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The association of religiosity with overweight/obese body mass index among Asian Indian immigrants in California

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ABSTRACT

Objective. The aim of this study was to examine the association between religiosity and overweight or obese body mass index among a multi-religious group of Asian Indian immigrants residing in California.

Methods. We examined cross-sectional survey data obtained from in-language telephone interviews with 3228 mostly immigrant Asian Indians in the 2004 California Asian Indian Tobacco Survey using multivariate logistic regression.

Results. High self-identified religiosity was significantly associated with higher BMI after adjusting for socio-demographic and acculturation measures. Highly religious Asian Indians had 1.53 greater odds (95% CI: 1.18, 2.00) of being overweight or obese than low religiosity immigrants, though this varied by religious affiliation. Religiosity was associated with greater odds of being overweight/obese for Hindus (OR 1.54; 95% CI: 1.08, 2.22) and Sikhs (OR 1.88; 95% CI: 1.07, 3.30), but not for Muslims (OR 0.69; 95% CI: 0.28, 1.70).

Conclusions. Religiosity in Hindus and Sikhs, but not immigrant Muslims, appears to be independently associated with greater body mass index among Asian Indians. If this finding is confirmed, future research should identify potentially mutable mechanisms by which religion-specific religiosity affects overweight/obesity risk.

Introduction

Asian Indians are one of the fastest growing ethnic groups in the U.S. (Barnes et al., 2008; Palaniappan et al., 2010). California has the largest state population of Asian Indians with over 528,000 people (U.S. Census Bureau, 2011). Compared to other racial/ethnic groups in the U.S., Asian Indians have greater risk of obesity-related conditions, such as diabetes mellitus and coronary heart disease (Flowers et al., 2010; Holland et al., 2011; Joshi et al., 2007; Misra et al., 2010; Mohanty et al., 2005; Palaniappan et al., 2010). Physical inactivity, diets low in fruits and vegetables, and a genetic predisposition to insulin resistance and central adiposity are believed to contribute to this disparity (Daniel and Wilbur, 2011; Fernandez et al., 2011; Ghai et al., 2012; Joshi et al., 2007; Ye et al., 2009).

Ninety-three percent of Asian Indian adults in the U.S. are foreign-born (Barnes et al., 2008). Similar to other immigrant groups who may face language and cultural barriers from participating in wider American society, Asian Indian immigrants may initially be involved in activities that revolve around traditional norms, such as participation in customary religious services in order to obtain social and other supports (Basch et al., 1994; Fekete and Williams, 2012; Kim, 1987; Pollard et al., 2003; Zhou, 1992). Immigrants may also adhere to dietary practices similar to those prescribed by their religious traditions (Fekete and Williams, 2012; Raj et al., 1999). For example, Muslims may abstain from alcohol or avoid pork, and Hindus and Sikhs may eat only plant foods (Eliasi and Dwyer, 2002; Jonnalagadda and Diwan, 2002; Raymond and Sukhwant, 1990). However, as immigrants increase their exposure to Western cultural practices, they may adopt less healthy food choices found in their host country (Akresh, 2007; Batis et al., 2011; Guendelman et al., 2011; Kim et al., 2007; Lv and Cason, 2004). For Asian Indians, this may mean reduced intake of plant foods or altered meal patterns that may increase risk for overweight/obesity and obesity-related conditions (Garduno-Diaz and Khokhar, 2012; Garduño-Diaz and Khokhar, 2012; Karim et al., 1986; Raj et al., 1999).

Religiosity in diverse racial/ethnic groups has been associated with greater body weight and/or overweight/obesity, and may influence overweight/obesity status among Asian Indians. Religious participation

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Table 1
Characteristics of Asian Indian adults in California in total (n = 3228) and analytic (n = 2213) samples, CAITS 2004.

Characteristic	Total weighted % or mean, SE (n)	Analytic weighted % or mean, SE (n)	p-value§
Age, mean in years	37.03, 0.26 (3199)	38.09, 0.32 (2213)	0.82
18–29 years	37.3 (829)	33.6 (483)	0.18
30–39 years	28.1 (1192)	28.7 (853)	0.76
40–49 years	16.9 (574)	18.2 (426)	0.59
50+ years	17.6 (604)	19.5 (451)	0.43
Sex			
Male	52.0 (1782)	52.3 (1236)	0.87
Female	48.0 (1446)	47.7 (977)	0.88
Marital status			
Married	73.4 (2502)	79.0 (1857)	<0.05
Divorced	2.3 (78)	1.8 (42)	0.86
Widowed	1.8 (60)	2.2 (48)	0.88
Separated	0.6 (21)	0.4 (9)	0.94
Never married	20.5 (514)	15.9 (244)	0.13
Member of unmarried couple	1.4 (38)	0.7 (13)	0.84
Educational attainment			
Less than high school	5.6 (158)	6.5 (122)	0.76
High school degree	6.5 (192)	6.4 (131)	0.97
Some college/tech	10.2 (279)	8.4 (154)	0.54
College degree	31.3 (998)	30.3 (666)	0.67
Graduate/professional degree	46.4 (1604)	48.4 (1140)	0.30
Annual household income			
<$20 K	9.5 (240)	9.3 (161)	0.94
$20–$50 K	17.6 (454)	17.1 (311)	0.86
$50–$75 K	17.0 (447)	17.2 (319)	0.94
$75–100 K	22.4 (599)	23.6 (450)	0.64
>$100 K	33.5 (1021)	32.8 (724)	0.76
Health status			
Excellent	38.4 (1232)	37.4 (828)	0.65
Very good	36.1 (1174)	37.0 (812)	0.68
Good	19.4 (631)	19.7 (446)	0.90
Fair	4.8 (147)	4.8 (101)	1.00
Poor	1.2 (42)	1.2 (26)	1.00
Health insurance			
Yes	89.5 (2903)	89.1 (1988)	0.65
No	10.5 (298)	10.9 (211)	0.89
Cigarette smoking status			
Current smoker	5.4 (168)	4.1 (92)	0.65
Past smoker	9.4 (342)	9.5 (232)	0.97
Never smoker	85.2 (2715)	86.4 (1889)	0.25
Birth country			
USA or Westernized country	10.1 (306)	2.1 (41)	0.09
India or non-Westernized country	89.9 (2848)	97.9 (2172)	<0.05
Acculturation items			
Years lived in the U.S., mean**	12.48, 0.20 (2951)	12.10, 0.23 (2213)	0.97
Percentage lifetime in U.S., mean**	32.23, 0.48 (2951)	30.71, 0.53 (2213)	0.96
Acculturation scale −11-item, 0–100 range, mean***	39.02, 0.38 (2712)	36.16, 0.38 (2213)	0.92
0–20 scale score	12.3 (318)	14.0 (295)	0.54
>20–40 scale score	43.2 (1187)	47.6 (1064)	0.04
>40–60 scale score	31.8 (864)	30.9 (686)	0.70
>60–100 scale score	12.7 (343)	7.5 (168)	0.08
Religious self-identification			
I believe that I am a religious person			
Strongly agree	42.9 (1262)	44.5 (967)	0.45
Somewhat agree	36.4 (1091)	35.5 (796)	0.69
Neither agree or disagree	8.2 (256)	7.9 (187)	0.91
Somewhat disagree	7.3 (220)	7.2 (164)	0.97
Strongly disagree	5.3 (145)	4.9 (99)	0.89
Religious beliefs			
My spiritual beliefs are the foundation to my approach to life			
Strongly agree	53.6 (1567)	55.6 (1232)	0.29
Somewhat agree	30.3 (888)	29.4 (650)	0.70
Neither agree or disagree	6.8 (210)	6.3 (148)	0.85
Somewhat disagree	5.2 (143)	5.0 (101)	0.94
Strongly disagree	4.1 (120)	3.7 (82)	0.89
Religious participation			
I observe the traditional holidays that are important in my culture and religion			
Yes, almost always	33.2 (1031)	35.4 (745)	0.34
Yes, much of the time	22.9 (756)	24.9 (561)	0.40
Yes, some of the time	31.7 (1059)	30.4 (712)	0.56
No, rarely or never	12.2 (383)	9.3 (195)	0.30
Religious affiliation			
Hinduism	59.8 (1950)	64.8 (1472)	<0.05
Sikhism	19.6 (574)	22.6 (449)	0.24
Islam	5.8 (180)	5.3 (120)	0.86
Other****	8.0 (246)	7.1 (152)	0.74
Atheism/agnosticism	6.7 (220)	n/a	–
*Body mass index (BMI, kg/m^2), mean*****	24.08, 0.08 (3122)	24.44, 0.09 (2213)	0.99

*Column totals may not sum to 100% due to rounding error or missing observations. Sample weights were applied to percentages/means to adjust for the complex survey design and for differential non-response.
**Limited to respondents not born in the United States.
***Acculturation scale, total sample: alpha = 0.73, median = 37.6, standard deviation = 17.4; analytic sample: alpha = 0.73, median = 35.0, standard deviation = 15.5.
****Other religious affiliation: Christianity, Judaism, Jainism, Zoroastrianism, Buddhism.
*****Mean BMI includes those with BMI < 18.5 kg/m^2 in total sample. Percentage overweight/obese (BMI ≥ 25 kg/m^2) by religious affiliation in total sample: Total 39.2%, Hindus 34.0%, Sikhs 51.7%, Muslims 41.6%, Other 42.1%, Atheists/agnostics 40.1%; in analytic sample: Total 39.2%, Hindus 34.1%, Sikhs 53.5%, Muslims 39.1%, Other 40.8%.
§ Differences in means obtained from *t*-test and differences in proportions from z-test, two-tailed test, significance level 0.05.

has been positively associated with obesity in Whites, African Americans, Hispanics, and Chinese Americans (Feinstein et al., 2010; Feinstein et al., 2012; Gillum, 2006), though these association may be explained by sociodemographic and health status confounders (Feinstein et al., 2012; Gillum, 2006). Religiosity and greater body mass index have been found to vary among Christian subgroups as well (Cline and Ferraro, 2006; Ferraro, 1998; Kim et al., 2003; Lapane et al., 1997). These studies have not included Asian Indians or traditional Asian Indian religions. Different religious affiliations within the heterogeneous Asian Indian community may affect smoking, drinking, and dietary practices (Eliasi and Dwyer, 2002; McCaffree, 2002). Our objective was to examine the association of religiosity with overweight/obesity among a multi-religious group of California Asian Indians.

Methods

Data source

The California Asian Indian Tobacco Use Survey (CAITS) was a multilingual (English, Gujarati, Hindi, or Punjabi), cross-sectional telephone survey administered to adults of Asian Indian background and resident in California in 2004 (McCarthy et al., 2005). Respondents provided information about health status, health services use, tobacco use, acculturation, and socio-demographics. Respondents were randomly sampled from phone lists of Asian Indian-surnames obtained from Social Security (Lauderdale and Kestenbaum, 2000) and parent names on birth certificates recorded in 1998–2002 from the California Department of Health Services. Using a stratified random sample, the household response rate was 67%, and within the household, the randomly selected interviewee response rate was 81%. The final number of respondents was 3228 (McCarthy et al., 2005). We received IRB exemption for these secondary data analyses.

Body mass index (BMI)

BMI was calculated from self-reported weight and height. BMI was missing for 106 observations (3.3% of the full sample); an additional 113 observations were dropped because of the association of underweight BMI (BMI < 18.5 kg/m^2; 3.5%) with malnutrition and other health problems (Flegal KM et al., 2005). In multivariate analysis, BMI was dichotomized as healthy (18.5 ≤ BMI < 25 kg/m^2) or overweight/obese (BMI ≥ 25 kg/m^2) (World Health Organization, 2004).

Religiosity

Religiosity was a composite of three measures: "I believe that I am a religious person," "My spiritual beliefs are the foundation of my approach to life," and "I observe the traditional holidays that are important in my culture and religion," which correspond to religious self-identification, religious beliefs (Schaefer and Gorsuch, 1991), and religious participation (Strawbridge et al., 1997), respectively. Responses for the first two items were on a 5-point Likert scale and responses for the third item were on a four-point scale (Table 1).

Principal components analysis of these items yielded a common factor, from which factor scores were obtained (coefficient alpha = 0.64). The religiosity composite was missing on 384 observations (10.7% full sample). Religiosity was dichotomized into the top quintile of religiosity versus a lower level of religiosity comprising the bottom four quintiles. Differences in demographics were observed comparing the highest religiosity quintile to the bottom four quintiles, and these differences could potentially confound the focal relationship between religiosity and BMI (Appendix A). Specifically, the highest religiosity quintile had a greater proportion of respondents who were older, female, married, had less than a college education, made less than $100,000 annual household income, were uninsured, non-smokers, and reported suboptimal health status compared to the bottom four religiosity quintiles.

Covariates

We included socio-demographic characteristics, illness burden, health care access, and acculturation as covariates in our analysis. We gauged illness burden by using self-reported health status, previously shown to be associated with mortality in a multiethnic cohort (McGee et al., 1999), and cigarette smoking status. We used having health insurance as a proxy measure for access to care. Socio-demographics included age, sex, marital status, educational attainment, and annual household income. Missing and refused observations were dropped from the analyses: 29 missing for age, 15 for marital status, 6 for educational attainment, 467 for income, 2 for health status, 27 for health insurance coverage, and 3 for smoking status.

Acculturation was assessed two ways. The first measure was percentage of lifetime in the U.S. calculated from years lived in the U.S. divided by respondent's current age. Years lived in the U.S. was answered only by foreign-born respondents, so 44 missing observations were dropped. Percentage of lifetime in the U.S. may be a better temporal measure than years lived in the U.S. because the former may better quantify the proportion of lifetime exposure to American cultural practices.

The second measure of acculturation was derived from a scale of 11 questions representing six aspects of acculturation: language use, media behavior, social customs, social contacts, cultural identity, and generational status (Appendix B provides description of core items). These items have been included in existing scales of acculturation (Abe-Kim et al., 2001; Anderson et al., 1993; Chung et al., 2004; Suinn et al., 1992). The unidirectional acculturation scale was standardized on a 0–100 scale, with higher scores indicating greater acculturation to American cultural practices (mean of 39 and a standard deviation of 17, median of 38, and Cronbach alpha of 0.73). A total of 2712 respondents had completed scale scores and non-respondents were not demographically different from respondents. The correlation between percentage of lifetime in the U.S. and the acculturation scale was r = 0.4.

Statistical analysis

We describe the prevalence of baseline characteristics in the total and analytic samples in Table 1. Multivariate binary logistic regression analyses were performed to estimate the odds of being classified as overweight/obese as a function of greater religiosity, adjusted for socio-demographic characteristics, illness burden, and acculturation. We dichotomized marital status, educational level, health status, and smoking status. Income was omitted from the model because of the large number of missing values for the variable. Insurance status was omitted as all persons with overweight/obese BMI had health insurance. Our analytic sample was limited to 2213 Asian Indian adult immigrants. The analytic sample was demographically similar to the total sample, except the analytic sample had more respondents who were married, born in India or non-Westernized country, affiliated with Hinduism, and had no atheists/agnostics (Table 1). Multivariate models were also stratified by religious affiliation. Religious affiliation was categorized as Hinduism, Sikhism, Islam, or Other. The "other" religious affiliation included Christianity, Judaism, Jainism, Zoroastrianism, and Buddhism. We conducted mediation analysis using the Sobel–Goodman (Sobel, 1986; UCLA: Statistical Consulting Group) and Karlson/Holm/Breen (Karlson and Holm, 2011) tests to determine if smoking status, health status, or educational attainment mediated the relationship between religiosity and BMI.

Post-stratification adjustment weights were used in the analyses to correct for nonresponse and noncoverage (i.e., surname missing from sampling frame). The post-stratification adjustment was stratified by gender and age grouping; strata sizes were determined using the 2000 Census distribution of Asian Indians in California (McCarthy et al., 2005). All analyses were conducted with STATA version 12.0.

Results

The mean age of Asian Indians in California was 37 years; most of the sample was married, well-educated, and insured (Table 1). On average, one-third of respondents' lives were spent in the U.S. More than half of the respondents were highly religious, and the majority practiced Hinduism, followed by Sikhism, other religions, and Islam. Approximately 40% were overweight/obese, and the mean BMI was 24.4 kg/m^2. Hindus had the lowest mean BMI at 24.1 kg/m^2 (34% overweight/obese) and Sikhs had the highest mean BMI at 25.2 kg/m^2 (52% overweight/obese). Mean BMI was greater among the highly religious compared with the less religious, and for those affiliated with Hinduism, Sikhism, or other religions (Fig. 1).

In the multivariate analysis, those in the highest religiosity quintile had 1.53 greater odds of being overweight/obese relative to all others (95% CI: 1.18, 2.00; Table 2). This increased odds ratio persisted for Hindus (OR 1.54, 95% CI: 1.08, 2.22) and Sikhs (OR 1.88, 95% CI: 1.07, 3.30), but not for Muslims. Other known predictors for overweight/obese BMI demonstrated associations consistent with previous literature, such as being male and married, while there were protective associations with having a college degree or higher education and excellent/very good health status (Kaplan et al., 2003). Acculturation was not significantly associated with BMI in adjusted models.

Some researchers have suggested lower BMI cut-offs for Asians, with overweight as BMI ≥ 23 kg/m^2 and obese as BMI ≥ 25 or 27.5 kg/m^2, though a recent study found no mortality differences among Asians at these lower BMI cut-offs (Misra and Khurana, 2011; World Health Organization expert consultation, 2004; Zheng et al., 2011). We found the association of overweight/obesity status with religiosity and other covariates to be similar across different BMI classifications and regardless of whether BMI was treated as a continuous variable or categorical variable (BMI ≥ 23 kg/m^2 vs. 18.5 ≤ BMI < 23 kg/m^2 or BMI ≥ 30 kg/m^2 vs. 18.5 ≤ BMI < 30 kg/m^2). In subgroup analyses, while overweight respondents (25 ≤ BMI < 30 kg/m^2) were more likely to be younger, male, more educated, have better health status, and be a past smoker than obese respondents (BMI ≥ 30 kg/m^2; all significant at $p < 0.005$), the association with high religiosity did not vary greatly (OR 1.45 overweight vs. OR 1.50 obese subgroup, $p < 0.05$). Whether underweight persons were included or excluded ((BMI < 18.5 kg/m^2), our results remained similar. BMI may differ for the elderly and may increasingly reflect the consequences of ill-health with increasing age (Lauderdale and Rathouz, 2000); however, our associations were similar when we limited our analyses to respondents aged >60 years.

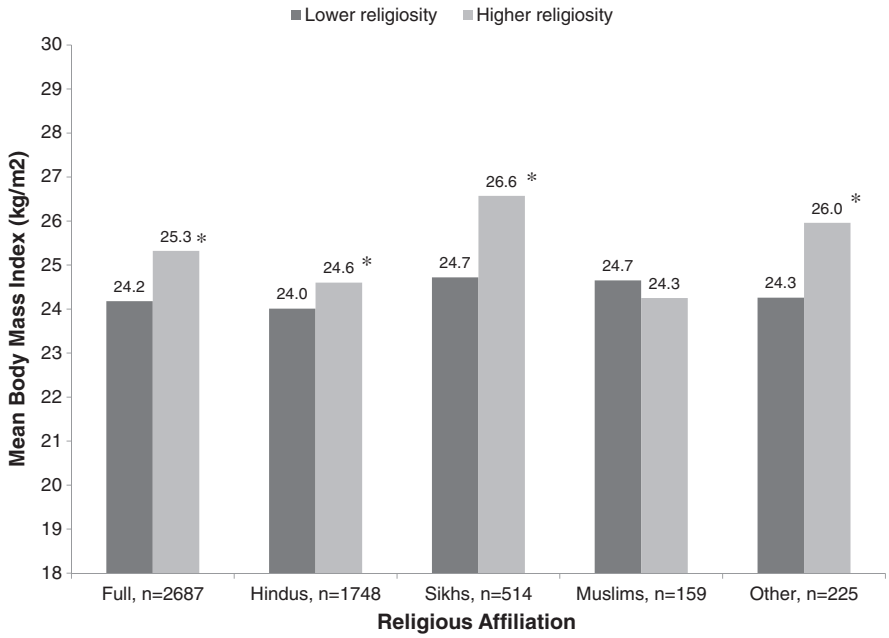

Fig. 1. Distribution of mean body mass index by religiosity level among Asian Indians in California, 2004.

Mean religiosity decreased linearly with greater acculturation scale score or percentage of lifetime in the U.S. (Fig. 2). Since prior research has shown a positive relationship between acculturation and overweight/obesity, we examined if acculturation moderated the association of religiosity with overweight/obesity through an interaction term. However, the interaction was not significant in adjusted models. Educational attainment was a significant mediator of the relationship between religiosity and overweight/obesity; the proportion of the total effect explained by the mediation ranged from 0.13 (BMI as a continuous variable; linear regression) to 0.19 (overweight/obesity categorical variable; logit regression). Among the participants who reported income (n = 1965), the proportion of the focal relationship mediated by education was 0.17 and income was 0.11. Smoking status and health status were not significant mediators.

Discussion

The positive association between religiosity and BMI among Asian Indian adults varied in magnitude by religious affiliation. Asian Indian immigrants who were male, married, less educated, and had less favorable health status also had greater odds of being overweight/obese. Our findings are consistent with prior cross-sectional analyses involving diverse, non-Asian Indian populations (Cline and Ferraro, 2006; Feinstein et al., 2010; Ferraro, 1998; Gillum, 2006; Kim et al., 2003; Lapane et al., 1997).

Several theories may explain why greater religiosity is associated with increased overweight/obesity risk. One explanation is the low prevalence of cigarette smoking among religious individuals (Kim et al., 2003), who therefore fail to benefit from nicotine as an appetite suppressant. However, analysis of the CAITS data showed no association between smoking status and BMI, perhaps because smoking prevalence in this population was exceptionally low. Other reasons may include the greater emphasis that religious organizations place on avoiding smoking than avoiding gluttony, the welcoming environment that religious organizations offer for those seeking protection from the social stigma of obesity, and/or that religious gatherings often involving consuming food and drink (Cline and Ferraro, 2006; Krause et al., 2002).

Immigration, with its attendant exposure to an obesogenic culture in the U.S., may also increase risk of overweight/obesity among Asian Indians. The risk of being overweight or obese in foreign-born immigrants from diverse ethnic backgrounds escalates with increasing duration of residence in the U.S. (Akresh, 2008; Argeseanu Cunningham et al., 2008; Barcenas et al., 2007; Goel et al., 2004; Gordon-Larsen et al.,

Table 2
Logistic regression unadjusted and adjusted odds ratio (OR) examining the association of religiosity with body mass index-based overweight/obesity status in Asian Indian immigrants in California, 2004 (95%CI).

	Unadj. OR full sample n = 2687	Adjusted OR full n = 2213	Hindus n = 1472	Sikhs n = 449	Muslims n = 120	Other n = 152
High religiosity	1.74 (1.40, 2.16)	1.53 (1.18, 2.00)	1.54 (1.08, 2.22)	1.88 (1.07, 3.30)	0.69 (0.28, 1.70)	1.46 (0.48, 4.41)
Acculturation scale		1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	0.99 (0.98, 1.01)	1.01 (0.98, 1.04)	0.99 (0.97, 1.02)
Percentage life in U.S.		1.01 (1.00, 1.01)	1.00 (1.00, 1.01)	1.01 (1.00, 1.02)	0.98 (0.96, 1.00)	1.01 (0.99, 1.04)
Age		1.02 (1.01, 1.03)	1.02 (1.01, 1.03)	1.02 (1.00, 1.04)	1.00 (0.97, 1.03)	1.00 (0.97, 1.03)
Male sex		1.69 (1.38, 2.07)	1.51 (1.17, 1.95)	2.01 (1.30, 3.11)	1.72 (0.66, 4.51)	2.11 (0.92, 4.86)
Married		1.84 (1.37, 2.48)	1.80 (1.22, 2.66)	1.41 (0.78, 2.54)	1.70 (0.55, 5.25)	8.09 (2.49, 26.8)
College degree or higher		0.54 (0.41, 0.71)	0.49 (0.33, 0.74)	0.80 (0.49, 1.29)	1.31 (0.47, 3.69)	0.64 (0.15, 2.77)
Excellent/very good health status		0.72 (0.58, 0.91)	0.69 (0.52, 0.91)	0.90 (0.56, 1.45)	0.78 (0.32, 1.92)	0.40 (0.15,1.06)
Current smoker		1.21 (0.69, 2.11)	1.28 (0.65, 2.52)	2.45 (0.41, 14.8)	1.15 (0.27, 4.88)	0.69 (0.14, 3.42)

CI = confidence interval.
High religiosity defined as the highest religiosity quintile (vs. bottom four quintiles).
"Other" religious affiliation includes: Christianity, Judaism, Zoroastrianism, Jainism, Buddhism.

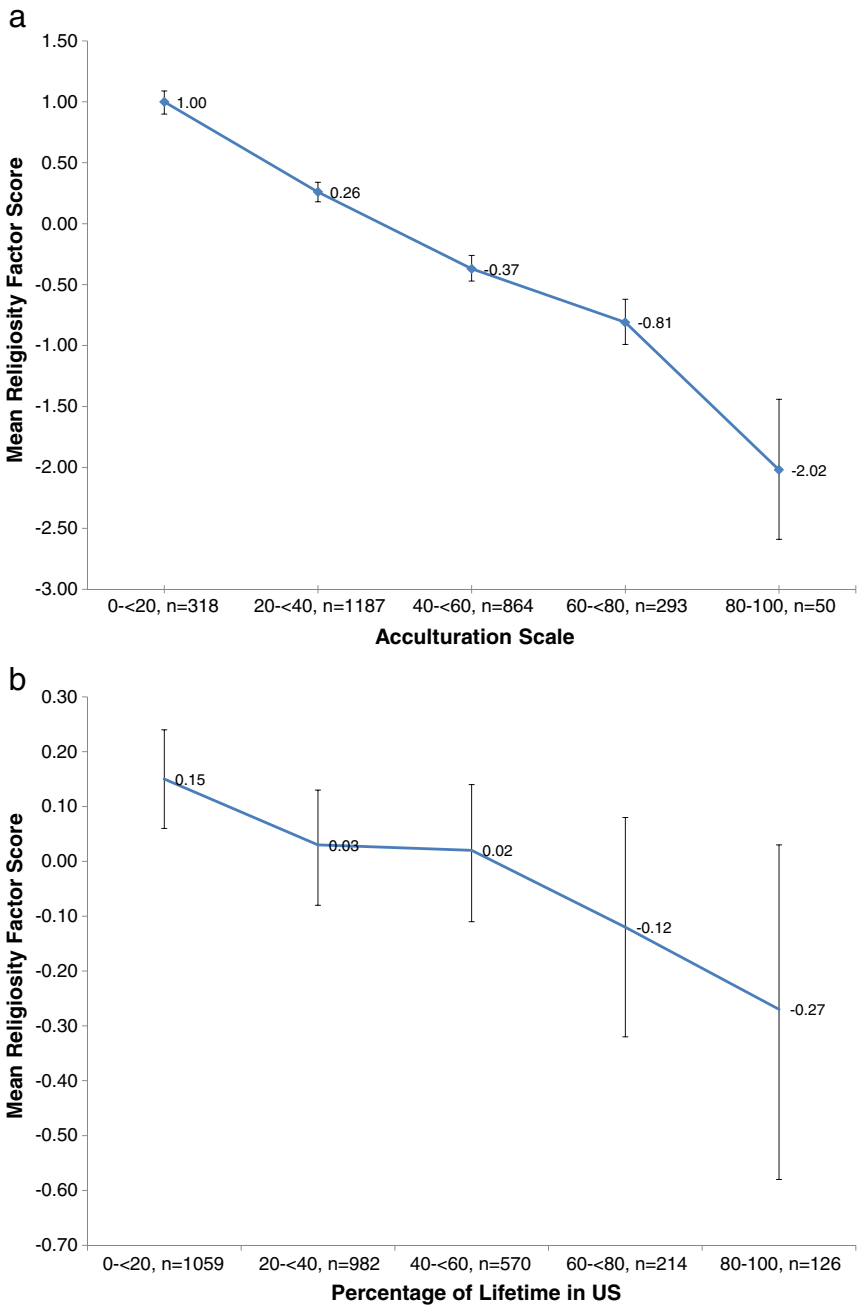

Fig. 2. Mean religiosity factor score by acculturation among Asian Indians in California, 2004: a) by acculturation scale categories, ologit nonlinear $F(1, 2487) = 313.82$, $p < 0.0001$, $n = 2488$; b) by percentage of lifetime in US categories, ologit nonlinear $F(1, 2658) = 10.87$, $p = 0.001$, $n = 2659$.

2003; Kaplan et al., 2004; Kaushal, 2009; Koya and Egede, 2007; Lauderdale and Rathouz, 2000; Roshania et al., 2008; Sanchez-Vaznaugh et al., 2008; Singh and Siahpush, 2002; Song et al., 2004). We found decreasing religiosity with greater acculturation to American culture among Asian Indian immigrants, and high religiosity was an independent factor associated with being overweight/obese even after controlling for acculturation. Educational attainment was found to be a significant mediator in our analysis and negatively associated with religiosity, but did not fully explain why overweight/obesity co-varied with religiosity.

We found religiosity and being overweight/obese to be positively associated for Asian Indians practicing Hinduism or Sikhism, but not for those practicing Islam. The different religious practices of these religions may explain why. For example, highly religious Muslims will abstain from alcohol in contrast to Hindus or Sikhs who may drink heavily during religious and social gatherings. Higher alcohol intake has been positively associated with weight gain (Breslow and Smothers, 2005; Mozaffarian et al., 2011; Raymond and Sukhwant, 1990). Alternatively, practicing Hindus and Sikhs limit themselves to plant foods, but foods high in saturated fat and refined sugar associated with increased overweight/obesity risk are commonplace at their religious ceremonies (Bes-Rastrollo et al., 2008; Deedwania and Singh, 2005; Jonnalagadda and Diwan, 2002). Highly religious Muslims observe five daily ritual prayers that involve changes in body position that some Muslims may regard as exercise (Greenhalgh et al., 1998; Reza et al., 2002; Tirodkar et al., 2011). However, we did not identify studies that correlated daily prayers with physical activity measures or weight changes. In addition, religious Muslims observe thirty days of fasting every year,

consuming no food or drink from sunrise to sunset. Some studies have suggested that Ramadan fasting is associated with a decrease in body weight and/or BMI during the month (Khaled and Belbraouet, 2009; Temizhan et al., 2000; Ziaee et al., 2006), but these changes do not persist beyond Ramadan (Khaled and Belbraouet, 2009; Khaled et al., 2006). Because diet, alcohol, and physical activity were not measured in this dataset, examination of these behaviors in other data sets may illuminate why traditional Asian Indian religious groups differ from each other in their members' overweight/obesity risk.

Our analyses had several limitations. The cross-sectional data precluded drawing causal inferences about religiosity and BMI. Self-reporting of height and weight data may underestimate one's true BMI, though this bias is unlikely to vary according to religiosity status (Merrill RM, 2009). In addition, the composites used for religiosity and acculturation may not be the most valid or reliable measures of these constructs, which would weaken associations with BMI. Our sample was exceptionally well-educated; its restricted range may not adequately capture associations between socioeconomic status, religiosity, and overweight/obesity. However, the sample was not demographically different from South Asians in the California Health Interview Study (California Health Interview Survey, 2010) despite the fact that three South Asian languages were used in the CAITS to better capture the heterogeneity of the Asian Indian population in California. One possible reason for this may be that fewer low-income Asian Indians respond to telephone surveys regardless of what language the interviewers speak.

Strengths of this study were the large random sample of Asian Indians and new health information on this population including acculturation, religious affiliation, and religiosity measures. Asian Indians may be socially and linguistically isolated from the majority community and they may derive social support from the religious community, which may actually encourage behaviors that increase the risk for overweight/obesity (Pollard et al., 2003). This may be especially true for recent immigrants, those with low English fluency, and women.

Increasingly obesity is being seen as a lifestyle-related disease (Dunstan et al., 2010). A major influence on lifestyle is religion (Powell et al., 2003). To have greater impact on lifestyle-related diseases, clinicians need to discuss with their patients the role that religion plays in the choice to smoke, drink alcohol, limit food choices to plant foods, and the forms of permissible exercise (Dagkas and Benn, 2006; Koenig, 2004; Spencer et al., 2007). Even if patients are not religious, their satisfaction with clinical care is enhanced when the clinician makes the effort to inquire about their religious practices (Williams et al., 2011). It is relevant for clinicians and public health practitioners who care for Asian Indians to be aware of how religiosity and religious affiliation may impact lifestyle practices and obesity risk, especially given that Asian Indians are at increased risk for diabetes mellitus and cardiovascular disease at younger ages (Joshi et al., 2007). More generally, understanding an immigrant patient's values and social norms may help healthcare providers to be more effective in encouraging healthier lifestyles. As such, religiosity is likely not only a factor for overweight/obesity risk and obesity-related illnesses, but may be important to include in health promotion strategies targeting Asian Indians.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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