Journal of Racial and Ethnic Health Disparities (2024) 11:3076–3090
https://doi.org/10.1007/s40615-023-01765-5

"Does Religious Service Attendance Modify the Relationship between Everyday Discrimination and Risk of Obesity? Results from the Study on Stress, Spirituality and Health"

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Received: 28 October 2022 / Revised: 18 July 2023 / Accepted: 15 August 2023 / Published online: 3 November 2023

Abstract

This study examined the association of everyday discrimination with risk of obesity and the potential modifying effect of religious service attendance. Participants included Black, South Asian, and white women in three cohort studies that belong to the Study on Stress, Spirituality and Health. Logistic regression models estimated odds of obesity classification (BMI ≥ 30) relative to experiences of everyday discrimination. In initial pooled analyses, high levels of discrimination were related to increased odds of obesity. Race-specific analyses revealed marginal associations for white and South Asian women. Among Black women, high levels of discrimination and religious service attendance were both associated with higher odds of obesity. However, among women who attended religious services frequently, higher levels of everyday discrimination were associated with slightly lower odds of obesity. These findings underline the complex association between obesity and religion/spirituality, suggesting that higher levels of discrimination may uniquely activate religious resources or coping strategies. Findings highlight the need for additional studies to examine the impact of everyday discrimination on risk of obesity across racial/ethnic communities and how religious practices or coping strategies might affect these dynamics.

Keywords Religion · Spirituality · Attendance · Race/Ethnicity · Discrimination · Obesity · Mediators of Atherosclerosis among South Asians Living in America · Black Women's Health Study · Nurses' Health Study II

Introduction

High rates of obesity in the U.S. are a major public health concern. Two out of every three adults are obese, defined as body mass index (BMI) ≥ 30 kg/m2 [1]. From 1999 to 2018, the age-adjusted prevalence of obesity in the U.S. increased from 30.5% to 42.4%, and the prevalence of severe obesity increased from 4.7% to 9.2% [2]. Projections are that nearly 1 out of 2 Americans will have overweight or obesity by 2030 [1]. Obesity has well-established links to a number of adverse health outcomes [3, 4], including increased mortality, risk of type 2 diabetes, hypertension, coronary heart disease, stroke, and some forms of cancer [5]. Obesity is especially high among older adult women [6] and those from low-income and minority communities [7, 8]. Black, Latino, and American Indian individuals face an especially high risk of obesity compared to their white counterparts [9, 10].

Growing evidence indicates that psychosocial stressors play a role in both disease progression and excess body fat accumulation [11, 12]. Perceived discrimination is

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associated with obesity [13], as well as a number of additional mental and physical health outcomes, including depressive symptoms [14], hypertension [15], coronary artery disease [16], alcohol consumption [17], and low birthweight [18]. Everyday discrimination has been associated with excess abdominal fat and increased waist circumference [19–21], and may in turn be associated with increased rates of type 2 diabetes, cardiovascular disease, and several types of cancers [22]. Everyday and institutional discrimination has also been linked to higher mean weight gain in Black women [23], incident obesity [24], and an overall increase in the risk of disability, morbidity, and mortality [3].

With respect to resources for resilience, several major religions view the body as holy, or as a temple of God, which has led to interpretations by many as encouraging care of the body and/or one's health as an expression of faith [25]. Previous studies have shown that religious attendance can buffer against deleterious health outcomes [26, 27]. No study to date has examined the potential buffering effect of religious service attendance on experiences of discrimination and obesity. In this study, we assess the association of everyday discrimination with risk of obesity and the potential modifying effect of religious service attendance among Black, South Asian, and white women in the Study on Stress, Spirituality and Health.

Everyday Discrimination

Everyday discrimination captures the impact of daily experiences of interpersonal mistreatment, sometimes described as daily nuisances, that take on an ongoing, chronic form [28]. Although some may dismiss these experiences as trivial [29], the chronic nature of these stressors makes them potentially more deleterious than other forms of discrimination [30]. Everyday discrimination is designed to capture such experiences regardless of one's social identity or position (e.g., sex, self-identified race). While experiences of everyday discrimination have been shown to occur and to be associated with adverse health outcomes across racial/ethnic communities [31, 32], racial and ethnic minority persons in the U.S. bear a disproportionately high rate of everyday discrimination [13]. Further, most research to date is limited to the experiences of Black and white individuals [32, 33].

Discrimination has been hypothesized to negatively influence health in several ways [32]. First, discrimination may limit socioeconomic resources, such as access to affordable healthcare [34]. Ongoing patterns of residential segregation negatively shape patterns of education and employment, thereby creating conditions that can be harmful to health in both the social milieu and physical environment [35]. Experiences within the healthcare system can also be negatively shaped by race, ethnicity, and migration status, resulting in poorer outcomes [36–38]. Scholars have hypothesized that the chronic nature of discriminatory stressors leads to cumulative wear and tear that, over the lifetime, leads to significant health detriments [32, 39]. Stress related to discrimination has been linked to negative coping behaviors, such as decreased physical activity, smoking, drinking, and overeating, which in turn increase risk of obesity [31, 34, 40, 41].

Discrimination and Religious Attendance

Importantly for this study, involvement with a religious institution or community may influence the relationship between discrimination and health [42, 43]. Religious service attendance has been shown to increase the odds of engaging in healthy behaviors [44], and religious institutions themselves often activate practices (whether through social interaction, specialized teachings, or through programs designed to serve their communities) that encourage healthy behaviors and promote healthier lifestyles [45, 46]. For example, leaders and members of religious institutions often provide emotional and instrumental support to their community members [47], which can be especially important within immigrant populations and other groups with low levels of social integration [48–50]. This support, along with positive messages combating the psychological effects of discrimination (such as messaging on forgiveness), may be powerful buffers against the deleterious effects of discrimination [47, 51]. Previous research has demonstrated health benefits from religious attendance, found primarily among those who attend religious services at least weekly [26, 27].

Studies of religious service attendance and obesity, however, reveal a complex relationship. Some studies have found significantly higher rates of obesity among religious service attenders [52, 53]. Various mechanisms have been suggested, including gluttony as a vice [54] and a focus on food at religious functions [55]. Whether at Sunday brunch or a church potluck, food—and especially high calorie food—often plays a central role in religious social organizations. Researchers have found that obesity is particularly prevalent among Baptists, Mormons, Hindus, and Sikhs [52, 56, 57].

Several studies have reported that religious involvement may offset some of these effects, in part due to messaging from religious leaders about denomination-specific health practices promoting healthy behaviors and lifestyles [58]. For example, Seventh-day Adventists promote a vegetarian diet and abstinence from smoking and alcohol [59]. Like much of the discrimination and health literature, however, studies assessing the relationship between religion, discrimination, and health have largely focused on the African American community [60–63].

The Present Study

In the current analysis, we address these gaps in the literature by examining: a) the influence of everyday discrimination on obesity, and b) religious service attendance as a possible modifier. We do so in a sample of Black, South Asian, and white women belonging to member studies of the Study on Stress, Spiritualty and Health (SSSH), a "cohort of cohorts" study (Kent et al. 2021). According to the most recent data, rates of obesity in Black, South Asian, and white communities are 46 [2], 30 [56], and 38 percent [2], respectively. We hypothesize that higher levels of everyday discrimination will be associated with higher odds of obesity across racial/ethnic categories, and that religious service attendance will attenuate the associations between everyday discrimination and obesity. Further, because some research has identified significant variation in the effect of discrimination on obesity by racial identification [64], we focus our examination of everyday discrimination, obesity, and religious service attendance on each racial/ethnic community, hypothesizing that everyday experiences of discrimination will be particularly relevant to Black women in the SSSH.

Methods

This analysis utilized data from the baseline Spiritualty Survey (SS-1) of the Study on Stress, Spirituality, and Health (SSSH), fielded by the National Consortium on Psychosocial Stress, Spirituality, and Health [65]. Three of the five core cohorts participating in the SSSH had measures of everyday discrimination available and were included in this analysis: Black Women's Health Study (BWHS), Mediators of Atherosclerosis Among South Asians Living in America (MASALA), and Nurses' Health Study II (NHSII). Brief cohort descriptions and sampling information follow; please see listed websites for further details.

The Black Women's Health Study was launched in 1995 to investigate hypertension, diabetes, and other diseases that disproportionately affect Black women (bu.edu\bwhs). In 2015, approximately 4000 participants who had completed the most recent wave of data collection were invited to complete the SS-1. More than 2400 women responded within the first two weeks of recruitment. A random sample of 1000 of these participants were included in the SSSH and are analyzed here. Comparisons to the full BWHS cohort indicate a high degree of compatibility across available religiosity and spirituality measures [66]. Participants represent all regions of the U.S.

The Mediators of Atherosclerosis in South Asians Living in America study examines cardiovascular disease among U.S. South Asians, with participants drawn from the Chicago and San Francisco Bay areas. To be eligible, respondents must have had at least three grandparents born in India, Pakistan, Bangladesh, Nepal, or Sri Lanka (masalastudy.org). All participants were invited to complete the SS-1. Since the focus of this study was limited to women, we excluded males, resulting in a sample size of 462.

The Nurses' Health Study II (NHSII) was established in 1989 to biennially investigate risk factors for major chronic diseases in women and is comprised of nurses from 14 states who are predominantly white (nurseshealthstudy.org). SS-1 data collection occurred from 2015–2016 with a sample of 1100; comparisons of religious service attendance for those sampled in the SS-1 are indistinguishable from the full cohort. Pertinent to this study, everyday discrimination was only assessed in a small ancillary survey conducted in 2013–2014 (the Mind–Body Study), resulting in a sample size of 152 NHSII participants.

Exposure

The *Everyday Discrimination Scale* (EDS) asks how often respondents experience unfair treatment in day-to-day life [28]. Response categories varied by cohort from five to nine items and are detailed as follows (see Table 1 for summary).

EDS Questions MASALA collected discrimination information in both the first (2010–2013) and second (2017–2018) recruitment wave baseline surveys. The full nine item scale was included, which utilizes the following markers of discrimination: (1) treated with less courtesy, (2) treated with less respect, (3) received poorer store or restaurant service, (4) perceived as being not as smart, (5) people acted afraid of them, (6) people acted as if they were dishonest, (7) people acted as if they were better than them, (8) called names or insulted, and (9) threatened or harassed. BWHS and NHSII both used shortened five question variants of the everyday discrimination scale. The 2009 BWHS questionnaire asked women if: (1) they received poorer store or restaurant service, (2) were perceived as being not as smart, (3) people acted afraid of them, (4) people acted as if they were dishonest, (5) people acted as if they were better than them. The 2013–2014 NHSII Mind Body Survey asked if: (1) they were treated with less courtesy, (2) were perceived as being not as smart, (3) people acted afraid of them, (4) people acted as if they were dishonest, (5) were threatened or harassed. No attribution as to why the discrimination occurred was collected in any of the instruments.

EDS Response Options Response options for MASALA included a 6-point response scale (never, less than once per year, a few times per year, a few times per month, once per week, and almost every day), while BWHS used a similar 5-point scale excluding the "less than once per year" response. The NHSII used a 5-point scale, but responses

Table 1 Everyday discrimination scale items by cohort

	BWHS[a]	MASALA[b]	NHSII[c]
You receive poorer service than other people at restaurants or stores	x	x	x
People act as if they think you are not smart (intelligent)	x	x	x
People act as if they are afraid of you	x	x	x
People act as if they think you are dishonest	x	x	
People act as if they're better than you are	x	x	
You are treated with less courtesy than other people are		x	x
You are threatened or harassed		x	x
You are treated with less respect than other people are		x	
You are called names or insulted		x	

[a]2009 BWHS Biennial Survey. Response: Never, A few times per year, Once per month, Once per week, Almost everyday

[b]2010 MASALA Baseline Survey. Response: Never, Less than once per year, A few times per year, A few times per month, Once per week, Almost everyday

[c]2013-2014 Mind Body Survey. Responses: Never, Rarely, Sometimes, Often, At least once per week

included (1) never, (2) rarely, (3) sometimes, (4) often, and (5) at least once per week. Response values were harmonized into a 5-point coding scheme, with the few MASALA respondents selecting "less than once per year" included in the "never" category (See Table 1). Sensitivity analyses were performed assessing the impact of the handful of MASALA respondents coded as "less than once per year" versus "never." This included moving these few respondents into the "a few times per year category" and this yielded no substantive change in the findings.

EDS Harmonization After recoding response options, items were averaged within each cohort (using either nine or five items) to produce a mean score comparable across cohorts. Higher values corresponded to higher levels of perceived everyday discrimination. Based on exploratory analyses of pooled data, a 3-level categorical variable was then constructed: among those who reported experiencing everyday discrimination, we used the median value as a cut point to construct the "low" and "high" discrimination categories, and coded those reporting no everyday discrimination as "none." Based on this coding scheme, respondents in the low discrimination category averaged a response across all items of approximately "rarely or a few times per year" or less, and those in the high discrimination category experienced higher rates, generally reporting rates of "sometimes" or "a few times per month" or higher. Sensitivity analyses were performed using the three scale sub-items available across all cohorts (perceived as being not as smart, people acted afraid of them, and people acted as if they were dishonest). Using this approach, the median response value was substantively unchanged, so we proceeded with analyses incorporating all scale items (nine or five) in the three-level variable.

Obesity

Body Mass Index (BMI) was assessed by dividing weight in kilograms by height in meters squared (see Table 2 for timing of primary study variables). Following the World Health Organization guidelines, obesity was defined as a BMI of greater than or equal to 30. The outcome variable was a binary indicatory of obesity ($1 = \text{BMI} \geq 30$, $0 = \text{BMI} < 30$ kg/m^2). However, evidence from both clinicians and epidemiologic studies have suggested that morbidities such as diabetes and atherosclerosis occur at lower BMI values for Asian Americans [67–69]. For this reason, a growing number of researchers have called for the adoption of a lower BMI cut point of 27.5 kg/m^2 for this population. Given our interest in understanding the relationship between everyday discrimination and obesity and other consequent health impacts, the association between BMI and clinical outcomes is central to our study. We ran sensitivity analyses using ethnicity specific cut points and the associations between discrimination, religion and obesity were substantively unchanged. A greater discussion about the benefits and drawbacks of using ethnicity specific measures is found in the limitations section.

Religious Service Attendance was assessed in the SS-1 by asking: How often do you attend religious services? Responses were (1) never, (2) rarely, (3) monthly, (4) a few times per month, (5) once a week, and (6) several times per week. Because of small cell size, particularly among white respondents, religious service attendance was recoded into a 3-level categorical variable: "Rarely" = those who attend never or rarely; "Low" = those who attend monthly or a several times per month; and "High" = those who attend weekly or more often [70, 71].

Table 2 Year variable assessed by survey

	BWHS[a]	MASALA[b]	NHSII[c]
Everyday Discrimination	2009	2010–2013; 2017–2018	2013-2014[e]
Religious Service Attendance[d]	2015	2016–2018	2015–2016
Race/Ethnicity	-[f]	2010–2013; 2017–2018	2005
Age[d]	2015	2016–2018	2015–2016
Marital Status	2005	2010–2013; 2017–2018	2013
Household Income	2003	2016–2018	2001
Current Smoker	2009	2010–2013; 2017–2018	2011
Self-Rated Health	2011	2016–2018	2016
Physical Activity	2005	2016–2018	2009
BMI	2010	2016–2018	2011

[a]BWHS Biennial Survey

[b]MASALA dates represent two iterations of initial data collection

[c]NHSII Biennial Survey

[d]Assessed via the Study on Stress, Spirituality and Health SS-1

[e]2013-2014 NHSII Supplemental Mind Body Survey

[f] Only Black respondents recruited in BWHS, race was not assessed via questionnaire

Both BWHS and MASALA are targeted to specific racial and ethnic groups, and they were coded accordingly (Black and South Asian). NHSII, while predominantly white, does include non-white respondents as well. Of those respondents in the NHSII Mind Body study, only 3 respondents self-identified as other than white (all were Black) and were coded accordingly.

Covariates

Based on prior studies, covariates included demographic variables, physical activity, smoking, and perceived health [21, 72, 73]. Demographic variables included *age* (continuous, in years at time of SS-1), *marital status* (1 = married, 0 = not married), *household income* (1 = less than $25,000; 2 = $25,000-$50,000; 3 = greater than $50,000). *Current smoker* was made dichotomous (1 = smoker; 0 = former or non-smoker). When we broke the groups into current, former, and never smoking categories we found no substantive differences between the former and never smoking groups. We thus combined them for the sake of parsimony. *Self-rated health* was coded 1–5 (poor to excellent). *Physical activity* was coded continuously using an estimated score in Metabolic Equivalent of Task or MET-hrs. One MET is the equivalent of energy expended sitting quietly for one hour [74]. The estimated Met-hrs score was assessed using a Physical Activity Questionnaire (PAQ) assessing hours per week of participation in walking for exercise, hours per week of moderate activity (e.g., housework, gardening, and bowling), and hours per week of strenuous activity (e.g., basketball, swimming, running, and aerobics) during the previous year. Researchers have previously validated PAQ estimates from the BWHS and NHSII against wearable actigraphs and exercise diaries [75, 76].

Statistical Analysis

Means with corresponding standard errors and proportions were generated to describe the sample by race/ethnic group (Table 3). Since the outcome variable was binary, logistic regression models were used to estimate odds ratios and confidence intervals (Table 4). Our initial model (Model 1) generated estimates for the cross-sectional association between discrimination and obesity in a pooled sample, controlling for all covariates. We then added race/ethnicity (Model 2), using white as the comparison group. Model 3 introduced religious attendance, and our full model (Model 4) added an interaction term between race and discrimination. Table 5 reports the odds ratios of within-group models for each specific racial/ethnic group. Finally, to aid in interpretation, we included a figure for the predicted probabilities of obesity based on the results of Table 5, Model 3. All analyses were performed using SAS 9.4.

While we had no missing data on our key exposure and outcome variables, missing data was of concern with respect to covariates, since approximately 30 percent of the sample had values missing for at least one covariate. The most common missing values were for physical activity and income. We observed a minor tendency for those with higher BMI not to report physical activity scores, though the difference was not significant using a Student's t-test. Therefore, missing data on the independent variables were assumed missing at random (MAR), which justified the use of multiple imputation techniques to generate replacement values [77]. This resulted in a final sample size of 1,618 women. Results are based on forty imputed datasets [78], but results were comparable with listwise deletion, when missing indicator techniques were employed, and when additional imputed datasets were analyzed [79].

Table 3 Notable characteristics of analytic sample by racial/ethnic group

	Black $n=1003$ Mean(SE)/prop	S. Asian $n=463$ Mean(SE)/prop	White $n=152$ Mean(SE)/prop	Total $n=1618$ Range
Age	57.6(0.24)	59.8(0.39)	63.6(0.32)	42–83
Family Income	2.2(0.02)	2.2(0.03)	2.9(0.03)	1–3
Married	0.45	0.85	0.78	–
Current Smoker	0.05	0.01	0.02	–
Physical Activity	10.8(0.54)	21.5(1.05)	29.2(2.30)	0–211
Self-Rated Health	3.6(0.03)	3.5(0.03)	4.0(0.07)	1–5
Obesity	0.46	0.33	0.22	–
Everyday Discrimination				
Never or less than once per year	0.07	0.25	0.25	–
Low (below median)	0.37	0.51	0.49	–
High (above median)	0.56	0.23	0.26	–
Religious Service Attendance				
Rarely or Never	0.32	0.06	0.40	–
Low (Monthly)	0.24	0.66	0.19	–
High (Weekly or more)	0.44	0.28	0.41	–

Age in years at time of the baseline Spirituality Survey (SS-1)

Income where 1 = less than $25,000; 2 = $25,000-$50,000; 3 = greater than $50,000

Physical Activity measured in MET-hrs/week

Self-Rated Health where 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent

Obesity where BMI ≥ 30 kg/m^2

Results

Distributions of sample characteristics by race/ethnicity are displayed in Table 3. Across all three groups, a majority reported at least some experience of everyday discrimination. More than 50 percent of Black women reported high levels of everyday discrimination compared to about one-quarter of South Asian and white women. Conversely, less than 10 percent of Black women reported never experiencing everyday discrimination, while approximately 25 percent of white and South Asian women reported never experiencing such discrimination.

White respondents were in their early 60's, on average, while Black and South Asian women were in their late 50's. The majority of the full sample did not smoke. Black women reported lower amounts of physical activity and a smaller proportion were married. White women reported the highest income and the highest self-rated health. A larger proportion of Black women attended church or religious services weekly or more often (44 percent), compared to 40 percent of white women and just under 30 percent of South Asian women.

The cross-sectional association between everyday discrimination and obesity in the pooled sample of women is shown in Table 4. Better self-rated health was associated with lower odds of obesity across all models. After adjusting for age, marital status, income, smoking status, physical activity, and self-rated health, high levels of everyday discrimination were associated with a 86 percent increase in the odds of obesity (OR 1.86, 95% CI [1.29–2.69]) in comparison to women not experiencing any discrimination. Model 2 added race/ethnicity, and attenuated the effect of discrimination. Race/ethnicity was significant in this model with Black women experiencing 100% higher odds (OR 2.00, 95% CI [1.24–3.21]), and South Asian women had lower odds of obesity (OR 0.35, 95%CI [0.21–0.68]). The addition of religious service attendance in Model 3 suggested that high levels of service attendance were associated with marginally increased odds of obesity in comparison to those who never or rarely attend. Interaction terms between race and discrimination were not statistically significant.

Table 5 reports the results of within-group models for each racial/ethnic group adjusted for covariates. Among South Asian women, low levels of discrimination were associated with a marginal increase in the odds of obesity in Model 1 (OR 1.38, 95% CI [0.97–2.21]), though this association was no longer significant in Model 2.

Among white women, there was little evidence of an association between everyday discrimination and obesity. The result in Model 1 was non-significant. Model 2 indicated a marginal reduction in odds for low discrimination once religious service attendance was accounted for. It also provided marginal evidence for low religious service

Table 4 Odds Ratios (95% CI in parentheses) for Pooled Analysis of Everyday Discrimination and Obesity Association (BMI > = 30). $n = 1618$

	Model 1	Model 2	Model 3	Model 4
Discrimination (reference = never or less than once per year)				
Low	1.29	0.96	0.96	0.71
	(0.92–1.82)	(0.65–1.26)	(0.65–1.43)	(0.26–1.92)
High	1.86**	1.09	1.08	1.08
	(1.29–2.69)	(0.72–1.61)	(0.81–1.65)	(0.36–3.10)
Race (reference = white)				
Black	–	2.00**	1.99**	1.25
		(1.24–3.21)	(1.24–3.22)	(0.58–2.44)
South Asian	–	0.35**	0.39**	0.44*
		(0.21–0.68)	(0.24–0.71)	(0.22–0.95)
Service Attendance (reference = rarely or never)				
Low	–	–	1.20	1.34†
			(0.92–1.75)	(0.99–1.80)
High	–	–	1.30†	1.29*
			(0.99–1.72)	(1.00–1.60)
Race and Discrimination Interaction				
Black x Low	–	–	–	1.99
				(0.81–4.31)
Black x High	–	–	–	1.40
				(0.72–3.70)
S. Asian x Low	–	–	–	1.08
				(0.33–3.31)
S. Asian x High	–	–	–	0.58
				(0.21–2.20)
Age	0.99	1.00	1.00	1.00
	(0.97–1.01)	(0.99–1.01)	(0.99–1.01)	(0.99–1.01)
Income	0.99	0.81	0.81	0.81
	(0.79–1.24)	(0.63–1.16)	(0.63–1.06)	(0.63–1.06)
Married	0.61*	0.89	0.83	0.97
	(0.48–0.81)	(0.75–1.25)	(0.78–1.25)	(0.79–1.28)
Smoking	0.82	0.64	0.65	0.68
	(0.43–1.29)	(0.39–1.15)	(0.40–1.15)	(0.39–1.16)
Physical Activity	0.98**	0.99	0.99	0.99
	(0.97–0.99)	(0.98–1.01)	(0.98–1.01)	(0.98–1.01)
Self-Rated Health	0.57***	0.50***	0.50***	0.53***
	(0.49–0.66)	(0.42–0.58)	(0.43–0.58)	(0.43–0.58)

†$p < .10$, *$p < .05$, ** $p < .01$, *** $p < .001$

Model 1: effects of discrimination, controlled for age, marital status, smoking, self-rated health, and physical activity

Model 2: controlled for variables in Model 1 plus race/ethnicity, using white as the comparison group

Model 3: controlled for variables in Model 2 plus religious attendance

Model 4: controlled for Model 3 variables plus an interaction term between race and discrimination

attendance being associated with increased odds of obesity. None of the interactions were statistically significant at the $p < 0.05$ level.

Among Black women in the sample, Model 1 indicated high levels of everyday discrimination were associated with 55 percent higher odds of obesity (OR 1.55, 95% CI [1.01–2.79]). Introducing religious service attendance into Model 2 revealed that high attendance was associated with 37 percent higher odds of obesity among those who regularly attend religious services compared to non-attenders (OR 1.37, 95% CI [1.00–1.87]), and high everyday discrimination remained associated with greater odds of obesity (OR 1.84, 95% CI [1.02–2.74]). Interacting everyday discrimination and service attendance in Model 3 revealed several significant findings that help elucidate the complex relationship between everyday discrimination, obesity, and religious service attendance among Black women. The interaction of high discrimination and low attendance was significant ($p = 0.015$) in Model 3, along with high discrimination and high attendance ($p = 0.024$). The interaction of low discrimination and high attendance was marginally significant ($p = 0.079$). For clarity, we present a crosstabulation between service attendance and discrimination (with column percentages) for Black women in Table 6.

To further aid in interpretation of our interaction results, we calculated predicted probabilities of obesity using the log odds coefficients generated by Model 3 (Fig. 1). The predicted probabilities presented were calculated for a hypothetical 40-year-old married Black woman with mean levels of income ($25,000-$50,000), physical activity (10.8 MET-hours/week), and health (good-very good). The probability of obesity was 17 percent if they did not attend religious services or experience any discrimination. The probability of obesity increased to over 40 percent if they experienced low or high levels of discrimination (43 and 41 percent, respectively). For the same woman who frequently attended religious services and did not report discrimination, the probability of obesity was 55 percent. However, if they reported experiencing discrimination, the probability of obesity was lower, with women suffering the highest amount of discrimination evincing the lowest predicted probabilities among high attenders. Among those who attended religious services less frequently, the predicted probability of obesity was 29 percent if they reported no discrimination, jumping to 43 percent with low levels of discrimination. The predicted probability for women who experienced high levels of discrimination and attended at lower levels dropped to 19 percent, a level similar to those who did not attend religious services and did not report experiencing discrimination.

In sum, Model 3 indicated that: 1) high level of service attendance was associated with higher probabilities of obesity for Black women across any level of discrimination, 2) that any level of discrimination (vs. no discrimination) was associated with higher probabilities of obesity for non-attenders; and 3) that among high attenders, those experiencing high levels of discrimination had a lower probability of obesity compared to those perceiving low or no discrimination, though the difference was small (49% to 55%).

Table 5 Odds Ratios (95% CI in parentheses) for Everyday Discrimination and Obesity (BMI > = 30) stratified among Black, South Asian and white women

	Black $n = 1003$	South Asian $n = 462$	White $n = 152$
Model 1			
Discrimination (reference = never or less than once per year)			
Low Discrimination	1.33	1.38†	0.63
	(0.88–2.48)	(0.97–2.21)	(0.42–1.78)
High Discrimination	1.55*	0.86	1.12
	(1.01–2.79)	(0.40–1.56)	(0.56–2.21)
Model 2			
Discrimination (reference = never or less than once per year)			
Low Discrimination	1.54†	1.15	0.61†
	(0.93–2.50)	(0.69–2.27)	(0.17–1.18)
High Discrimination	1.84*	0.71	0.97
	(1.02–2.74)	(0.37–2.21)	(0.31–2.07)
Service Attendance (reference: rarely or never)			
Low Attend	1.17	1.47	2.19†
	(0.82–1.67)	(0.62–3.88)	(0.92–4.18)
High Attend	1.37*	1.18	1.20
	(1.00–1.87)	(0.34–3.23)	(0.42–3.31)
Model 3			
Discrimination (reference = never or less than once per year)			
Low Discrimination	3.70*	2.05	0.15*
	(1.19–8.22)	(0.20–2.89)	(0.09–0.96)
High Discrimination	3.22*	2.83	1.00
	(1.05–7.38)	(0.24–3.41)	(0.34–5.33)
Service Attendance (reference: rarely or never)			
Low Attendance	1.94	1.30	1.57
	(0.41–5.33)	(0.28–2.73)	(0.53–3.38)
High Attendance	5.84*	0.55	0.39
	(1.53–11.22)	(0.07–2.21)	(0.06–2.30)
Discrimination and Attendance Interaction			
Low Disc x Low Attend	0.49	0.29†	2.96
	(0.09–2.10)	(0.08–1.10)	(0.36–11.28)
High Disc x Low Attend	0.17*	1.02	6.24†
	(0.04–0.72)	(0.21–3.83)	(0.89–18.81)
Low Disc x High Attend	0.67†	1.10	0.61
	(0.11–1.11)	(0.33–5.11)	(0.12–7.33)
High Disc x High Attend	0.25*	2.01	1.26
	(0.09–0.96)	(0.19–6.80)	(0.10–11.34)

†$p < .10$, *$p < .05$

Model 1: effects of discrimination, controlled for age, marital status, smoking, self-rated health, and physical activity

Model 2: controlled for variables in Model 1 plus religious attendance

Model 3: controlled for variables in Model 2 plus interaction of discrimination and attendance

Discussion

We examined the relationship between everyday discrimination and obesity among women from three racial/ethnic communities – Black, South Asian, and white – represented in the Study on Stress, Spirituality and Health (SSSH). The findings suggested that while a sizeable portion of Black, South Asian, and white women experience everyday discrimination, the association with higher obesity prevalence was most pointedly experienced by Black women. These results also indicated that religious service attendance was generally associated with increased obesity – opposite our hypothesized direction. However, we observed that among frequently attending Black women, the probability of obesity

Table 6 Chi-Square and crosstabulation with column percentages of Attendance and Discrimination for Black women ($n = 1003$)

	Discrimination never or less than once per year	Low discrimination	High discrimination	Total
Rarely or /Never Attend	28 41.2%	126 34.1%	166 29.3%	320 31.9%
Low Attendance	13 19.1%	97 26.2%	130 23.0%	240 23.9%
High Attendance	27 39.7%	147 39.7%	269 47.6%	443 44.2%
Total	68 100%	370 100%	565 100%	1003 100%
				$\chi^2 = 10.590$*

*$p < .05$

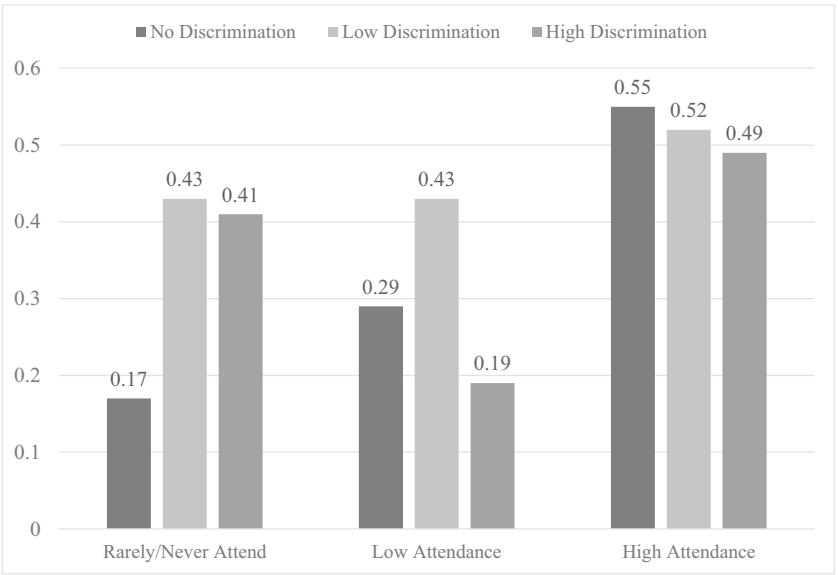

Fig. 1 Predicted probabilities of obesity for a married, 40-year-old Black woman with varying levels of church attendance (covariates fixed at mean levels). Note: See Table 5, model 3

was slightly lower when higher levels of discrimination were reported (49% versus 55% for no discrimination).

Our results echoed previous findings demonstrating significant variation in the association of discrimination with obesity when comparing Black and white individuals [9, 80, 81]. Systemic racism in our society, and an increasing tolerance for racism and white supremacy in certain quarters of our political and social culture, profoundly affects Black Americans, as well as other minority communities. Substantial progress in eliminating health disparities cannot be made without addressing the larger social environment and racist culture that minority persons in the U.S. must navigate; these exposures increase risk for many chronic diseases and help to generate dramatic racial/ethnic disparities in the burden of illness [82].

Previous research investigating the impact of religious service attendance on various disease endpoints has been mixed. For example, of 29 extant analyses evaluating religious service attendance and overweight/obesity, 17 suggested that religious attendance may be associated with increased obesity prevalence for at least some groups (e.g. [83, 84],), while nine found little to no association (e.g. [44, 85],). Three found evidence that religious service attendance was associated with reduced obesity. Only three of the 29 studies were prospective in nature and only one found attendance to be associated with lower risk of incident obesity among US women [52]. We could identify no extant study investigating the relationship between religious service attendance and obesity among South Asians. At least one cross-sectional study indicated that religious service attendance could mitigate the negative effects of discrimination [44]. Most existing studies on discrimination, religiosity, and health focus on the experience of African American Community [60], and cover a range of conditions such as cardiovascular events [62], psychological outcomes [61], and HIV related disease progression [63].

Our study showed that among Black women, religious service attendance was associated with a significantly higher obesity prevalence compared to those who rarely/never attended or attended at low levels. There are a number

of probable reasons for this, such as gatherings that may include high fat and high calorie foods [55]. It may also be that religion does not lead to overweight and obesity, but rather, that religion provides a welcoming setting for those experiencing stigmatization due to their weight [86]. While religious involvement is often adjoined by healthy behaviors (e.g., less smoking, drinking, etc.), diet may be a significant risk factor beyond the experience of discrimination. Leaders in the Black church community acknowledge this concern and a variety of interventions have been tested [87, 88].

Interestingly, among those who attend frequently, the predicted probability of obesity was lowest among those with the highest levels of discrimination. While the differences were small (49% vs. 55%), it is possible that the highest levels of stress from discrimination may "activate" religious coping resources, such as instrumental and emotional support, that disrupt the stress process and contribute to lower obesity [89]. It is also possible that those facing high levels of discrimination feel more situational pressure to conform to hegemonic white body norms, resulting in lower levels of obesity [90].

In addition, those who experienced high levels of everyday discrimination and were low attenders of religious services had predicted probabilities of obesity near those who had not experienced any everyday discrimination at all. It is possible that low attenders may receive some of the benefits associated with religiosity without having the same requirements and possible stresses of membership, such as pressure to conform to community norms [91]. They may also have reduced exposure to additional gatherings of the religious community that can often be centered on unhealthy foods that frequent attendance might bring [55]. Taken together, these findings suggest that, at least for the Black women in our sample, both the claim that attendance is associated with higher rates of obesity and that religiosity can mitigate those deleterious effects may be true. Our results demonstrate that religious service attendance may affect the discrimination-obesity relationship differently at varying levels of discrimination.

With regard to the other two racial/ethnic groups in our sample, South Asian women experienced slightly lower levels of discrimination compared to white women (23% versus 26%); we did not find a significant relationship between discrimination and obesity once covariates were controlled.

The marginal association of low levels of discrimination with obesity in controlled models may reflect multiple issues at play. First, the particular type of everyday discrimination is not available in the SSSH measure of everyday discrimination, and it is possible that the discrimination experienced may be related to socioeconomic status, immigrant status, language, or culture among South Asians, as opposed to racially motivated discrimination experienced by Black Americans. Most respondents in our South Asian cohort were first-generation immigrants and the migration experience likely carries unique stressors not experienced by Black or white women in our study. Dramatic qualitative differences in experience of discrimination for the groups examined here are likely, and this should be considered in future research.

Second, first-generation South Asian immigrants are more likely to live in ethnic enclaves, and the enclave may not only reduce the exposure to everyday discrimination, but also provide resources that buffer the potentially harmful stressors that recent immigrants experience [92, 93]. The marginal negative association of religious service attendance at low levels of discrimination with obesity may also be indicative that these religious organizations decrease risk of obesity in the lives of immigrants [94, 95]. Interestingly, only 6 percent of South Asians rarely or never attended religious services in comparison to 32 percent of Black and 40 percent of white women, a feature likely connected to this recent immigrant population's deployment of religion as an identity marker [96].

Limitations

This study has several limitations that should be noted. First, the sample of white women in the SSSH may not represent white women nationally given that they were all nurses, and thus may have greater awareness of the potential deleterious effects of obesity than white women generally. This sample of white female nurses also has a higher income than the Black and South Asian women in the SSSH sample, and it may be that upward mobility had a buffering effect on the discrimination-obesity relationship. Second, because the SSSH currently only has one wave of data, the models presented here are necessarily cross-sectional and thus cannot support inferences about the causal relationships between everyday discrimination and obesity. It is possible that obesity explains part of the reason people experience discrimination. Future waves of data from the SSSH are planned in the coming years and these will provide an opportunity to examine these relationships prospectively.

This analysis looked at religious service attendance, one of the most commonly investigated religion/spirituality exposures in health literature. Future investigations can and should interrogate other measures which may more fully capture religious/spiritual participation, particularly for non-Christian populations. Importantly, Hinduism (the most prominent religion in the MASALA cohort) is not centered around weekly attendance at the temple, so it is possible that the religious attendance variable so commonly used in Western research inadequately captures religious participation for this group [97].

Additionally, while BMI is considered a reasonable approximation of obesity [98], it cannot distinguish between

fat and lean tissue. Other measures, such as waist circumference or body fat percentage, may be better indicators [67, 99], but these were not available across cohorts. Further, there has been considerable debate regarding which threshold of BMI should be used to define obesity within the Asian community. Asian populations have been noted to experience higher rates of obesity related health concerns (e.g., type-2 diabetes), than Western populations at any BMI [68, 69, 100, 101], supporting the use of a group-specific BMI cut point (27.5 kg/m^2) when investigating risk of disease. We performed sensitivity analyses using the ethnicity specific obesity threshold of 27.5 kg/m^2 for South Asian women (see Table 7). The main findings regarding everyday discrimination and religious service attendance were substantively unchanged. However, the effect of race/ethnicity for South Asian women was no longer significant at that lower cut point. Analyses using standard 30 kg/m^2 threshold could lead to the erroneous conclusion that South Asian women are at low risk for obesity and obesity related complications. We wish to avoid entrenching racial and ethnic divides in health but are also concerned about research methodologies that neglect to meet the South Asian communities' health needs. Future research should continue to examine measures of obesity in nuanced ways, including assessments of these dynamics within the varying South Asian sub-populations.

Despite these limitations, this study provides the first assessment of associations between everyday discrimination and risk of obesity risk across these three racial/ethnic communities. This study also provides the first examination of religious service attendance as a potential buffer against the adverse health effects of everyday discrimination across samples of Black, South Asian, and white women.

Conclusion

In sum, this study finds evidence for an association between everyday discrimination and obesity, particularly among Black women. Broadly speaking, religious service attendance was associated with higher rates of obesity. Among Black women who attended services frequently, higher levels of discrimination were associated with modestly lower rates of obesity, perhaps capturing a deployment of religious resources as coping mechanisms. The relationship between everyday discrimination and obesity is complex, and further research is needed to better understand these dynamics, including how discrimination may function differently in relation to obesity depending on the level of discrimination experienced and the racial/ethnic identity of the individual.

Further research is also needed to better understand the complex ways that religious service attendance modifies the relationship between discrimination and obesity. For example, being part of a Black religious community and attending church regularly likely captures something culturally and experientially different than Hindu South Asians attending temple. More work is needed to rigorously assess

Table 7 Odds Ratios (95% CI in parentheses) for Pooled Analysis of Everyday Discrimination and Obesity (BMI > = 30 for Black and white women, BMI > = 27.5 for S. Asian women) Association (n = 1618)

	Model 1	Model 2	Model 3	Model 4
Discrimination (reference = never or less than once per year)				
Low	1.29	1.15	1.13	0.81
	(0.92–1.82)	(0.83–1.63)	(0.80–1.61)	(0.26–1.91)
High	1.48**	1.17	1.14	1.05
	(1.05–2.07)	(0.83–1.69)	(0.81–1.65)	(0.36–3.10)
Race (reference = white)				
Black	–	1.83**	1.83*	1.13
		(1.16–2.96)	(1.15–2.82)	(0.42–3.06)
South Asian	–	1.00	0.90	0.74
		(0.61–1.63)	(0.55–1.49)	(0.29–1.91)
Service Attendance (reference = never or rarely)				
Low	–	–	1.35†	1.33†
			(0.99–1.85)	(0.98–1.83)
High	–	–	1.29†	1.28†
			(0.99–1.70)	(0.97–1.69)
Race and Discrimination Interaction				
Black x Low	–	–	–	1.89
				(0.60–5.95)
Black x High	–	–	–	1.43
				(0.43–4.84)
S. Asian x Low	–	–	–	1.73
				(0.43–5.23)
S. Asian x High	–	–	–	0.67
				(0.21–2.31)
Age	0.99	1.00	1.00	1.00
	(0.97–1.01)	(0.99–1.01)	(0.99–1.01)	(0.99–1.01)
Income	0.73**	0.73**	0.73**	0.72**
	(0.59–0.92)	(0.58–0.92)	(0.58–0.92)	(0.57–0.92)
Married	0.83	0.99	0.99	0.99
	(0.67–1.03)	(0.79–1.25)	(0.78–1.26)	(0.77–1.26)
Smoking	0.74	0.67	0.69	0.68
	(0.43–1.29)	(0.39–1.17)	(0.40–1.20)	(0.39–1.19)
Physical Activity	0.98**	0.99	0.99	0.99
	(0.97–0.99)	(0.98–1.01)	(0.98–1.01)	(0.98–1.01)
Self-Rated Health	0.55***	0.53***	0.53***	0.53***
	(0.49–0.62)	(0.46–0.61)	(0.46–0.61)	(0.45–0.60)

†$p < .10$, *$p < .05$, ** $p < .01$, *** $p < .001$

Model 1: effects of discrimination, controlled for age, marital status, smoking, self-rated health, and physical activity

Model 2: controlled for variables in Model 1 plus race/ethnicity, using white as the comparison group

Model 3: controlled for variables in Model 2 plus religious attendance

Model 4: controlled for Model 3 variables plus an interaction term between race and discrimination

the influence of religious or spiritual practices, beliefs, and experiences on important health outcomes, and how these relationships differ across racial/ethnic communities, religious tradition, and socioeconomic status. Religiosity and spirituality remain understudied in health research but may function as important resources for resilience in coping with discrimination, poverty, abuse, and other psychosocial stressors known to increase risk of disease. Religiosity and spiritual influences may prove especially important for particular racial/ethnic communities that persistently experience a disparate burden of chronic disease, and thus represent an important resource for addressing health disparities, such as tailoring of public health messages or innovative interventions that harness individuals' spiritual beliefs to engage them in healthy behaviors. Such interventions may be especially important and impactful with respect to Black Americans.

Authors' Contribution James Clark Davidson, Blake Victor Kent, Yvette C. Cozier, Alka M. Kanaya, Erica T. Warner, A. Heather Eliassen, David R. Williams, and Alexandra E. Shields contributed to this study. James Clark Davidson, Blake Victor Kent, Erica T. Warner, David R. Williams, and Alexandra E. Shields strongly contributed to the study design and conception. Data analysis and first draft of the paper was written by James Clark Davidson. Blake Victor Kent provided significant support in developing the discussion and in the revision process. All authors commented on previous drafts of the manuscript. All authors read and approved the final manuscript.

Funding This analysis was supported by a grant from the John Templeton Foundation and the Study on Stress, Spirituality, and Health (grant #59607). The Black Women's Health Study was supported by NIH grants UM1CA164974, U01CA164974, and R01CA058420. The MASALA Study was supported by NIH grants 1R01HL093009, 2R01HL093009, R01HL120725, UL1RR024131, UL1TR001872, and P30DK098722. The Nurses' Health Study II was supported by NIH grants U01 CA176726 and R01 CA163451. The funders had no role in the design of this study, interpretation of the data, or writing of this manuscript.

Data Availability The data that support the findings of the study are not available publicly but may be available by request and with consent of the respective owners of the data: The Study on Stress, Spirituality, and Health; Black Women's Health Study; The MASALA Study; and Nurses' Health Study II.

Code Availability Data analysis was performed using SAS 9.4. Questions concerning code used in the analysis of this study should be directed to the first author. Code requests may be subject to the approval of the participating owners of the data: the Study on Stress, Spirituality, and Health; Black Women's Health Study; The MASALA Study; and Nurses' Health Study II.

Declarations

Ethics Approval This study analyzes data collected by the Study on Stress, Spirituality, and Health; The Black Women's Health Study; The MASALA Study; and Nurses' Health Study II, and was approved by their respective oversight bodies. Massachusetts General Hospital Research Institute confirms no additional ethical approval is required.

Consent to Participate Informed Consent was obtained from all participants.

Consent for Publication Not Applicable.

Conflict of Interest The authors have no conflicts of interest to declare.

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