

The association between church attendance and obesity-related lifestyle behaviours among New Zealand adolescents from different Pacific Island ethnic groups

Ofa Dewes PhD; Robert Scragg PhD; C Raina Elley PhD

School of Population Health,
Faculty of Medical and Health
Sciences, The University of
Auckland, Auckland, New
Zealand

ABSTRACT

INTRODUCTION: Obesity is disproportionately prevalent among Pacific population groups in New Zealand. Lifestyle behaviours of excessive consumption of high energy, unhealthy foods and inadequate physical activity are risk factors for obesity that can be modified.

AIM: To identify and describe the risk factors for and protective factors against obesity among Pacific Island (PI) adolescents who attend church and compare them with PI adolescents who do not attend church.

METHODS: We investigated the lifestyle behaviours of 2495 PI adolescents at six secondary schools in Auckland, New Zealand (NZ), 77% of whom attend a church or other place of worship. The cross-sectional survey was undertaken in 2005. Structured individual interviews and anthropometric measurements were undertaken.

RESULTS: Church attendees had a higher mean body mass index (BMI) compared with non-attendees (BMI 27.4 vs BMI 26.6), adjusted for age, gender and PI ethnicity ($p=0.01$). The weight status of attendees was associated with less healthy breakfast and lunch sources, lower levels of physical activity, and limited knowledge of the risk factors for obesity ($p<0.05$).

DISCUSSION: Culturally appropriate and ethnic-specific weight management interventions, including monitoring and policy development programmes, are needed urgently to change pro-obesity lifestyle behaviours in PI adolescents and to avoid the burgeoning future obesity-related illnesses that would otherwise result. The church may be an important venue and change agent in the prevention of obesity for this population.

KEYWORDS: Adolescents; church; health behaviors; obesity; Oceanic ancestry group; Pacific Islands

J PRIM HEALTH CARE
2013;5(4):290–300.

CORRESPONDENCE TO:

Ofa Dewes

Pacific Health Section,
School of Population
Health, Faculty of
Medical and Health
Sciences, The University
of Auckland, PB 92019,
Auckland, New Zealand
o.dewes@auckland.ac.nz

Introduction

Obesity, although preventable, continues to escalate as a significant contributor to global population ill health and a threat to Pacific Island (PI) peoples. Obesity has been described by the World Health Organization (WHO) as ‘one of today’s most blatantly visible, yet most neglected, public health problems’.¹

The prevalence of overweight and obesity has escalated rapidly worldwide, with approximately

1 billion people overweight and more than 300 million people estimated to be obese, an increase of 100 million since 1995.² Studies of PI populations have recorded some of the highest prevalence of obesity in the world and reported increasing prevalence over the past few decades, indicating a major public health threat to PI people’s lives and placing them at greater risk of short-term and long-term health consequences.^{3,4} This is further highlighted in the 2006/2007 New Zealand (NZ) Health Survey on the burden of obesity, where 23.3% of PI children (aged

2–14 years), and 63.7% of PI adults were found to be obese.⁵ When compared with other ethnic groups in NZ, these results indicate that obesity is more prevalent among PI children and adults than any other ethnic group in NZ. Moreover, obese children are likely to become more obese in adulthood and experience health conditions such as high blood pressure, cardiovascular disease, Type 2 diabetes and psychosocial problems.^{5–7}

Potential factors contributing to unhealthy weight include a high intake of energy-dense micronutrient-poor foods, sugar-sweetened carbonated drinks and fruit juices, and sedentary lifestyles.^{1,2} The 2002 National Children's Nutrition Survey found that PI children in New Zealand were likely to skip breakfast, source their school food and drink from outside the home (shop, dairy, 'takeaways', school canteen), consume less breakfast cereals and vegetables, and watch more television than other children.⁸

Churches play an influential role in the lives of many PI peoples, providing them with a sense of belonging and a social institution to foster and develop their spiritual as well as cultural beliefs, values and practices.^{9,10} Up to 97% of PI population groups in NZ have an affiliation with a Christian religion.¹¹ Previous international research has shown that obesity is more common in church attending populations,^{12,13} thus reinforcing the need for further studies to explicate the linkages between religion and obesity, and a role for church leaders to consider interventions for attendees.¹³ The association between church attendance (including attendance at other places of worship) and obesity-related lifestyle behaviours has not been examined previously in NZ. We have examined this among adolescents from different PI ethnic groups in NZ to assist in addressing this gap in the literature.

Methods

Study sample

The study sample (n=2495) comprised all participants of PI ethnicity from a cross-sectional sample of 4250 students (59%), aged 13–18 years.¹⁴ Students were recruited in 2005 from six schools in a low socioeconomic area of Auckland for

WHAT GAP THIS FILLS

What we already know: Obesity is a major public health threat placing Pacific peoples at greater risk of short-term and long-term health consequences. The majority of Pacific peoples in New Zealand are affiliated with a Christian church. Previous international and national research has shown that obesity is more common in church-attending populations.

What this study adds: The association between church attendance and obesity-related lifestyle behaviours has not been examined previously in New Zealand. We have examined this among adolescents from different Pacific ethnic groups in New Zealand to assist in addressing this gap in the literature. The church may be an appropriate venue and agent for effective lifestyle change to reverse the burgeoning burden of obesity and its consequences.

the Pacific Obesity Prevention in Communities (OPIC) Project.¹⁴ Due to the need to study the correlates of obesity in this population group and the obesity prevention study being community-based, all four high schools in the Mangere community were selected, along with two comparison schools in other parts of South Auckland of a similar school socioeconomic decile and ethnic composition as the intervention schools.^{14,15} Ethical approval was granted by the Human Participants Ethics Committee of the University of Auckland (Ref. 2004/429).

Interview process

All students were invited to participate and informed consent was obtained from students (and from parents of students under 16 years of age). Students were interviewed at school in their classes (approximately 30 per class) and completed the interviews within one class period (approximately 50 minutes). Separate stations were provided in the classroom for anthropometric measurements.

Information collected

A self-administered paper questionnaire was used to collect information relating to personal contact details, church attendance, and quality of life. Students used a personal digital assistant (PDA; Hewlett Packard Pocket PC 2003 Prem) electronic questionnaire to provide information on demographic variables (school year and class, ethnicity,

birth date, country of birth, household composition; church attendance; food and nutrition behaviours; physical activity, including screen time; the home, school and church environment; and knowledge questions relating to the risk factors for obesity. These questions were developed from several surveys, including the NZ 2002 National Children's Survey,⁸ Australian 1995 National Nutrition Survey,¹⁶ and the National Health Medical Research Council Dietary Key Indicators Study,¹⁷ and installed on the PDAs using eSTEPS computer software developed by the World Health Organization (WHO) for conducting health research surveys.¹⁸

For ethnicity, students were asked to select one ethnic group they mostly identified with including Samoan, Cook Island Maori, Tongan, Niuean, Tokelauan, Tuvaluan, Fijian and Other Pacific.

For anthropometric measurements, students removed their shoes, socks or stockings, and coats/jackets and emptied their pockets. Weight was measured to the nearest 0.1 kg with a Tanita BC 418 MA Segmental Body Composition Analyser (BCA; Tanita Company, Tokyo, Japan). The BCA was also used for measuring body mass index (BMI). Height was measured to the nearest 0.1cm on a portable stadiometer. The international WHO classification of obesity was used to classify each student's weight status as either underweight, normal weight, overweight or obese.^{6,19}

Statistical analysis

Statistical analyses were carried out using the statistical analysis software package SAS version 9.1. Univariate analyses (tabulated distribution of variables and outcomes) of all the variables were applied to demonstrate any significant differences (using the Chi-square test) between church attendees and non-attendees. The level of statistical significance was set at $p=0.05$.

Results

Demographic variables

At baseline, there were 7373 eligible students on the school rolls, with 4250 students participating

(response rate 58%).¹⁴ The demographic variables of the total OPIC sample ($n=4250$) including the total PI subsample of 2495 (59%) students are presented in Table 1. The PI subsample comprised adolescents who identified themselves as Samoan (44%; $n=1107$), Cook Island Maori (22%; $n=557$), or Tongan (24%; $n=592$). Those who identified themselves as Niuean, Tokelauan, Tuvaluan, Fijian or Other Pacific were grouped as Other Pacific (10%; $n=239$). The PI subsample comprised slightly more females (52%) than males (48%), with a mean age of 14 years (13–14 years, 57%; 15 years, 17%; 16 years, 15%; 17+ years, 11%). Almost all students (91%) were living with at least one parent, with nearly half (48%) living in households of seven or more people during the school week, and 42% living with other adult relatives. Most students (77%) reported attendance at a place of worship.

Anthropometry

Table 2 presents the BMI and obesity levels of church attendees and non-attendees in the PI subsample, adjusted for age, gender, and PI ethnicity as appropriate. Church attendees were more likely to have a higher mean BMI than non-attendees ($p=0.01$). Less than a third were normal weight, with 35% overweight and 36% obese according to the WHO classification. Using the international thresholds for obesity, attendees were more likely to be obese than non-attendees ($p=0.0002$).

Food patterns

The food consumption patterns of the PI subsample are shown in Table 3. Although church attendees were more likely to eat breakfast and lunch than non-attendees, they were also more likely to purchase their breakfast ($p=0.03$) and lunch ($p=0.002$) on school days from a shop or school canteen, rather than bring it from home. A significant difference in the consumption of other foods among churchgoers was also noted. Church attendees were more likely to report eating ≥ 2 serves of fruit ($p=0.008$) and vegetables ($p=0.02$) daily than non-attendees. The majority of PI adolescents (91%) reported drinking soft drinks (non-diet) on school days; however, there was no significant difference

Table 1. Demographic characteristics of the Pacific Island ethnic subsamples and the total sample

Variable	Samoan %	Cook Island Maori %	Tongan %	Other Pacific* %	Total Pacific %	Total sample %
Total	1107	557	592	239	2495[†]	4216[‡]
Gender						
Male	47	47	50	46	48	48
Female	53	53	50	54	52	52
Age groups						
13	33	40	34	34	35	33
14	22	22	23	21	22	22
15	17	16	16	21	17	17
16	15	14	14	14	15	15
17+	13	8	13	10	11	13
Household composition						
Two parents	76	64	75	75	73	70
One parent	16	24	17	16	18	22
No parents	8	12	8	9	9	8
Living with adult relatives						
Yes	40	45	46	38	42	36
No	60	55	54	62	58	63
Household size						
0–4	15	20	13	21	16	26
5–6	36	40	31	37	36	36
7–8	30	20	28	30	28	23
≥9	19	20	28	12	20	15
Attend church or temple/mosque						
No	12	50	10	39	23	41
Church	87	50	90	56	76	53
Temple/mosque	1	0	0	5	1	6

* Other Pacific includes those adolescents who identified themselves as Niuean, Tokelauan, Tuvaluan, or other Pacific.

† Sample size in subsequent tables may be smaller due to missing data

‡ Excludes 34 with missing data

Table 2. Body mass index (BMI) and obesity levels of church attendees and non-attendees in the Pacific Island subsample, adjusted for age, gender and Pacific Island ethnicity (as appropriate)

Variable	Samoan		Cook Island Maori		Tongan		Other Pacific		Total Pacific	
Total	1103		555		590		239		2487	
Attends church	Yes (n=972)	No (n=131)	Yes (n=269)	No (n=286)	Yes (n=511)	No (n=79)	Yes (n=134)	No (n=105)	Yes (n=1886)	No (n=601)
BMI – Mean (SE)	28.0 (0.2)	27.1 (0.5)	26.6 (0.4)	25.8 (0.3)	27.8 (0.3)	27.4 (0.6)	26.9 (0.5)	26.1 (0.6)	27.4 (0.2)	26.6 (0.2)
p-value	0.11		0.09		0.55		0.32		0.01	
Obesity category %										
Normal weight	28	31	34	40	26	27	36	37	29	36
Overweight	34	34	37	37	37	44	33	34	35	37
Obese	38	35	29	23	37	29	31	29	36	27
p-value	0.7		0.2		0.3		0.9		0.0002	

Table 3. Food consumption patterns of church attendees and non-attendees by Pacific Island ethnic group

Variable	Samoan		Cook Island Maori		Tongan		Other Pacific		Total Pacific	
Total	1107		556		592		239		2494	
	Yes (n=975) %	No (n=132) %	Yes (n=269) %	No (n=287) %	Yes (n=512) %	No (n=80) %	Yes (n=134) %	No (n=105) %	Yes (n=1890) %	No (n=604) %
Attends church										
On school days where do you usually get your breakfast?										
Home	62	66	64	67	68	64	63	60	64	65
Canteen	9	6	7	4	5	10	3	0	7	5
Shop	15	14	15	12	16	16	16	18	16	14
Don't eat breakfast	14	14	14	17	11	10	18	22	13	16
p-value	0.7		0.2		0.4		0.3		0.03	
Where do you usually get your lunch from?										
Home	28	32	27	26	24	25	29	36	27	29
Canteen	56	49	58	58	55	58	52	48	56	54
Shop	13	14	12	10	18	10	14	10	14	11
Don't eat lunch	3	5	3	6	3	7	5	6	3	6
p-value	0.3		0.3		0.04		0.6		0.002	
How many serves of fruit* do you usually eat each day?										
≤1 serve	36	37	28	39	31	36	44	48	34	40
2–3 serves	50	53	55	51	52	58	46	35	51	49
≥4 serves	14	10	17	10	17	6	10	17	15	11
p-value	0.4		0.009		0.04		0.1		0.008	
How many serves of vegetables† do you usually eat each day?										
≤1 serve	35	38	42	44	45	50	38	54	39	45
2–3 serves	47	49	45	41	42	36	52	36	46	42
≥4 serves	18	13	13	15	13	14	10	10	15	13
p-value	0.3		0.7		0.7		0.04		0.02	
In the last 5 school days on how many days did you have regular soft drinks‡?										
0 days	10	2	9	12	6	10	9	9	9	9
1–2 days	32	46	37	35	36	31	38	33	34	37
3–4 days	38	34	31	38	40	38	31	37	37	37
5 days	20	18	23	15	18	21	22	21	20	17
p-value	0.002		0.054		0.5		0.8		0.6	
How often do you usually eat pies, takeaways or fried foods?										
Every day/Almost every day	10	13	8	8	10	9	5	6	9	9
Most days	22	14	20	19	23	23	15	22	22	19
Some days	49	52	55	53	54	42	59	56	52	52
Hardly ever	19	21	17	20	13	26	21	16	17	20
p-value	0.2		0.9		0.02		0.5		0.2	

* A serve of fruit = 1 apple or 2 plums or 1 cup of diced fruit

† A serve of vegetables = ½ cup cooked vegetables or 1 cup of raw vegetables/salad

‡ Coke, Sprite, Fanta

in the frequency of soft drinks consumed by church attendees compared with non-attendees ($p=0.6$). There was also no significant difference between church attendees and non-attendees in the frequency of eating pies, takeaways or fried foods ($p=0.2$).

Some differences were more evident among certain ethnic subgroups. Among Tongans, church attendees were significantly more likely to purchase their school lunch when compared with non-attendees ($p=0.04$). Compared with non-attendees, Cook Island Maori and Tongan church attendees were also more likely to consume ≥ 2 serves of fruit daily ($p<0.05$), while Other Pacific church attendees were more likely to consume ≥ 2 serves of vegetables daily ($p=0.04$). A significant difference in the frequency of soft drink consumption during the school week was also found, with Samoan church attendees likely to consume more soft drinks when compared with non-attendees ($p=0.002$).

Physical activity patterns

Table 4 presents the physical activity patterns of the different PI subgroups. Overall, compared with non-attendees, church attendees were less likely to walk/bike to/from school ($p<0.0001$) but more likely to be physically active at school during the lunch break ($p=0.002$). They were also significantly more likely to spend less time watching television, videos or DVDs on Saturday and Sunday, respectively ($p=0.02$; $p<0.0001$), or playing video games/using the computer (not for homework) on the last school day ($p=0.002$), when compared with non-attendees.

Significant differences among ethnic-specific church attendees, compared with non-attendees, showed Samoan churchgoers to be less likely to walk/bike to/from school ($p=0.0005$). Significant differences were also found among Other Pacific church attendees who were more likely to spend less time watching television, videos or DVDs on Saturday ($p=0.04$). Samoan, Cook Island Maori and Tongan church attendees, respectively, were also significantly more likely to spend less time watching television, videos or DVDs on Sunday when compared with non-attendees ($p=0.001$; $p=0.02$; $p=0.01$).

Knowledge

The results to 'knowledge statements regarding obesity risk factors' are presented in Table 5. Although there were no significant differences in the results for the PI ethnic groups, church attendees as a whole were significantly more likely to agree (incorrectly) that missing breakfast or lunch is a good way to lose weight than non-attendees ($p=0.0002$), and that fruit drinks and cordials have less sugar than soft drinks, such as Coke ($p=0.004$). With regard to the knowledge statements relating to fruit and vegetables, the majority of students (85%) correctly disagreed with the statement that 'eating a lot of fruit and vegetables is bad for your weight'; no difference was found in the responses of church attendees when compared with non-attendees ($p=0.9$). There was also no significant difference found between church attendees and non-attendees responses to the knowledge statement relating to television watching ($p=0.08$). Overall, church attendees were less aware of nutritional factors that protect against obesity.

Discussion

The study found that church attendance was positively associated with higher levels of BMI compared with non-attendance. Churchgoers were also more likely to source their breakfast and lunch from outside the home, and have a limited knowledge of the risk factors for obesity. Even so, church attendees tended to eat more fruit and vegetables and were less likely to engage in sedentary behaviours, such as watching television, compared with non-attendees, so the reasons behind higher obesity rates in church-going adolescents than non-church-going adolescents were not clear when examining the usual risk factors for obesity.

No other studies were found in the published literature comparing the food behaviour patterns of PI adolescents who attend church and those who do not. However, studies of church-based lifestyle interventions in other population groups have found fruit and vegetable consumption to be high among religious groups.²⁰ The finding that a higher proportion of PI adolescents source their breakfast and lunch from outside the

Table 4. Physical activity patterns of church attendees and non-attendees by Pacific Island ethnic group

Variable	Samoan		Cook Island Maori		Tongan		Other Pacific		Total Pacific	
Total	1107		556		592		239		2494	
Attends church	Yes (n=975) %	No (n=132) %	Yes (n=269) %	No (n=287) %	Yes (n=512) %	No (n=80) %	Yes (n=134) %	No (n=105) %	Yes (n=1890) %	No (n=604) %
In the last 5 school days, how many times did you walk or bike to or from school?										
0 times	20	10	15	11	14	19	25	17	18	13
1–5 times	45	45	37	44	53	42	37	36	45	42
6–10 times	21	35	31	30	18	25	25	36	22	32
>10 times	14	10	17	15	15	14	13	11	15	13
p-value	0.0005		0.4		0.3		0.2		<0.0001	
In the last 5 school days, what did you do most of the time at lunchtime (apart from eating)?										
Mostly just sat down										
Mostly stood or walked around	10	14	11	13	13	6	13	18	11	13
Mostly played active games	47	47	49	57	45	58	55	50	47	54
	43	39	40	30	42	36	32	32	42	33
p-value	0.3		0.08		0.08		0.5		0.002	
Last Saturday, how many hours did you spend watching TV, videos or DVDs?										
0–1 hour	35	38	42	44	39	45	45	50	39	54
2–3 hours	47	49	45	41	46	42	42	36	52	36
≥4 hours	18	13	13	15	15	13	13	14	9	10
p-value	0.3		0.7		0.7		0.04		0.02	
Last Sunday, how many hours did you spend watching TV, videos or DVDs?										
0–1 hour	48	33	42	32	50	41	45	37	48	34
2–3 hours	30	33	28	37	30	24	25	32	29	34
≥4 hours	22	34	30	31	20	35	30	31	23	32
p-value	0.001		0.02		0.01		0.4		<0.0001	
On the last school day that you spent time playing video games or using the computer (not for homework), how long did you play for?										
0–1 hour	80	74	76	71	77	73	84	73	79	72
2–3 hours	12	18	14	16	18	16	9	16	14	17
≥4 hours	8	8	10	13	5	11	7	11	7	11
p-value	0.1		0.4		0.1		0.1		0.002	

Table 5. Knowledge of obesity risk factors among church attendees and non-attendees by Pacific Island ethnic group

Variable	Samoan		Cook Island Maori		Tongan		Other Pacific		Total Pacific	
Total	1107		555		592		239		2493	
Attends church	Yes (n=975) %	No (n=132) %	Yes (n=269) %	No (n=286) %	Yes (n=512) %	No (n=80) %	Yes (n=134) %	No (n=105) %	Yes (n=1890) %	No (n=603) %
Skipping breakfast or lunch is a good way to lose weight										
Strongly agree/Agree	30	21	28	21	32	29	19	14	29	21
Neither agree nor disagree	20	17	17	22	17	14	12	16	18	19
Disagree/Strongly disagree	50	62	55	57	51	57	69	70	53	60
p-value	0.045		0.2		0.6		0.4		0.0002	
Eating a lot of fruit and vegetables is bad for your weight										
Strongly agree/Agree	11	10	8	9	9	15	7	6	10	9
Neither agree nor disagree	4	7	6	4	8	6	4	4	5	5
Disagree/Strongly disagree	85	83	86	87	83	79	89	90	85	86
p-value	0.3		0.6		0.2		0.9		0.9	
Fruit drinks and cordials have less sugar than non-diet soft drinks*										
Strongly agree/Agree	63	52	55	54	62	59	60	53	62	54
Neither agree nor disagree	19	25	21	23	19	17	21	22	19	22
Disagree/Strongly disagree	18	23	24	23	19	24	19	25	19	24
p-value	0.052		0.8		0.6		0.5		0.004	
Watching a lot of TV does not lead to weight gain										
Strongly agree/Agree	40	35	38	35	37	34	35	28	38	34
Neither agree nor disagree	19	19	18	23	22	20	17	25	20	22
Disagree/Strongly disagree	41	46	44	42	41	46	48	47	42	44
p-value	0.5		0.3		0.7		0.3		0.08	

* Coke, Sprite, Fanta

home is consistent with previous research where school food purchases were common amongst PI children.²¹ Moreover, shop or school canteen have also been found to be the primary source of breakfast and lunch among NZ school children⁸ and, therefore, are a major risk factor for obesity, especially if easy access to healthy food and drinks options are limited at these outlets, and the food and drink can be easily sourced at schools or in close proximity to schools.²²⁻²⁴ These nutritional behaviours are obesity risk factors among PI adolescents in NZ who attend church and could have contributed to the higher rates

of obesity. However, there were no significant differences seen in the consumption of regular soft drinks, such as Coke (Coca-Cola) or Sprite, and takeaways or fried foods, between church attendees and non-attendees. The lack of consistency in these findings and incongruence with the high BMI found among church attendees suggest possible other stronger social forces²⁵ may be influencing the obesogenic environment of PI communities who attend church. For example, patterns of food consumption at church functions may contribute to the differences, but the current survey did not collect this information.

Church attendees were also less likely to walk or bike to and from school, but more likely to play active games during lunchtime. Church attendees were more likely to have less screen time during the school week and weekends, especially on Sunday when they were most likely to be at church. Church attendees may therefore be travelling to/from school by other forms of transport, such as a private vehicle or public transport, suggesting that they may not be living close to school. However, when compared with non-attendees, church attendees were more active at school. The reduced screen time among church attendees may likely be due to their attendance at church functions after school and on weekends. The lack of consistency also in the physical activity patterns of church attendees, and with the literature on sedentary behaviour,²⁶ also suggests that other factors may be at play.²⁵

With regard to the knowledge about risk factors for obesity, church attendees were less aware of the risk factors for obesity. Unfortunately, the myth of skipping meals in order to lose weight continues to persist and distort people's knowledge and understanding of healthy eating habits.²⁷

As expected, the highest number of PI adolescents were Samoan, the largest Pacific population group in NZ in both the 2001 and 2006 censuses.^{11,28} There were slightly more females than males, with just over half of the females in the 13–14 years age group. The majority of PI students were living with at least one parent and attended church at least once a week. These findings were consistent with previous census reports on the PI population in NZ.^{11,28}

Thirty-six percent of church attendees were obese and would benefit from a weight management programme. The increased BMI level in church attendees is consistent with previous US studies.^{12,13} More than 20 years ago, African American adult men and women were found to have unfavourable weight measurements among church attendees.²⁹ Subsequent studies also found church attendees more likely to be overweight.^{30–32} Studies in NZ have also found unfavourable weight measurements among PI church attendees.^{33–35} The study by Bell and colleagues was able to demonstrate that a nutrition

and exercise weight loss programme for controlling weight in Samoan church communities stalled weight gain and encouraged a number of people to increase the intensity of their leisure-time activities.³³ Although these studies were on adult groups, their findings are indicative of the likelihood of children and adolescents progressing from normal to overweight or obese status as they reach adulthood.³⁶ They are also significant in light of the paucity of other studies on the weight status of PI ethnic groups who attend church compared with non-attendees.

In contrast, a longitudinal survey of Seventh Day Adventist children aged 6 to 18 years in Southern California found them to be leaner than their public school counterparts, although this denomination has high rates of vegetarianism.³⁷ Some caution is therefore warranted in offering a conclusion about the ubiquitous or immediate association of church attendance and obesity.

Strengths and limitations

This study included the largest survey of lifestyle risk factors for obesity in PI adolescents to date. The response rate of eligible adolescents in the schools was high. The six schools were chosen because they were from an area of high PI population, but were not necessarily representative of the PI population in NZ at large, which may limit the generalisability of findings. For example, adolescent participants were drawn from a low socioeconomic area of Auckland, introducing possible selection bias. Therefore, the findings may be less generalisable to the total PI population or PI adolescents in higher socioeconomic areas, other geographical regions in NZ, or in other countries. Furthermore, adolescents who have left school by age 16 would not have been included, introducing another possible source of selection bias.

On the other hand, restricting selection of participants to schools with low socioeconomic deciles is a strength of the study as this would have limited any confounding effects associated with socioeconomic status.³⁸ Although the cross-sectional design of the study provided a survey of lifestyle behaviours and associations at one point in time, associations do not imply causality, or even association over time. In addition, some of the signifi-

cant differences in the lifestyle between church attendees and non-attendees may be false positive findings due to multiple comparisons. However, this concern is unlikely for the obesity findings (as shown in Table 2) where there is a consistent pattern of higher levels of obesity in each of the four Pacific ethnic groups (although not significant because of the small sample sizes) for church attendees compared with non-attendees.

Conclusions and recommendation

The literature and study findings point to an association between PI populations affiliated with the church and higher levels of obesity. The study identified an association between church attendance and obesity. However, the associations between church attendance and risk factors were mixed, so an obvious cause for the higher prevalence of obesity in church attendees was not clear. It may be due to a number of risk behaviours, perhaps some associated with church activities, although this has not been investigated, specifically. While attendance at church has an association with a high prevalence of obesity, it may also represent an opportunity to change risk behaviours for obesity, particularly as church attendance remains high amongst PI adolescents.

Effective strategies for PI adolescents are likely to be those that focus on raising the awareness of obesity-related risk factors, promoting healthy food and drink consumption, including sourcing breakfast and lunch from home, and increasing physical activity levels. Planning of ethnic-specific PI interventions around food, activity and behaviour support should consider risk factors relevant to the population group as identified in this study. A logical venue for weight management and effective lifestyle change agent may be the church, thus providing an ideal role for practical interventions to address the high prevalence of obesity among church attendees.

References

1. World Health Organization. Report of the Joint WHO/FAO Expert Consultation on diet, nutrition and the prevention of chronic diseases. WHO Technical Series 916. Geneva: World Health Organization; 2002.
2. World Health Organization. World Health Assembly 55th Meeting. Global strategy on diet, physical activity and health. Geneva: World Health Organization; 2004.
3. Curtis M. The obesity epidemic in the Pacific Islands. *J Development Social Transformation*. 2004;1:37–42.
4. Becker A, Gilman SE, Burwell RA. Changes in prevalence of overweight and in body image among Fijian women between 1989 and 1998. *Obes Res*. 2005;13(1):110–117.
5. Ministry of Health. A portrait of health: key results of the 2006/07 New Zealand Health Survey. Public Health Intelligence. Wellington: Ministry of Health; 2008: 361.
6. World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO Consultation. WHO Technical Report Series 894. Geneva: World Health Organization; 2000.
7. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. *Pediatrics*. 2005;115(1):22–7.
8. Ministry of Health. NZ food NZ children: key results of the 2002 National Children's Nutrition Survey. Wellington: Ministry of Health; 2003.
9. Ministry of Health. A portrait of health: key results of the 2002/03 New Zealand Health Survey. Public Health Intelligence Occasional Bulletin No. 21. Wellington: Ministry of Health; 2004:1–153.
10. Ministry of Health. Improving quality of care for Pacific peoples. Wellington: Ministry of Health; 2008:1–58.
11. Statistics New Zealand. Pacific Peoples. 2006 census of population and dwellings. Wellington: Statistics New Zealand; 2007.
12. Oman D, Reed D. Religion and mortality among the community-dwelling elderly. *Am J Public Health*. 1998;88(10):1469–75.
13. Cline KMC, KF Ferraro. Does religion increase the prevalence and incidence of obesity in adulthood? *J Sci Study Relig*. 2006;45(2):269–281.
14. Utter J, Faeamani G, Malakellis M, Vanualailai N, Kremer, P, Scragg R, et al. Lifestyle and obesity in South Pacific youth: baseline results from the Pacific Obesity Prevention in Communities (OPIC) Project in New Zealand, Fiji, Tonga and Australia. Auckland: The University of Auckland; 2008.
15. Utter J, Scragg R, Robinson E, Warbrick J, Faeamani G, Foroughian S, et al. Evaluation of the Living 4 Life project: a youth-led, school-based obesity prevention study. *Obes Rev*. 2011;12(Suppl. 2):S1–60.
16. AusStats 1998. 4805.0 National Nutrition Survey: Nutrient Intakes and Physical Measurements Australia. 1995 (Survey No. 4805.0). Canberra: Australian Bureau of Statistics.
17. National Health and Medical Research Council 1997. Acting on Australia's Weight. Canberra: National Health and Medical Research Council, Commonwealth of Australia.
18. Yu P, Yu H. Lessons learned from the practice of mobile health application development. Proceedings of the 28th Annual International Computer Software and Applications Conference. Hong Kong. IEEE Computer Society. 2004;2:58–59.
19. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320:1240–3.
20. Holt CL, Haire-Joshu DL, Lukwago SN, Lewellyn LA, Kreuter MW. The role of religiosity in dietary beliefs and behaviors among urban African American women. *Cancer Control*. 2005;12(Suppl 2):84–90.
21. Utter J, Scragg R, Schaaf D, Fitzgerald E. Nutrition and physical activity behaviours among Maori, Pacific and NZ European children: identifying opportunities for population-based interventions. *Aust N Z J Public Health*. 2006;30(1):50–56.
22. Maher A, Wilson N, Signal L. Advertising and availability of obesogenic foods around New Zealand secondary schools: a pilot study. *N Z Med J*. 2005;118(1218):U1556.
23. Kipke MD, Iverson E, Moore D, Booker C, Ruelas V, Peters AL, et al. Food and park environments: neighborhood-level risks for childhood obesity in east Los Angeles. *J Adolesc Health*. 2007;40(4):325–33.

24. van der Horst K, Timperio A, Crawford D, Roberts R, Brug J, Oenema A. The school food environment associations with adolescent soft drink and snack consumption. *Am J Prev Med*. 2008;35(3):217–23.
25. Hill JO, Wyatt HR, Reed GW, Peters JC. Obesity and the environment: where do we go from here? *Science*. 2003;299:853–855.
26. Scragg R, Quigley R, Taylor R. Does watching TV contribute to increased body weight and obesity in children? A report prepared by the Scientific Committee of the Agencies for Nutrition Action. July 2006.
27. Drummond S. Bringing the sense back into healthy eating advice. *J Fam Health Care*. 2006;16(5):143–5.
28. Statistics New Zealand. Pacific Peoples. 2001 census of population and dwellings. Wellington: Statistics New Zealand; 2002.
29. Gottlieb NH, Green LW. Life events, social network, life-style, and health: an analysis of the 1979 National Survey of Personal Health Practices and Consequences. *Health Educ Behav*. 1984;11(1):91–105.
30. Lapane KL, Lasater CA, Allan C, Carleton RA. Religion and cardiovascular disease risk. *J Relig Health*. 1997;36(2):155–163.
31. Ferraro KF. Firm believers? Religion, body weight and well-being. *Rev Religious Res*. 1998;39(3):224–244.
32. Kim KH, Sobal J, Wethington E. Religion and body weight. *Int J Obes Relat Metab Disord*. 2003;27:469–477.
33. Bell, AC, Swinburn BA, Amosa H, Scragg RK. A nutrition and exercise intervention program for controlling weight in Samoan communities in New Zealand. *Int J Obes Relat Metab Disord*. 2001;25(6):920–7.
34. Simmons D, Fleming C, Voyle J, Fou F, Feo S, Gatland B. A pilot urban church-based programme to reduce risk factors for diabetes among Western Samoans in New Zealand. *Diabet Med*. 1998;15(2):136–42.
35. Simmons D, Voyle JA, Fou F, Feo S, Leakehe L. Tale of two churches: differential impact of a church-based diabetes control programme among Pacific Islands people in New Zealand. *Diabet Med*. 2004;21(2):122–8.
36. Serdula M, Ivery KD, Coates RJ, Freedman DS, Williamson DF, Byers T. Do obese children become obese adults? A review of the literature. *Prev Med*. 1993;22(2):167–77.
37. Sabate J, Lindsted KD, Harris RD, Johnston PK. Anthropometric parameters of schoolchildren with different life-styles. *Am J Dis Child*. 1990;144(10):1159–63.
38. Rothman KJ, Greenland S, Lash TL. *Modern epidemiology*. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2008.

ACKNOWLEDGEMENTS

The authors would like to thank the following for their support of this research: participating schools, principals, teachers, parents and students in South Auckland; the Health Research Council of New Zealand; the Pacific Health Branch, Ministry of Health, New Zealand; Pacific Health Section, School of Population Health, Faculty of Medical and Health Sciences, The University of Auckland, New Zealand.

FUNDING

The study received funding from the Health Research Council of New Zealand, the National Health and Medical Research Council of Australia, and the Wellcome Trust, UK.

COMPETING INTERESTS

None declared.