

Religiosity, dietary habit, intake of fruit and vegetable, and vegetarian status among Seventh-Day Adventists in West Malaysia

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Abstract Religion has been shown to be salutary on health, and a possible link between religion and positive health outcomes is diet. Research has shown that religiosity is associated with better diet but most studies were conducted in a multi-denominational context, which might be confounded with theological differences. This study examined the relationship between religiosity and diet within a homogenous group of believers. Data from survey of 574 Seventh-Day Adventists residing in West Malaysia, aged 18–80, were analyzed using multiple regressions. While none of the religious variables were significantly associated with fruit and vegetable intake, a higher level of religiosity was associated with a better dietary habit and vegetarian status. The mixed relationship between religiosity and diet suggest that further research is needed to explore how religion might influence the diet of adherents.

Keywords Religion · Religiosity · Spirituality · Diet · Fruit and vegetable intake · Vegetarian

Introduction

Diet is an integral part of health promotion and disease management. It plays an important role in maintaining health and in the development of non-communicable diseases (NCDs), which are responsible for 63 % or about 36 million deaths globally (World Health Organization 2003, 2009). About 30–40 % of cancers are preventable by adopting a healthy lifestyle and diet (Tienboon 2012). High saturated and trans-fat intake has been shown to be positively associated with an increased risk of cardiovascular diseases (Kromhout 2000). About 1.7 million deaths worldwide are attributed to low fruit and vegetable consumption (World Health Organization 2013a).

Research has shown that a higher level of religiosity and/or spirituality (R/S) is associated with better mental and physical health (Chatters 2000; Levin 1994), including lower levels of stress (Chang et al. 2001; Larson 2006; Oman 2006), lower levels of depressive and suicidal symptoms (Nisbet 2000; Van Voorhees 2008), higher levels of well-being, self-esteem and optimism (Crabtree and Pelham 2009; Koenig and Vaillant 2009; Krause 2003, 2006), lower all-cause mortality (Kim et al. 2014; Strawbridge et al. 1997), and a lower risk of NCDs such as cardiovascular diseases (Burazeri 2008; Obisesan et al. 2006) and cancers (Gillum and Williams 2009; Jaffe 2005). In addition, R/S is also positively associated with a lower risk of obesity (Ayers et al. 2010) and hypertension (Gillum and Ingram 2006; Levin and Vanderpool 1989)—two major risks factors of NCDs.

Many mechanisms have been proposed to explain the positive association between R/S and better health outcomes and one of the proposed mechanisms is through the practice of health-promoting behaviors and avoidance of

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health-risk behaviors (George et al. 2002; Levin 1994). Many religions hold that the human body is sacred and needs to be cared for, hence the many prohibitions against physically harmful behaviors that could inhibit spiritual growth. Health-promoting behaviors that are conducive to spiritual development are encouraged. Supporting this idea, it has been found that a higher level of R/S is associated with lower prevalence of health-risk behaviors such as smoking (Blay et al. 2008; Koenig et al. 1998), alcohol consumption (Michalak et al. 2007; Patock-Peckham et al. 1998), substance abuse (Miller et al. 2000; Steinman 2008), and a higher prevalence of health-promoting behaviors such as physical activity (Strawbridge et al. 2001).

One of the main health-promoting behaviors found in many religions is the adoption of a better diet (Tan et al. 2014). Many religions have specific dietary laws, which fall into two categories: “a temporal abstinence from all or certain foods (fasting)” and “stable and distinctive dietary habits that differ from the general population” (Sabate 2004). For example, Hindus avoid beef and are vegetarians on certain days; Muslims fast during Ramadan and avoid unclean meat such as pork; Buddhists monks and nuns are vegans; Catholics avoid meat during Lent fasting. Even in religions that do not have specific dietary laws, such as Protestantism in general, the teaching that the body is “the holy temple of God” (1 Corinthians 6:19) might encourage the believers to adopt a better diet. The religious dietary laws are practiced mainly for spiritual development rather than health *per se*; however, since they are being practiced over the long term, they could have an influence on diet-related NCDs. For example, the Seventh-day Adventist Church and the Church of Jesus Christ of the Latter-day Saints both encourage their believers to consume more fruit and vegetable and less fat, and there is evidence that their adherents enjoy better physical health and longer lifespans than the general population (Enstrom 1978; Mills et al. 1994). A higher level of R/S was shown to be associated with higher intake of fruit and vegetable (Baruth et al. 2011; Debnam et al. 2012; Lytle et al. 2003) and lower intake of overall and saturated fat (Hart et al. 2007), both of which are associated with lower risk of cardiovascular diseases; regular breakfast (Wallace and Forman 1998) and lower soft drinks consumption among adolescents (Pitel et al. 2012); healthful nutrition (Chliaoutakis et al. 2002; Homan 2010; Reid and Smalls 2004); healthy food choices and eating patterns (Rew et al. 2007); and better healthy eating index (Sahyoun and Zhang 2005).

However, non-significant relationship between R/S and diet has also been reported in other studies. In a recent systematic review, about half of the 46 studies included in the review showed no significant relationship between R/S and the intake of fruit, vegetable and fat (Tan et al. 2013). In a study of Jewish adolescents’ health behaviors, R/S was

not associated with regular breakfast, soft drinks consumption, and fast food consumption (Benjamins 2012). A web-based study of Buddhists in the U. S also found no association between Buddhist devoutness and adopting a vegetarian diet (Wiist et al. 2012). There are also studies that showed mixed or negative association between R/S and diet. One study reported that monthly religious attendance was associated with reduced odds of sound diet quality (Hill et al. 2006). In another study African Americans who prayed regularly and placed more importance in religion were more likely to consume fast food, while those who attend religious services more were less likely to consume fast food (Dodor 2012).

The contradictory findings warrant further research to investigate the relationship between R/S and diet. Most of the previous R/S and diet studies were conducted in a multid denominational/multi-religious setting, where respondents from more than one religious group or denominations within a religion were included, and this is a potential confounder. The very few studies conducted among single denomination were on Jews. The use of multid denominational/multi-religious sample might lead to different understanding and interpretation of the questionnaire. Items related to R/S among the heterogeneous respondents may have different interpretations, such as the notion of religious attendance for Buddhists who do not have a calendar of weekly visits and Christians who do. Even within the same religion, a religious construct could be interpreted differently by members of different denominations. For the Seventh-Day Adventists and the Seventh-Day Baptists, the Sabbath falls on Saturday, while for many other Christian denominations it falls on Sunday. These kinds of issues would need to be carefully monitored in any questionnaire used across heterogeneous denominations. Single denominational studies, on the other hand, eliminates the need to control for potential denominational differences (Lee et al. 2009).

The purpose of this study was to investigate the relationship between R/S and diet in a single denomination. The target population was the Seventh-Day Adventist currently residing in West Malaysia. The Adventists are a group of conservative Christians who are supposed to follow strict dietary guidelines, and healthy eating is part of the doctrinal teaching of the Church. Unclean meat such as pork and shellfish, recreational drugs, smoking, and alcohol are proscribed, and the members are encouraged to consume more fruit, vegetable and nuts, and if possible, to be vegetarians. Although considerable diet and health research has been done on the Adventists (Le and Sabate 2014; Pettersen et al. 2012) and some have tried to investigate the relationship between R/S and health among the Adventists in recent years (Lee et al. 2009), the results of these studies with the Adventists were mainly from North America and

developed countries, as are most other R/S and health studies. There was no study on R/S and diet in Malaysia, a multiracial developing country, which has different cultures and dietary practices from developed countries. The current study was the first to examine the relationship between R/S and diet among Adventists outside a North American context.

Methods

This was a cross-sectional study based on questionnaire responses to items about R/S, diet, and socio-demographics.

Sample

The sampling frame of the study was all baptized Seventh-Day Adventists who were above 18 years old and were currently residing in West Malaysia. Potential respondents were recruited through the pastors of the congregations. The participants were given a questionnaire by their pastors or the researchers through personal communication and an online version was also available. The participants of online questionnaire were recruited through social media and emails.

Measures

Religious variables

Four dimensions of R/S were included in the study: organizational religiosity, non-organizational religiosity, intrinsic religiosity and Sabbath-keeping. The first three dimensions were measured by the Duke University Religion Index (DUREL)—a five-item scale. The organizational religiosity subscale is composed of a single item that measures the frequency of religious attendance. The non-organizational religiosity subscale is composed of a single item that measures the frequency of private religious activities such as prayers, reading of religious literature, listening or watching religious program etc. The intrinsic religiosity subscale is composed of three items that measure the degree of religious motivation. The DUREL has moderate internal consistency (Cronbach's $\alpha = 0.60$, in this study). For ease of understanding, the terms “religious attendance” and “private religious activities” are used in the remaining sections of the paper. Sabbath-keeping was measured by the Secular Activities on Sabbath scale, one of the three subscales of the Sabbath-Keeping Scale (Lee et al. 2006, April). The Adventist Church encourages its members to keep the Sabbath by not engaging in secular activities. The Secular Activities on Sabbath contains four

items that measure how much a participant engages in secular activities (shopping, reading secular magazines, attending secular concert or watching movie, and watching or listening to news programs) during Sabbath. It is scored on a 6-point response scale from every Sabbath to never. The scale was reversed coded from 1 to 6 so that a higher score indicates better Sabbath-keeping. The Secular Activities on Sabbath subscale has been used to study the relationship between Sabbath-keeping and health (Supervill et al. 2013) and has a good internal consistency (Cronbach's $\alpha = 0.80$, in this study).

Dietary variables

Diet was measured using a dietary habit scale, a measure of fruit and vegetable intake, and self-identification of vegetarian status. Dietary habit was measured by using the Nutrition subscale of Health Promotion Lifestyle Profile II (HPLPII). The Nutrition subscale contains nine items that assess various aspects of dietary habit such as choosing a low-fat, low-salt and low-sugar diet, regular consumption of fruit and vegetable, eating breakfast etc. The items are scored on a 4-point response scale (never, sometimes, often, routinely), and a higher score indicates a higher frequency. A total score for the subscale was obtained by calculating the mean of the responses to the nine items (Walker et al. 1995). The internal consistency of the Nutrition Subscale is acceptable (Cronbach's $\alpha = 0.71$, in this study). Fruit and vegetable intake was measured with WHO STEPS instrument (World Health Organization 2013b). The participants were asked “In a typical week, on how many days do you eat fruit/vegetable?” and “How many servings of fruit/vegetable do you eat on the day you eat fruit?” A sum of fruit and vegetable intake was obtained by adding the number of servings of fruit and vegetable. The participants were also asked to identify their dietary practices as vegan/vegetarian or non-vegetarian.

Demographic variables

The participants were asked about their age, gender, ethnicity, marital status, employment status, income, level of education, age of conversion/baptism, and whether they were born into an Adventist family.

Analysis

The Pearson product-moment correlations were computed to examine the relationship among the different religious variables. Multiple regression analysis was conducted to analyze the relationship between religious variables and dietary variables. To examine the independent effect of the religious variables, they were entered into the model

Table 1 Demographics

Variables	All	Males (n = 253)	Females (n = 321)
<i>Demographics</i>			
Age (years)	34.6 ± 13.70	35.31 ± 14.42	34.0 ± 13.09
<i>Ethnicity</i>			
Chinese (%)	54.0	51.5	56.0
Indian (%)	9.4	10.4	8.6
Indigenous (%)	25.5	24.0	26.6
Others (%)	11.2	14.2	8.8
<i>Education</i>			
Secondary school or less (%)	37.1	35.8	38.1
Diploma (%)	25.7	22.9	28.0
Bachelor's degree (%)	30.0	33.1	27.6
Graduate degree (%)	7.1	8.2	6.3
<i>Marital status</i>			
Never married (%)	52.4	54.8	50.6
Currently married (%)	41.4	42.5	40.6
Previously married (%)	6.1	2.7	8.8
<i>Income</i>			
Less than RM1000 (%)	23.5	23.6	23.5
RM1001-2999 (%)	35.6	30.9	39.4
RM3000-4999 (%)	23.2	22.6	23.6
Above RM5000 (%)	17.7	22.9	13.5
Age of baptism (years)	19.4 ± 10.08	19.6 ± 10.36	19.2 ± 8.86
Born in Adventist family (yes) (%)	45.7	46.2	45.3
<i>Religious variables</i>			
Religious attendance	4.3 ± 0.79	4.3 ± 0.83	4.2 ± 0.76
Private religious activities	4.7 ± 0.73	4.7 ± 0.66	4.6 ± 0.78
Intrinsic religiosity (3 = low, 15 = high)	14.0 ± 1.52	14.0 ± 1.51	14.1 ± 1.53
Sabbath-keeping (4 = low, 24 = high)*	20.8 ± 3.86	20.4 ± 4.15	21.1 ± 3.59
<i>Dietary variables</i>			
Vegetarian status (yes) (%)	17.8	17.4	18.1
Average daily fruit and/or vegetable servings	4.8 ± 2.32	4.9 ± 2.56	4.6 ± 2.10
Dietary habit (1 = never, 4 = routinely)***	2.7 ± 0.48	2.7 ± 0.44	2.8 ± 0.50

Significant differences by gender: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

simultaneously. Multiple linear regressions were conducted to analyze the relationship between religious variables and dietary habit and fruit and vegetable intake. Logistic regression was used to analyze the relationship between religious variables and vegetarian status and odds ratios were obtained. All regressions were controlled for age, gender, ethnicity, marital status, employment status, income, level of education, age of conversion/baptism, and whether one was born into an Adventist family. About 10 % of the cases included some missing data. Multiple imputation was conducted to overcome this. It is a statistical technique to impute incomplete data and has been shown to reduce bias and increase efficiency compared to

listwise deletion (Honaker et al. 2011). Unlike other procedures for handling missing data, multiple imputation does not assume that the data are randomly missing (Tabachnick and Fidell 2013). Five imputed datasets were obtained and each dataset was analyzed separately and their results were pooled according to Rubin's rule (Rubin 2004).

To determine the 95 % confidence intervals for the odds ratio, bootstrapping was conducted 1000 times on each of the five imputed datasets. The means of coefficients were obtained from the five sets of bootstrap samples and sorted in ascending order. The 25th and 975th values were exponentiated to obtain the 95 % confidence interval.

Table 2 Zero-order correlation coefficients among religious variables

	Religious attendance	Private religious activities	Intrinsic religiosity	Sabbath-keeping
Religious attendance	1.00			
Private religious activities	0.30***	1.00		
Intrinsic religiosity	0.11**	0.32***	1.00	
Sabbath-keeping	0.18***	0.20***	0.19***	1.00

Significant differences: ** $P < 0.01$; *** $P < 0.001$

Bootstrapping was employed because it does not assume normality of the sampling distribution (Efron and Tibshirani 1994; Mooney and Duval 1993).

Data were analyzed with R software.

Results

Demographics

There were 607 returned questionnaires, where 500 were hardcopies, and 107 were online questionnaires. Thirty-three questionnaires were excluded because the participants were below 18 years old, did not indicate their age, or were Adventists not residing in West Malaysia, or non-Adventists. Five hundred seventy-four questionnaires from 45 Adventist congregations in West Malaysia were available for analysis.

The average age of the sample was 34.6 years, while the average age of baptism (joining the Seventh-Day Adventist Church) was 19.4 years (Table 1). About half of the participants were Chinese, and a quarter was indigenous Malaysians.¹ About 44 % of the participants were male and about 63 % of the sample had completed tertiary education, and about 40 % were currently married. About 45 % of them were born and raised by parent(s) who are Seventh-Day Adventists.

There were no significant demographic differences between males and females. There were also no significant differences on religious variable between males and females, with the exception of Sabbath-keeping (females scored significantly higher). Females had better dietary habit than the males, while there was no significant difference in fruit and vegetable intake and vegetarian status. The average daily fruit and vegetable intake of all participants was about five servings. Forty-two percent of the participants consumed more than five servings of fruit and vegetable daily (not shown in table). About 18 % of the participants were vegans or vegetarians.

¹ Non-Malay Bumiputras.

Correlations

Table 2 presents the correlations among the four religious variables. All correlations were significant, with most being positive and small, except the correlations between religious attendance and private religious activities ($r = 0.30$), and between private religious activities intrinsic religiosity ($r = 0.32$), which were moderate.

Regressions

Regression of dietary habit on religious variables was conducted (Table 3). Results are shown for the analysis for the full scale; however, we also checked the results using the dietary habit scale after the fruit and vegetable items were removed. It made no substantive difference to the results, and we retained the full scale to remain consistent with the extant literature. Intrinsic religiosity and Sabbath-keeping were positively associated with better dietary habit. None of the religious variables were significantly associated with fruit and vegetable intake (Table 4). All religious variables, except private religious activities, were significantly associated with vegetarian status. Those who had higher religious attendance had 1.6 times higher odds of being vegetarians; and those who had higher intrinsic religiosity and better Sabbath-keeping had 1.3 times higher odds of being vegetarians (Table 5).

It should be noted that age of baptism and born in Adventist family were significantly associated with dietary habit. Adventists who were baptized earlier and born in Adventist family were more likely to have a better diet. However, age of baptism and born in Adventist family were not significantly associated with fruit and vegetable intake and vegetarian status.

Discussions

The current study showed that the relationship between R/S and diet among Seventh-Day Adventists in West Malaysia was mixed. While none of the religious variables were significantly associated with fruit and vegetable intake, a higher level of R/S was associated with a better dietary

Table 3 Multiple linear regression of dietary habit on religious variables

Variables	B	SE	β	t	R ²
Religious attendance	0.029	0.032	0.039	0.911	0.156***
Private religious activities	−0.014	0.053	−0.012	−0.280	
Intrinsic religiosity	0.035	0.018	0.112	2.603**	
Sabbath-keeping	0.015	0.010	0.118	2.830**	
Age	0.006	0.021	0.173	2.752**	
Gender					
Male					
Female	0.123	0.040	0.128	3.125**	
Ethnicity					
Chinese					
Indians	−0.112	0.069	−0.261	−1.621	
Indigenous [†]	0.050	0.052	0.063	0.962	
Others	−0.085	0.067	−0.175	−1.346	
Marital status					
Never married					
Currently married	−0.018	0.066	−0.039	−0.325	
Previously married	0.074	0.094	0.076	0.788	
Education					
Secondary school or less					
Diploma	0.113	0.243	2.388	2.250*	
Bachelor's	0.120	0.052	0.125	2.366*	
Graduate	0.113	0.085	0.154	1.394	
Income					
Less than RM1000					
RM1001-RM2999	−0.023	0.055	−0.020	−0.425	
RM3000-4999	0.088	0.093	0.280	1.479	
Above RM5000	0.131	0.153	1.065	1.945	
Employment					
Employed					
Unemployed	0.029	0.326	0.847	0.676	
Age of baptism	−0.009	0.002	−0.009	−3.624***	
Born in Adventist family					
No					
Yes	0.102	0.050	0.238	2.216*	

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

[†] Controlled for covariates (age, gender, ethnicity, marital status, income, employment, education, age of baptism, born in Adventist family or not)

habit (intrinsic religiosity and Sabbath-Keeping) and vegetarian status (all religious variables except private religious activities). Diet is “the kinds of food that a person... habitually eats” (“Diet” 2015), and the dietary habit scale examined diet more holistically; it measured nine dimensions of a diet and not just intake of certain food groups. Compared with fruit and vegetable intake and vegetarian status, the positive association between R/S and dietary habit scale was more informative and comprehensive.

Compared with other denominations, religions or the general population, Adventists consumed more fruit and

vegetable (Alexander et al. 1999; Kent and Worsley 2009; Kuczmarski et al. 1994; Sabate et al. 1990). However, it was unknown whether among the Adventists the practice is adopted homogeneously. The current study showed that there was no significant relationship between R/S and fruit and vegetable intake, and this was consistent with many previous studies (Hart et al. 2004; Benjamins 2012). It might be that the regular consumption of fruit and vegetable is inherent in the doctrine of the Seventh-Day Adventist Church; Adventists would have known about the importance of regular consumption of fruit and veg-

Table 4 Multiple linear regression of fruit and vegetable intake on religious variables

Variables	B	SE	β	t	R ²
Religious attendance	0.180	0.160	0.050	1.126	0.068
Private religious activities	-0.306	0.264	-0.054	-1.157	
Intrinsic religiosity	0.094	0.069	0.061	1.363	
Sabbath-keeping	0.011	0.029	0.018	0.420	
Age	0.006	0.022	0.037	0.556	
Gender					
Male					
Female	-0.222	0.202	-0.048	-1.104	
Ethnicity					
Chinese					
Indians	-0.354	0.360	-0.170	-0.999	
Indigenous [†]	-0.369	0.264	-0.097	-1.398	
Others	0.906	0.324	0.381	2.796	
Marital status					
Never married					
Currently married	-0.397	0.285	-0.175	-1.401	
Previously married	-0.672	0.482	-0.142	-1.394	
Education					
Secondary school or less					
Diploma	0.057	0.530	0.243	0.219	
Bachelor's	0.364	0.259	0.078	1.408	
Graduate	1.010	0.416	0.282	2.440	
Income					
Less than RM1000					
RM1001-RM2999	-0.091	0.277	-0.016	-0.329	
RM3000-4999	-0.078	0.316	-0.051	-0.256	
Above RM5000	-0.214	0.393	-0.356	-0.622	
Employment					
Employed					
Unemployed	0.227	0.518	1.340	1.017	
Age of baptism	-0.010	0.012	-0.002	-0.839	
Born in Adventist family					
Yes					
No	0.211	0.237	0.101	0.896	

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

[†] Controlled for covariates (age, gender, ethnicity, marital status, income, employment, education, age of baptism, born in Adventist family or not)

etable through Bible studies before they were baptized and joined the Church, and many are already practicing it regardless of R/S, as shown by 40 % of Adventists who are consuming five or more than five servings of fruit and vegetable daily. This seems to support that the regular consumption of fruit and vegetable is practiced fairly homogenously among the Adventists, at least in West Malaysia, regardless of R/S. The insignificant prediction in the present study is likely due to ceiling effect.

Intrinsic religiosity is characterized as religion that is an end in itself; intrinsically motivated individuals *live* their

religion, as compared to extrinsically motivated individuals who *use* their religion as a means to an end, for example, to seek social networks, status, security and comforts etc. (Allport and Ross 1967; Masters 2013). People who exhibit high extrinsic religiosity are more likely to conform to social norm rather than religious teachings. The other three religious variables included in this study were religious attendance (how often one attends religious services); private religious activities (how often one conducts personal prayers, reads religious literature etc.); and Sabbath-keeping, which is the observance of the seventh day (Saturday)

Table 5 Logistic regression of vegetarian status on religious variables

Variables	B	SE	Odds ratio (CI)
Religious attendance	0.45	0.23	1.6 (1.05,2.49)*
Private religious activities	0.03	0.41	1.0 (0.52,2.44)
Intrinsic religiosity	0.27	0.22	1.3 (1.04,1.79)*
Sabbath-keeping	0.25	0.24	1.3 (1.16,1.54)***
Age	-0.01	0.07	1.0 (0.95,1.01)
Gender			
Male			
Female	-0.02	0.26	1.0 (0.59,1.71)
Ethnicity			
Chinese			
Indians	-0.59	0.53	0.6 (0.19,1.29)
Indigenous [†]	-1.30	0.43	0.3 (0.11,0.55)**
Others	0.15	0.39	1.2 (0.53,2.39)
Marital status			
Never married			
Currently married	0.42	0.49	1.5(0.74,3.37)
Previously married	0.51	0.61	1.7 (0.35,6.81)
Education			
Secondary school or less			
Diploma	0.37	2.16	1.4 (0.75,2.96)
Bachelor's	0.68	0.33	2.0 (1.10,4.28)*
Graduate	0.86	0.49	2.4 (0.83,6.40)
Income			
Less than RM1000			
RM1001-RM2999	0.30	0.36	1.3 (0.66,2.69)
RM3000-4999	-0.54	0.81	0.6 (0.21,1.24)
Above RM5000	-0.44	1.03	0.6(0.24,1.55)
Employment			
Employed			
Unemployed	-0.04	2.10	1.0 (0.52,1.77)
Age of baptism	-0.01	0.02	1.0 (0.96,1.02)
Born in Adventist family			
Yes			
No	0.45	0.34	1.6 (0.91,2.71)

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

[†] Controlled for covariates (age, gender, ethnicity, marital status, income, employment, education, age of baptism, born in Adventist family or not)

as sacred where the day is devoted to the pursuit of religious-related activities such as reading religious literature, attending religious services, listening to or watching religious program, visiting the sick, while secular activities

such as working, shopping, listening to or watching non-religious programs are avoided (Superville et al. 2014).

In the current study, while higher intrinsic religiosity and better Sabbath-keeping were positively associated with

a better dietary habit, there was no significant relationship between religious attendance, private religious activities and dietary habit. Religious attendance and private religious activities are the behavioral aspects of religion that could be practiced by individuals who are motivated intrinsically and extrinsically. One could be attending religious services and yet not keeping the Sabbath when they are not in the sight of other congregational members, and private religious activities could be practiced by those who are extrinsically motivated because of utilitarian purposes (e.g. to ask for personal gains from God). Thus, high religious attendance and more private religious activities do not necessarily imply that an Adventist is convinced by the Adventist health message to practice a better diet, even though adopting and maintaining a healthy diet is encouraged by the Church. In contrast, a higher score of Sabbath-keeping is more likely to be manifested among those who are motivated intrinsically. Adventists who had higher intrinsic religiosity and Sabbath-keeping scores might have “internalized” their religion and are more convinced by the notion that the body is the “holy temple of God” (1 Corinthians 6:19), motivating better dietary practice.

Note that even though intrinsic religiosity and Sabbath-keeping were positively associated with a better dietary habit, their coefficients were rather small, indicating a significant but small effect. This might be due to the choice of single-denominational sample that was already exposed to healthy eating. Thus, an increase of R/S score was associated with a minor increase of dietary habit score.

While Adventists who practiced a good dietary habit had higher intrinsic religiosity and kept the Sabbath better, the vegetarian Adventists had higher scores in both the overt behaviors of R/S (religious attendance) and the non-overt aspects of R/S (intrinsic religiosity and Sabbath-keeping). Religious attendance, even though not significantly associated with dietary habit and fruit and vegetable intake, was the strongest predictor of vegetarianism among the Adventists in West Malaysia. Religious attendance is one of the widely used religious variable in R/S and health research and appears to be a strong predictor of health (Levin and Vanderpool 1987; Williams 1994). As in other religious variables, one of the proposed links between religious attendance and positive health outcomes is the practice of health-promoting behaviors and avoidance of health risk behaviors. In fact, frequent attenders tend to exhibit better health behaviors such as quitting smoking and become more physically active (Strawbridge et al. 2001), and lower rates of heavy drinking and smoking (Hill et al. 2006). Religious attendance might have an impact on health behaviors due to frequent exposure of attendees to denominational/religious health norms and activities, doctrine related to health, and higher social support because of

friendship within a congregation (Hill et al. 2006). Instead of just practicing a healthier diet, the frequent attenders in this study might be more exposed to the vegetarian message of the Church and vegetarian-related practices (potluck, health promotion activities), and hence more likely to adopt vegetarianism. In addition, Adventists who attend religious services regularly are also more likely to receive social support in initiating and maintain a vegetarian diet. Their vegetarian behavior is more likely to be reinforced through encouragement from the church.

Some limitations should be noted in this study. First it included only four dimensions of R/S, which is a multi-dimensional construct. Other important R/S measures, such as religious coping and religious support, were not included in this study. Second, the study is cross-sectional and no causal association could be indicated. While it is more likely that R/S precedes better dietary habit and vegetarianism rather than vice versa, it is possible that Adventists who practice healthy lifestyle are more likely to be drawn to attend church more and are more religious, rather than religion *per se* that have a positive influence on lifestyle. In addition, some other variables may be affecting this relationship too. Second, this study was based on self-reported R/S and diet, which might have led to recall bias as well as social desirability bias. Third, even though there is official statistics about the membership of Adventists in West Malaysia, the record has not been updated regularly and the exact number of Adventists in West Malaysia is unknown. Efforts have been made to recruit as many Adventists in West Malaysia as possible. However, those who refused to or did not participate might have different characteristics than those who participated. Finally, this study included three dimensions of diet, none of which was a detailed record of dietary intake. Dietary record, the “golden standard” in dietary research where the respondents record all food and beverage consumed within a period (Thompson and Byers 1994), was not used in this study.

Taking into considerations of the limitations of the current study, future research should include other dimensions of R/S such as religious coping and religious support and use better dietary measure to shed more light on the relationship between R/S and diet. Longitudinal studies can be employed to investigate how diet changes over time in relation to R/S. One of the strengths of this study was the use of singledenomination, which removed the need to control for denominational differences. The results of the study showed that even within a single denomination, R/S still play a role in the adoption of a healthy diet. Similar singledenominational studies conducted on other religions or Christian denomination, especially those that have specific dietary guidelines such as Mormonism and Islam, might also help in understanding the relationship between R/S and diet.

Despite its limitations, the current study showed a connection between R/S and diet. Given that religion is considered important by many people around the world, especially those from Asian and Africa (Crabtree and Pelham 2009), and many of them are likely to be following the dietary guidelines required by their religions, religion could be a potential channel to promote a healthy diet. In fact, many faith-based health promotion projects have been conducted successfully (Campbell et al. 1999; McNabb et al. 1997; Yanek et al. 2001). The study of R/S and diet may lead to more effective interventions.

Compliance with ethical standards

Conflict of interest Min-Min Tan, Carina K.Y. Chan and Daniel D. Reidpath declare that they have no conflict of interest.

Human and animal rights and Informed consent All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study.

References

- Alexander, H., Lockwood, L. P., Harris, M. A., & Melby, C. L. (1999). Risk factors for cardiovascular disease and diabetes in two groups of Hispanic Americans with differing dietary habits. *Journal of the American College of Nutrition, 18*, 127–136.
- Allport, G. W., & Ross, J. M. (1967). Personal religious orientation and prejudice. *Journal of Personality and Social Psychology, 5*, 432.
- Alton Hart, J., Tinker, L. F., Bowen, D. J., Satia-Abouta, J., & McLerran, D. (2004). Is religious orientation associated with fat and fruit/vegetable intake? *Journal of the American Dietetic Association, 104*, 1292–1296.
- Ayers, J. W., Hofstetter, C. R., Irvin, V. L., Song, Y., Park, H. R., Paik, H. Y., & Hovell, M. F. (2010). Can religion help prevent obesity? Religious messages and the prevalence of being overweight or obese among Korean women in California. *Journal for the Scientific Study of Religion, 49*, 536–549.
- Baruth, M., Wilcox, S., & Condrasky, M. (2011). Perceived environmental church support is associated with dietary practices among African-American adults. *Journal of the American Dietetic Association, 111*, 889–893.
- Benjamins, M. R. (2012). Religious beliefs, diet, and physical activity among Jewish adolescents. *Journal for the Scientific Study of Religion, 51*, 588–697.
- Blay, S. L., Batista, A. D., Andreoli, S. B., & Gastal, F. L. (2008). The relationship between religiosity and tobacco, alcohol use, and depression in an elderly community population. *The American journal of geriatric psychiatry, 16*, 934–943.
- Burazeri, G. (2008). Religious observance and acute coronary syndrome in predominantly Muslim Albania: a population-based case-control study in Tirana. *Annals of Epidemiology, 18*, 937.
- Campbell, M. K., Demark-Wahnefried, W., Symons, M., Kalsbeek, W. D., Dodds, J., Cowan, A., & Lashley, J. (1999). Fruit and vegetable consumption and prevention of cancer: the Black Churches United for Better Health project. *American Journal of Public Health, 89*, 1390–1396.
- Chang, B. H., Skinner, K. M., & Ulrike, B. (2001). Religion and mental health among women veterans with sexual assault experience. *International Journal of Psychiatry in Medicine, 31*, 77–95.
- Chatters, L. M. (2000). Religion and health: Public health research and practice. *Annual Review of Public Health, 21*, 335–367.
- Chliaoutakis, J. E., Drakou, I., Gnardellis, C., Galariotou, S., Carra, H., & Chliaoutaki, M. (2002). Greek Christian Orthodox Ecclesiastical lifestyle: Could it become a pattern of health-related behavior? *Preventive Medicine, 34*, 428–435.
- Crabtree, S., & Pelham, B. (2009). *Religion provides emotional boost to world's poor*. Retrieved Jan 21, 2013. <http://www.gallup.com/poll/116449/religion-provides-emotional-boost-world-poor.aspx>.
- Debnam, K., Holt, C. L., Clark, E. M., Roth, D. L., & Southward, P. (2012). Relationship between religious social support and general social support with health behaviors in a national example of African Americans. *Journal of Behavioral Medicine, 35*, 179–189.
- Diet. (2015). In *Merriam-Webster.com*. Retrieved from <http://www.merriam-webster.com/dictionary/diet>.
- Dodor, B. (2012). The impact of religiosity on health behaviors and obesity among African Americans. *Journal of Human Behavior in the Social Environment, 22*, 451–462.
- Efron, B., & Tibshirani, R. J. (1994). *An introduction to the bootstrap* (Vol. 57). Boca Raton: CRC Press.
- Enstrom, J. E. (1978). Cancer and total mortality among active Mormons. *Cancer, 42*, 1943.
- George, L. K., Ellison, C. G., & Larson, D. B. (2002). Explaining the relationships between religious involvement and health. *Psychological Inquiry, 13*, 190–200.
- Gillum, F., & Ingram, D. (2006). Frequency of attendance at religious services, hypertension, and blood pressure: The third national health and nutrition examination survey. *Psychosomatic Medicine, 68*, 382–385.
- Gillum, F., & Williams, C. (2009). Associations between breast cancer risk factors and religiosity in American Women in a national health survey. *Journal of Religion and Health, 48*, 178–188. doi:10.2307/20685216
- Hart, A., Bowen, D., Kuniyuki, A., Hannon, P., & Campbell, M. (2007). The relationship between the social environment within religious organizations and intake of fat versus fruits and vegetables. *Health Education and Behavior, 34*, 503–516.
- Hill, T. D., Burdette, A. M., Ellison, C. G., & Musick, M. A. (2006). Religious attendance and the health behaviors of Texas adults. *Preventive Medicine, 42*, 309–312.
- Homan, K. J. (2010). Religiosity, sense of meaning, and health behavior in older adults. *The International Journal for the Psychology of Religion, 20*, 173–186.
- Honaker, J., King, G., & Blackwell, M. (2011). Amelia II: A program for missing data. *Journal of Statistical Software, 45*, 1–47.
- Jaffe, D. H. (2005). Does living in a religiously affiliated neighborhood lower mortality? *Annals of Epidemiology, 15*, 804–810.
- Kent, L. M., & Worsley, A. (2009). Does the prescriptive lifestyle of Seventh-day Adventists provide 'immunity' from the secular effects of changes in BMI? *Public Health Nutrition, 12*, 472–480. doi:10.1017/s1368980008002334
- Kim, J., Smith, T. W., & Kang, J. H. (2014). Religious affiliation, religious service attendance, and mortality. *Journal of Religion and Health, 54*(6), 2052–2072.
- Koenig, H., George, L., Cohen, H., Hays, J., Larson, D., & Blazer, D. (1998). The relationship between religious activities and cigarette smoking in older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 53*, M426–M434.

- Koenig, L., & Vaillant, G. (2009). A prospective study of church attendance and health over the lifespan. *Health Psychology, 28*, 117–124.
- Krause, N. (2003). Religious meaning and subjective well-being in late life. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 58*, S160.
- Krause, N. (2006). Religious doubt and psychological well-being: A longitudinal investigation. *Review of Religious Research, 47*, 287–302. doi:10.2307/3512359
- Kromhout, D. (2000). Diet and cardiovascular diseases. *The Journal of Nutrition, Health and Aging, 5*, 144–149.
- Kuczmarski, R. J., Anderson, J. J. B., & Koch, G. G. (1994). Correlates of blood pressure in Seventh-day Adventist (SDA) and non-SDA adolescents. *Journal of the American College of Nutrition, 13*, 165–173.
- Larson, R. W. (2006). Differing profiles of developmental experiences across types of organized youth activities. *Developmental Psychology, 42*, 849.
- Le, L. T., & Sabate, J. (2014). Beyond meatless, the health effects of vegan diets: Findings from the Adventist cohorts. *Nutrients, 6*, 2131–2147.
- Lee, J. W., Morton, K. R., Walters, J., Bellinger, D. L., Butler, T. L., Wilson, C., & Fraser, G. E. (2009). Cohort profile: The biopsychosocial religion and health study (BRHS). *International Journal of Epidemiology, 38*, 1470–1478.
- Lee, J. W., Morton, K. R., Walters, J. W., Mahoney, M. L., & Veluz, R. (2006). Beliefs about Sabbath and their associations with religious coping, intrinsic religiosity, mental and physical health. In: *Paper presented at the Western Psychological Association, Palm Springs, CA.*
- Levin, J. (1994). Religion and health: Is there an association, is it valid, and is it causal? *Social Science and Medicine, 38*, 1475–1482.
- Levin, J., & Vanderpool, H. (1987). Is frequent religious attendance really conducive to better health?: Toward an epidemiology of religion. *Social Science and Medicine, 24*, 589–600.
- Levin, J., & Vanderpool, H. (1989). Is religion therapeutically significant for hypertension. *Social Science and Medicine, 29*, 69–78.
- Lytle, L. A., Varnell, S., Murrain, D. M., Story, M., Perry, C., Birnbaum, A. S., & Kubik, M. Y. (2003). Predicting adolescents' intake of fruits and vegetables. *Journal of Nutrition Education and Behavior, 35*, 170–178.
- Masters, K. S. (2013). Encyclopedia of behavioral medicine. In M. Gellman & J. R. Turner (Eds.), *Intrinsic religiosity (Religiosity)* (1st ed., pp. 1117–1118). New York: Springer.
- McNabb, W., Quinn, M., Kerver, J., Cook, S., & Karrison, T. (1997). The PATHWAYS church-based weight loss program for urban African-American women at risk for diabetes. *Diabetes Care, 20*, 1518–1523.
- Michalak, L., Trocki, K., & Bond, J. (2007). Religion and alcohol in the US National Alcohol Survey: How important is religion for abstinence and drinking? *Drug and Alcohol Dependence, 87*, 268–280.
- Miller, L., Davies, M., & Greenwald, S. (2000). Religiosity and substance use and abuse among adolescents in the National Comorbidity Survey. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 1190–1197.
- Mills, P. K., Beeson, W. L., Phillips, R. L., & Fraser, G. E. (1994). Cancer incidence among California Seventh-day Adventists, 1976–1982. *American Journal of Clinical Nutrition, 59*, 1136S–1142S.
- Mooney, C. Z., & Duval, R. D. (1993). *Bootstrapping: A nonparametric approach to statistical inference*. Thousand Oaks: Sage.
- Nisbet, P. A. (2000). The effect of participation in religious activities on suicide versus natural death in adults 50 and older. *The Journal of Nervous and Mental Disease, 188*, 543.
- Obisesan, T., Livingston, I., Trulear, H. D., & Gillum, F. (2006). Frequency of attendance at religious services, cardiovascular disease, metabolic risk factors and dietary intake in Americans: An age stratified exploratory analysis. *International Journal of Psychiatry in Medicine, 36*, 435–448.
- Oman, D. (2006). Passage meditation reduces perceived stress in health professionals: A randomized, controlled trial. *Journal of Consulting and Clinical Psychology, 74*, 714.
- Patock-Peckham, J. A., Hutchinson, G. T., Cheong, J., & Nagoshi, C. T. (1998). Effect of religion and religiosity on alcohol use in a college student sample. *Drug and Alcohol Dependence, 49*, 81–88.
- Pettersen, B. J., Anousheh, R., Fan, J., Jaceldo-Siegl, K., & Fraser, G. E. (2012). Vegetarian diets and blood pressure among white subjects: Results from the Adventist Health Study-2 (AHS-2). *Public Health Nutrition, 15*, 1909–1916.
- Pitel, L., Geckova, A. M. G., Kolarcik, P., Halama, P., Reijneveld, S. A., & van Dijk, J. P. (2012). Gender differences in the relationship between religiosity and health-related behaviour among adolescents. *Journal of Epidemiology and Community Health, 66*, 1122–1128.
- Reid, T. L. B., & Smalls, C. (2004). Stress, spirituality and health promoting behaviors among African American college students. *The Western Journal of Black Studies, 28*, 283–291.
- Rew, L., Wong, Y. J., Torres, R., & Howell, E. (2007). A linguistic investigation of mediators between religious commitment and health behaviors in older adolescents. *Issues in Comprehensive Pediatric Nursing, 30*, 71–86.
- Rubin, D. B. (2004). *Multiple imputation for nonresponse in surveys* (Vol. 81). New York: Wiley.
- Sabate, J. (2004). Religion, diet and research. *British Journal of Nutrition, 92*, 199–201.
- Sabate, J., Lindsted, K. D., Harris, R. D., & Johnston, P. K. (1990). Anthropometric parameters of schoolchildren with different lifestyles. *American Journal of Diseases of Children, 144*, 1159–1163.
- Sahyoun, N. R., & Zhang, X. L. (2005). Dietary quality and social contact among a nationally representative sample of the older adult population in the United States. *The Journal of Nutrition, Health and Aging, 9*, 177–183.
- Steinman, K. J. (2008). The dose-response relationship of adolescent religious activity and substance use: Variation across demographic groups. *Health Education and Behavior, 35*, 22–43.
- Strawbridge, W. J., Cohen, R. D., Shema, S. J., & Kaplan, G. A. (1997). Frequent attendance at religious services and mortality over 28 years. *American Journal of Public Health, 87*, 957–961.
- Strawbridge, W. J., Shema, S. J., Cohen, R. D., & Kaplan, G. A. (2001). Religious attendance increases survival by improving and maintaining good health behaviors, mental health, and social relationships. *Annals of Behavioral Medicine, 23*, 68–74.
- Superville, D. J., Pargament, K. I., & Lee, J. W. (2014). Sabbath keeping and its relationships to health and well-being: A mediational analysis. *The International Journal for the Psychology of Religion, 24*, 241–256.
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. New Jersey: Pearson Education Inc.
- Tan, M. M., Chan, C. K. Y., & Reidpath, D. D. (2013). Religiosity and spirituality and the intake of fruit, vegetable, and fat: A systematic review. *Evidence-Based Complementary and Alternative Medicine*. doi:10.1155/2013/146214.
- Tan, M. M., Chan, C. K. Y., & Reidpath, D. D. (2014). Faith, food and fettle: Is individual and neighborhood religiosity/spirituality associated with a better diet? *Religions, 5*, 801–813.
- Thompson, F. E., & Byers, T. (1994). Dietary assessment resource manual. *The Journal of Nutrition, 124*, 2245s–2317s.
- Tienboon, P. (2012). Diet and cancer. *Chiang Mai Medical Journal, 23*, 261–265.

- Van Voorhees, B. W. (2008). Protective and vulnerability factors predicting new-onset depressive episode in a representative of US adolescents. *Journal of Adolescent Health, 42*, 605.
- Walker, S. N., Sechrist, K. R., & Pender, N. J. (1995). *Health promotion model-instruments to measure health promoting lifestyle: Health-promoting lifestyle profile [HPLP II] (Adult version)*. Retrieved June 19, 2013. https://deepblue.lib.umich.edu/bitstream/handle/2027.42/85349/HPLP_II-Scoring_Instructions.pdf?sequence=5&isAllowed=y.
- Wallace, J., & Forman, T. (1998). Religion's role in promoting health and reducing risk among American youth. *Health Education and Behavior, 25*, 721–741.
- Wiist, W. H., Sullivan, B. M., St George, D. M., & Wayment, H. A. (2012). Buddhists' religious and health practices. *Journal of Religion and Health, 51*, 132–147. doi:10.1007/s10943-010-9348-5.
- Williams, D. R. (1994). The measurement of religion in epidemiologic studies. In J. S. Levin (Ed.), *Religion in aging and health: Theoretical foundations and methodological frontiers* (pp. 125–148). Thousand Oaks: Sage.
- World Health Organization. (2003). Diet, nutrition and the prevention of chronic diseases: Report of a joint WHO/FAO expert consultation *WHO technical report series*, (Vol. 916).
- World Health Organization. (2009). *Global health risks: Mortality and burden of disease attributable to selected major risks*. Geneva: World Health Organization.
- World Health Organization. (2013a). Noncommunicable diseases: Fact sheet. Retrieved May 30, 2014. <http://www.who.int/mediacentre/factsheets/fs355/en>.
- World Health Organization. (2013b). The STEPS Instrument and Support Materials. Retrieved June 19, 2013. <http://www.who.int/chp/steps/instrument/en/index.html>.
- Yanek, L. R., Becker, D. M., Moy, T. F., Gittelsohn, J., & Koffman, D. M. (2001). Project Joy: faith based cardiovascular health promotion for African American women. *Public Health Reports, 116*, 68.