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# The Association Between *Camellia sinensis* Tea Consumption and Reduced Risk of Anxiety Disorder for Covid-19 Survivors: A Cross-Sectional Study among Medical Students

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**Abstract:**

Negative stigma for Covid-19 survivors might induce anxiety. *Camellia sinensis* (*C. sinensis*) tea has been used to treat anxiety but no studies evaluate the tea on risk of anxiety among medical students who were Covid-19 survivors. Hence, we aimed to evaluate the risk of anxiety for *C. sinensis* tea drinkers among them**.** A cross-sectional study was conducted at Medical Faculty Universitas Lambung Mangkurat in December 2021. Information about tea consumption was collected from a questionnaire and anxiety disorder was determined by Zung Self-Rating Anxiety Scale. Logistic regression analysis was used to calculate the risk. Of 129 students, 55 students (42.64%) had anxiety. Students who drank tea at least 2 glasses/day had a lower risk of anxiety by 90.4% than non-tea drinkers. Thus, *C. sinensis* tea was significantly associated with a lower risk of anxiety started from at least 2 glasses/day among medical students who were Covid-19 survivors.

**Keywords:** Anxiety; *Camellia sinensis*; Covid-19 Survivors; Medical Students; Tea

## Introduction

Covid-19 has become a serious threat in the world, including in Indonesia. The incidence of this global pandemic is still high and every person is predisposed to this disease regardless their age groups, including young adults such as university students.[1] Even though Covid-19 survivors have been declared disease-free, they are naturally afraid of infecting others.[2] Furthermore, they do not seldom experience a negative stigma from society because they are still considered as an active carrier.[3] Thus, other than physical health, Covid-19 also might affect mental health including anxiety, stress, and depression for both patients and survivors of Covid-19.[4]

In Indonesia about 6% of 14 million people under 15 years old experience anxiety disorders in 2018.[5] A study performed in a faculty of medicine in Bali, Indonesia indicated that 76.9% and 23.1% of students had moderate and mild anxiety disorder, respectively. Another study conducted in a faculty of medicine in Bandung, Indonesia also demonstrated more likely similar results. Of 25.29% of students who had anxiety disorders, 22.35%, 1.76%, and 1.11% had mild-moderate anxiety disorders, moderate-severe anxiety disorders, and severe anxiety-panic disorders, respectively. These numbers are higher than among their counterparts from different majors. This disorder might weaken their memory, distract their focus, and disturb their information processes. Ultimately, it affects their performance in studying.[6]

One modality to treat anxiety disorders is anti-anxiety drugs. Unfortunately, these disorders need a long-term medication that might induce negative effects, i.e., physical and/or psychological dependency. Thus, there is a need of a non-pharmacological treatment as an alternative or complementary medication to overcome anxiety disorders.[7]

*Camellia sinensis* (*C. sinensis*) is the most common species of tea marketed and consumed by population in Indonesia. It is not only used as a beverage, but also as a traditional medicine.[8] The active ingredient in *C. sinensis*, *Gamma-etylamino-L-Glutamic-Acid* (L-theanine) was reported to have relaxation effect to overcome anxiety, stress, and depression.[9] For instance, L-theanine in *Matricaria recutita* (camomile) tea has been known to have antianxiety effect in human and its effect is positively correlated to the dose.[10, 11]

There have been several published articles assessing the effect of both *C. sinensis* tea and its ingredient, i.e, L-theanine on the risk of anxiety disorders. However, to the best of our knowledge, the risk among medical students, especially for Covid-19 survivors has never been evaluated. We, therefore, conducted a study assessing the risk of anxiety disorder for *C. sinensis* tea drinkers compared to non-tea drinkers among medical students who were Covid-19 survivors. The impact of dose of tea used on this association was also studied.

## Research Method

### Study design and data source (setting)

A cross sectional study among medical students who were Covid-19 survivors at Faculty of Medicine, Universitas Lambung Mangkurat, Banjarmasin-Banjarbaru, South Kalimantan, Indonesia from four undergraduate schools, i.e., School of Medicine, School of Public Health, School of Nursing, and School of Psychology were conducted. Due to Covid-19 pandemic, all variables, i.e., baseline characteristics, status of tea consumption, and status of anxiety disorder of respondents were collected by using online questionnaires in December 2021. These questionnaires were distributed to all undergraduate medical students. This proposal has been approved by the Ethic Committee for Health Research, Faculty of Medicine, Universitas Lambung Mangkurat, Banjarmasin, Indonesia under number No. 180/KEPK-FK ULM/EC/VI/2022.

### Variables of interest

The status of tea consumption is determined based on how many glasses (± 200 ml) of tea consumed within the last week prior to the study, regardless how the tea leaves were processed and how tea was consumed either as a hot, warm, or cold tea, with or without sugar and/or milk. If respondents were unsure about the species, they were asked to write down the brand name of tea, then we defined the species according to information written at the tea box or label. Status of tea consumption was then categorized into 3 groups, i.e., *a non-tea drinker* if a respondent did not have even a glass of tea within the last week, or as *up to 1 glass per day* if a respondent had up to a glass of tea per day, or *≥ 2 glasses per day* if a respondent had at least 2 glasses of tea in a day within the last week.

Anxiety disorder was determined by using the Zung Self-rating Anxiety Scale (ZSAS). This scale focuses on common symptoms in anxiety disorders. It consists of 20 questions, including 15 questions of somatic symptoms and 5 questions of affective symptoms related to anxiety disorder. Each answer is scored 1 if a respondent answered ***never***, 2 if ***sometimes***, 3 if ***most of times***, and 4 if ***almost every time***. A total score of 20-44 indicates normal value or no anxiety disorder, 45-59 indicates mild-moderate anxiety, 60-74 indicates moderate-severe anxiety, and ≥75 indicates severe anxiety-panic. However, since our sample size was small, we modified the ZSAS score. Thus, a total score of 20-44 was categorized as a normal value (no anxiety disorder) and of 45-80 was categorized as having anxiety disorder.

### Potential confounders

Several potential confounders that potentially interfere the association between tea consumption and the risk of anxiety disorder were considered, including age, sex, sleep quality, origin of school, length of study, origin of province, residency status, and status of Covid-19 vaccination. Potential confounders measured prior to the study were a personal and familial history of anxiety disorders, a personal history of antianxiety drugs use, and familial history of having Covid-19 infection.

### Statistical analyses

Demographic and medical data of anxiety group and non-anxiety disorder group were compared using t-test or chi-square whichever applicable. Binomial logistic regression was used to estimate crude and adjusted odds ratios (ORs) and 95% confidence intervals (95%CI) of the risk of anxiety disorder for tea drinkers among medical students who were Covid-19 survivors. All the analyses were performed using a statistical software IBM SPSS 26 and a significance threshold was 5% (p-values of < 0.05).

## Results

### Characteristics of the study population

We conducted this observational study on December 2021 to figure out the risk of anxiety disorder for *C. sinensis* tea drinker within medical students who were Covid-19 survivors. Three hundred and thirty-two undergraduate students at Faculty of Medicine, Universitas Lambung Mangkurat filled out and sent back the questionnaire. Of them, 129 respondents (38.86%) were Covid-19 survivors, including 55 respondents (42.64%) with anxiety disorder and 74 respondents (57.36%) without it. Most of respondents (71 respondents, 55.04%) drank the tea up to 1 glass per day in the last week, whereas 43 respondents (33.33%) and 15 respondents (11.63%) did not drink the tea and drank the tea at least 2 glasses per day in the last week, respectively.

The average ages for anxiety disorder and no anxiety disorder group were 19.13 (± 1.58) years old and 19.76 (± 1.25) years old, respectively. Most of our respondents were females, from School of Medicine, and have had complete Covid-19 vaccination. Most of them did not have a personal history of anxiety disorders, a familial history of anxiety

disorders, nor a familial history of Covid-19 infection. None of respondents took drugs associated with anxiety within the last week prior to the study. However, most of respondents had poor sleep quality.

Most of respondents who had anxiety disorders were in the 1st semester (32.7%), from any other provinces than South Kalimantan (61.8%), and lived in a dormitory or a rental house (65.5%). While, most of respondents who had no anxiety disorders were in the 3rd semester (32.4%), lived in South Kalimantan province (70.3%), and lived with their nuclear or extended family (54.1%).

We found significantly differences in age, sex, province of origin, status of residency, and a familial history of Covid-19 infection between anxiety and non-anxiety disorder group (p<0.05) (**Table 1**).

**Table 1** Baseline characteristics of respondents for *Camellia sinensis* tea drinkers compared to non-drinkers on the risk of anxiety disorders among medical students who were Covid-19 survivors at Faculty of Medicine Universitas Lambung Mangkurat

| Characteristics | | Anxiety Disorder | | p-*value* |
|---|---|---|---|---|
| | | No, (n=74) | Yes, (n=55) | |
| Age | Years (mean) ± sd | 19.76 ± 1.25 | 19.13 ± 1.58 | 0.016* |
| Sex | Males, n (%) | 32 (43.2) | 14 (25.5) | 0.037* |
| | Females, n (%) | 42 (56.8) | 41 (74.5) | |
| Schools | School of Medicine, n (%) | 34 (45.9) | 18 (32.7) | 0.454 |
| | School of Psychology, n (%) | 14 (18.9) | 11 (20.0) | |
| | School of Public Health, n (%) | 14 (18.9) | 15 (27.3) | |
| | School of Nursing, n (%) | 12 (16.2) | 11 (20.0) | |
| Length of Study (semester) | 1, n (%) | 10 (13.5) | 18 (32.7) | 0.059 |
| | 3, n (%) | 24 (32.4) | 11 (20.0) | |
| | 5, n (%) | 21 (28.4) | 14 (25.5) | |
| | 7, n (%) | 19 (25.7) | 12 (21.8) | |
| Province of origin | South Kalimantan, n (%) | 52 (70.3) | 21 (38.2) | 0.000* |
| | Other than South Kalimantan, n (%) | 22 (29.7) | 34 (61.8) | |
| Residency Status | Dormitory or rental house, n (%) | 34 (45.9) | 36 (65.5) | 0.028* |
| | Living with nuclear or extended family, n (%) | 40 (54.1) | 19 (34.5) | |
| Sleep Quality | Good, n (%) | 10 (13.5) | 5 (9.1) | 0.438 |
| | Poor, n (%) | 64 (86.5) | 50 (90.9) | |
| Personal History of Anxiety Disorders | Yes, by a psychologist, n (%) | 1 (1.4) | 4 (7.3) | 0.160 |
| | Yes, by a doctor, n (%) | 1 (1.4) | 0 (0.0) | |
| | No, n (%) | 72 (97.3) | 51 (92.7) | |
| Familial History of Anxiety Disorders | Yes, n (%) | 5 (6.8) | 8 (14.5) | 0.242 |
| | No, n (%) | 48 (64.9) | 38 (69.1) | |
| | Unknown, n (%) | 21 (28.4) | 9 (16.4) | |
| History of Drug Used Associated with Anxiety | Yes, n (%) | 0 (0.0) | 0 (0.0) | NA |
| | No, n (%) | 74 (100.0) | 55 (100.0) | |
| Familial History of Covid-19 Infection | Yes, n (%) | 26 (35.1) | 6 (10.9) | 0.002* |
| | No, n (%) | 48 (64.9) | 49 (89.1) | |
| Status of Covid-19 Vaccination | Never, n (%) | 1 (1.4) | 0 (0.0) | 0.216 |
| | Yes, incomplete, n (%) | 3 (4.1) | 0 (0.0) | |
| | Yes, complete, n (%) | 70 (94.6) | 55 (100.0) | |

NA: No applicable

*Statistically significant (p < 0.05)

### Risk of anxiety

We found no significant different in anxiety disorder between medical students who drank up to 1 glass of the tea per day compared to non-tea drinkers among Covid-19 survivors within medical students. However, those who were Covid-19 survivors who drank at least 2 glasses *C. sinensis* tea per day associated with a lower risk of anxiety disorder by 90.4% compared to those who were not drinking the tea a week prior to the study (Adj. OR 0.096, 95%CI; 0.015-0.615) (**Table 2**).

**Table 2.** Odds ratios for anxiety disorders or *Camelia sinensis* tea drinkers compared to non-tea drinkers among medical students who were Covid-19 survivors

| Tea consumption | Anxiety disorder | | Crude OR (95% CI) | Adjusted OR (95% CI) |
|---|---|---|---|---|
| | Yes, (n=74) | No (n=55) | | |
| Non tea drinkers, n (%) | 21 (28.8) | 22 (40.0) | 1 (reference) | 1 (reference) |
| Up to 1 glass per day, n (%) | 40 (54.1) | 31 (56.4) | 0.676 (0.340-1.346) | 0.878 (0.363-2.123) |
| ≥ 2 glasses per day, n (%) | 13 (17.6) | 2 (3.6) | 0.128 (0.027-0.606) | 0.096 (0.015-0.615)* |

OR: odds ratio; CI: confidence interval
*Statistically significant (p<0.05)
Adjusted for age, sex, origin of school, lengths of study, origin of province, residency status, sleep quality, personal history of anxiety disorders, familial history of anxiety disorders, familial history of Covid-19 infection, and status of Covid-19 vaccination

## Discussion

University students are in a higher risk of mental disorders. According to a survey conducted by National Alliance on Mental Illness (NAMI), all around the world 73% of them have experienced mental disorders.[12] Covid-19 pandemic also gives pressure to them that leads to anxiety. Excessive anxiety can reduce immune system, hence the risk of being infected by this virus is even higher. A significant impact experienced by Covid-19 survivors is a negative social impact. Even though they are completely cured, they are still seen as a carrier of this infectious disease. This stigma induces anxiety for stigmatized person.[3, 13]

Our finding is in line with previous studies. Oolong and camomile tea can reduce anxiety and stress among university students.[14, 15] Shen *et al*demonstrated that drinking tea frequently and consistently decreases a symptom of depression, i.e., anxiety.[16] Our previous study (2022) also indicated that medical students who drank occasionally *C. sinensis* tea (<1 glass per day) were associated with a lower risk of mild-moderate anxiety disorder by 9% and of moderate-severe anxiety disorder by 45% compared to non-tea drinkers. Meanwhile, drinking *C. sinensis* tea 1 glass per day and 2-3 glasses per day were associated with a reduced risk of mild-moderate anxiety disorder by 20% and 54%, respectively in comparison to non-tea drinkers.[17] Steptoe *et al* (2007) specifically mentioned that drinking 4 cups of black tea per day for 6 weeks might help to recover from psychophysiological stress.[18] Anti-anxiety effect of tea is influenced by the dose. The effect is positively correlated to the dose. This effect is seen in 30-40 minutes following the consumption.[11, 19]

L-theanine is allegedly associated with the antianxiety effect of *C. sinensis* tea.

William *et al* (2020) mentioned that having 200-400 mg per day of concentrated L-theanine can alleviate stress and anxiety.[9] Hidese *et al* (2019) also found that taking L-theanine for 4 weeks combats symptoms and signs of stress and is associated with positive cognitive function.[20]

As antianxiety L-theanine in *C. sinensis* tea is suspected to work through 2 different mechanisms. First, this amino acid directly stimulates α wave production in occipital, parietal, and frontal areas in brain. Then, it creates a state of relaxation mimicking meditation as a therapeutic method. Second, L-theanine partly plays a role in the production of a neurotransmitter antagonist, i.e., *Gamma-Aminobutyric Acid.* It then influences any other neurotransmitters, i.e., dopamine and serotonin. These neurotransmitters are important for creating relaxation.[19]

### Strengths and limitation

We identified several strengths in our study. First, as far as the authors know, this was the first study evaluated the association between *C. sinensis* tea consumption and the risk of anxiety disorders specifically within medical students who were Covid-19 survivors. Second, most of factors that might influence the association between consumption of the tea and the risk of anxiety disorder were adjusted statistically in our analyses. Thus, we minimized potential bias caused by unmeasured confounders.

However, we acknowledge several limitations in this study. First, our sample size is small due to low response rate from potential respondents. Hence, we did not have sufficient power to detect relatively low association between two main variables. Second, the diagnosis of anxiety disorder was established by the ZSAS questionnaire rather than by a psychiatrist or a psychologist. Finally, we used a cross-sectional design to conduct this study. The weakness of this study design was a difficulty to determine causal relationship between these main variables. In addition, in a cross-sectional study, we were not able to estimate the absolute risks that might be estimated in a cohort study.

This result is scientific evidence on the benefits of using *C. sinensis* tea for reducing the risk of anxiety disorder. Furthermore, our finding is also important for stake holders in the university and specifically in faculty level to take some actions in order to reduce the incidence of anxiety disorders within medical students. Further studies are needed to confirm this potential association by using different study designs, such as case control study, cohort study, and clinical trial.

### Conclusion

In summary, risk of anxiety disorders for *C. sinensis* tea drinkers was about 90% significantly lower than non-tea drinkers among medical students who were Covid-19 survivors started from at least 2 glasses per day.

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