**Title**

The association between regular yoga practice and falls and injuries: Results of a national cross-sectional survey among Australian Women

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**Abstract**

*Introduction*

Falls are the leading cause of injuries in women across all ages. While yoga has been shown to increase balance, it has also been associated with injuries due to falls during practice. This study aimed to analyse whether regular yoga practice is associated with the frequency of falls and fall-related injuries in upper middle-aged Australian women.

*Methods*

Women aged 59-64 years from the Australian Longitudinal Study on Women’s Health (ALSWH) were queried regarding falls and falls-related injuries; and whether they regularly practiced yoga. Associations of falls and falls-related injuries with yoga practice were analysed using chi-squared tests and multiple logistic regression modelling.

*Results*

Of 10,011 women, 4,413 (44.1%) had slipped, tripped or stumbled, 2,770 (27.7%) had fallen to the ground, 1,398 (14.0%) had been injured as a result of falling, and 901 (9.0%) women had sought medical attention for a fall-related injury within the previous 12 months. Yoga or meditation was practiced regularly by 746 (7.5%) women. No associations of falls, fall-related injuries and treatment due to falls-related injury with yoga practice were found.

*Discussion*

No association between yoga practice and falls or fall-related injuries have been found. Further studies are warranted for conclusive judgement of benefits and safety of yoga in relation to balance, falls and fall-related injuries.

**Introduction**

Falls are the leading cause of non-fatal injuries that lead to treatment in an emergency room in women across all ages; however the total number of falls and falls-related treatments linearly increases with age [[1](#_ENREF_1), [2](#_ENREF_2)]. About half of all injuries that require treatment in upper middle-aged women are falls-related [[1](#_ENREF_1)]; and falls are an important risk factor for disability and disablement [[3](#_ENREF_3)]. In middle-aged women, falls most often occur during ambulation but are also frequently associated with sports and other rigorous physical activity [[2](#_ENREF_2)].

Yoga is gaining increased popularity as a therapeutic and preventive medicine approach [[4-7](#_ENREF_4)]. A number of clinical studies suggest that yoga might increase balance and hence decrease the risk of falling [[8-11](#_ENREF_8)]; and it has also been shown that many women prefer yoga over other approaches when considering fall prevention strategies [[12](#_ENREF_12)].

It has however been argued that yoga practice might itself be a risk factor for falls-related injury: although very rarely, yoga has been associated with contusion, fracture, and nerve damage due to falls´; injuries resulting in emergency treatments [[13](#_ENREF_13), [14](#_ENREF_14)]. It thus remains unclear whether regular yoga practice decreases or even increases the risk of falling in upper middle-aged women.

The aim of this study was to analyse whether regular yoga practice was associated with the frequency of falls and fall-related injuries in upper middle-aged Australian women.

**Methods**

This analysis was conducted on data from the Australian Longitudinal Study on Women’s Health (ALSWH), which was designed to investigate multiple factors affecting the health and wellbeing of women over a 20-year period. Women in three age groups were randomly selected from the national Medicare database in 1996 [[15](#_ENREF_15)], with the respondents having been shown to be broadly representative of the national population of women in the target age group [[16](#_ENREF_16)]. For this sub-study, analyses focused on 10,011 women from the 1946-1951 cohort, who at the 2010 survey were aged between 59 and 64 years.

*Fall and injuries*

Women were asked if they had: slipped, tripped or stumbled; have a fall to the ground; been injured as a result of the fall; and needed to seek medical attention for an injury from the fall during the previous 12 months. Questions were answered on a yes or no basis.

*Yoga practice*

The women were also asked how often they had practiced yoga or meditation in the last twelve months, with responses being categorized as follows: ‘never’, ‘rarely’ and ‘sometimes’ as non-regular practice; and the response ‘often’ as regular practice.

*Confounders*

Women were further asked about health problems and diseases. Those with a possible influence on the outcome of interest were extracted from the data and included in the analysis. Confounders included diseases such as osteoarthritis, rheumatoid arthritis, Parkinson’s disease or depression; and symptoms such as dizziness and loss of balance. In addition, women were asked about their alcohol consumption; which was classified as low vs. high risk according to the National Health and Medical Research Council (NHMRC) [[17](#_ENREF_17)].

*Statistical Analyses*

Chi-squared tests were used to compare socio-demographic characteristics between those women who regularly practiced yoga and meditation vs. those who did not.

Multiple logistic regression analyses were conducted to determine whether yoga and meditation practice (independent variable) was associated with the four types of falls-related events (dependent variables). Adjusted odds ratios with 95% confidence intervals were computed for all predictor variables. Analyses were adjusted for socio-demographic characteristics and confounding variables. Statistical significance was set at p-value < 0.05 (i.e. α = 0.05). All analyses were conducted using the statistical program Stata 11.1.

**Results**

Of the 10,011 women who returned a completed questionnaire, 4,413 (44.1%) had slipped, tripped or stumbled, 2,770 (27.7%) women had a fall to the ground, 1,398 (14.0%) women had been injured as a result of a fall, and 901 (9.0%) women had sought medical attention for an injury from a fall, within the previous 12 months. Also, yoga or meditation was practiced often by 746 (7.5%) women.

Table 1 shows the association between the four falls-related events and the practicing of yoga or meditation. In comparison to women who did not practice yoga or meditation often, there was a slightly lower percentage of women who regularly practiced yoga or meditation who slipped, tripped or stumbled (p=0.323) and/or had a fall to the ground (p=0.314). However, neither of these associations was statistically significant. A similar distribution of women who did or did not practice yoga or meditation often was observed between women who had or had not been injured as a result of a fall (p=0.599) and/or women who did or did not seek medical attention for an injury from a fall (p=0.523). Neither of these associations was statistically significant.

The output from the adjusted logistic regression models used to determine the association between practicing yoga or meditation often and the four falls-related events is presented in Table 2. Women who regularly practiced yoga or meditation were less likely to have slipped, tripped or stumbled (OR=0.92; 95% CI: 0.79, 1.08), had a fall to the ground (OR=0.90; 95% CI: 0.76, 1.08), and/or sought medical attention for an injury from a fall (OR=0.93; 95% CI: 0.70, 1.22), compared to women who did not practice yoga or meditation regularly. Conversely, women who regularly practiced yoga or meditation had 1.04 (95% CI: 0.83, 1.29) times higher odds to have been injured as a result of a fall in the previous 12 months. However, none of these associations were statistically significant.

**Discussion**

This is the first study to investigate associations between yoga practice and falls on the basis of a cohort study.

This study found that a large number of women slipped, tripped or had a fall within the past 12 months, and about one in ten women had an injury or needed medical attention as a result of the fall. The study further found that 7.5% of the women practiced yoga or meditation regularly. Regression analysis however revealed no association between regular yoga and meditation practice and the frequency of falls and fall-related injuries.

There were two more plausible outcomes of this analysis. First, one might have thought that yoga may be able to reduce falls and fall-related injuries. Several trials have indeed investigated the effects of yoga on balance and fall prevention in older adults or diseased patients; and most of them found beneficial effects [[8-11](#_ENREF_8), [18](#_ENREF_18)]. The effects are considered results of increased postural awareness [[19](#_ENREF_19), [20](#_ENREF_20)] and proprioception [[19-21](#_ENREF_19)], as well as increases in muscle strength [[22-24](#_ENREF_22)]. Results of the trials however have to be handled with care because of their often low quality and/or the underutilizing of appropriate measures of balance. It is also not established that effects found for balance tests are associated with lower risk of falls in everyday function, and whether such effects are limited to patients with severe impairments in balance.

Second, one might also have thought that yoga practice is associated with increased frequency of falls, especially during yoga practice. Although adverse events and side effects usually are poorly reported in randomised controlled trials [[25](#_ENREF_25)], and case reports mainly focus on noticeable and extraordinary events [[25](#_ENREF_25), [26](#_ENREF_26)]. It is however plausible that certain yoga poses (one leg stand, head stand, hand stand) may be too demanding, and depending on qualification of yoga teachers, the physical status of practitioners and the inclusion of such demanding practices the prevalence of falls and injuries may be quite heterogeneous. For example, a case of a 67-year-old women has been reported who practiced a yoga pose characterized by both feet behind her neck and all body weight on hands [[13](#_ENREF_13)]. As she accidentally lost her balance and fell over in this position, she injured both sciatic nerves and reached only partial recovery during the next few months. However, cases of serious injury due to yoga-related falls are rare: in a nation-wide survey among Japanese yoga teachers, only 9 cases of moderate or severe yoga-related falls were reported; some of them however requiring discontinued class participation, medical examination or even emergency transport [[14](#_ENREF_14)]. About 25% of all long-term practitioners have ever been injured during their yoga practice [[14](#_ENREF_14), [27](#_ENREF_27), [28](#_ENREF_28)]; but the risk of yoga-associated injuries has been estimated as only 1.45 per 1,000 hours of yoga practice [[29](#_ENREF_29)]; and falls are only a minor cause for yoga-related injury [[14](#_ENREF_14), [27](#_ENREF_27)]. Overall, the risk of yoga-related injuries has been shown to be comparable to other forms of moderate intensity exercise such as stretching or walking [[25](#_ENREF_25)].

This study has several limitations. Yoga and meditation practice were investigated as one item, therefore separate results for yoga and meditation practice may have been different. Furthermore data are based on self-reports and women may not have recollected all falls and injuries correctly, especially falls without consequences. They also did answer the question on a yes/no answer rather than reporting the number of falls and related events, which might have been more informative.

However, 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, represent the strengths of this analysis.

**Conclusion**

No association between yoga practice and falls or fall-related injuries have been found. Further studies are warranted for conclusive judgement of benefits and safety of yoga in relation to balance, falls and fall-related injuries.

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**Tables:**

**Table 1 The bivariate association between practicing yoga or meditation often and four falls-related events, for 9,822 Australian women aged 59-64 years.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Falls-related events** | | **Regular Yoga/Meditation**  **Practice** | |  |
|  |
| **No** | **Yes** | **p-value** |
| (n=9,076) | (n=746) |  |
|  |  | **N (%)** | **N (%)** |  |
| **Slipped, tripped or stumbled** | No | 5,013 (55.2) | 426 (57.1) | 0.323 |
| Yes | 4,063 (44.8) | 320 (42.9) |  |
| **Had a fall to the ground** | No | 6,523 (71.9) | 549 (73.6) | 0.314 |
| Yes | 2,553 (28.1) | 197 (26.4) |  |
| **Been injured as a result of a fall** | No | 7,801( 86.0) | 636 (85.3) | 0.599 |
| Yes | 1,275 (14.1) | 110 (14.8) |  |
| **Sought medical attention for an injury from a fall** | No | 8,246 (90.9) | 683 (91.6) | 0.523 |
| Yes | 830 (9.1) | 63 (8.5) |  |

**Table 2 Output from four logistic regression models showing the association between practicing yoga or meditation often and four falls-related dependent variables, for 9,822 Australian women aged 59-64 years.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Dependent**  **Variable** | **Independent**  **Variable** |  | **Odds Ratio \*** | **95% C.I.** | **p-value** |
| **Slipped, tripped or stumbled** | Regular Yoga/ Meditation practice | No | 1.00 | ⎯ |  |
| Yes | 0.92 | 0.79, 1.08 | 0.307 |
| **Had a fall to the ground** | Regular Yoga/ Meditation practice | No | 1.00 | ⎯ |  |
| Yes | 0.90 | 0.76, 1.08 | 0.254 |
| **Been injured as a result of a fall** | Regular Yoga/ Meditation practice | No | 1.00 | ⎯ |  |
| Yes | 1.04 | 0.83, 1.29 | 0.741 |
| **Sought medical attention for an injury from a fall** | Regular Yoga/ Meditation practice | No | 1.00 | ⎯ |  |
| Yes | 0.93 | 0.70, 1.22 | 0.590 |

\* adjusted for the following confounders: osteoarthritis, rheumatoid arthritis, osteoporosis, depression, dizziness, eyesight problems, alcohol consumption.

**References**

[1] Center for Disease Control and Prevention. The 10 leading causes of nonfatal unintentional injury in women. Web-based Statistical Query and Reporting System, United States 2011 Retrieved online from <http://webappacdcgov/sasweb/ncipc/nfilead2001html>, August 10, 2015. 2013.

[2] Talbot LA, Musiol RJ, Witham EK, Metter EJ. Falls in young, middle-aged and older community dwelling adults: perceived cause, environmental factors and injury. BMC Public Health. 2005;5:86.

[3] Stalenhoef PA, Diederiks JP, de Witte LP, Schiricke KH, Crebolder HF. Impact of gait problems and falls on functioning in independent living persons of 55 years and over: a community survey. Patient Educ Couns. 1999;36:23-31.

[4] Clarke TC, Black LI, Stussman BJ, Barnes PM, Nahin RL. Trends in the use of complementary health approaches among adults: United States, 2002-2012. Natl Health Stat Report. 2015:1-16.

[5] Cramer H, Lauche R, Ward L, Steel A, Dobos G, Zhang Y. Prevalence, Pattern and Predictors of yoga use in the US: Results of a representative survey. Am J Prev Med. 2015.

[6] Macy D. Yoga journal releases 2008 "Yoga in America" market study [[http://www.yogajournal.com/advertise/press\_releases/10]](http://www.yogajournal.com/advertise/press_releases/10%5d). Yoga Journal. 2008.

[7] Saravanakumar P, Higgins IJ, Van Der Riet PJ, Marquez J, Sibbritt D. The influence of tai chi and yoga on balance and falls in a residential care setting: a randomised controlled trial. Contemp Nurse. 2014:5231-55.

[8] Ikai S, Uchida H, Suzuki T, Tsunoda K, Mimura M, Fujii Y. Effects of yoga therapy on postural stability in patients with schizophrenia-spectrum disorders: A single-blind randomized controlled trial. J Psychiatr Res. 2013;47:1744-50.

[9] Ni M, Mooney K, Richards L, Balachandran A, Sun M, Harriell K, et al. Comparative impacts of Tai Chi, balance training, and a specially-designed yoga program on balance in older fallers. Arch Phys Med Rehabil. 2014;95:1620-8 e30.

[10] Tiedemann A, O'Rourke S, Sesto R, Sherrington C. A 12-week Iyengar yoga program improved balance and mobility in older community-dwelling people: a pilot randomized controlled trial. J Gerontol A Biol Sci Med Sci. 2013;68:1068-75.

[11] Zettergren KK, Lubeski JM, Viverito JM. Effects of a yoga program on postural control, mobility, and gait speed in community-living older adults: a pilot study. J Geriatr Phys Ther. 2011;34:88-94.

[12] Brewin D, Naninni A. Women's perspectives on falls and fall prevention during pregnancy. MCN Am J Matern Child Nurs. 2014;39:300-5.

[13] Dacci P, Amadio S, Gerevini S, Moiola L, Del Carro U, Radaelli M, et al. Practice of yoga may cause damage of both sciatic nerves: a case report. Neurol Sci. 2013;34:393-6.

[14] Matsushita T, Oka T. A large-scale survey of adverse events experienced in yoga classes. Biopsychosoc Med. 2015;9:9.

[15] Brown WJ, Bryson L, Byles JE, Dobson AJ, Lee C, Mishra G, et al. Women's Health Australia: recruitment for a national longitudinal cohort study. Women Health. 1998;28:23-40.

[16] Brown WJ, Dobson AJ, Bryson L, Byles JE. Women's Health Australia: on the progress of the main cohort studies. J Womens Health Gend Based Med. 1999;8:681-8.

[17] National Health and Medical Research Council. Australian Alcohol Guidelines: Health Risks and Benefits. Endorsed October 2002. Canberra (ACT): Commonwealth of Australia; 2001. 2001.

[18] Jeter PE, Nkodo AF, Moonaz SH, Dagnelie G. A systematic review of yoga for balance in a healthy population. J Altern Complement Med. 2014;20:221-32.

[19] Cramer H, Lauche R, Haller H, Langhorst J, Dobos G, Berger B. "I'm more in balance": a qualitative study of yoga for patients with chronic neck pain. J Altern Complement Med. 2013;19:536-42.

[20] Gard T, Noggle JJ, Park CL, Vago DR, Wilson A. Potential self-regulatory mechanisms of yoga for psychological health. Front Hum Neurosci. 2014;8:770.

[21] Cramer H, Lauche R, Hohmann C, Ludtke R, Haller H, Michalsen A, et al. Randomized-controlled trial comparing yoga and home-based exercise for chronic neck pain. Clin J Pain. 2013;29:216-23.

[22] Tracy BL, Hart CE. Bikram yoga training and physical fitness in healthy young adults. J Strength Cond Res. 2013;27:822-30.

[23] Lau C, Yu R, Woo J. Effects of a 12-Week Hatha Yoga Intervention on Cardiorespiratory Endurance, Muscular Strength and Endurance, and Flexibility in Hong Kong Chinese Adults: A Controlled Clinical Trial. Evid Based Complement Alternat Med. 2015;2015:958727.

[24] Rachiwong S, Panasiriwong P, Saosomphop J, Widjaja W, Ajjimaporn A. Effects of Modified Hatha Yoga in Industrial Rehabilitation on Physical Fitness and Stress of Injured Workers. J Occup Rehabil. 2015.

[25] Cramer H, Ward L, Saper R, Fishbein D, Dobos G, Lauche R. The Safety of Yoga: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Am J Epidemiol. 2015;182:281-93.

[26] Cramer H, Krucoff C, Dobos G. Adverse events associated with yoga: a systematic review of published case reports and case series. PLoS One. 2013;8:e75515.

[27] Penman S, Cohen M, Stevens P, Jackson S. Yoga in Australia: Results of a national survey. Int J Yoga. 2012;5:92-101.

[28] Uebelacker LA, Weinstock LM, Kraines MA. Self-reported benefits and risks of yoga in individuals with bipolar disorder. J Psychiatr Pract. 2014;20:345-52.

[29] Mikkonen J, Pedersen P, WMcCarthy PW. A Survey of Musculoskeletal Injury among Ashtanga Vinyasa Yoga Practitioners. Int J Yoga Ther. 2008;18:59-64.