

ORIGINAL RESEARCH

# The Association of Sudarshan Kriya Yoga with Happiness: A Case-Control Observational Study from Singapore

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## ABSTRACT

Happiness is a complex subjective experience that is essential to societal progress. This study investigated the association between Sudarshan Kriya Yoga (SKY) and subjective happiness in Singapore. Subjective happiness data were collected from a convenience sample (N = 733) comprised of 2 groups: SKY (n = 385) and non-SKY (n = 348) practitioners. SKY was categorized into non-, monthly, weekly, and daily practitioners and happiness was categorized into lower, middle and higher tertile groups. Confounding variables included age, gender, ethnicity, marital status, education level, body mass

index (BMI), smoking status, alcohol consumption and self-reported health. Daily SKY participation was positively associated with a 2-fold higher likelihood of being happier in a multivariate regression analysis. The trend analysis showed that as SKY frequency increases, the odds of being happier increases. These findings help generate the hypothesis that yogic breathing may promote happiness. Further experimental and prospective investigations are warranted. (*Altern Ther Health Med.* [E-pub ahead of print.]

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## INTRODUCTION

According to the Centers for Disease Control and Prevention (CDC), happiness is a critical component of well-being and health.<sup>1,2</sup> In 2011, the United Nations (UN) General Assembly asserted that “happiness is an art of living and can be taught, learned and transmitted.”<sup>3</sup> Some factors that can influence happiness may include genetics, education, economics, stress, marital status, use of time and social networks.<sup>2</sup> Because happiness has been recognized as an essential concept in individual and public health, the UN launched the annual World Happiness Report to help promote happiness and social progress.<sup>3,4</sup>

Similar to the UN, Singapore administers a periodic National Quality of Life Survey.<sup>5</sup> The researchers recently reported that happiness has significantly decreased in Singapore over more than 10 years despite sustained enjoyment.<sup>5</sup> The investigators hypothesized that this decline

might have to do with the country’s rapid economic success and the growing pressures of modern life in Singapore.<sup>5</sup> Recently, economists have postulated that subjective happiness might be a better indicator of social progress and may go beyond economic success.<sup>6</sup> However, reliable interventions that may improve or sustain happiness are not well understood.<sup>2</sup>

Subjective happiness is a stable construct consisting of emotional and cognitive components.<sup>2,7</sup> It has been defined as having frequent positive emotions—such as joy, interest and pride—and infrequent (although not absent) negative emotions—such as sadness, anxiety and anger.<sup>8,9</sup> To measure subjective happiness, Lyubomirsky, et al developed the Subjective Happiness Scale (SHS), which is correlated with but distinct from stress, depression and anxiety scales.<sup>2,8</sup> As further pointed out by Steptoe, “the absence of negative states such as depression and distress does not mean that a person is happy.”<sup>2</sup> The SHS has also been associated with specific structure and functionality in the human brain.<sup>7,10</sup> Recently, physicians and scientists have called for more research regarding various techniques and interventions that aim to promote happiness in healthcare and community settings.<sup>2,6,11</sup>

There is a growing body of empirical evidence that mind-body activities (eg, yoga, meditation, breathing techniques, qigong, and Tai’chi) may provide a useful means of improving mental health.<sup>12-14</sup> In particular, Sudarshan Kriya Yoga (SKY), has been reported to be an effective

therapeutic modality for helping to manage anxiety, posttraumatic stress syndrome (PTSD), insomnia, depression, stress-related medical illness and substance abuse.<sup>15</sup> SKY is distinct from physical posture/exercise- (asanas) based yoga in that it primarily focuses on an integrated series of self-regulated yogic breathing (pranayama) techniques and meditation (dhyana) while seated upright.<sup>15</sup> Based on an evidence review, Brown, et al. established clinical practice recommendations for SKY. The investigators summarized that individuals should engage in regular SKY practice (30 minutes/day) to maximize therapeutic benefits.<sup>15</sup> Despite these clinical recommendations, evidence for the relationship between SKY and happiness is absent.

Broadly, there is suggestive evidence that yoga may enhance mood and psychological well-being, but evidence for happiness is scant.<sup>16-19</sup> To date, there have been 2 pilot studies on SKY and well-being in adults and college students, respectively. Researchers found preliminary evidence that daily SKY practice for 6 weeks improved subjective optimism and reduced stress in a small sample (N = 55) of Swedish adults.<sup>20</sup> In another pilot investigation, it was found that college students (N = 74) who participated in SKY for 5 weeks had improved life satisfaction and reduced stress/depression at 1 month follow-up.<sup>21</sup> Because most evidence has focused on mental health outcomes, there may be *a priori* assumptions about SKY's relationship with happiness.

Therefore, the aim of this study was 2-fold: (1) determine the relationship between SKY participation and subjective happiness in adults, and (2) determine whether there is a trend between the frequency of SKY participation and subjective happiness.

## METHODS

### Participants

De-identified secondary data were obtained from a health and wellness survey conducted by the Sri Sri Institute for Advance Research in Singapore. Singapore is a cosmopolitan island city-state located in the southeast region of Asia. The Art of Living Foundation is a nonprofit humanitarian and educational organization that provides community capacity-building for SKY throughout Singapore and globally. SKY sessions are commonly held at community centers, worksites, universities and in homes. Although an instructor initially taught all SKY practitioners, we did not ascertain whether SKY practitioners continued to practice with a group instructor, independently or some combination of the two. The health and wellness survey was conducted within a 5-month time frame (July 2019 to November 2019). Participation in the survey was voluntary, and informed consent was obtained from each respondent in accordance with the Singapore Office of Human Research Protection Program. The Institutional Review Board of the Sri Sri Institute for Advanced Research ethics committee approved this unmatched case-control observational study.

Convenience sampling was used in similar locations (ie, community settings, community events, universities,

homes, worksites) to survey non-SKY (unexposed) and SKY (exposed) respondents. Volunteers from the Art of Living Foundation contacted potential survey respondents at the locations mentioned at random times. Once contacted, the study was explained to the respondents, and consent was obtained to complete a single 10-minute paper-based or online survey. All respondents were English-speaking.

**Inclusion criteria** for SKY respondents were if they previously completed a SKY course provided by the Art of Living Foundation and had participated in at least 1 SKY session within the past 6 weeks. The inclusion criterion for non-SKY respondents was that they had no previous instruction/practice in SKY or any other forms of mind-body activities to prevent any possible overlap with SKY methods.

Overall, a total of 788 adult respondents residing in Singapore were surveyed. Respondents identified with missing data fields germane to our data analysis (n = 55) were excluded. A total of 733 people (n = 348 non-SKY, n = 385 SKY) between age 18 and 83 years (mean age  $41.4 \pm 10.51$ ) were used in our final analysis.

### Sudarshan Kriya Yoga (SKY)

SKY is a cyclical controlled breathing and meditation practice taught by the nonprofit Art of Living Foundation. Detailed descriptions of SKY can be found in previous review articles.<sup>15,22</sup> A fundamental aim of SKY is to elicit a mind-body interaction of calmness and alertness. A typical SKY breathwork session is 30 minutes long and consists of 4 distinct yogic breathing stages (Ujjayi, Bhastrika, OM, and Sudarshan Kriya) done in a seated posture with eyes closed. Ujjayi involves experiencing the conscious sensation of the breath touching the throat. This slow breath technique is performed at a rate of 2 to 4 breaths per minute (bpm). During Bhastrika, the air is rapidly inhaled and forcefully exhaled at a rate of 30 bpm. Three 1-minute rounds of Bhastrika are followed by a few minutes of normal breathing. Next, Om is chanted 3 times with very prolonged expiration. Lastly, Sudarshan Kriya rhythmic breathing is done with slow (20 bpm), medium (40 to 50 bpm), and fast (60 to 80 bpm) respirations.

After completing breathwork, the meditation component of SKY if performed, which consists of 15 minutes of deep rest, in which the participant may choose to lie down, followed by 10 minutes of yoga Nidra (body scan) in the supine position. Based on the data collection and previous investigations, we classified SKY participation into monthly ( $\leq 1$ /month), weekly (1 to 3 days/week) or daily ( $\geq 5$  days/week).<sup>15,23</sup>

### Subjective Happiness Scale (SHS)

Lyubomirsky and Lepper developed the SHS as a brief questionnaire to indicate a stable measure of an individual's overall subjective happiness.<sup>8</sup> Previous studies have shown that the SHS has good-to-excellent reliability and validity across diverse populations. The SHS has adequate levels of internal consistency (Cronbach's  $\alpha$ : 0.70) and the existence of a single factor for all items (58% explained variance).<sup>8</sup>

Cronbach's  $\alpha$  was 0.78 in the present study. The SHS consists of four questions, and each question is rated on a 7-point Likert scale. Item 1 asks respondents to what extent they identify themselves as being a happy person (1= not a very happy person, 7 = a very happy person), whereas item 2 asks respondents to rate their level of happiness relative to their peers (1= less happy, 7 = happier). The third question describes happy individuals and asks respondents to what extent each characterization describes them (1 = not at all, 7 = a great deal). Question 4 describes unhappy individuals and asks respondents to what extent each characterization describes them (7 = not at all, 1 = a great deal).<sup>9</sup> Question 4 is reverse coded using a descending sequence.

Scores are totaled for the 4 items and range from 4 to 28. The average of the 4 items provides a composite score for global subjective happiness.<sup>8</sup> English is the primary language spoken in Singapore; therefore, we used the original English version of the SHS. There is no universally accepted SHS composite score threshold to define happiness level. Therefore, similar to other epidemiologic investigations, we categorized SHS scores into tertiles (lower, mid, higher) with the non-SKY group serving as the referent group.<sup>24</sup>

### Covariates

The study covariates included self-reported age (continuous), gender (male or female), ethnicity (Chinese, Indian, Malay, other), marital status (married, divorced, widowed or single), education (graduate school or not), aerobic exercise ( $\geq 1$  hour/week), current smoker (yes or no), drinks alcohol (yes or no) and self-rated health ( $\geq$ good or  $<$ good).<sup>25</sup> Self-rated health is a valid measure of health-related quality of life and consists of a single question in which respondents rate their overall health on a Likert scale.<sup>26</sup> Less than good ratings have been found to be significantly associated with a higher likelihood of chronic disease, health care utilization, and physical and mental decline.<sup>26</sup> Body mass index (BMI) categorization was based on the World Health Organization report for Asians ( $<23$ , 23 to 26.9,  $\geq 27$  kg/m<sup>2</sup>).<sup>27</sup>

### Analysis

Descriptive statistics were examined across the SKY and non-SKY groups. Logistic regression was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs). The frequency of SKY participation was divided into 3 groups (monthly, weekly, daily), with the non-SKY group serving as the referent group. SHS scores were divided into tertiles, the first (SHS 4.5), second (SHS  $>4.5 \leq 5.5$ ) and third (SHS  $> 5.5$ ) to create lower, mid- and higher happiness categories. ORs were provided for multivariate-adjusted models across participation groups for each category of happiness. The multivariate model adjusted for age and all covariates.  $P < .05$  was considered statistically significant. The Statistical Package for Social Science (version 18.0) was used for statistical analysis (SPSS, Inc., Chicago, Illinois, USA).

**Table 1.** Participant Demographics

	Total	SKY	Non-SKY	P Value <sup>a</sup>
<b>N (%)</b>	733 (100)	385 (52.52)	348 (47.47)	
<b>Age (n%)</b>				$P = .46$
$\geq 50$	156 (21.3)	86 (22.3)	70 (20.1)	
$< 50$	577 (78.7)	299 (77.7)	278 (79.9)	
<b>Gender (n%)</b>				$P = .03$
Male	248 (33.8)	144 (37.4)	104 (29.9)	
Female	485 (66.2)	241 (62.6)	244 (70.1)	
<b>Ethnicity (n%)</b>				$P < .001$
Indian, Malay & others	560 (69.4)	332 (86.2)	228 (65.5)	
Chinese	173 (23.6)	49 (12.4)	124 (34.5)	
<b>Marital Status (n%)</b>				$P < .001$
Married	559 (76.3)	318 (82.6)	241 (69.3)	
Unmarried	174 (23.7)	67 (17.4)	107 (30.7)	
<b>Education (n%)</b>				$P < .001$
College graduate	542 (73.4)	309 (80.3)	233 (70.0)	
Other	191 (26.1)	76 (19.7)	115 (30.0)	
<b>Smoker (n%)</b>				$P = .14$
Yes	30 (4.1)	12 (3.1)	18 (5.2)	
No	703 (95.9)	373 (96.9)	330 (94.8)	
<b>Drinks Alcohol (n%)</b>				$P = .01$
Yes	249 (34)	115 (29.9)	134 (38.5)	
No	484 (66)	270 (70.1)	214 (61.5)	
<b>BMI (n%)</b>				$P = .30$
$< 23$ kg/m <sup>2</sup>	270 (36.8)	135 (35.1)	135 (38.8)	
$\geq 23$ kg/m <sup>2</sup>	463 (63.2)	250 (64.9)	213 (61.2)	
<b>Exercise (n%)</b>				$P = .66$
$\geq 1$ hour/week	280(38.2)	150(53.6)	130 (46.4)	
$< 1$ hour/week	453(61.8)	235(51.9)	218 (48.1)	
<b>Self-Reported Health (n%)</b>				$P = .83$
$\geq$ Good	617 (84.2)	323 (83.9)	294 (84.5)	
$<$ Good	116 (15.8)	62 (16.1)	54 (15.5)	

Note:  $P$  value based on  $\chi^2$  test

<sup>a</sup> $P < .05$  considered significant.

**Abbreviations:** SKY, Sudarshan Kriya Yoga.

### RESULTS

The demographics of the study sample are presented in Table 1. The multi-ethnic Asian population mix consisted of (a) 23.6% Chinese, (b) 1.8 % Malay, (c) 69.3% East Indian, and (d) 5.3% other. The prevalence of higher happiness in our sample was 33.2% ( $n = 243$ ). The  $\chi^2$  test of independence showed that the unmatched SKY and non-SKY groups primarily differed across education, marital status and ethnicity ( $P$ 's  $< .001$ ). After adjusting for all study covariates, the results show in Table 2 showed that monthly and weekly SKY participation was not significantly associated with being happier than non-SKY participation. In the SKY group, we also found that there was no significant difference ( $P > .05$ ) in the mean number of years practiced ( $9.97 \pm SD 7.57$ ). There was a weak but significant inverse association for daily practitioners to have lower odds of mid-level happiness and

**Table 2.** Multivariate Adjusted Odds Ratios of Subjective Happiness Score (SHS) Categories According to Frequency of SKY Participation

SHS/SKY	Never	Occasionally	Weekly	Daily	P for Trend
N = 733	n = 348	n = 98	n = 145	n = 142	
Lower	1.00	1.28 (0.77-2.12)	1.22 (0.77-1.94)	0.73 (0.44-1.21)	.23
Mid	1.00	1.10 (0.68-1.79)	0.70 (0.44-1.11)	0.62* (0.39-0.98)	.04
Higher	1.00	0.68 (0.39-1.19)	1.23 (0.78-1.95)	1.96* (1.26-3.05)	.003

**NOTES:** P value based on  $\chi^2$  test; P <.05 considered significant

Values are odds ratios and 95% confidence intervals estimated from logistic regression models predicting the likelihood of having lower, mid or higher subjective happiness scores (SHS). Lower, mid and higher represent the first (SHS ≤ 4.5), second (SHS >4.5 ≤ 5.5), third (SHS >5.5) tertile groups respectively.

Models adjusted for study covariates including age, gender, ethnic group, marital status, education, exercise, BMI, smoker, alcohol, self-reported health.

**Abbreviations:** BMI, body mass index.

a clear positive association for daily practitioners to have a higher happiness level (OR, 1.96; 95% CI, 1.26 to 3.05). The P for trend was .003. Supplement 1 includes the detailed unadjusted, age-adjusted OR and 95% CIs tables for each happiness category.

## DISCUSSION

This study aimed to examine the independent association of SKY participation with general happiness in a multi-ethnic Asian population of adults in Singapore. After adjustment for age, gender, ethnicity, marital status, education, exercise, BMI, smoking, alcohol intake and self-reported overall health, we found that daily SKY participation was independently associated with higher odds of being happier. Also, our findings suggest a possible dose-response association with an increased frequency of SKY participation and happiness. Our findings are in line with previous clinical treatment recommendations.<sup>15</sup> To the best of our knowledge, this is the first study to report the positive relationship between SKY and subjective happiness in adults.

Investigations regarding the relationship between SKY and happiness is absent from the literature. However, there is limited evidence for the positive relationship between yoga and mindfulness meditation with happiness in young adults and women, respectively.<sup>17,19</sup> Gupta and colleagues conducted a cross-sectional investigation on healthy young (age 17 to 27 years) daily yoga (various styles) practitioners (n = 100) and non-practitioners (n = 100).<sup>17</sup> The investigators reported a significantly higher mean score for the happiness component from the Wellbeing Manifestation Measuring Scale in the SKY practitioner group. However, the findings should be treated with caution, as confounding variables were not accounted for in the investigation.<sup>2</sup> O’Leary and colleagues presented more substantial evidence regarding the impact of meditation on SHS scores in women age 18 to 46 years (n=65).<sup>19</sup> Women who engaged in mindfulness meditation 4 times per week for 3 weeks significantly improved their SHS scores, while women in the control group demonstrated no improvements.

Although subjective stress, anxiety and depression are different constructs than subjective happiness, they are marginally associated with SHS scores.<sup>8</sup> Such indicators of mental health may be part of emotional and cognitive processing towards subjective happiness.<sup>9</sup> Evidence suggests that the meditative breathing techniques used in SKY may induce vagus nerve stimulation, resulting in calming of the frontal cerebral cortex, which is responsible for reasoning and emotional processing.<sup>15</sup> There is further evidence suggesting that pranayama normalizes sympathetic nervous system activity and increases parasympathetic nervous system tone as indicated by heart rate variability, reducing anxiety and depression.<sup>15,21</sup> SKY has also been shown to reduce cortisol and adrenocorticotrophic hormone levels related to stress reduction.<sup>15</sup> Another underlying mechanism that may be related to promoting happiness is the influence of the internal endocannabinoid system. A recent pilot investigation found that 4 days of meditative yoga increased blood endocannabinoids and brain-derived neurotrophic factor along with subjective happiness and well-being scores up to 1 month.<sup>28</sup> There is also some anecdotal evidence that yogic breathing may elicit a similar response.

Emerging evidence suggests that a specific area of the human brain is directly related to subjective happiness. Sato and colleagues recently conducted 2 separate investigations to determine how emotional and cognitive processing toward happiness occurs in the human brain.<sup>7,10</sup> Their neuroimaging investigations revealed a positive relationship between SHS scores, gray matter volume and neural activity in the right precuneus. The precuneus is linked to episodic memory, self-reflection, awareness and conscious information processing.<sup>10</sup> Based on the findings, the researchers hypothesized that subjective happiness might be associated with a “reduction in mind wandering, clinging, and self-referential mental states, which are well integrated with emotional processing towards subjective happiness.”<sup>7</sup> The researchers further hypothesized that mind-body practices might improve happiness because meditation has been

respectively associated with larger gray matter volume in the precuneus and improved SHS scores.<sup>7,19,29</sup> In a related study, Villemure, et al showed a positive dose-response relationship with a higher frequency of yoga-based meditation participation and increased gray matter volume in the precuneus.<sup>30</sup> Along with these neurologic findings and our results, further experimental investigations may be warranted.

Beyond SKY and happiness's possible neurologic connections, SKY practitioners may follow an overall healthier lifestyle. Recent evidence has shown that asanas-based yoga causes small to moderate improvements in well-being and health-related quality of life in older adults and is broadly associated with a healthier lifestyle in Western women.<sup>31-33</sup> Our analysis (see Table 1) shows that only drinking alcohol behavior was lower in SKY practitioners across lifestyle factors (smoking, drinking, exercise, weight, self-reported health). However, whether or not SKY practitioners have a more significant total number of healthy lifestyle factors that may promote well-being than non-practitioners is currently unclear. Further research is needed to verify this potential association.

### Study Limitations

The primary limitation of this investigation is that it was a case-control observational study; therefore, we cannot rule out the potential for selection bias. To minimize the potential for bias we adjusted for the covariates in a multivariate analysis. Second, although we detected a positive trend, we cannot determine a causal relationship or rule out a possible bidirectional association. Third, we used convenience sampling to observe a multi-ethnic Asian population; therefore, the generalizability of these results may be limited. Fourth, we cannot rule out the potential for recall bias because of the self-report method. Lastly, we cannot rule out that SKY practitioners may live a healthier lifestyle or participate in other forms of mind-body activities that may influence happiness.

### CONCLUSION

Adults who practice SKY regularly are more likely to report being happier than non-SKY practitioners. In addition, the trend indicates that as SKY practice increases, the likelihood of happiness increases. SKY is a high reach low-cost activity, and our findings may be used to help inform public health initiatives to promote happiness in communities. Lastly, this study's association and the trend may help form a hypothesis that can then be tested more rigorously by randomized controlled trials or cohort studies.

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### CONFLICT OF INTEREST

None.

### ETHICS APPROVAL

The Institutional Review Board of the Sri Sri Institute for Advanced Research ethics committee approved this study.

### CONSENT TO PARTICIPATE AND CONSENT FOR PUBLICATION

Survey respondents gave consent for de-identified use of data and publication of results in accordance with Singapore standards.

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### Supplement.

SKY GROUP LEVELS				
Low-Happiness Group	NONE	MONTHLY	WEEKLY	DAILY
n= (total 733)	348	98	145	142
Prevalence of score <=4.5; n=254 (%)	126 (49.6)	41 (16.1)	55 (21.7)	32 (12.6)
OR without adjustment (95 % CI)	1.00	1.267 (0.802-2.002)	1.077 (0.721-1.607)	0.513 (0.327-0.804)
Age-adjusted OR (95 % CI)	1.00	1.320 (0.827-2.109)	1.212 (0.803-1.828)	0.574 (0.363-0.910)
Multivariate OR* (95% CI)	1.00	1.28 (0.77-2.12)	1.22 (0.77-1.94)	0.73 (0.44-1.21)

SKY GROUP LEVELS					
Mid-Happiness Group	NONE	MONTHLY	WEEKLY	DAILY	P for trend
n = (total 733)	348	98	145	142	-
Prevalence of score >4.5 to ≤ 5.5; n = 236 (%)	122 (51.7)	35 (14.8)	40 (17.0)	39 (16.5)	-
OR without adjustment (95 % CI)	1.00	1.029 (0.664-1.644)	0.706 (0.461-1.080)	0.701 (0.457-1.077)	.105
Age-adjusted OR (95 % CI)	1.00	1.023(0.640-1.635)	0.688(0.448-1.055)	0.678(0.440-1.044)	.078
Multivariate OR* (95% CI)	1.00	1.10(0.678-1.79)	0.70(0.44-1.11)	0.62(0.39-0.98)	.04

SKY GROUP LEVELS					
Upper-Happiness Group	NONE	MONTHLY	WEEKLY	DAILY	P for trend
n = (total 733)	348	98	145	142	-
Prevalence of score >5.5 n = 243 (%)	100(41.2)	22(9.0)	50(20.6)	71(29.2)	-
OR Without adjustment (95 % CI)	1.00	0.718(0.423-1.218)	1.305(0.863-1.974)	2.480(1.658-3.709)	<.001
Age-adjusted OR (95 % CI)	1.00	0.732(0.431-1.245)	1.284(0.846-1.947)	2.436(1.624-3.653)	<.001
Multivariate OR* (95% CI)	1.00	0.68(0.39-1.19)	1.23(0.78-1.95)	1.96(1.26-3.05)	.003

Note: Adjusted for age, sex, ethnic group, marital status, education, BMI, smoker, alcohol, self-reported health, aerobic exercise.

**Abbreviations:** BMI, body mass index; CI, confidence interval; OR, odds ratio; SKY, Sudarshan Kriya Yoga.