

**Title**

Is the practice of yoga or meditation associated with a healthy lifestyle? Results of a national cross-sectional survey of 28695 Australian Women

**Running title**

Yoga/meditation and healthy lifestyle

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**ABSTRACT***Objectives*

To examine the relationship between yoga/meditation practice and health behavior in Australian women.

*Methods*

Women aged 19-25 years, 31-36 years, and 62-67 years from the Australian Longitudinal Study on Women's Health (ALSWH) were surveyed regarding smoking, alcohol or drug use, physical activity and dietary behavior; and whether they practiced yoga/meditation on a regular basis. Associations of health behaviors with yoga/meditation practice were analyzed using multiple logistic regression modelling.

*Results*

11344, 8200, and 9151 women aged 19-25 years, 31-36 years, and 62-67 years, respectively, were included of which 29.0%, 21.7%, and 20.7%, respectively, practiced yoga/meditation. Women practicing yoga/meditation were significantly more likely to be physically active (OR=1.50-2.79) and to follow a vegetarian (OR=1.67-3.22) or vegan (OR=2.26-3.68) diet, but also to use marijuana (OR=1.28-1.89) and illicit drugs (OR=1.23-1.98).

*Conclusions*

Yoga/meditation practice was associated with physical activity, and vegetarian/vegan diet. While health professionals should keep the potential vulnerability of yoga/meditation practitioners to drug use in mind, the positive associations of yoga/meditation with a variety of positive health behaviors warrant its consideration in preventive medicine and healthcare.

Key words: Yoga; Meditation; Health Behavior; Exercise; Diet; Survey

## INTRODUCTION

Non-communicable diseases such as cardiovascular disease, cancer, and type 2 diabetes have become the major causes of mortality worldwide, accounting for almost two thirds of global deaths (2, 3). Major risk factors for non-communicable diseases include modifiable behavioral lifestyle factors such as smoking, risky drinking, unhealthy diet, and insufficient physical activity (3, 4). The World Health Organization (WHO) has defined the reduction of such unhealthy lifestyle behavior as their global target for reducing the incidence of non-communicable disease and subsequent premature death worldwide (2).

Originally rooted in traditional Indian philosophical, spiritual, and health practice (5, 6), yoga has become a popular avenue to promote physical and mental well-being worldwide (7, 8). In Europe, Australia and the US, yoga is now most often associated with physical postures (asanas), breathing techniques (pranayama), and meditation (dyana) (5, 9). However, traditionally, yoga is a complex system that also incorporates advice to achieve an ethical and healthy lifestyle (5, 6, 10). In particular, yoga's ethical guidelines or 'restraints' (11) include recommending behavior that does not hurt oneself or others (5). This so-called 'ahimsa' is referred to as nonviolence against all living being – including animals but also the practitioners themselves (5). Based on these guidelines, several yoga traditions view following a vegetarian diet as an ethical and health necessity to practice yoga because eating meat would induce animal suffering (6, 12). Other behaviors potentially endangering oneself or others, such as smoking, alcohol and drug use, which are also thought to interfere with mental yoga exercises, are also often viewed as incompatible with yoga practice (12). Overall, a generally healthy lifestyle is frequently recommended in addition to formal yoga exercises (6, 13). Likewise, almost all commonly used

meditation practices stem from spiritual/religious traditions such as Buddhism in the case of mindfulness meditation and Hinduism in the case of Transcendental meditation (14); traditions that also recommend restraining from eating meat and/or from using alcohol or drugs for ethical reasons and because their consumption is believed to interfere with practice (15, 16).

However, few studies have empirically investigated associations of yoga/meditation practice with health behavior, mostly indicating that yoga practitioners might be less likely to smoke and more likely to follow a vegetarian diet and to be physically active than the national norm (17, 18). Conversely, it has been reported that alcohol intake might be higher in yoga practitioners than in non-practitioners (17), while associations of yoga practice with consumption of other drugs has not been investigated. Although meditation is a commonly-used approach to health behavior change (19), we were unable to locate any studies examining relations between meditation practice and health behaviors. Moreover, very few analyses have used nationally representative surveys with adequate non-yoga/meditation control groups, and all of them are from the US and used data from the early 2000s (20, 21). Thus, this study aimed to analyze associations of yoga and meditation practice with health behavior in a large nationally representative sample of Australian women.

## **METHODS**

The analyses reported here were conducted using data from the Australian Longitudinal Study on Women's Health (ALSWH), which was designed to assess the health and wellbeing and associated factors in Australian women. Ethics approval for the ALSWH was gained from the relevant ethics committees at the University of Newcastle and the University of Queensland. Women in three different age groups

(born between: 1921-1926, 1946-1951, and 1973-1978) were randomly selected from the national Medicare database in 1996 (22), with respondents shown to be broadly representative of the national population of women in the respective age cohorts (23). In 2012, a new cohort was recruited (born between: 1989-1995).

Besides age and gender, no further inclusion criteria were defined.

Women were sent the initial survey items by post, two follow-up mailings were sent to non-responders. The surveys contained items regarding use and satisfaction with health care services, life stages and key events, and health behavior.

For the analyses reported here, we focused on 9151 women from the 1946-1951 cohort (Survey 7, 2013), 8200 women from the 1973-1978 cohort (Survey 5, 2009), and 11345 women from the 1989-1995 cohort (Survey 2, 2014). The oldest cohort could not be included because it did not contain questions around yoga use..

Initial response rates ranged from 42% to 56%, further participants were lost during the course of the study (figure 1).

	1946-1951	1973-1978	1989-1995
	Initial Response Rate 56%	Initial Response Rate 42%	Initial Response Rate: NA
Survey 1	13,714	14,247	17,015
Survey 2	12,338	9,688	11,345
Survey 3	11,226	9,081	8,961
Survey 4	10,905	9,145	7,287
Survey 5	10,638	8,200	
Survey 6	10,011	8,009	
Survey 7	9,151	7,186	

**Figure 1:** Responder rates of participants throughout the ALSWH study from its inception (1996). The 1989-1995 cohort was established in 2013. The fields highlighted in grey indicate the survey, from which the data were extracted. The initial response rate is an estimated provided by ALSWH, for the youngest cohort however no such estimate could be provided due to recruitment via social media.

Several of the ALSWH data from the latest surveys have been compared to women of the same age in the Australian population, using data from the Australian Census conducted closest to the survey (24). While differences between responders and the age matched population can be found in terms of education (respondents being more likely to have tertiary education), marital status (respondents being more likely married), and employment (respondents being more likely to be employed and work longer hours), relative risk estimated for all cohorts did not indicate serious bias due to loss to follow-up (24). As for the youngest ALSWH cohort (1985-1995) it was stated that they were broadly representative in

terms of area of residence, state and territory distribution, marital status and age distribution, with overrepresentation of women with tertiary education.

#### *Yoga/meditation practice*

The women were asked how often they had practiced yoga/meditation in the last twelve months; they could select *never*, *rarely*, *sometimes* or *often*. For the present analyses, the categories *never* and *rarely* were combined, due to low responses for the *rarely* category.

#### *Smoking*

Women were queried whether they currently smoke cigarettes or tobacco products, or whether they have smoked in the past. Those who reported that they currently smoke were further queried about the frequency and quantity. For the present analyses, those who smoke regularly (on more than one day per week) were compared to those who do not (including occasional smokers).

#### *Alcohol use*

The use of alcohol was determined with a series of questions analyzing frequency and amount of alcohol consumption. Alcohol use was recoded according to the National Health and Medical Research Council (NHMRC) classification, and recoded for the comparisons of those with high risk drinking behavior (including risky drinkers with 2.01 to 4.00 drinks per day and high risk drinkers with more than 4.00 drinks per day) vs. those without (including non-drinkers and low risk drinkers with up to 2.00 drinks per day).

#### *Marijuana use*

Women in the 1973-1978 and the 1989-1995 cohorts were asked whether they had used marijuana (cannabis, hash, grass, dope, pot, yandi) for non-medicinal



purposes; they could choose between *never, more than 12 months ago, in the last 12 months*. In the present analyses, those who used marijuana in the past 12 months were compared to those who did not.

Recreational marijuana use is illegal in Australia as was medicinal use at the time of the surveys.

#### *Illicit drug use*

Women in the 1973-1978 and the 1989-1989 cohorts were asked whether they had used illicit drugs (amphetamines, LSD, natural hallucinogens, tranquilizers, cocaine, ecstasy, inhalants, heroin or barbiturates) for non-medicinal purposes; they could choose between *never, more than 12 months ago, in the last 12 months*. In the present analysis, those who used illicit drugs in the past 12 months were compared to those who did not.

Women in the 1973-1978 cohort had also been asked to specify which illicit drugs they had used in an earlier survey (2006); those data were analyzed descriptively to provide more information on the most commonly used illicit drugs but were not included in the regression analysis.

#### *Physical activity*

Physical activity was assessed by a series of questions regarding the types of activity (walking, moderate, vigorous activities), and frequency/duration of those activities within the past week. Based on those numbers, women were categorized into physically active (at least 150 min. of moderate-to-vigorous physical activity per week) and low activity/sedentary (less than 150 min. of moderate-to-vigorous physical activity per week) (25).

#### *Dietary behavior*

Dietary behavior was analyzed using data from the Dietary Questionnaire for Epidemiological Studies Version 2, a 101-item food frequency questionnaire (FFQ) (19, 26). Based on the respondents' usual eating habits in the past 12 months, full-time vegetarians (no meat, poultry, or fish) and vegans (no animal products, including meat, poultry, eggs, dairy products of any kind) were identified based on the frequencies of food items consumed. For the present analysis, two comparisons were made: those who follow a vegetarian diet (including vegans) vs. those who do not; and those who follow a vegan diet vs. those who do not.

### *Statistical Analyses*

Analyses were conducted separately for the three cohorts. Chi-square tests were used to compare socio-demographic characteristics and health behavior between those women who practiced yoga/meditation frequently versus those who practiced occasionally versus those who did not practice yoga/meditation to determine potential predictors for further analyses (results not shown). Multiple logistic regression modelling was conducted to determine whether yoga/meditation practice (independent variables, categories: practiced some yoga vs. no yoga; practiced yoga often vs. practiced yoga less than often) was associated with smoking, alcohol, marijuana and illicit drug use, physical activity, and vegetarian or vegan diet. Adjusted odds ratios with 99.5% confidence intervals were computed for all predictor variables. Analyses were adjusted for socio-demographic characteristics and confounding variables (socioeconomic status including marital status, education, income, area of residence, body mass index, and self-reported doctor-diagnosed depression, diabetes (for exercise and diet) or low iron (for diet only)). Due to the large sample sizes, statistical significance was set at  $p < 0.005$ . All statistical

analyses were performed using IBM SPSS ® software (IBM SPSS Statistics for Windows, release 22.0. Armonk, NY: IBM Corp.). Data were analyzed in 2016.

## RESULTS

Overall, 9151 Australian women aged 62-67 years (1946-1951 cohort), 8200 Australian women aged 31-36 years (1973-1978 cohort), and 11344 Australian women aged 19-25 years (1989-1995 cohort) completed the questionnaires.

The prevalence of yoga/meditation practice in each cohort can be found in Table 1.

**Table 1:** Frequency of health behaviors in Australian women aged 62-67 years (1946-51 cohort), 31-36 years (1973-78 cohort), and 19-25 years (1989-95 cohort).

Variable	1946-51 cohort (n=9151)	1973-78 coh ort (n=8200)	1989-95 cohort (n=11344)
	%	%	%
Yoga/meditation use (Some)	9.6	14.0	19.8
Yoga/meditation use (Often)	11.1	7.7	9.2
Smoking (Regularly)	2.3	10.5	0.5
Alcohol use (High risk drinker)	6.0	4.4	2.9
Marijuana use (Last 12 months)		9.2	28.8
Illicit drug use (Last 12 months)		6.1	16.5
Exercising (Highly active)	37.3	25.0	47.5
Vegetarian Diet	2.0	3.8	8.7
Vegan Diet	0.1	0.2	1.6

In the 1946-1951 cohort 20.7% practiced yoga/meditation, and 21.7% to 29.0% in the younger cohorts. However, the majority of them practiced only sometimes (up to 19.8%) and only few practiced often. In the 1946-1951 cohort, more women practiced yoga/meditation often as compared to sometimes, and as compared to the other cohorts.

In terms of health behaviors, alcohol was consumed by the vast majority of women. However, only a minority showed high risk or risky drinking behavior. A substantial proportion of women, especially in the 1989-1995 cohort, reported having used marijuana in the past 12 months (16.5-28.8%). Most women in the cohorts were physically active, with the oldest and youngest cohorts showing highest prevalence for high physical activity levels. Vegetarian, and especially vegan diets, were, however, endorsed by only a minority of the older cohorts, while only in the 1989-1995 cohort was substantial prevalence found.

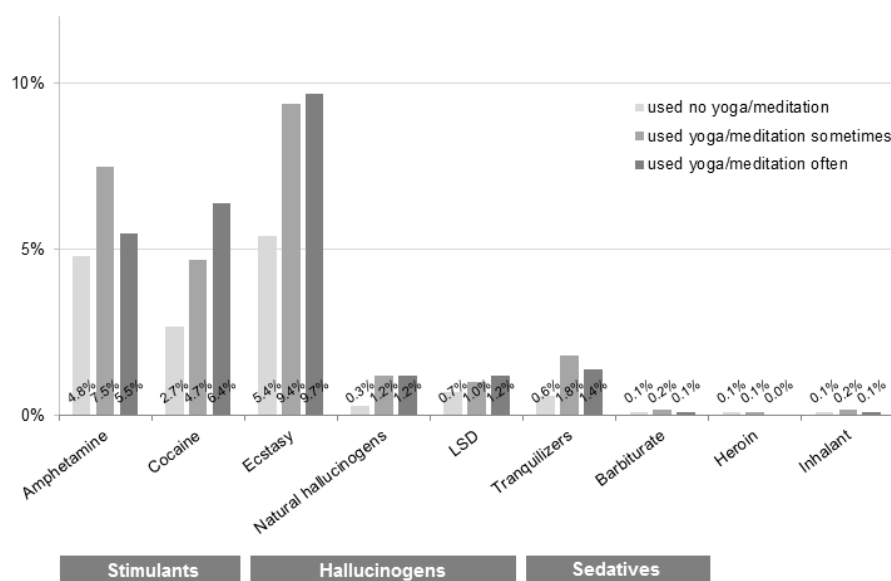
Table 2 shows the associations between yoga/meditation practice and health behaviors. Women in the 1973-1978 cohort practicing yoga/meditation often were less likely to smoke regularly (OR 0.51) compared to non-yoga/meditation practitioners. The regression analyses for alcohol consumption showed no significant differences between women who practice yoga/meditation often and those who did not. Women aged 31-36 and 19-25 years were more likely to have used marijuana (OR 1.25-1.86) and illicit drugs (OR 1.23-1.91) in the past 12 months as compared to non-yoga/meditation practitioners (Table 2). Figure 2 shows the associations between yoga practice and illicit drug use in the 1973-1978 cohort. The prevalence of drug use was substantially higher in yoga practitioners, with prevalence rates up to 4 times greater (natural hallucinogens) than non-practitioners. The main drugs used were amphetamines, cocaine, ecstasy, LSD and natural hallucinogens. Conversely, women practicing yoga/meditation were more likely to be physically active (OR 1.50-2.79) than women not practicing yoga/meditation, regardless of whether they practiced often or only sometimes and independent of their age; and they were more likely to follow a vegetarian (OR 1.72-3.22) or vegan diet (OR 2.26-3.68). See Table 2.

**Table 2:** Output from the logistic regression models showing the association between practicing yoga/meditation and several health behavior categories, in Australian women aged 62-67 years (1946-51 cohort), 31-36 years (1973-78 cohort), and 19-25 years (1989-95 cohort). OR: Odds Ratio; CI: Confidence interval. Please note: Vegan diet could not be analyzed due to the very low number of cases.

Dependent Variable	Independent Variable (Yoga practice)	1946-51 cohort (n=9151)		1973-78 cohort (n=8200)		1989-95 cohort (n=11344)	
		OR (99.5% CI)	p-value	OR (99.5% CI)	p-value	OR (99.5% CI)	p-value
Smoking (Regularly vs. not)	no yoga/meditation	Reference		Reference		Reference	
	some yoga/meditation	0.75 (0.31; 1.79)	0.265	0.88 (0.62; 1.27)	0.341	1.04 (0.38; 2.87)	0.912
	often yoga/meditation	0.44 (0.15; 1.24)	0.020	0.51 (0.28; 0.94)	0.002	0.97 (0.22; 4.42)	0.974
Alcohol use (High risk drinking vs. not)	no yoga/meditation	Reference		Reference		Reference	
	some yoga/meditation	0.79 (0.47; 1.33)	0.204	0.99 (0.62; 1.59)	0.955	0.87 (0.57; 1.33)	0.360
	often yoga/meditation	0.94 (0.59; 1.48)	0.681	0.53 (0.23; 1.20)	0.029	0.63 (0.32; 1.25)	0.057
Marijuana use (Last 12 months vs. others)	no yoga/meditation			Reference		Reference	
	some yoga/meditation			1.62 (1.18; 2.23)	<0.001	1.28 (1.10; 1.49)	<0.001
	often yoga/meditation			1.86 (1.25; 2.77)	<0.001	1.25 (1.01; 1.54)	0.003
Illicit drug use (Last 12 months vs. others)	no yoga/meditation			Reference		Reference	
	some yoga/meditation			1.39 (0.94; 2.06)	0.019	1.23 (1.03; 1.48)	0.001
	often yoga/meditation			1.91 (1.22; 2.98)	<0.001	1.31 (1.03; 1.68)	0.002
Exercising (Exercising vs. sedentary)	no yoga/meditation	Reference		Reference		Reference	
	some yoga/meditation	1.70 (1.32; 2.19)	<0.001	1.50 (1.23; 1.84)	<0.001	1.69 (1.43; 1.98)	<0.001
	often yoga/meditation	1.70 (1.33; 2.17)	<0.001	2.24 (1.69; 2.96)	<0.001	2.79 (2.15; 3.63)	<0.001

Vegetarian Diet (Vegetarian vs. not)	no yoga/meditation	Reference		Reference		Reference	
	some yoga/meditation	1.67 (0.73; 3.82)	0.084	1.90 (1.21; 2.98)	<0.001	1.72 (1.37; 2.17)	<0.001
	often yoga/meditation	3.18 (1.69; 5.97)	<0.001	2.83 (1.74; 4.60)	<0.001	2.42 (1.83; 3.20)	<0.001
Vegan Diet (Vegan vs. not)	no yoga/meditation					Reference	
	some yoga/meditation					2.26 (1.36; 3.75)	<0.001
	often yoga/meditation					3.68 (2.10; 6.45)	<0.001

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**Figure 2:** 12-month prevalence of illicit drug use among Australian women from the 1973-1978 cohort never, sometimes, or often practicing yoga/meditation.

## DISCUSSION

This study presents several key findings. First, prevalence of yoga/meditation practice was high across all cohorts compared to other countries (7, 8), although a majority of women practiced only occasionally. Secondly, yoga/meditation practice was associated with positive health behavior, specifically with a higher likelihood of adhering to regular physical activity and vegetarian diet. These findings are in line with prior studies showing that convenience samples of yoga practitioners more often demonstrated such health behaviors than the national norm (27), as well as with earlier nationally representative samples that confirmed associations of yoga practice with non-smoking and exercising (20, 21). While the cross-sectional nature

of this analysis precludes definite causal interpretation of the findings, they are in line with a number of longitudinal clinical trials showing positive short-term effects of yoga/meditation interventions on exercise behavior (28), and unhealthy eating patterns (29-32). Thus, the practice of yoga might positively influence health behavior, potentially by improving body image and body connectivity (33) as well as self-caring and self-compassion (34). Further, it can be assumed that yoga teachers often demonstrate healthy lifestyle behavior such as vegetarianism, which is an important part of yoga philosophy, and might thus have served as a role model.

While there are also findings of positive effects of yoga on smoking behavior in clinical trials (26, 35, 36), this was only found in a subgroup of women in this study. The findings on associations of yoga with physical activity behavior further need to be interpreted with care, since yoga includes a dimension of physical activity itself, which might have confounded the findings.

A large body of evidence has demonstrated beneficial effects of yoga interventions on the most important modifiable biological risk factors for non-communicable diseases in clinical trials on healthy as well as on high-risk populations (37). Given that smoking, predominantly meat-based diet, and inadequate physical activity are among the most important modifiable risk factors for non-communicable diseases and premature death (2, 3), the associations between yoga/meditation and health behaviors found in this analysis can have direct implications for health policy and health economics.

However, yoga/meditation practice was also associated with a slightly higher prevalence of marijuana use and a considerably higher prevalence of LSD and natural hallucinogens use. Yoga and meditation were originally spiritual practices (5), and spirituality may be an important part of meditators' continued practice (38).



Similarly, spirituality is an often-cited reason for starting yoga (7, 39). Among long-term yoga practitioners, spirituality often even becomes the most important reason for continued use (39). Likewise, marijuana and hallucinogens have been indigenously used for religious, divinatory and healing purposes, and often are still used for spiritual reasons such as getting deeper insight and understanding (40, 41). Natural hallucinogens have been shown to regularly initiate mystical experiences that are rated as being among the most important spiritual or meaningful experiences in the consumers' lives (42, 43). Thus, while a causal relationship between yoga/meditation practice and drug use cannot be ruled out due to the cross-sectional study design, it seems likely that certain personality traits such as openness to experiences or spirituality may predispose individuals to both practicing yoga/meditation and using drugs (44, 45). While openness to experiences has also been associated with smoking (46), higher levels of spirituality seem to be associated with lower odds of smoking (47), and might thus be a more likely explanation of the patterns found in this study. On the other hand, yoga/meditation practice was also associated with a higher likelihood of cocaine use. In contrast to hallucinogens, cocaine is mainly used to improve functioning and vigilance (32). This finding might be related to common reasons for using yoga that also include improving energy, functioning and performance (8). Yoga is mainly practiced by younger well-educated women with higher socioeconomic status (8) who might also be prone to using cocaine for improving performance. However, as the analyses controlled for education and socioeconomic status, these associations can most likely not explain the findings.

In general, further studies are warranted to better understand the associations between yoga/meditation practice and health behavior, especially around drug use.

Specifically, longitudinal studies could increase confidence in causal or merely associative interpretations of the relations found in this analysis.

The ALSWH is a comprehensive and well-respected source for epidemiological data and the large number of participants as well as the inclusion of the most important confounders within the regression models provides strength to the analyses reported here. There are, however, some limitations as well: yoga/meditation practice was assessed as a single item; therefore, it is impossible to tell whether the findings are driven by the practice of yoga, the practice of meditation, or both. In addition, the data are based on recollected self-reports. Further, the sample is comprised only of women; it would be important for future research to also examine relations between men's yoga and meditation practices and health behaviors.

## **CONCLUSION**

This cross-sectional analysis of three large cohorts of Australian women found differentiated association of yoga/meditation use with health behavior. While yoga/meditation use was associated with a higher likelihood of regular physical activity, vegetarian diet, and perhaps non-smoking, it also was associated with a higher likelihood of marijuana and illicit drug use. Health professionals need to keep this potential vulnerability to possibly dangerous drug use in mind when evaluating health status and risk profiles of yoga or meditation practitioners. Nevertheless, while longitudinal studies are needed for conclusive interpretations, the positive associations of yoga/meditation with a variety of positive health behaviors warrant the consideration of yoga/meditation in preventive medicine and healthcare.

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**Title**

Is the practice of yoga or meditation associated with a healthy lifestyle? Results of a national cross-sectional survey of 28695 Australian Women

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**Highlights:**

- Yoga/meditation practice is associated with physical activity and vegetarian diet
- Women practicing yoga/meditation less often smoke
- They more often use marijuana and illicit drugs

ACCEPTED MANUSCRIPT