Can Religion Help Prevent Obesity? Religious Messages and the Prevalence of Being Overweight or Obese Among Korean Women in California

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This research examines the influence of messages from religious leaders and congregants on whether Korean women are overweight or obese. Data were drawn from telephone interviews with a probability sample (N = 591) of women of Korean descent living in California. Overweight or obese prevalence was measured using World Health Organization standards for Asians (BMI > 23). Respondents reported the frequency of messages discouraging "excessive eating" or encouraging "exercise" from religious leaders and congregants during a typical month. When conditioned on leaders' messages, the frequency of congregants' messages was associated with a significantly lower probability of being overweight or obese, although messages from either in the absence of the other were unassociated with being overweight or obese. At least for Korean women, religion may help prevent obesity via religious-based social mechanisms.

INTRODUCTION

In the American context, both religious beliefs (Sherkat and Ellison 1999) and obesity (Chang and Lauderdale 2005) are common. Approximately 31 percent of adults are obese and 66 percent are overweight or obese, and these figures continue to increase (Chang and Lauderdale 2005; Hedley et al. 2004). Being overweight or obese increases the risk for Type 2 diabetes, cardiovascular disease, mortality, limited respiratory function, reduced physical function, and

reduced quality-of-life. One of the most efficacious preventatives of these problems is healthy diet and exercise.

Persons of Korean descent constitute a rapidly growing minority in the United States (Yu, Choe, and Han 2002). Korean migration to the United States has been associated with sharp increases in Christian participation (Hurh and Kim 1990; Kwon, Ebaugh, and Hagan 1997; Kwon, Kim, and Warner 2001). For instance, a regional survey of Koreans in Chicago found that 21 percent of respondents were affiliated with a Christian church in Korea compared to 77 percent after immigration to the United States (Hurh and Kim 1990). Korean churches are socially inclusive and ethnically homogeneous, offer a place of cultural preservation, and provide social services to members who share similar problems (Hurh and Kim 1990; Kwon, Ebaugh, and Hagan 1997; Kwon, Kim, and Warner 2001). We are aware of only two population-based studies exclusively focused on religion and health among Korean Americans. Hofstetter et al. (2010) found religious participation among Korean Americans was positively associated with healthy tobacco control behaviors, for example, rules against smoking. Ayers et al. (2009) found that messages among Korean women discouraging "excessive drinking" were associated with a lower probability of any drinking and among current drinkers. However, the degree to which religion facilitates positive health outcomes among Korean Americans and how religion is associated with the prevalence of overweight or obesity more broadly remains unclear.

Since 95 percent of Korean Americans in California were born in South Korea (Hofstetter et al. 2004), it is important to consider obesity patterns there. Obesity disproportionately impacts developed rather than developing populations and is rapidly increasing with economic growth in Asia (Kim, Moon, and Popkin 2000; Popkin 2001). Kwon et al. (2007) observed a 2.5-fold increase in obesity (though they used a higher than necessary cut point, BMI > 30) among men and 2.3-fold increase among women in Korea from 1992 to 2000. In 2001 about 30.6 percent (32.4 percent in men and 29.4 percent in women) were overweight or obese (BMI> = 25) an increase from 13.9 percent (11.7 percent in men and 18.0 percent in women) in 1995 (Kim, Ahn, and Nam 2005).

Immigration and exposure to an obesogenic culture in the United States may increase obesity among Koreans in the United States. Koreans in the United States are characterized by relatively high rates of being overweight or obese compared to whites (Cho and Juon 2001) and this may be increasing with acculturation (Song et al. 2006). Cho and Juon (2006) found that approximately 50 percent of Korean Americans in California were overweight or obese, higher than that for all other ethnic groups in California, including whites.

Religiosity has been associated with numerous desirable health outcomes and behaviors (George, Ellison, and Larson 2002) but associations with obesity in observational studies are rarely reported and the results are mixed. An early study by Ferraro (1998) found states with either a larger proportion of residents claiming religious affiliation or Baptists had more obese residents. In the same study religious practice was positively associated with BMI. Kim, Sobal, and Wethington (2003) found that men in conservative Protestant denominations had a 1.17 (+/−.45) higher body mass index (about five pounds heavier) than men with no religious affiliation but no statistically significant associations were observed among women. Lapane et al. (1997) found church members in a New England community study were 19.3 percent more likely to be overweight than nonchurch members. Gillum (2006) in the largest study to date found crude associations between religious service attendance and increased odds of being overweight or obese (58 percent among weekly attendees versus 53 percent for less frequent attendees) but this association was no longer statistically significant after adjusting for individual traits.

Other research suggests religion may promote a healthy body weight. Participation in religious organizations has been associated with increased consumption of fruits and vegetables and decreased consumption of fatty food (Hart et al. 2007). Wallace and Forman (1998) found that high school seniors who professed high and medium-high levels of religiosity were more likely to eat properly than those who professed medium-low and low levels of religiosity.

Unfortunately, the theoretical assumptions favoring positive or negative associations with obesity using religious indicators are not articulated in these studies. One exception was Cline and Ferraro's (2006) study that suggested consuming more religious media was positively associated with obesity among women with the clear assumption that increased consumption was associated with sedentary lifestyles. However, we are unaware of observational studies linking specific religious reinforcement to obesity. Moreover, Cline and Ferraro (2006) argued that churches might not advocate healthy weight control through diet and exercise except for a few religious denominations like Seventh Day Adventists and Mormons.

The uncertainty surrounding the possible religion and obesity connection and failure to identify possible health mechanisms in religious settings may be due to inadequacies in both theory and methods. Scholars of religious influence consistently focus on ideational qualities of religiosity and measures of participation with minimal innovation over 40 years, for example, consider studies associating religion and alcohol use (Michalak, Trocki, and Bond 2006; Straus and Bacon 1953). Without taking into account and measuring other aspects of religious influence, religion and health scholars have omitted consideration of prominent risk factors and outcomes like obesity. This exploratory study estimates the possible association between social contingencies for diet or activity and weight status that might be promoted through religious institutions.

Following the behavioral ecological model, an extension of social learning theory developed by Hovell, Wahlgren, and Gehrman (2002), social reinforcement may explain religious health influences. Religious institutions include the operation of peer networks in which behaviors are modeled and reinforced. This view assumes that some faiths explicitly prescribe good health habits, which prohibit smoking, alcohol use, sex outside of marriage, and overeating, and most faiths, if not all, teach that the body is a temple for the soul and should be treated with respect and appreciation (Chatters 2000; Ellison and Levin 1998; George, Ellison, and Larson 2002; Levin 1994). As a result, it is likely that some churches promote such teachings in the form of religious leaders' and congregants' messages. It is even more likely among immigrant or ethnic churches since they are accustomed to sending messages outside of religion's natural purview, often helping with an array of social and personal problems, including downward social mobility, as is true among Korean Americans (Hurh and Kim 1990).

Indeed, Steinman and Bambakidis (2008) using data from the General Social Survey suggest a high degree of church involvement in health promotion, though they were unable to address associations with health outcomes due to data limitations. Some work has connected the role of specific messages in religious settings but most of this has been in the religiopolitical literature. Paul Djupe has made among the strongest arguments in favor of viewing religious institutions as peer networks with religious messages being among the primary social mechanisms of interpersonal influence (Djupe and Gilbert 2003). One such study showed that exposure to bishops' messages admonishing support of liberal politicians among Catholics was associated with a Bush preference for political conservatives but a Kerry preference for political liberals (Hofstetter, Ayers, and Perry 2008). A focus on such social mechanisms within churches may be similarly effective in the religiohealth literature, as Ellison et al. (2006) suggest.

Other ecological models have drawn attention to many levels of social influence (Glass and McAtee 2006) but the behavioral ecological model differs by assuming the influence of proximal reinforcers is conditioned on that of distal reinforcers. For instance, religious leaders may discourage fatty food consumption and encourage exercise among parishioners, which may encourage individuals in the religious institution to reinforce these same behaviors through peer-to-peer messages. Exposure to higher level contingencies may also condition members to be more susceptible to congregants' messages. This interaction of messages may reduce obesity and these expectations lead to the following hypotheses:

H1: Persons exposed to leaders' messages encouraging healthy eating and/or exercise will report greater exposure to similar messages from congregants.

> H2: Exposure to leaders' or congregants' messages encouraging healthy diet and/or exercise will be associated with a lower probability of being overweight or obese.
>
> H3: Leaders' messages moderate the association among congregants' messages and obesity, so exposure to leaders' messages will strengthen the negative association between congregants' messages and lower probability of being overweight or obese.

<h2 style="text-align:center">METHODS</h2>

Data were drawn from a 2007 telephone survey ($N = 591$) representative of Korean women in California (aged 18 or over). California provides a useful setting since about one-third of people of Korean descent in the United States reside in California (U.S. Census Bureau 2000). The survey instrument was designed to collect data concerning Korean-American women's health. The instrument was first developed in English and back translated into Korean with the assistance of international co-investigators in Seoul, South Korea, and in the United States. The instrument was pilot tested using focus groups to ensure accurate translation and valid response options.

An electronic list of telephone subscribers with the 300 most common Korean surnames (encompassing over 95 percent of all Korean surnames) was purchased from a commercial firm that compiled its list from listed numbers in telephone directories as well as membership, warrantee, subscription, and other sources so that the sample represented Koreans in California fairly accurately. Respondents were drawn randomly from the list and further screened for ethnicity by interviewers to ensure that all were adult women of Korean descent.

Closely supervised, bilingual, professional interviewers conducted the interviews. Interviews were conducted with the adult in the household who had the most recent birthday. About 70 percent of eligible persons contacted completed interviews and 92 percent of the interviews were conducted in the Korean language by participant preference. The sample slightly overrepresented older women and underrepresented younger women. Findings were replicated when analyses were weighted by age from the U.S. Census for California (U.S. Bureau of the Census 2000). There were no meaningful differences in significance results, although weighted data were used in analysis to ensure accurate point estimates for population parameters. All procedures were approved by the Institutional Review Board at San Diego State University.

Measures

Obesity was measured by computing BMI as indicated by self report, kg/m^2. Following established practice for Asians, persons with BMI > 23 were classified as being overweight and BMI over 27.5 as obese (Yajnik and Yudkin 2004). Exposure to religious leaders' messages was measured by a composite of: "About how many times during an average month does the Christian minister, father, Buddhist priest, Muslim imam, counselor in your religious institution include any message . . . against excessive eating . . . encouraging exercise?" Responses were summed to form a single reliable item (Kuder Richardson 20 = .94). Exposure to messages from fellow congregants was measured by: "About how many times during an average month do acquaintances who are not church officials at your religious institution include any message . . . against excessive eating . . . encouraging exercise?" Responses were summed to form a single reliable scale (Kuder Richardson 20 = .81).

Kuder-Richardson 20 (KR20) is an approximation of the interitem correlation for dichotomous items (Cronbach's alpha is the equivalent for continuous items) that, according to Ghiselli (1964:286), is often an underestimate of reliability. The KR20 for messages on healthy diet and exercise were greater than .80 for both leaders and congregants, suggesting strong reliability and these messages identify the same concept: reinforcement discouraging obesity. Both leader and congregant scales were transformed to constrain right skewness for multivariable analysis (not

descriptive or bivariate analysis) by replacing the top 5 percent of cases with the 95th percentile value.

An interaction term multiplying leaders' and congregants' dietary/exercise messages was included in the multivariable model. This term represents the association between congregants' messages and overweight or obesity when conditioned on higher level reinforcement by ministers.

Exercise was measured by reports of either obtaining 10 minutes of moderate activity (more than five days per week) or 10 minutes of aerobic exercise (more than three days per week). Given the small variances within classifications for moderate, 6 percent, and aerobic exercise, 7 percent, a single variable was computed. Reports of either moderate or aerobic exercise were coded 1, otherwise 0. While this measure does not constitute the current CDC/ACSM recommended guidelines (Pate et al. 1995), lesser physical activity has been associated with reduced health risks (Caspersen, Powell, and Christenson 1985) and possibly lower BMI.

Acculturation was assessed using the Suinn-Lew Asian Self-Identity Acculturation Scale (Suinn, Khoo, and Ahuna 1995; Suinn et al. 1987) adapted to telephone interviewing (Song et al. 2004). Eleven items were used to measure aspects of cultural preferences involving language, music, food, and self-identification including how persons identified with the United States and Korea, father's identification, and social linkages including ethnicity of peers and preferred associations. After conversion to a common metric (z-scores), the items were summed (Cronbach's $\alpha = .90$).

Religious attendance was coded into three dummy indicators for no attendance (no religious service attendance), infrequent attendance (less than once per week), and frequent attendance (at least once per week) following methods used by Gillum (2006). For purposes of analysis, no attendance was specified as the reference category.

Years of education, after correcting for overlapping years of education in the United States and in Korea, age in years, working outside the home, income, and marital status were measured by self-report. Age was transformed due to right skewness by replacing the top 5 percent of cases (73 or older) with the 95th percentile value for multivariable analysis. Slightly less than 45 percent did not provide data for family income, and income was been omitted from further analysis.

Measures of religious beliefs or doctrine were not included in the final analysis. Except for Kim, Sobal, and Wethington (2003) and Fraser (2003), we are unaware of studies that identify mechanisms for diet and exercise advocacy in religious beliefs or denominations. As a result any association between denominations and overweight or obesity may be spurious and atheoretical. Seventh-Day Adventists and Mormons are groups with strong health behavioral convictions, but only 12 respondents reported affiliation with these groups, and no difference in results was apparent when these women were excluded from analysis. Of the total sample, about 44 percent were Presbyterian, 12.8 percent Catholic, 7.8 percent Baptist, 4.3 percent Methodist, 4.3 percent nondenominational, 13 percent miscellaneous Christian, 3.1 percent Buddhist, and 10.6 percent reported no religious preference. Analyses were computed with and without denominational indicators and the results were consistent with those reported in this article regardless of the inclusion of religious denomination and with various selections of denominational measures. These analyses revealed no significant associations among denomination and obesity. It is possible that messages on healthy diet and exercise are more common in some denominations than others but this remains beyond the purview of this study.

Analysis Strategy

The analysis proceeds in two steps. First, descriptive characteristics of the sample are described. Second, multivariable binary logistic regression was used to decompose the association of leaders' and congregants' reinforcement with being overweight or obese. Statistical diagnostics suggested there were no serious model violations, though analysis relied on a robust variance

Table 1: Characteristics of the sample[a]

Indicator	Mean	95%CI	N
Overweight or obese (BMI > 23)	.305	(.267, .342)	591
Obese (BMI > 27.5)	.041	(.025, .057)	591
Infrequent religious service attendance	.540	(.499, .580)	591
Frequent religious service attendance	.279	(.243, .315)	591
Any physical exercise	.122	(.095, .148)	591
Acculturation	−.283	(−.331, −0.235)	591
Education	15.224	(14.995, 15.452)	591
Work outside the home	.376	(.337, .415)	590
Married	.775	(.741, .809)	591
Age	46.009	(44.842, 47.176)	591

[a]Numbers in cells are means, 95% confidence intervals, and useful sample size.

estimator (White 1982) for hypothesis testing in order to make tests conservative and robust to possible violations.

RESULTS

Ninety-six percent of respondents were born in Korea, mean age was 46 years, and 78 percent were married. Mean years of education was 15.2 and 37.6 percent reported working outside the home. Exercise was uncommon among Korean women with 12.2 percent of respondents reporting at least 10 minutes of moderate activity (more than five days per week) or 10 minutes of aerobic exercise (more than three days per week). Fifty-four percent attended religious services infrequently and 27.9 percent attended religious services frequently. See confidence intervals in Table 1.

Thirty percent of respondents were overweight or obese and 4.1 percent were obese. Korean Americans appear to be less susceptible to excess weight than other women in California. According to the 2005 Behavioral Risk Factor Surveillance System (BRFSS), a subsample of Asian female respondents in California ($N = 194$), about 47.9 percent were overweight and 11.3 percent obese, although interviews for the BRFSS were conducted in English, which confounds weight with acculturation (CDC 2005). Among all Californian women, 51.6 percent were classified as overweight and 22.4 percent obese using standard cut points for Asian and non-Asian respondents where appropriate.
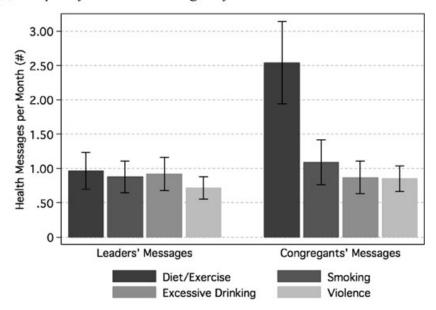
Reports of religious leaders' advocacy on healthy diet and exercise averaged about .967 (95% CI .698, 1.236) messages during a typical month, statistically as common as messages discouraging smoking, excessive drinking, and violence as displayed in Panel A of Figure 1. Reports of congregants' advocacy on healthy diet and exercise averaged about 2.540 (95% CI 1.940, 3.140) messages per month, statistically significantly more than messages discouraging smoking, excessive drinking, and violence. Reports of congregants' messages on healthy diet and exercise were more than twice as common as messages on other health issues, and statistically significant. Since the mean religious service attendance was 5.290 visits per month, the average respondent heard messages on healthy diet and exercise from leaders about one out of every six services and slightly more than two out of every three services from congregants, assuming only one message from each source at any service.

The first hypothesis suggests that women reporting leaders' messages on healthy diet and exercise will be more likely to report similar messages from congregants, since leaders' messages prime congregants to discuss diet and exercise. The data support this hypothesis. Respondents who attended religious services but did not report any messages on healthy diet and exercise from leaders reported on average 2.031 (95% CI 1.270, 2.791) messages on healthy diet and exercise
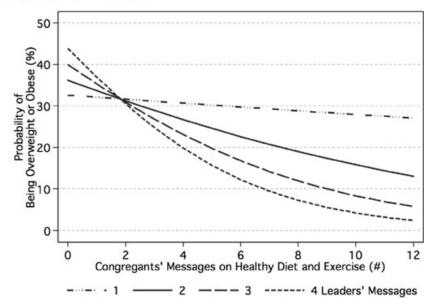
Figure 1
Leaders' and congregants' messages on healthy diet and exercise and overweight
and/or obesity[a]

(a) Frequency of Health Messages by Source

(b) Probability of Being Overweight or Obese by Leaders' &
Congregants' Messages

[a]Panel A shows the mean frequency of health messages per month based on respondents' self-reports. Panel B shows the predicted probability of being overweight or obese by congregants' messages encouraging healthy diet and exercise conditioned on exposure to leaders' messages with all other predictors held at their mean value.

Table 2: Overweight or obese status (BMI > 23) regressed on religious social reinforcers among Californian women of Korean descent, 2007[a]

Predictors	Model 1	Model 2
Leaders' messages on eating and exercise	.878	1.174
	(.724, 1.066)	(.912, 1.511)
Congregants' messages on eating and exercise	1.009	1.069
	(.939, 1.084)	(.987, 1.157)
Leaders' messages * congregants' messages	–	.915**
	–	(.858, .976)
Infrequent religious service attendance	1.849*	1.717
	(1.023, 3.339)	(.943, 3.124)
Frequent religious service attendance	1.990*	1.703
	(1.040, 3.807)	(.869, 3.336)
Physical exercise	.335**	.352**
	(.171, .656)	(.179, .691)
Acculturation	.905	.896
	(.603, 1.358)	(.593, 1.355)
Education	.990	.993
	(.919, 1.067)	(.922, 1.069)
Work outside the home	1.365	1.413
	(.907, 2.054)	(.930, 2.148)
Married	.917	.898
	(.566, 1.484)	(.552, 1.460)
Age	1.571***	1.580***
	(1.330, 1.856)	(1.339, 1.865)
Nagelkerke R^2	.185	.209
(N)	590	590

[a]Numbers in cells are adjusted odds ratios, 95% confidence intervals, and two-tailed probabilities *$p < .05$, **$p < .01$, ***$p < .001$ using robust standard errors.

from congregants per month compared to 5.611 (95% CI 4.024, 7.198) among women reporting exposure to at least one leaders' message, a statistically significant difference of 3.580 messages ($t = 4.018$, $p < .001$). The next step evaluated the association of leaders' and congregants' messages with overweight and/or obesity.

Multivariable Analysis

The prevalence of being overweight or obese was regressed on exposure to leaders' or congregants' messages with controls as detailed in the first column of Table 2 (Model 1).

Contrary to hypothesized expectations, reports of leaders' (OR = .878; 95% CI .724, 1.066) and congregants' messages (OR = 1.009; 95% CI .939, 1.084) were not statistically significantly associated with being overweight or obese. On the other hand, infrequent (OR = 1.849; 95% CI 1.023, 3.339) or frequent (OR = 1.990; 95% CI 1.040, 3.807) religious service attendance was associated with a greater probability of being overweight or obese relative to no religious service attendance.

Exercise (OR = .335; 95%CI .171, .656) and younger age (OR = 1.571; 95% CI 1.330, 1.856) were significantly associated with a lower probability of being overweight or obese. Acculturation, education, work, and marital status were not significantly associated with being overweight or obese.

In the next step the association of congregants' messages conditioned on leaders' messages with the odds of being overweight or obese was explored as detailed in the second column of Table 2 (Model 2). Interpretation of constitutive terms for the interaction indicated the conditional association of leaders' or congregants' messages with being overweight or obese in absence of the other (Brambor, Clark, and Golder 2006).

Reports of messages from leaders in the absence of congregants' messages was statistically unassociated with being overweight or obese (OR = 1.174; 95% CI .912, 1.511) as also was the case for congregants' messages (OR = 1.069; 95% CI .987, 1.157) in absence of messages from leaders. In contrast, exposure to congregants' messages in the presence of leaders' messages was significantly associated with a reduced likelihood of being overweight or obese (OR = .915; 95% CI .858, .976). This interaction suggests that when reinforcers at lower levels (congregants) followed those at higher levels (leaders) women were less likely to be overweight or obese. For instance, reports of two messages from leaders and five from congregants was associated with a 43 percent reduction in the odds of overweight and obesity (OR = .569; 95% CI .353, .916). This is consistent with the behavioral ecological model assertions that religious reinforcements have a cascading influence where higher level reinforcers moderate the association among lower level reinforcers and health.

To clarify the interaction, probabilities of being overweight or obese were calculated for congregants' messages given variable reports of leaders' messages when all other predictors in the logistic equation were set to their means (Long and Freese 2005). The change in probabilities can be interpreted as the association of congregants' messages with being overweight or obese given exposure to leaders' messages for the otherwise "average" respondent (Long 1997).

Panel B of Figure 1 presents the probability of being overweight or obese along the ordinate for variation in reports of congregants' messages along the abscissa conditioned by the presence of at least one to four leaders' messages during a typical month by different slopes. The association of congregants' messages on healthy eating and exercise with being overweight or obese was much greater when conditioned on leaders' messages indicated by the steepening slope as reports of leaders' messages increased.

For instance, when congregants' messages were conditioned on at least one leaders' message the average likelihood of being overweight or obese was about .04 percent lower for each additional congregant message. Following two leaders' messages, each additional congregant's message was associated with a 1.9 percent lower probability of being overweight or obese. For three and four leaders' messages the probability of being overweight or obese was 2.8 percent and 3.4 percent lower for each additional congregants' message, respectively. As suggested by these values, the association among congregants' messages and probability of being overweight or obese was more than 10 times as strong when conditioned on reports of three or more leaders' messages than when conditioned on one or fewer messages.

The association among religious service attendance and being overweight or obese was no longer significant in the interactive model as evidenced by associations involving infrequent (OR = 1.717; 95% CI .943, 3.124) and frequent (OR = 1.703; 95% CI .869, 3.336) religious service attendance. Physical exercise (OR = .352; 95% CI .179, .691) and younger age (OR = 1.580; 95% CI 1.339, 1.865) were significantly associated with a lower probability of being overweight or obese. Acculturation, education, work, and marital status were not significantly associated with being overweight or obese.

It is possible that the association of religious messages on healthy diet and exercise are a result of differential selection for religious attendees versus nonattendees. The analysis reported in the second column of Table 2 was replicated for the subset of women who attended religious services. Findings were statistically and practically indistinguishable from those of all respondents, the combination of leaders' those and congregants' messages (OR = .915; 95% CI .857, .977; N = 484), suggesting that reinforcement is the key variable in the religion-obesity connection.

Discussion

This study suggests that communication content within religious institutions may reduce the probability of Korean women being overweight or obese. As expected, congregants were more likely to speak out on healthy diet and exercise in the presence of equivalent leaders' messages than not. When messages from congregants were conditioned on at least one message from a leader, the probability of being overweight or obese was reduced. As hypothesized, the negative association increased as the frequency of leaders' messages increased.

The primary strengths of this study were a theoretical argument, design, and analysis strategy that identified religious health messages as a possible mechanism for healthy body weight and how messages across levels of observation interact. The primary limitations were a cross-sectional sampling frame with measures based on self-reported survey responses subject to recall and reporting biases (Zaller 1992). For instance, reports of religious leaders' and congregants' messages were assumed to be indicative of exposure. Reports that involve recall of social interaction, however, are common in research, and Marsden (1990) suggests such reports are valid though precision may be problematic across studies. An additional limitation was that the sampling frame based on Korean surnames may have excluded some women who married non-Korean men and took their surname. However, our sample demographics approximated U.S. Census distributions. Due to limited measures we were unable to apply methods that permitted the allocation of variance to specific sequences of variables, likely through diet and exercise, in explaining the association between messages and obesity. The analysis strategy used, however, was appropriate to estimate the total association between messages and obesity, regardless of the specific pathways responsible for the total association (Imai, King, and Stuart 2008).

This study was a natural extension of Steinman and Bambakidis's (2008) conclusion that religious organizations incorporate health messages and programs with some regularity. Leaders discussed healthy diet and exercise with equivalent frequency as other health issues including smoking, excessive drinking, and violence, while congregants promoted healthy diet and exercise more than twice as often as other health issues according to Korean women. It is important to note that only 12 women in this study were Mormon or Seventh-Day Adventist, two groups with strict dietary conventions, suggesting that messages on healthy diet and exercise occur in many religious groups. The combination of our findings with Steinman's provide an alternative to previous logic and suggest that, at least among Korean women, religious institutions may be regularly involved in the promotion of healthy body weight.

Prior studies dedicated to obesity have generally described differences among religious groups, failing to focus on mechanisms. Cline and Ferraro (2006), an exception to this generality, suggested that sedentary activity in religious practice increased obesity. Their findings, like ours, point toward general contingencies that happen to be religious because of their setting, contingencies that can also be used to reduce obesity. Part of the reason studies that do not specify religious mechanisms provided mixed results may be a result of the ecological contingencies religious institutions are embedded in, not the reinforcers in these institutions as described in this study. For many, religiosity is concurrent with low socioeconomic status and habits associated with low status may increase the odds of being overweight or obese (Mokdad et al. 2003). In this study, religious service attendance was crudely associated with a greater probability of being overweight or obese but this association attenuated and was no longer statistically significant after adjusting for the interaction of leaders' messages with congregants' messages. Associations based on general religiosity indicators ignore how some aspects of religion can be promoting and others demoting of health. In this case, we observed some health promoting health messages, but additional consideration should reveal additional mechanisms.

As obesity becomes prevalent among immigrant minorities, serious consideration for using religious institutions to reinforce pro-health behaviors should be an effective way to modify health, especially when churches provide clusters of non-English speakers who are otherwise

difficult to reach. Such groups now constitute a significant percentage of the U.S. population. The case is particularly pertinent among Korean Americans due to their high levels of religious participation (Kwon, Kim, and Warner 2001) and moderately high, but possibly increasing, rates of obesity. For instance, interventions among Koreans have utilized churches to increase hepatitis B virus vaccination (Juon et al. 2008), mammography screening (Kim and Sarna 2004), and pap smears screening (Juon, Seung-Lee, and Klassen 2003). However, these studies did not observe or manipulate existing religious mechanisms directly, such as health messages in churches. Previous church-based interventions among Koreans may be thought more as faith placed rather than faith based, but this study suggests some aspects of religiosity may promote health and should be manipulated.

Public health interventions promoting dialogues involving both religious leaders and congregants that encourage discussion of exercise, healthy eating, and obesity may be influential in reducing obesity. Interventions including ministers and lay leaders that focus on increasing the clarity and frequency of clerical messages about diet and exercise and enhancing interpersonal interaction to reinforce these messages among congregants are likely to be the most efficacious. Such interventions would take advantage of the existing health structures in the Korean church. An advantage of this approach is supported by other work that suggests interventions within religious settings have better adherence than those in nonreligious settings (Sbrocco et al. 2005).

Researchers should consider applying behavioral logic and measures emphasizing the mechanisms of religious social influence. Religious institutions, like other organizations, are network driven. Churchgoers have more social ties and interact with these ties more than nonchurchgoers (Ellison and George 1994) but exactly how these ties translate into better health has not been well advanced. Smith and Christakis (2008) have argued that linkages within a network are not endowed with any specific health promoting/demoting qualities, but are the pathways by which health relevant mechanisms flow, including social (e.g., social leaning) and biological (e.g., infection vectors) mechanisms. Focusing on specific mechanisms that flow through network pathways will benefit exploration of religion and health mechanisms. We explored how messages on healthy diet and exercise constitute one mechanism that operates through religious social ties in this study. This type of investigation may very well provide a model that supplants a loose interest in social support, just as social support studies once replaced general ideational explanations for religion and health associations.

Studies of social mechanisms will begin to inform us of the degree to which religious institutions act as hubs for healthier lives and can be manipulated further to improve public health. This strategy may open up a broad range of health behaviors and outcomes that have been underserved because previous approaches did not have clear expectations for how processes operate involving specific health risks such as obesity. The degree to which messages influence smoking, sexual practices, partner violence, and others remains to be explored, though advances are being made (Ayers et al. 2009). These investigations would benefit from exploring mechanisms beyond simple messages. Social criticisms, models of behaviors, rules, and enforcement of rules remain to be operationalized for observational studies of religious influence. Unlike this study, which relied on general descriptors of social learning process, future studies may benefit by identifying social networks in religious settings and mapping how through these pathways messages and other social learning mechanisms flow. This will provide a much richer investigation than was possible in this study.

A focus on mechanisms within religious institutions is critical to the advancement of the linkage between religion and health, and focusing on messages is one way to proceed. Exactly how the messages observed in this study were translated into women's lower probability of being overweight or obese is not certain. The behavioral ecological model, and more broadly social learning theory, suggests messages on healthy diet and exercise prompted behavior changes that reduced obesity in order for women to conform to social reinforcements that were greater than other reinforcers that promoted obesity in their broader social environment. An alternative

explanation may be that exposure to both leaders' and congregants' messages were a marker for other unmeasured religious contingencies related to obesity. For instance, those exposed to both leaders' and congregants' messages may be more likely to face other social criticisms, models, and structures in religious institutions that favor healthy body weight. Identification of additional reinforcers within and apart from religious settings may elucidate the degree to which unobserved confounding explains the pathways through which messages translate into reduced obesity.

The generalizability of our findings to Korean men or to other populations is unknown until further studies are conducted. One *a priori* reason could be that associations between messages and obesity is stronger among women, relative to men, because of a male-dominated culture that places Korean women in positions where deference is given to the wishes of others (Min 2001). Since Koreans are especially dependent on the church because of their immigrant status, the associations observed may be weaker among nonimmigrant populations. However, the behavioral ecological model suggests people would be expected to respond to religious or other salient messages delivered from valued persons concerning diet, exercise, and other health concerns (Hovell, Wahlgren, and Gehrman 2002). Messages have been shown to constitute a key component of the reinforcers associated with human interaction in varying situations with regard to health and health behaviors among Koreans and across cultures (Ayers et al. 2010; Hofstetter et al. 2004, 2010). At least for Korean women religion may help prevent obesity.

REFERENCES

Ayers, John.W., C. Richard Hofstetter, Suzanne C. Hughes, Veronica L. Irvin, D. Eastern Kang Sim, and Melbourne F. Hovell. 2009. Exploring religious mechanisms for healthy alcohol use: Religious messages and drinking among Korean women in California. *Journal of Studies on Alcohol and Drugs* 70(6):890–98.

Ayers, John.W., C. Richard Hofstetter, Haeryun Park, Hee-Young Paik, Veronica L. Irvin, Yoon J. Song, and Melbourne F. Hovell. 2010. Social contingencies and smoking behaviors among adults in Seoul, Korea. *International Journal of Public Health*. DOI: 10.1007/500038-010-0126-7.

Brambor, Thomas, William R. Clark, and Matt Golder. 2006. Understanding interaction models: Improving empirical analyses. *Political Analysis* 14(1):63–82.

Caspersen, Carl J., Kenneth E. Powell, and Gregory M. Christenson. 1985. Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports* 100(2):126–31.

Centers for Disease Control and Prevention (CDC). 2005. *Behavioral risk factor surveillance system survey data*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Chang, Virginia W. and Diane S. Lauderdale. 2005. Income disparities in body mass index and obesity in the United States, 1971–2002. *Archives of Internal Medicine* 165(18):2122–28.

Chatters, Linda M. 2000. Religion and health: Public health research and practice. *Annual Review of Public Health* 21(1):335–67.

Cho, Juhee and Hee-Soon Juon. 2001. Assessing overweight and obesity risk among Korean Americans in California using World Health Organization body mass index criteria for Asians. *Preventing Chronic Disease* 3:(3). Available at http://www.cdc.gov/pcd/issues/2006/jul/05_0198.htm, accessed on September 25, 2009.

Cline, Krista M. C. and Kenneth F. Ferraro. 2006. Does religion increase the prevalence and incidence of obesity in adulthood? *Journal of the Scientific Study of Religion* 45(2):269–81.

Djupe, Paul A. and Christopher P. Gilbert. 2003. *The prophetic pulpit: Clergy, churches, and communities in American politics*. Lanham, MD: Rowman and Littlefield.

Ellison, Christopher G. and Linda K. George. 1994. Religious involvement, social ties, and social support in a southeastern community. *Journal for the Scientific Study of Religion* 33(1):46–61.

Ellison, Christopher G. and Jeffrey Levin. 1998. The religion-health connection: Evidence, theory, and future directions. *Health Education and Behavior* 25(6):700–20.

Ellison, Christopher G., Margaret L. Vaaler, Kevin J. Flannelly, and Andrew J. Weaver. 2006. The clergy as a source of mental health assistance: What Americans believe. *Review of Religious Research*, 48(2):190–211.

Ferraro, Kenneth F. 1998. Firm believers? Religion, body weight, and well-being. *Review of Religious Research* 39(3):224–44.

Fraser, Gary E. 2003. *Diet, life expectancy and chronic disease: Studies of Seventh-Day Adventists and other vegetarians*. New York: Oxford University Press.

George, Linda K., Christopher G. Ellison, and David B. Larson. 2002. Explaining the relationships between religious involvement and health. *Psychological Inquiry* 13(3):190–200.

Ghiselli, Edwin E. 1964. *Theory of psychological measurement*. New York: McGraw-Hill Book Company.

Gillum, R. Frank. 2006. Frequency of attendance at religious services, overweight, and obesity in American women and men: The third national health and nutrition examination survey. *Annals of Epidemiology* 16(9):655–60.

Glass, Thomas A. and Mathew J. McAtee. 2006. Behavioral science at the crossroads in public health: Extending horizons, envisioning the future. *Social Science and Medicine* 62(7):1650–71.

Hart Jr., Alton, Deborah J. Bowen, Alan Kuniyuki Peggy Hannon, and Marci K. Campbell. 2007. The relationships between the social environment within religious organizations and intake of fat versus fruits and vegetables. *Health Education & Behavior* 34(3):503–16.

Hedley, Allison A., Cynthia L. Ogden, Clifford L. Johnson, Margaret D. Carroll, Lester R. Curtin, and Katherine M. Flegal. 2004. Prevalence of overweight and obesity among U.S. children, adolescents, and adults, 1999–2002. *Journal of the American Medical Association* 291(23):2847–50.

Hofstetter, C. Richard, John W. Ayers, Veronica L. Irvin, D. Eastern K. Sim, Suzanne C. Hughes, Fredrick Reighard, and Melbourne F. Hovell. 2010. Does church participation facilitate tobacco control? A report on Korean immigrants. *Journal of Immigrant and Minority Health*.12(2):187–97.

Hofstetter, C. Richard, John W. Ayers, and R. Perry. 2008. The bishops and their flock: John Kerry and the case of Catholic voters in 2004. *Politics and Religion* 1:436–55.

Hofstetter, C. Richard, Melbourne F. Hovell, Veronica L. Irvin, John W. Ayers, Suzanne C. Hughes, and Sunny Kang. 2010. It's others, not the police: Smoking, reprimands, and fines among adults of Korean descent in California. *Health Psychology* 29(3):255–61.

Hofstetter, C. Richard, Melbourne F. Hovell, Jooeun Lee, Joy Zakarian, Haeryun Park, Hee-Young Paik, and Veronica Irvin. 2004. Tobacco use and acculturation among Californians of Korean descent: A behavioral epidemiological analysis. *Nicotine and Tobacco Research* 6(3):481–89.

Hovell, Melbourne F., Dennis R. Wahlgren, and Christine Gehrman. 2002. The behavioral ecological model: Integrating public health and behavioral science. In *New and emerging models and theories in health promotion and health education*, edited by Ralph J. DiClemente, Richard Crosby, and Michelle Kegler, pp. 347–85. San Francisco, CA: Jossey-Bass.

Hurh, Won M. and Kwang C. Kim. 1990. Religious participation of Korean immigrants in the United States. *Journal for the Scientific Study of Religion* 29(1):19–34.

Imai, Kosuka, Gary King, and Elizabeth Stuart. 2008. Misunderstandings among experimentalists and observationalists about causal inference. *Journal of the Royal Statistical Society, Series A* 171(2):481–502.

Juon, Hee-Soon, Christine Seung-Lee, and Ann C. Klassen. 2003. Predictors of regular pap smears among Korean-American women. *Preventive Medicine* 37(6):585–92.

Juon, Hee-Soon, Christine Strong, Thomas H. Oh, Theresa Castillo, Grace Tsai, and Leslie D. Hsu Oh. 2008. Public health model for prevention of liver cancer among Asian Americans. *Journal of Community Health* 33(4):199–205.

Kim, Dol M., Chul W. Ahn, and Soo Y. Nam. 2005. Prevalence of obesity in Korea. *Obesity Review* 6(2):117–21.

Kim, Karen H., Jeffery Sobal, and Elaine Wethington. 2003. Religion and body weight. *International Journal of Obesity and Related Metabolic Disorders* 27:469–77.

Kim, Soowon, Soojae Moon, and Barry M. Popkin. 2000. The nutrition transition in South Korea. *American Journal of Clinical Nutrition* 71(1):44–53.

Kim, Young H. and Linda Sarna. 2004. Intervention to increase mammography use by Korean American women. *Oncology Nursing Society* 31(1):105–10.

Kwon, Ho-Youn, Kwang C. Kim, and R. Stephen Warner (Eds.). 2001. *Korean Americans and their religions: Pilgrims and missionaries from a different shore*. University Park, PA: Pennsylvania State University Press.

Kwon, Jin-Wong, Yun-Mi Song, Joohon Sung, Yeolin Sohn, and Sung-Il Cho. 2007. Varying patterns of BMI increase in sex and birth cohorts of Korean adults. *Obesity* 15(2):277–82.

Kwon, Victoria H., Helen R. Ebaugh, and Jacqueline Hagan. 1997. The structure and functions of cell group ministry in a Korean Christian church. *Journal for the Scientific Study of Religion* 36(2):247–56.

Lapane, Kate L., Thomas M. Lasater, Catherine Allan, and Richard A. Carleton. 1997. Religion and cardiovascular disease risk. *Journal of Religion and Health* 36(2):155–63.

Levin, Jeffrey S. 1994. Religion & health: Is there an association, is it valid, and is it causal? *Social Science & Medicine* 38(11):1475–82.

Long, John S. 1997. *Regression models for categorical and limited dependent variables*. Thousand Oaks, CA: Sage.

Long, John S. and Jeremy Freese. 2005. *Regression models for categorical and limited dependent variables with Stata*, 2nd ed. College Station, TX: Stata Press.

Marsden, Peter V. 1990. Network data and measurement. *Annual Review of Sociology* 16(1):435–63.

Michalak, Laurence, Karen Trocki, and Jason Bond. 2006. Religion and alcohol in the U.S. National Alcohol Survey: How important is religion for abstention and drinking. *Drug and Alcohol Dependence* 87(2):268–80.

Min, Pyong G. 2001. Changes in Korean immigrants' gender role and social status, and their marital conflicts. *Sociological Forum* 16(2):301–20.

Mokdad, Ali H., Earl S. Ford, Barbara A. Bowman, William H. Dietz, Frank Vinicor, Virginia S. Bales, and James S. Mark. 2003. Prevalence of obesity, diabetes, and obesity-related health risk factors. *Journal of the American Medical Association* 289(1):76–79.

Pate, Russell R., Michael Pratt, Steven N. Blair, William L. Haskell, Caroline A. Macera, Claude Bouchard, David Buchner, et al. 1995. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association* 273(5):402–07.

Popkin, Barry M. 2001. The nutrition transition and obesity in the developing world. *Journal of Nutrition* 131(3):871S–73S.

Sbrocco, Tracy, Michele M. Carter, Evelyn L. Lewis, Nicole A. Vaughn, Kimberly L. Kalupa, Sandra King, Sonia Suchday, et al. 2005. Church-based obesity treatment for African American women improves adherence. *Ethnicity and Disease* 15(2):246–55.

Sherkat, Darren E. and Christopher G. Ellison. 1999. Recent developments and current controversies in the sociology of religion. *Annual Review of Sociology* 25(1):363–94.

Smith, Kristen P. and Nicholas A. Christakis. 2008. Health and social networks. *Annual Review of Sociology* 34(1):405–29.

Song, Yoon J., C. Richard Hofstetter, Melbourne F. Hovell, Hee-Young Paik, Haeryun Park, and Veronica L. Irvin. 2004. Acculturation and health risk behaviors among Californians of Korean descent. *Preventive Medicine* 39(1):147–56.

Steinman, Kenneth S. and Athe Bambakidis. 2008. Faith-health collaboration in the United States: Results from a nationally representative study. *American Journal of Health Promotion* 22(4):256–63.

Straus, Robert and Selden D. Bacon. 1953. *Drinking in college*. New Haven, CT: Yale University Press.

Suinn, Richard M., Gillian Khoo, and Carol Ahuna. 1995. The Suinn-Lew Asian self-identity acculturation to U.S. society scale: Cross-cultural information. *Journal of Multicultural Counseling & Development* 23(3):139–48.

Suinn, Richard M., Kathryn Rickard-Figueroa, Sandra Lew, and Patricia Vigil. 1987. The Suinn-Lew Asian self-identity acculturation to U.S. society scale: An initial report. *Educational & Psychological Measurement* 47(2):401–07.

U.S. Bureau of the Census. *Census of population and housing, 2000, PCT5. 2000. "Population in households" (Sex by Age, Korean Alone), Census 2000 Summary File 2 (SF 2)*. Washington, DC: U.S. Department of Commerce. Available at http://www.census.gov/prod/2002pubs/c2kbr01-16.pdf, accessed on June 8, 2008.

Wallace, John M. and Tyrone A. Forman. 1998. Religion's role in promoting health and reducing risk among American youth. *Health Education and Behavior* 25(6):721–41.

White, Halbert. 1982. Maximum likelihood estimation of misspecified models. *Econometrica: Journal of the Econometric Society* 50(1):1–25.

Yajnik, Chittaranjan S. and John S. Yudkin. 2004. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 363(9403):157–63.

Yu, Eui-Young, Peter Choe, and Sang I. Han. 2002. Korean population in the United States, 2000: Demographic characteristics and socio-economic status. *International Journal of Korean Studies* 1(1):71–107. Available at http://www.icks.org/publication/pub_2002_s.htm, accessed on August 28, 2009.

Zaller, John. 1992. *The nature and origins of mass opinion*. London, UK: Cambridge University Press.