Household income
Less than $35,000 — 14
$35,000 to $74,999 — 20
$75,000 or more — 26
Prefer not to answer — 23

Urban / rural
Urban — 22
Rural — 21

UVR vulnerability
No sunburn or nothing would happen — 14
Burn with some darkening or tanning — 23
Sunburn with blisters or peeling — 25

Color of hair
Blonde / Strawberry Blonde / Red — 28
Auburn / Light Brown — 23

Percentages are those that have high knowledge of melanoma and the risks and warnings signs.
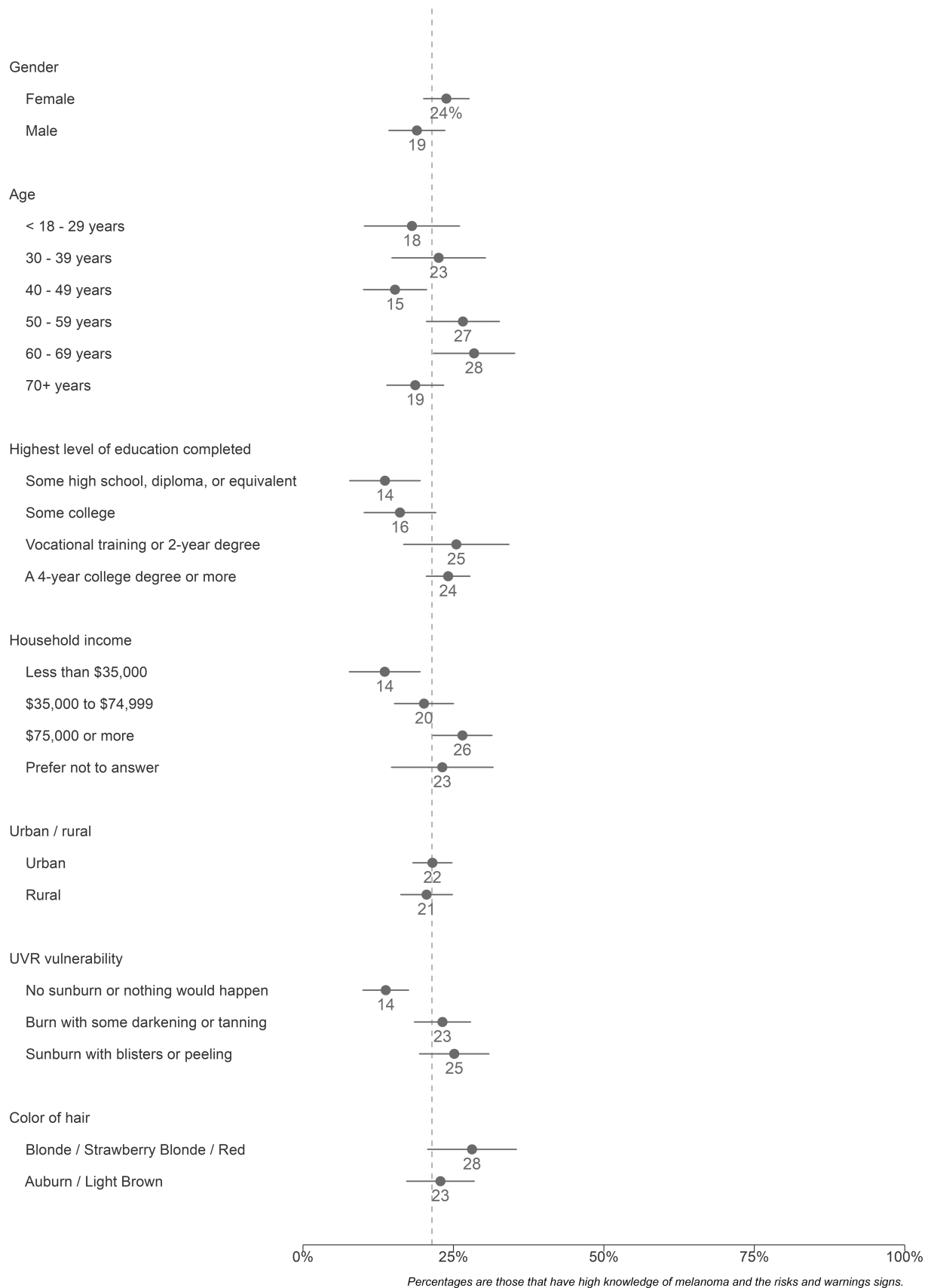
FIGURE 1 Percentage scoring high on melanoma literacy items. Percentage of high scores (at least 20/24 correct) stratified by respondent characteristics. The blue dashed line represents the proportion of high knowledge for all respondents (population-weighted, 21.4%). The blue circles indicate the proportion for each subgroup, with 95% confidence intervals.
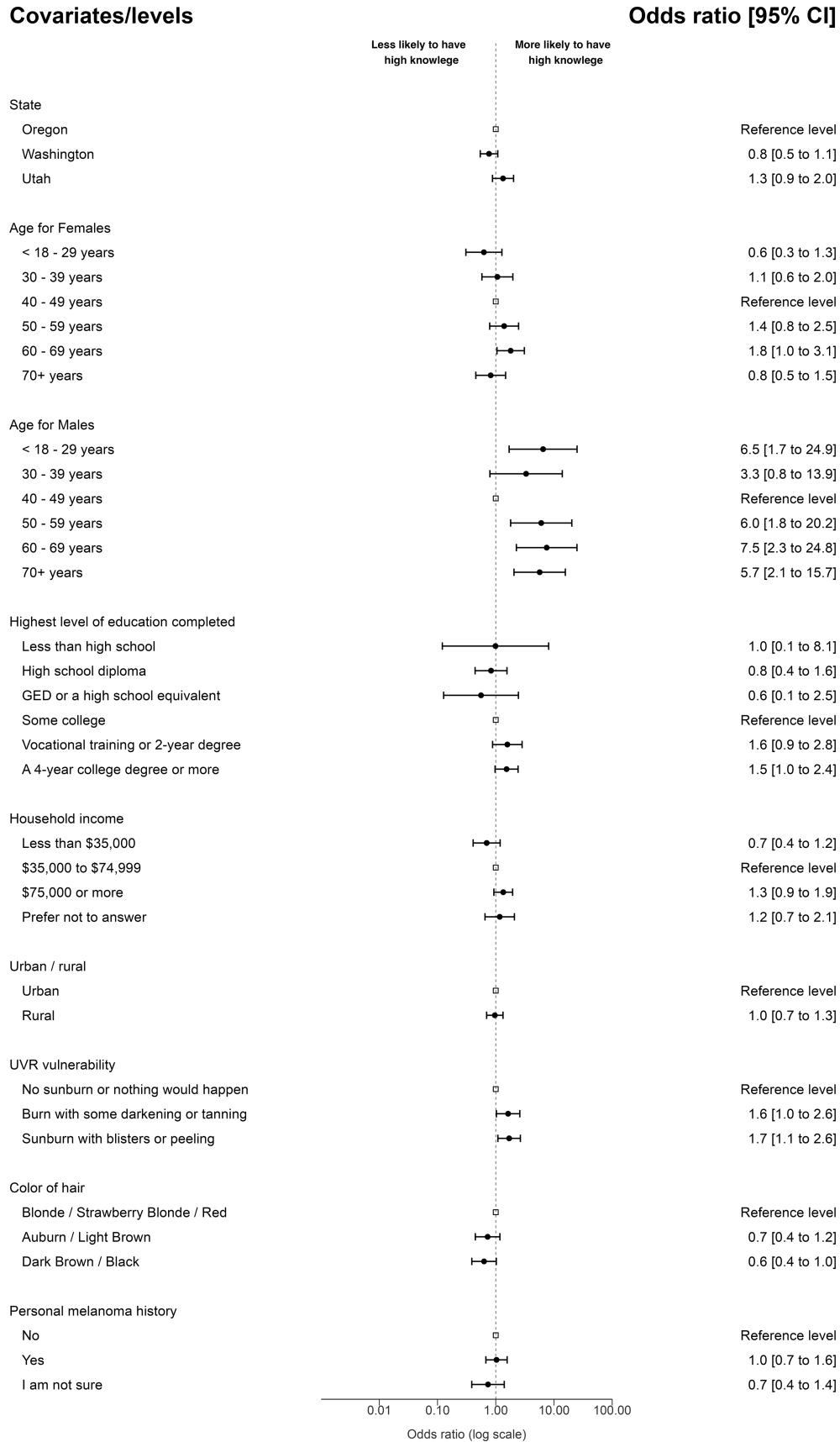
Covariates/levels

Odds ratio [95% CI]

Less likely to have high knowlege / More likely to have high knowlege

State
Oregon — Reference level
Washington — 0.8 [0.5 to 1.1]
Utah — 1.3 [0.9 to 2.0]

Age for Females
< 18 - 29 years — 0.6 [0.3 to 1.3]
30 - 39 years — 1.1 [0.6 to 2.0]
40 - 49 years — Reference level
50 - 59 years — 1.4 [0.8 to 2.5]
60 - 69 years — 1.8 [1.0 to 3.1]
70+ years — 0.8 [0.5 to 1.5]

Age for Males
< 18 - 29 years — 6.5 [1.7 to 24.9]
30 - 39 years — 3.3 [0.8 to 13.9]
40 - 49 years — Reference level
50 - 59 years — 6.0 [1.8 to 20.2]
60 - 69 years — 7.5 [2.3 to 24.8]
70+ years — 5.7 [2.1 to 15.7]

Highest level of education completed
Less than high school — 1.0 [0.1 to 8.1]
High school diploma — 0.8 [0.4 to 1.6]
GED or a high school equivalent — 0.6 [0.1 to 2.5]
Some college — Reference level
Vocational training or 2-year degree — 1.6 [0.9 to 2.8]
A 4-year college degree or more — 1.5 [1.0 to 2.4]

Household income
Less than $35,000 — 0.7 [0.4 to 1.2]
$35,000 to $74,999 — Reference level
$75,000 or more — 1.3 [0.9 to 1.9]
Prefer not to answer — 1.2 [0.7 to 2.1]

Urban / rural
Urban — Reference level
Rural — 1.0 [0.7 to 1.3]

UVR vulnerability
No sunburn or nothing would happen — Reference level
Burn with some darkening or tanning — 1.6 [1.0 to 2.6]
Sunburn with blisters or peeling — 1.7 [1.1 to 2.6]

Color of hair
Blonde / Strawberry Blonde / Red — Reference level
Auburn / Light Brown — 0.7 [0.4 to 1.2]
Dark Brown / Black — 0.6 [0.4 to 1.0]

Personal melanoma history
No — Reference level
Yes — 1.0 [0.7 to 1.6]
I am not sure — 0.7 [0.4 to 1.4]

0.01   0.10   1.00   10.00   100.00
Odds ratio (log scale)

FIGURE 2 Adjusted odds ratios for high melanoma knowledge among population survey respondents. Odds ratios and 95% CI estimated from a multivariable logistic regression model on binary knowledge outcome (high vs. medium/low knowledge scores) including all variables listed above plus an age-by-sex interaction term. Referent groups designated by open square. Significant covariates included as follows: age in men and sunburn with blisters or peeling.
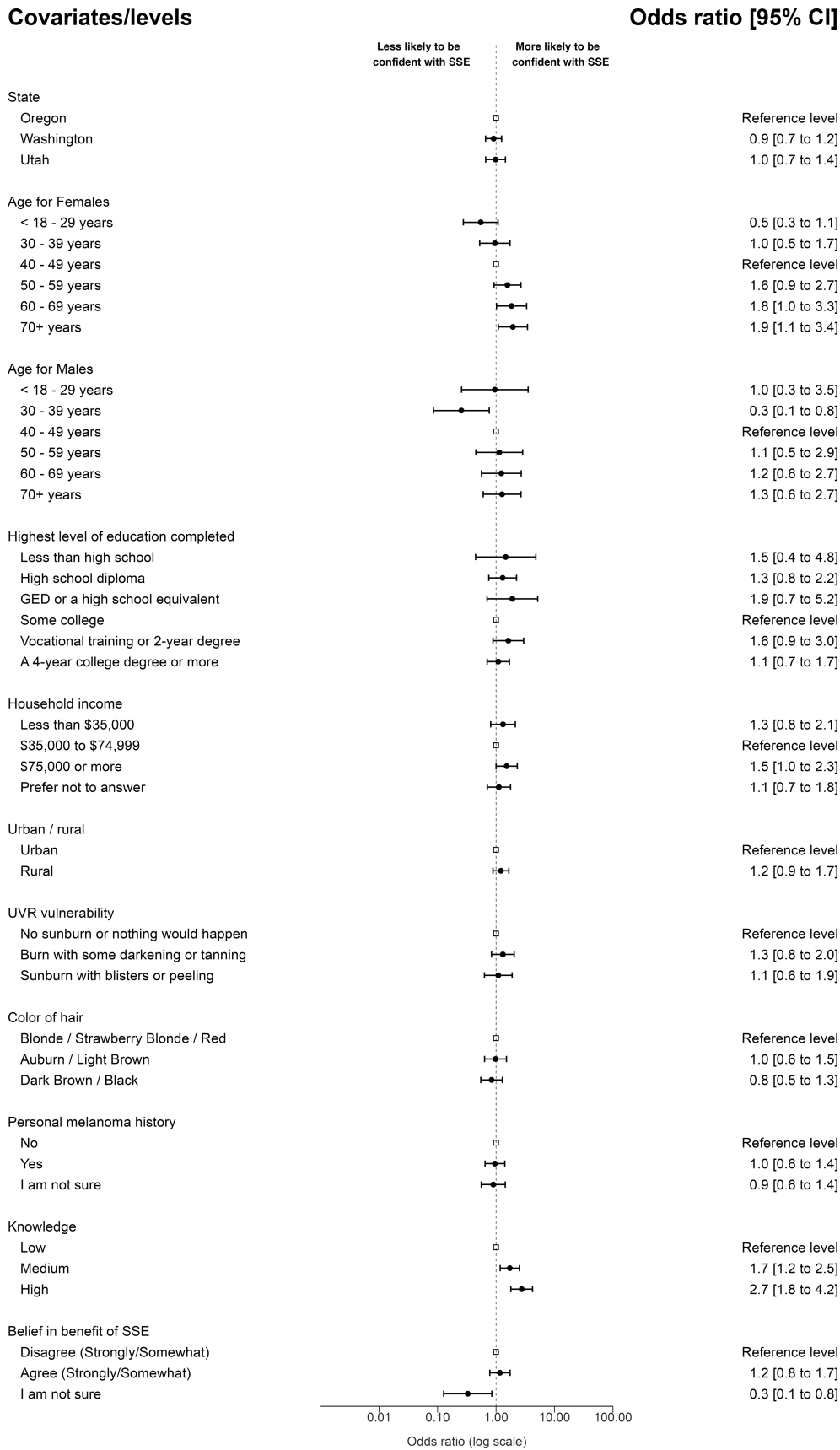
Covariates/levels

Odds ratio [95% CI]

FIGURE 3 Adjusted odds ratios of high confidence with skin self-examination (SSE), including knowledge, and personal history of melanoma. Odds ratios and 95% confidence interval estimated from a multivariable logistic regression model on binary confidence outcome (fairly/very vs. not at all/not very confident) including all variables listed above plus an age-by-sex interaction term. Referent groups designated by open square. Significant covariates included as follows: females over 70 years, medium and high knowledge levels.

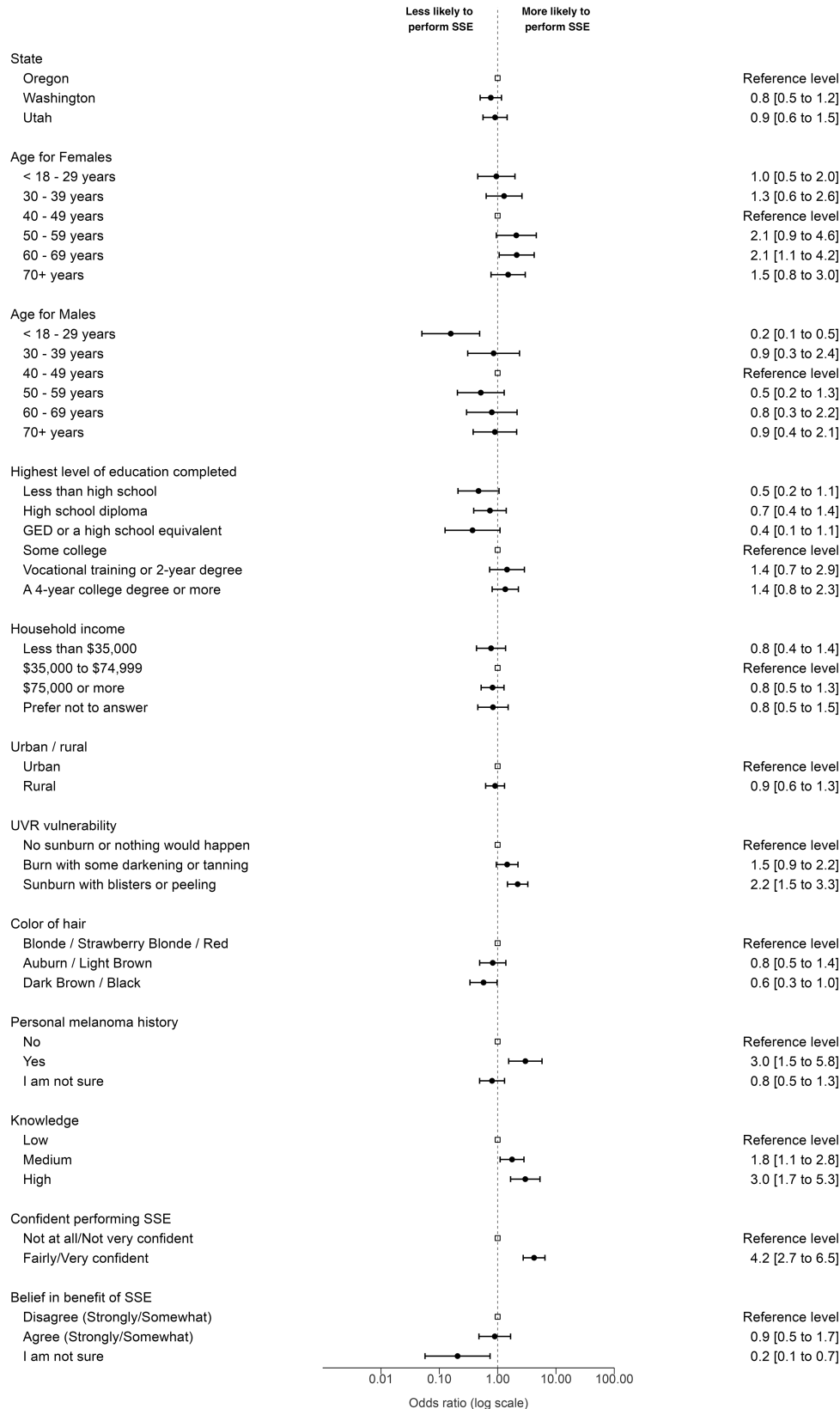## Covariates/levels

Odds ratio [95% CI]

Less likely to perform SSE   More likely to perform SSE

State
Oregon	Reference level
Washington	0.8 [0.5 to 1.2]
Utah	0.9 [0.6 to 1.5]

Age for Females
< 18 - 29 years	1.0 [0.5 to 2.0]
30 - 39 years	1.3 [0.6 to 2.6]
40 - 49 years	Reference level
50 - 59 years	2.1 [0.9 to 4.6]
60 - 69 years	2.1 [1.1 to 4.2]
70+ years	1.5 [0.8 to 3.0]

Age for Males
< 18 - 29 years	0.2 [0.1 to 0.5]
30 - 39 years	0.9 [0.3 to 2.4]
40 - 49 years	Reference level
50 - 59 years	0.5 [0.2 to 1.3]
60 - 69 years	0.8 [0.3 to 2.2]
70+ years	0.9 [0.4 to 2.1]

Highest level of education completed
Less than high school	0.5 [0.2 to 1.1]
High school diploma	0.7 [0.4 to 1.4]
GED or a high school equivalent	0.4 [0.1 to 1.1]
Some college	Reference level
Vocational training or 2-year degree	1.4 [0.7 to 2.9]
A 4-year college degree or more	1.4 [0.8 to 2.3]

Household income
Less than $35,000	0.8 [0.4 to 1.4]
$35,000 to $74,999	Reference level
$75,000 or more	0.8 [0.5 to 1.3]
Prefer not to answer	0.8 [0.5 to 1.5]

Urban / rural
| Urban | Reference level |
| Rural | 0.9 [0.6 to 1.3] |

UVR vulnerability
No sunburn or nothing would happen	Reference level
Burn with some darkening or tanning	1.5 [0.9 to 2.2]
Sunburn with blisters or peeling	2.2 [1.5 to 3.3]

Color of hair
Blonde / Strawberry Blonde / Red	Reference level
Auburn / Light Brown	0.8 [0.5 to 1.4]
Dark Brown / Black	0.6 [0.3 to 1.0]

Personal melanoma history
No	Reference level
Yes	3.0 [1.5 to 5.8]
I am not sure	0.8 [0.5 to 1.3]

Knowledge
Low	Reference level
Medium	1.8 [1.1 to 2.8]
High	3.0 [1.7 to 5.3]

Confident performing SSE
| Not at all/Not very confident | Reference level |
| Fairly/Very confident | 4.2 [2.7 to 6.5] |

Belief in benefit of SSE
Disagree (Strongly/Somewhat)	Reference level
Agree (Strongly/Somewhat)	0.9 [0.5 to 1.7]
I am not sure	0.2 [0.1 to 0.7]

0.01   0.10   1.00   10.00   100.00

Odds ratio (log scale)

FIGURE 4 Adjusted odds ratios of performing skin self-examination (SSE), including knowledge, confidence, and personal history of melanoma. Odds ratios and 95% CI estimated from a multivariable logistic regression model on binary SSE performance outcome (performing vs. not performing) including all variables listed above plus an age-by-sex interaction term. Referent groups designated by open square. Significant covariates included as follows: females aged 60–69 years, sunburn with peeling or blistering, medium or high knowledge levels, personal history of melanoma, and being "fairly" or "very" confident in performing SSE.

at diagnosis and improved survival (Aitken et al., 2010; Berwick et al., 1996; Nagore et al., 2001; Paddock et al., 2016; Torrecilla-Martínez et al., 2021).

We believe there is great potential to increase the rate of SSE by implementing a state-wide, education-based, public health campaign aimed at increasing melanoma knowledge and strengthening confidence in the ability to carry out SSE, with the goal to increase SSE rates within the target population. These survey data reveal the baseline level of knowledge, self-efficacy, and SSE prior to intervention and will permit an assessment of impact in these areas by a future educational campaign (Nelson et al., 2022).

5 | LIMITATIONS

This study is subject to well-known limitations that pertain to any population-based survey. Our respondents represented a small proportion of invited households, and the returned surveys tended to come from older female respondents. The sampling design, strategies to adjust for non-response, and raking procedure allowed us to weight responses to more accurately represent the populations of the three states involved, but we cannot discount the possibility that the respondents may have represented a more aware population subset with higher rates of SSE performance. There are also no reliable data available for comparison on hair pigment prevalence in the US population, or for personal history of melanoma in a survey of this type. Constraints on survey length meant that some key constructs, including self-efficacy, were assessed using simplified and/or few survey items. Future efforts should measure these constructs in more detail to confirm and clarify the strength, boundary conditions, and nuances of our findings.

6 | FUTURE DIRECTIONS

These data support the rationale for a statewide public education intervention (in Oregon compared to two non-interventional states). Our data also serves as a baseline from which the success of that campaign can be determined. We predict that a public education campaign will improve melanoma literacy and confidence in conducting SSE, which in turn will improve melanoma prognostic indicators, including incidence, mortality, and/or costs of melanoma care that occur during the same time period. Additionally, the consistency and completeness of SSE performance requires further investigation.

7 | CONCLUSIONS

This study's findings provide evidence that greater knowledge and self-efficacy are robustly associated with greater self-reported SSE performance in Oregon, Washington, and Utah. In consonance with the existing literature, our findings suggest that a population-wide education campaign that successfully improves confidence to perform SSE and addresses melanoma knowledge deficits (thus improving melanoma literacy) has the potential to increase the rate of SSE performance and thereby make an impact on melanoma mortality.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data associated with this article will be made available for any purpose to researchers whose use of the data has been approved. To request data, email Dr. Sancy A. Leachman at leachmas@ohsu.edu.

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SUPPORTING INFORMATION

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