Racial and ethnic differences in reproductive knowledge and awareness among women in the United States

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Objective: To evaluate if knowledge and awareness of concepts and concerns pertaining to reproductive health and fertility vary by race/ethnicity among reproductive-aged women in the United States.

Methods: A 2013 cross-sectional web-based survey assessed reproductive health-related knowledge, awareness, and perceptions of 1,000 women (18–40 years). Multivariable logistic regression analyses, adjusting for age, education, income, marital status, employment, region, and pregnancy history, examined the association between race/ethnicity and subfertility-related risk factor awareness; knowledge of factors that may affect pregnancy susceptibility; and future fertility-related concerns.

Results: Knowledge and awareness related to reproductive wellness and fertility differed by race/ethnicity in US women. Compared with Caucasians, Hispanic women were less likely to be aware of smoking-related harm to fertility (odds ratio [OR], 0.57; 95% confidence interval [CI], 0.38–0.86); African American women were more aware of the implications of sexually transmitted infections on fertility (OR, 2.13; 95% CI, 1.15–3.94); and Asian women demonstrated greater awareness of a possible relationship between dysmenorrhea and subfertility (OR, 2.05; 95% CI, 1.09–3.86). Asian women consider fertility socially taboo to talk about and a private affair that is difficult to discuss (OR, 2.63; 95% CI, 1.32–5.29 and OR, 1.99; 95% CI, 1.05–3.75, respectively), were more concerned about their future fertility (OR, 2.36; 95% CI, 1.24–4.52), and more likely to perceive a need for future fertility treatment (OR, 2.36; 95% CI, 1.18–4.71).

Conclusion: Among reproductive-aged women in the United States, knowledge, awareness, and perceptions relating to reproductive health vary by race/ethnicity. Our findings suggest race/ethnicity as potential modulators of population perceptions regarding reproductive health and infertility.

Clinical Trial Registration Number: NIH ZIA# HD008985. (Fertil Steril Rep® 2022;3:46–54. ©2022 by American Society for Reproductive Medicine.)

Key Words: Ethnicity, diversity, fertility knowledge, race, reproductive health

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I n an era of willful postponement of planned reproduction, population awareness of the determinants regarding reproductive wellbeing is important (1, 2). In recent years, efforts have focused on gaining insights into the overall awareness of reproductive facts (3–6). However, our understanding of any relevance of race and ethnicity in shaping public awareness of reproductive issues remains limited (5–9).

Health literacy is critical to a population's reproductive health (10). Women's health organizations,

https://doi.org/10.1016/j.xfre.2022.03.006

including the American Society for Reproductive Medicine and the American Congress of Obstetricians and Gynecologists, are striving to improve public awareness and understanding of the relevance of exposures (such as smoking and alcohol), extremes of age and body mass index, and gynecological conditions, including sexually transmitted infections, fibroids, and endometriosis, to health and fertility (11, 12). However, access to and utilization of informative material by reproductive-aged individuals is limited (13), with studies highlighting the need for improving cross-cultural care (14) and mitigating racial disparities in health care (15, 16). In 2020, women from ethnic and racial minority groups in the United States remained disproportionately burdened with issues relevant to women's health (17–19). Existing efforts examining the relevance of race and ethnicity for women's health are sparse, and representation of the perspectives of the multiracial and multiethnic or "diverse" US population remains disproportionately skewed (3, 7, 8, 20–23).

We previously reported on a cross-sectional web-based survey examining knowledge and attitudes relating to reproductive health among a diverse population of reproductive-aged women in the United States (3). For the present study, we analyzed the survey data to examine if knowledge, awareness, and perceptions regarding reproductive health and fertility varied by race and ethnicity among a large representative population sample of reproductive-aged women in the United States.

MATERIALS AND METHODS
Sampling and Recruitment

From March 4 to March 10, 2013, an online survey was conducted by Edelman-Berland, a market research company. We have previously published the findings among reproductive-aged women in the United States regarding the relationship between age and reproductive health and fertility knowledge, awareness, and perceptions (3). The survey was conducted online and in English only; survey sampling and web-based screening and implementation were undertaken by the marketing research company. Online invitations were sent directly to existing survey panelists who previously agreed to take part in opinion-based research. Participants who clicked on the invitation then received a set of screening questions (gender, age, region, race, and ethnicity) demographics to ensure a general representation of the reproductive-aged women in the United States (3). Interested responders provided consent by completing an online privacy statement, as previously detailed; the screened-in individuals were then invited to participate in the full survey. Survey respondents were provided compensation in the form of online "points" for their participation, which could be redeemed for cash or merchandise; no personally identifying information was collected. By design, the population sampled was generally representative of the US population, by racial and ethnic distributions and regional representation of reproductive-aged women (ages 18–40 years), consistent with the 2010 and 2012 US censuses (24, 25).

Of the 1,606 participants interested in the survey, 73 did not meet screening quota restrictions, 363 had incomplete surveys, 15 did not meet data quality standards (either potential duplicate survey or survey completion time determined to be too short), and 155 were removed randomly to ensure a final quota of 1,000 female participants, which was a balanced representative sample of race, ethnicity, and geographic region (Supplemental Fig. 1, available online).

The Yale University Human Subjects Committee institutional review board determined the study exempt from committee review because the analysis of the data was from a deidentified survey, and no personally identifying information was collected.

Population and Measures

A total of 1,000 participants comprised the final sample for analysis for this study. The demographic information collected included age, race (Caucasian, African American, Asian, American Indian or Alaskan Native, Native Hawaiian or Pacific Islander, and Other), ethnicity (Hispanic or Latino descent), geographical region of residence, education, income, marital status, employment status, and metropolitan status of residence (urban, suburban, or rural).

Race/ethnicity was categorized as follows: White or Caucasian; Black or African American; Hispanic; Asian; and Other. The "Other" category included: American Indian or Alaskan Native, Native Hawaiian or Pacific Islander, and Other race, because of small sample sizes. Analysis of race/ethnicity used White or Caucasian as the reference group.

Survey questions were formulated through a series of iterations and consensus among a team of subject matter experts on reproductive health and infertility issues (L.P.), women's health (J.L.I., L.P.), and epidemiology (L.P., J.L.I.); the overarching goal of the survey questions was to assess the prevalent state of awareness, knowledge, and perception of risk factors for fertility problems among reproductive-aged women in the United States. Individual survey questions were categorized into three primary topic areas or domains (outcomes), an approach similar to previous studies (3, 4, 6). The specified domains were: Domain 1: subfertility risk factor awareness (i.e., identification of obesity, painful menses, smoking, and sexually transmitted infections [STIs] as risk factors for decreased fertility); Domain 2: awareness of factors that may delay pregnancy susceptibility (awareness of the relevance of the fertile window during the menstrual cycle for successful conception and the understanding of age-related decline in oocyte quantity and its impact on fertility); and Domain 3: attitudes and perceived concern or "burden" about future fertility (perceptions of fertility-related issues as being stressful, socially taboo and/or private, and concerns regarding their own future fertility). Domain-specific questions and response categories are presented in Supplemental Table 1.

Individual question responses regarding subfertility risk factor awareness (Domain 1) and factors that may delay pregnancy susceptibility (Domain 2) were modeled as those responding correctly to survey items (vs. those responding incorrectly or not sure). Attitudes and perceived burden

TABLE 1

Survey participant characteristics by race/ethnicity.

Characteristics	Caucasian n (%) 731 (74.1)	Hispanic n (%) 125 (12.5)	African American n (%) 78 (7.8)	Asian n (%) 44 (4.4)	Other n (%) 22 (2.2)	P value
Age (y)						.616
18–24	108 (14.7)	23 (18.4)	18 (23.0)	9 (20.5)	5 (22.7)	
25–34	444 (60.7)	72 (57.6)	42 (53.8)	23 (52.3)	11 (50.0)	
35–40	179 (24.5)	12 (24.0)	18 (23.1)	12 (27.3)	6 (27.3)	
Education						<.001
High school or less	155 (21.2)	29 (23.8)	9 (11.7)	3 (6.8)	5 (23.8)	
Some college	299 (40.9)	46 (37.7)	35 (45.5)	8 (18.2)	8 (38.1)	
College degree/ more	227 (37.9)	47 (38.5)	33 (42.9)	33 (75.0)	8 (38.1)	
Employment						<.001
Employed full-time	265 (36.3)	42 (33.6)	29 (37.2)	24 (54.6)	6 (27.3)	
Employed part-time	116 (15.9)	22 (17.6)	12 (15.4)	6 (13.6)	4 (18.2)	
Unemployed	78 (10.7)	14 (11.2)	17 (21.8)	2 (4.6)	4 (18.2)	
Homemaker	206 (28.2)	36 (28.8)	11 (14.1)	9 (20.5)	4 (18.2)	
Student	59 (8.1)	9 (7.2)	9 (11.5)	3 (6.8)	1 (4.6)	
Retired, not answered	7 (1.0)	2 (1.6)	0 (0)	0 (0)	3 (13.6)	
Income						<.01
≤$50,000	370 (50.6)	70 (56.0)	52 (66.7)	14 (31.8)	11 (50.0)	
>$50,000	321 (43.9)	49 (39.2)	25 (32.0)	29 (65.9)	7 (31.8)	
Prefer to not answer	40 (5.5)	6 (4.8)	1 (1.3)	1 (2.3)	4 (18.2)	
Region of the Country						<.01
Northeast	141 (19.3)	22 (17.6)	11 (14.1)	6 (13.6)	5 (22.7)	
Midwest	191 (26.1)	17 (13.6)	14 (18.0)	5 (11.4)	3 (13.6)	
South	243 (33.2)	47 (37.6)	36 (46.2)	15 (34.1)	9 (40.9)	
West	156 (21.3)	39 (31.2)	17 (21.8)	18 (40.9)	156 (21.3)	
Metropolitan status						<.001
Urban	151 (20.8)	63 (53.4)	32 (41.6)	19 (43.1)	4 (22.2)	
Suburban	356 (49.1)	38 (32.2)	37 (48.0)	23 (52.3)	8 (44.4)	
Rural	218 (30.0)	17 (14.4)	8 (10.4)	2 (4.6)	6 (33.3)	
Pregnancy history						.61
Do not have children	311 (42.5)	46 (36.8)	33 (42.3)	22 (50.0)	10 (45.5)	
Have children	420 (57.5)	79 (63.2)	45 (57.7)	22 (50.0)	12 (54.5)	
Relationship status						<.01
Married	385 (53.7)	70 (56.0)	25 (56.8)	22 (28.6)	12 (57.1)	
Not married	345 (47.3)	55 (44.0)	19 (43.2)	55 (71.4)	9 (42.9)	

Note: Totals may not add up to 1,000 because of missing observations. n = number

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regarding future fertility (Domain 3) were modeled as responses of "strongly agree" or "somewhat agree" vs. "neutral," "somewhat disagree," or "strongly disagree."

To better understand the preferred reproductive health sources of information, we further examined the three top sources of "information on getting pregnant" revealed among a subgroup of respondents who reported "having" or "wanting" children (n = 855). Response options were categorized as "health providers" (such as obstetricians and gynecologists and primary care physicians); "social resources" (such as a parent, partner, and friend); and "informative material" (such as books, pregnancy websites, and smartphone apps).

Statistical Analysis

Bivariate analysis was performed to examine the association between participant characteristics and race/ethnicity using χ^2 or Fisher's exact test as appropriate. Associations between race/ethnicity and individual outcome measures within domains were evaluated using unadjusted and adjusted multivariable logistic regression. Multivariable models were adjusted for potential confounding variables, including age, education, income, region, marital status, employment, and pregnancy history. Unadjusted and adjusted odds ratio (OR) estimates and 95% confidence intervals (CI) were calculated. The association between race/ethnicity and preferred sources of reproductive health information was examined using the χ^2 or Fisher's exact test. A P value of <.05 was considered statistically significant. Statistical analyses were performed using Statistical Analysis Software 9.3 (SAS Institute, Cary, NC).

RESULTS

Participant characteristics by race and ethnicity are presented in Table 1. To create a cohort similar to the population at the time, race/ethnicity participant percentages were based on the 2010 and 2012 US censuses and; thus, resulted in 74.1% Caucasian, 12.5 % Hispanic, 7.8% African American, 4.4% Asian, and 2.2% Other. Sociodemographic characteristics varied significantly across race/ethnicity categories, including education, employment, income, relationship status, region of the country, and metropolitan status (all P values <.01). Asian women reported the highest levels of education (75%), full-time employment (55%), and income >$50,000/year (66%).

TABLE 2

Association between race/ethnicity and factors related to subfertility risk factor awareness (Domain 1).

n (%)	Obesity 740 (74.0) OR (95% CI)	Dysmenorrhea 304 (30.4) OR (95% CI)	Smoking 713 (71.3) OR (95% CI)	Sexually transmitted infection 694 (69.4) OR (95% CI)
Race/ethnicity				
Caucasian/White	REF	REF	REF	REF
Hispanic				
Unadjusted	0.86 (0.56, 1.31)	0.94 (0.62, 1.43)	0.56 (0.38, 0.83)	1.08 (0.71, 1.63)
Adjusted	0.89 (0.57, 1.39)	0.97 (0.63, 1.50)	0.57 (0.38, 0.86)	1.12 (0.74, 1.72)
African American				
Unadjusted	1.04 (0.60, 1.79)	1.07 (0.65, 1.78)	0.86 (0.51, 1.43)	1.98 (1.10, 3.55)
Adjusted	1.16 (0.66, 2.05)	1.13 (0.67, 1.91)	0.95 (0.55, 1.63)	2.13 (1.15, 3.94)
Asian				
Unadjusted	0.72 (0.37, 1.38)	2.01 (1.09, 3.72)	0.63 (0.33, 1.19)	0.82 (0.44, 1.55)
Adjusted	0.61 (0.31, 1.22)	2.05 (1.09, 3.86)	0.53 (0.28, 1.04)	0.83 (0.43, 1.60)
Other				
Unadjusted	0.48 (0.20, 1.15)	2.42 (1.03, 5.66)	0.96 (0.37, 2.48)	2.98 (0.87, 10.18)
Adjusted	0.47 (0.18, 1.24)	1.87 (0.73, 4.76)	1.02 (0.35, 2.97)	8.91 (1.18, 67.49)

Note: For all unadjusted models, n = 1,000. Adjusted models n = 986, controlling for age, income, education, employment, pregnancy history, marital status, and region.
n = number; OR = odds ratio; CI = confidence interval

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Subfertility Risk Factor Awareness (Domain 1)

Among survey respondents, the majority recognized smoking, STIs, and obesity as risk factors for subfertility; however, less than one-third were aware that dysmenorrhea might impact fertility (Table 2). After adjustment for covariates, Asian women were significantly more likely to be aware of a possible relationship between painful menses and fertility (OR, 2.05; 95% CI, 1.09–3.86) compared with the reference Caucasian population. African American women were significantly more likely to be aware of the risk of infertility associated with STIs (OR, 2.13; 95% CI, 1.15–3.94) as were women of "Other" race (OR, 8.91; 95% CI, 1.18–67.49), while Hispanic women were significantly less likely to be aware of the detrimental implications of smoking on fertility (OR, 0.57; 95% CI, 0.38–0.86) compared with Caucasian women.

Knowledge Regarding Factors That Can Impact Pregnancy Susceptibility (Domain 2)

Table 3 presents the association between race/ethnicity and factors that can affect pregnancy susceptibility (Domain 2). Over 80% of the participants recognized that advancing age increases the length of time to conceive. Hispanic respondents were significantly less likely to correctly identify the false statement: "A woman's ovaries continue to create new eggs during reproductive years," compared with Caucasian respondents (OR, 0.58; 95% CI, 0.37–0.90). Although African American respondents were less knowledgeable regarding questions about aging-related implications for reproductive success and less aware of the fertility window, none of these associations reached statistical significance (*P*>.05). Knowledge of the peak fertility window demonstrated variation by race/ethnicity and was notably low in all groups (15.9% Asian, 9.6% Hispanic, 9.3% Caucasian, and 6.4% African American; data not shown), with Asian respondents being more knowledgeable regarding the peak fertility window

compared to Caucasian respondents (OR, 2.46; 95% CI, 1.00–6.01).

Attitudes and Perceived Concerns Regarding the Potential for Future Fertility (Domain 3)

Results for respondents' attitudes and perceived burden regarding future fertility by race are presented in Table 4. Two-thirds of the respondents (64%) indicated that it was stressful to think about trying to conceive and 39% reported that trying to conceive is a private issue; one-fifth (21%) perceived that there would be a good chance they would need fertility treatment in the future.

Asian women were significantly more likely to acknowledge conversations regarding attempting conception as "socially taboo" (OR, 2.63; 95% CI, 1.32–5.29) and "a private issue" which is "difficult to discuss" (OR, 1.99; 95% CI, 1.05–3.75) compared with Caucasians. Furthermore, Asian respondents were twice as likely to experience concerns about their own future fertility potential (OR, 2.36; 95% CI, 1.24–4.52) and were significantly more likely to perceive a need for fertility treatment for future conception (OR, 2.36; 95% CI, 1.18–4.71) compared to the reference Caucasian population.

Preferred Sources of Pregnancy-Related Information

Although most respondents identified a women's health provider (obstetrician/gynecologist or midwife) as a primary source of information regarding pregnancy, statistically significant differences were observed in this category by race/ethnicity (*P*<.01; Supplemental Table 2, available online). Compared with "Other" racial/ethnic groups, Asian respondents report notably lower rates of seeking information relating to fertility and pregnancy from reproductive health care providers (75% Caucasian, 76.8% Hispanics, 83.6% African Americans, 86% "Other" vs. 47.4% Asian). Product

TABLE 3

Association between race/ethnicity and factors related to pregnancy susceptibility (Domain 2).

n (%)	Aging increases the length of time it may take to conceive (TRUE) 808 (80.8)	Intercourse within 2 days after ovulation increases the chance of pregnancy (FALSE) 92 (9.2)	A woman's ovaries continue to create new eggs during reproductive years (FALSE) 370 (37.0)
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Race/ethnicity			
Caucasian/White	REF	REF	REF
Hispanic			
Unadjusted	1.03 (0.63, 1.70)	1.04 (0.54, 1.97)	0.57 (0.38, 0.87)
Adjusted	1.15 (0.68, 1.95)	1.15 (0.59, 2.23)	0.58 (0.37, 0.90)
African American			
Unadjusted	0.64 (0.37, 1.10)	0.67 (0.26, 1.71)	0.68 (0.41, 1.12)
Adjusted	0.65 (0.37, 1.15)	0.73 (0.28, 1.92)	0.68 (0.39, 1.16)
Asian			
Unadjusted	0.86 (0.40, 1.83)	1.85 (0.79, 4.30)	0.87 (0.47, 1.64)
Adjusted	0.70 (0.32, 1.54)	2.46 (1.002, 6.01)	0.57 (0.30, 1.10)
Other			
Unadjusted	0.32 (0.13, 0.76)	NAC	0.71 (0.29, 1.77)
Adjusted	0.51 (0.18, 1.43)	NAC	0.99 (0.37, 2.64)

Note: For all unadjusted models n = 1,000. Adjusted models n = 986, controlling for age, income, education, employment, pregnancy history, marital status, and region. NAC = not able to calculate.

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branding, such as advertisements, demonstrated differences across race/ethnicity ($P<.01$); however, the number of respondents who chose this option was small (n = 14). Other information sources were not significantly associated with race/ethnicity.

DISCUSSION

Among reproductive-aged women in the United States, knowledge, awareness, and perceptions relating to reproductive health vary by race/ethnicity. Compared with Caucasians, Hispanic respondents were less likely to be aware of smoking-related harm to fertility; African Americans were more aware of the implications of STIs on fertility, and Asians demonstrated greater awareness of a possible relationship between dysmenorrhea and infertility. Additionally, Asian women had a significantly greater perceived burden around the topic of future fertility.

Previous studies regarding fertility and reproductive knowledge included limited sample sizes (4, 20). The strengths of our study included the large representative sample of the US population, which permitted statistical modeling of the primary outcomes after adjustment for potential confounders and make it generalizable to the US population regarding race/ethnicity, and geographic region among women aged 18–40 years at the time of the study. In contrast to prior studies that have often categorized Asian participants together with other racial groups (6, 8), we evaluated the Asian race as a distinct category when analyzing the association between race/ethnicity and specified domains.

Racial disparities have been described in many aspects relevant to women's health, including sexual health-related knowledge (8, 18), access to preventive women's health care (16), and knowledge of and access to family planning services (26). Others have reported reduced awareness of adverse implications of obesity and aging for fertility among African American women (6); however, no such awareness gaps were apparent in our sample. Rather, we found associations between race/ethnicity and reproductive health knowledge, awareness, and perceptions that were unique and independent of potential confounding as we performed multivariable adjustment.

Racial disparities in the burden of infertility, access to infertility services, and treatment outcomes are recognized (18). However, few studies have examined the racial differences in perceived infertility, fertility awareness, and relevance of cultural nuances for reproductive knowledge and sexuality, including an evaluation of these measures specifically among Asian Americans (5–7, 21, 22, 27). Our findings of reported hesitation among Asian women regarding discussions about fertility-related concerns are particularly meaningful, as this awareness can guide health care providers in preemptively seeking womens' perspectives and concerns regarding culturally sensitive topics. Further, our findings underscore concepts, including cultural competency, effective communication, and utilization of interpreters as essential for optimal health care delivery (14).

Previous international research regarding fertility knowledge and beliefs also examined specific topic domains related to conception and fertility, defined by indicators for reduced fertility, misconceptions about fertility, and basic facts about fertility (27); fertility knowledge was primarily linked to sociodemographic factors (including education, employment, country development index). In our population, the observed associations between race and ethnicity and knowledge related to reproductive facts were independent of

TABLE 4

Association between race/ethnicity with attitudes and perceived concern about future fertility (Domain 3).

n (%)	When trying to have a family, it's stressful to think about getting pregnant[a,c] 644 (64.4) OR (95% CI)	It's socially taboo to talk about trying to get pregnant[a,c] 271 (27.1) OR (95% CI)	If I were trying, I would be concerned about my ability to get pregnant[b,d] 369 (39.5) OR (95% CI)	If I were trying, I think there is a good chance I would need to seek fertility treatment[b,d] 197 (21.1) OR (95% CI)	Trying to get pregnant is a private issue that is difficult to discuss[a,c] 391 (39.1) OR (95% CI)
Race/ethnicity					
Caucasian/White	REF	REF	REF	REF	REF
Hispanic					
Unadjusted	0.89 (0.60, 1.32)	1.46 (0.90, 2.37)	1.34 (0.90, 1.99)	1.03 (0.64, 1.66)	0.80 (0.54, 1.19)
Adjusted	0.90 (0.60, 1.35)	1.29 (0.78, 2.16)	1.40 (0.93, 2.11)	0.99 (0.60, 1.65)	0.80 (0.53, 1.20)
African American					
Unadjusted	1.01 (0.62, 1.66)	1.63 (0.91, 2.89)	0.99 (0.61, 1.64)	0.52 (0.25, 1.06)	0.86 (0.53, 1.39)
Adjusted	1.20 (0.71, 2.01)	1.73 (0.94, 3.19)	0.99 (0.59, 1.67)	0.54 (0.26, 1.13)	0.89 (0.53, 1.48)
Asian					
Unadjusted	0.94 (0.50, 1.78)	3.02 (1.57, 5.81)	2.33 (1.25, 4.35)	2.03 (1.06, 3.90)	2.21 (1.19, 4.10)
Adjusted	0.92 (0.48, 1.78)	2.63 (1.32, 5.29)	2.36 (1.24, 4.52)	2.36 (1.18, 4.71)	1.99 (1.05, 3.75)
Other					
Unadjusted	0.65 (0.28, 1.52)	0.58 (0.13, 2.53)	1.86 (0.75, 4.65)	1.75 (0.65, 4.68)	0.45 (0.16, 1.23)
Adjusted	0.74 (0.29, 1.91)	0.63 (0.14, 2.80)	1.59 (0.58, 4.38)	1.76 (0.59, 5.31)	0.53 (0.19, 1.49)

Note: Response of strongly agree or somewhat agree (vs. neutral, somewhat disagree, strongly disagree). For unadjusted models:
[a] n = 1,000
[b] n = 934 individuals not currently pregnant. Adjusted models
[c] n = 98
[d] n = 920 individuals not currently pregnant; controlling for age, income, education, employment, pregnancy history, marital status, and region.

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socioeconomic status. Similar to our findings, one study also noted racial/ethnic differences in sexual literacy (8); however, their cohort was categorized differently from ours, grouping Asian and Others together and separating more distinct Hispanic ethnicity groups: non-Hispanic White, non-Hispanic Black, foreign-born Hispanic, and native-born Hispanic. Additionally, knowledge deficits regarding the peak fertile window have been shown to be prevalent across all races in prior studies (5).

There are limitations to this study. First, our survey was not validated; however, observed racial disparities in the awareness and knowledge of reproductive health-related information are consistent with previous literature, reassuring both the contents and construct validity (4–7, 20–22, 26). Additionally, our data are cross-sectional; thus, we are unable to draw conclusions regarding causality. The survey did not collect detailed information regarding menstrual cycle history, fertility history, seeking fertility treatment, and/or clinical diagnosis of infertility or subfertility, which would be informative for future studies. Additionally, the survey was conducted in 2013 and; therefore, may not be representative of the responses today because of shifts in population demographics and internet access; however, cultural influences are likely to be similar and present. Overall, the racial and ethnic makeup of the United States has changed since the time when the survey was conducted (28, 29), and the current census has the ethnicity of Hispanic/Latino as a separate category which started in 2018, whereas before, it was together with race. Therefore, total percentages of race currently do not include Hispanics as a category. Additionally, from 2010 to 2020, the "White alone" population has decreased by 8.6%, and the "multiracial" population has increased by 276%, from 9 million to 33.8 million (29). Our data did not have "multiracial" as an option, although individuals may have chosen "Other" or picked the race they identify with more. Recent US 2019 demographic statistics among women aged 15–44 years report race as 73.0% White, 15.1% African American, 7.1% Asian, 1.7% American Indian/Alaskan/Hawaiian/Pacific Islander combined, 3.1% two or more races, and ethnicity as 21.1% Hispanic and 78.9 % non-Hispanic (30). Although similar trends in race and ethnicity across the United States may still remain today, these changes in demographics are difficult to compare to our cohort where ethnicity and race were combined and, therefore, may not necessarily be completely reflective of today's population.

Our study provided a diverse sample with opportunities to evaluate specific racial and ethnic groups. Sub-category information on the Hispanic and Asian familial country of origin (i.e., Japanese, Chinese, Korean) was collected, but the numbers per country were too small for sub-analyses. Country of birth (United States vs. foreign-born) or length of residency in the United States was also not available, which may have influenced our findings. Because race is not monolithic, there are likely cultural differences within subgroups that have ancestry from various national origins, and it is difficult to isolate those nuances.

We recognize that our study is reflective of the race/ethnicity and region population statistics of 2012–2013 among reproductive-aged women in the United States, which is a limitation that merits acknowledgment. Although we collected information regarding income, education, and employment in the survey, these measures were not used in the sampling methodology of the cohort; therefore, we cannot ensure an overall representation of the socioeconomic status among women in the United States aged 18–40 years. Further, we did not include an assessment of variables, including insurance coverage (5), previous sexual education, cultural background (22), and religious affiliations (31). Additionally, not all persons who can bear children identify as female; this survey was conducted among individuals who self-identified as female; the study design thus did not allow us to determine if there was a representation of non-binary or transgender individuals.

The online survey only being available in English is another limitation, as incorrect responses to survey questions may have resulted from deficiencies in literacy and comprehension rather than from deficits in knowledge. This survey did not assess if English was the participant's first language, which may also have impacted participants' responses and is a potential bias. Our observations of racial and ethnic differences in knowledge may suggest the importance of using translation tools in future studies and ensuring that accurate multilingual reproductive health information and resources are available and accessible to non-English speaking populations.

Finally, internet access, engagement with social media, and the use of health-related smartphone apps (32) can provide opportunities for the wider dissemination of information on reproductive health in the public domain. Although our survey reported the use of technology-based information sources as 28%–50% for pregnancy-focused websites, 26%–40% for medical websites, and 5%–18% for pregnancy smartphone apps, current utilization is likely higher given the increased usage of smartphones and the increased rates of internet access from 74% in 2013 to 85% in 2018 (33, 34). Computer and smartphone access and usage were less during our survey administration in 2013 than they are now; therefore, at the time, those without consistent internet access may have been excluded from participation in our online survey.

Our observations underscore a need for the broader participation of family, educators, community, health providers, and health care systems in the efforts aimed at enhancing population awareness of reproductive wellness-related information. In the United States, less than half of all States require sex education within the curricula of public schools (35). It is interesting that the Asian participants in our study had a higher level of formal education and income, but did not display a higher level of fertility knowledge for most questions. Therefore, given the gaps in knowledge seen across all racial/ethnic groups, more specific reproductive education is needed.

Racial and ethnic differences in cultural perspectives and ease of communication on issues related to sex, gender, sexuality, fertility, and disparities in formal sex education are recognized (8, 36). Increasing translator support and multilingual reproductive health education materials continuously need improvement. On the whole, it is important to be inclusive and analyze the multiple race/ethnic groups in addition

to the predominant three: Caucasian, African American, and Hispanic. Assessment of race and ethnicity should further encompass the assessment of individuals identifying as Asian, Middle-eastern, two or more races, as well as by reported countries of origin and should also be recognized when addressing diversity.

CONCLUSION

Overall, we identified racial and ethnic differences in reproductive health knowledge, awareness, and perceptions related to reproduction and fertility. These findings were independent of other sociodemographic factors, including education, income, and employment. Our findings suggest that unquantified underpinnings to race and ethnicity may modulate perceptions regarding reproductive health and fertility. Further research is warranted when studying diversity and should expand beyond Caucasian, African American, and Hispanic populations; Asian Americans had their own significant findings in this analysis.

Our results emphasize that providers' mindfulness of possible disparities in patients' awareness and knowledge of concepts germane to reproductive wellness is critical to the delivery of optimal care among the racially diverse US population. Our study demonstrates a need for active partnership between health care providers and the community and a multidisciplinary approach to achieve effective dissemination of information about fertility knowledge, risk factor awareness, and misperceptions regarding infertility. Future directions include studies that target improving reproductive education in school and access to information and improved care through targeted educational initiatives with before and after knowledge assessments. Additionally, cross-sectional surveys can be conducted to focus on recruiting subgroups within a specific race/ethnicity to differentiate cultural nuances between countries of origin and compare views between foreign-born vs. American-born individuals. Although there has been major progress in diversity research in the past decade, more is required to improve our understanding of various cultural views and beliefs that affect the population's receptivity to, and both utilization and interpretation of, existing informative resources on reproductive wellness and health. A deeper understanding will allow for more sensitive and effective health care from reproductive health care providers.

REFERENCES

1. Female age-related fertility decline. Committee Opinion No. 589. Obstet Gynecol 2014;123:719–21.
2. Wyndham N, Marin Figueira PG, Patrizio P. A persistent misperception: assisted reproductive technology can reverse the "aged biological clock.". Fertil Steril 2012;97:1044–7.
3. Lundsberg LS, Pal L, Gariepy AM, Xu X, Chu MC, Illuzzi JL. Knowledge, attitudes, and practices regarding conception and fertility: a population-based survey among reproductive-age United States women. Fertil Steril 2014; 101:767–74.
4. Bunting L, Boivin J. Knowledge about infertility risk factors, fertility myths and illusory benefits of healthy habits in young people. Hum Reprod 2008;23:1858–64.
5. Polis CB, Zabin LS. Missed conceptions or misconceptions: perceived infertility among unmarried young adults in the United States. Perspect Sex Reprod Health 2012;44:30–8.
6. Deatsman S, Vasilopoulos T, Rhoton-Vlasak A. Age and fertility: a study on patient awareness. JBRA Assist Reprod 2016;20:99–106.
7. Place JM, Bireley M. Exploring Infertility from the cultural context of latino college students: results from a preliminary focus group. J Racial Ethn Health Disparities 2016;4:803–11.
8. Guzzo KB, Hayford SR. Race-ethnic differences in sexual health knowledge. Race Soc Probl 2012;4:158–70.
9. Quelopana AM, Alcalde C. Exploring knowledge, belief and experiences in sexual and reproductive health in immigrant Hispanic women. J Immigr Minor Health 2014;16:1001–6.
10. Kilfoyle KA, Vitko M, O'Connor R, Bailey SC. Health literacy and women's reproductive health: a systematic review. J Womens Health (Larchmt) 2016;25:1237–55.
11. Gianaroli L, Racowsky C, Geraedts J, Cedars M, Makrigiannakis A, Lobo RA. Best practices of ASRM and ESHRE: a journey through reproductive medicine. Fertil Steril 2012;98:1380–94.
12. Practice Committee of the ASRM. Optimizing natural fertility: a committee opinion. Fertil Steril 2022;117:53–63.
13. Hampton KD, Newton JM, Parker R, Mazza D. A qualitative study of the barriers and enablers to fertility-awareness education in general practice. J Adv Nurs 2016;72:1541–51.
14. Horvat L, Horey D, Romios P, Kis-Rigo J. Cultural competence education for health professionals. Cochrane Database Syst Rev; 2014, Cd009405.
15. Sue S, Dhindsa MK. Ethnic and racial health disparities research: issues and problems. Health Educ Behav 2006;33:459–69.
16. ACOG Committee Opinion No. 649: racial and ethnic disparities in obstetrics and gynecology. Obstet Gynecol 2015;126:e130–4.
17. Jacoby VL, Fujimoto VY, Giudice LC, Kuppermann M, Washington AE. Racial and ethnic disparities in benign gynecologic conditions and associated surgeries. Am J Obstet Gynecol 2010;202:514–21.
18. Huddleston HG, Cedars MI, Sohn SH, Giudice LC, Fujimoto VY. Racial and ethnic disparities in reproductive endocrinology and infertility. Am J Obstet Gynecol 2010;202:413–9.
19. Bornstein E, Eliner Y, Chervenak FA, Grünebaum A. Racial disparity in pregnancy risks and complications in the US: temporal Changes during 2007–2018. J Clin Med 2020;9:1414.
20. Guzman L, Caal S, Peterson K, Ramos M, Hickman S. The use of fertility awareness methods (FAM) among young adult Latina and black women: what do they know and how well do they use it? Use of FAM among Latina and black women in the United States. Contraception 2013;88:232–8.
21. Frost M, Cares A, Gelman K, Beam R. Accessing sexual and reproductive health care and information: perspectives and recommendations from young Asian American women. Sex Reprod Healthc 2016;10:9–13.
22. Okazaki S. Influences of culture on Asian Americans' sexuality. J Sex Res 2002;39:34–41.
23. Hayford SR, Guzzo KB. Racial and ethnic variation in unmarried young adults' motivation to avoid pregnancy. Perspect Sex Reprod Health 2013; 45:41–51.
24. United States Census Bureau. 2012 Statistical Abstract. Washington, DC: US Census Bureau. Available at: https://www.census.gov/library/publications/2011/compendia/statab/131ed/population.html. Accessed February 5, 2022.
25. United States Census Bureau. 2010 census briefs: an overview of race and Hispanic origin. Available at: https://www.census.gov/library/publications/2011/dec/c2010br-02.html. Accessed February 5, 2022.
26. Dehlendorf C, Rodriguez MI, Levy K, Borrero S, Steinauer J. Disparities in family planning. Am J Obstet Gynecol 2010;202:214–20.
27. Bunting L, Tsibulsky I, Boivin J. Fertility knowledge and beliefs about fertility treatment: findings from the International Fertility Decision-making Study. Hum Reprod 2013;28:385–97.
28. United States Census Bureau. Quick Facts. Available at: https://www.census.gov/quickfacts/fact/table/US/PST045219. Accessed February 5, 2022.

29. Jones NM R, Ramirez R, Rios-Vargas M. 2020 census illuminates racial and ethnic composition of the country. Available at: https://www.census.gov/library/stories/2021/08/improved-race-ethnicity-measures-reveal-united-states-population-much-more-multiracial.html. Accessed February 5, 2022.

30. United States Census Bureau. Population estimates by age, sex, race, and hispanic origin. Available at: https://www.census.gov/newsroom/press-kits/2020/population-estimates-detailed.html. Accessed February 5, 2022.

31. Martin N, Baralt L, Garrido-Ortega C. What's religion got to do with it? exploring college students' sexual and reproductive health knowledge and awareness of sexual and reproductive health services in relation to their gender and religiosity. J Relig Health 2018;57:1856–75.

32. Setton R, Tierney C, Tsai T. The Accuracy of web sites and cellular phone applications in predicting the fertile window. Obstet Gynecol 2016;128:58–63.

33. United States Census Bureau. Computer and internet access in the United States: 2012. Available at: https://www.census.gov/data/tables/2012/demo/computer-internet/computer-use-2012.html. Accessed February 5, 2022.

34. Martin M. Computer and internet use in the United States, 2018. Available at: https://www.census.gov/library/publications/2021/acs/acs-49.html. Accessed February 5, 2022.

35. National Conference of State Legislatures. State policies on sexual education in schools. Available at: http://www.ncsl.org/research/health/state-policies-on-sex-education-in-schools.aspx#1. Accessed February 5, 2022.

36. South-Paul JE. Cross-cultural issues concerning sexuality, fertility, and childbirth. J Am Board Fam Pract 2003;16:180–1.