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Original Article

The effect of *Mentha piperita* L. on the mental health issues of university students: A pilot study

[Efecto de *Mentha piperita* L. en los problemas de salud mental de los estudiantes universitarios: Un estudio piloto]

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Abstract

Context: Stress, sleep disorders, and anxiety are common mental health problems affecting many university students. Peppermint, as a traditional herb, may be used as an alternative to stimulant drugs with less adverse effects to deal with mental health problems of the students.

Aims: To evaluate the impact of oral *Mentha piperita* (peppermint) on self-reported memory performance, anxiety, stress, and the quality of sleep in science students at Taibah University.

Methods: Eligible participating students were allocated either to the experimental group or the control group. The experimental group was asked to drink either an infusion of fresh aerial parts of peppermint once a day for four weeks, and the control group asked not to drink any peppermint or any other herbs during the study (no treatment). Anxiety, stress, memory performance, and sleep quality of the participating student were assessed by self-reported questionnaires before and after the peppermint treatment. Anxiety in the students was assessed by the State-Trait Anxiety Inventory, memory performance was evaluated using the Prospective and Retrospective Memory questionnaire and the Pittsburgh Sleep Quality Index was used to assess the sleep quality and patterns in students.

Results: The scores of all the scales and subscales of the State-Trait Anxiety Inventory, Prospective and Retrospective Memory, and the Pittsburgh Sleep Quality Index were significantly decreased in the peppermint group in comparison with the control group after four weeks.

Conclusions: Peppermint appears to significantly enhance memory, reduce anxiety and stress, and improve the sleep quality of university students.

Keywords: anxiety; memory; peppermint; pilot study; sleep quality; stress.

Resumen

Contexto: El estrés, los trastornos del sueño y la ansiedad son problemas de salud mental comunes que afectan a muchos estudiantes universitarios. La menta, como hierba tradicional, se puede utilizar como alternativa a las drogas estimulantes con menos efectos adversos para tratar los problemas de salud mental de los estudiantes.

Objetivos: Evaluar el impacto de la *Mentha piperita* (menta) oral en el rendimiento autoinformado de la memoria, la ansiedad, el estrés y la calidad del sueño en estudiantes de ciencias de la Universidad de Taibah.

Métodos: Los estudiantes participantes elegibles fueron asignados a los grupos experimental o control. Se pidió al grupo experimental que bebiera una infusión de partes aéreas frescas de menta una vez al día durante cuatro semanas, y al grupo de control se le pidió que no bebiera menta ni ninguna otra hierba durante el estudio (sin tratamiento). La ansiedad, el estrés, el rendimiento de la memoria y la calidad del sueño del estudiante participante se evaluaron mediante cuestionarios autoinformados antes y después del tratamiento con menta. La ansiedad en los estudiantes se evaluó mediante el inventario de ansiedad de rasgo estatal, el rendimiento de la memoria se evaluó mediante el cuestionario de memoria prospectiva y retrospectiva y el índice de calidad del sueño de Pittsburgh se utilizó para evaluar la calidad y los patrones del sueño en los estudiantes.

Resultados: Las puntuaciones de todas las escalas y subescalas del inventario de ansiedad rasgo del estado, la memoria prospectiva y retrospectiva y el índice de calidad del sueño de Pittsburgh disminuyeron significativamente en el grupo de menta en comparación con el grupo de control después de cuatro semanas.

Conclusiones: La menta parece mejorar significativamente la memoria, reducir la ansiedad y el estrés y mejorar la calidad del sueño de los estudiantes universitarios.

Palabras Clave: ansiedad; estrés; estudio piloto; memoria; menta; calidad sueño.

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INTRODUCTION

Mentha piperita L., traditionally known as peppermint, belongs to the genus *Mentha* (*Lamiaceae* family). Peppermint is a flowering perennial herb cultivated for its extensive uses in food, cosmetics, medicine, and pharmaceutical applications (McKay and Blumberg, 2006). The medicinal uses of peppermint as a folk remedy include anti-inflammatory, antispasmodic, antioxidant, anti-bacterial, urinary tract infections, antiallergenic and sedative (Baliga and Rao, 2010).

Peppermint being prepared in a tea form or when taken in a dose less than 270 mg is usually considered as being safe. The United States Food and Drug Administration classified peppermint essential oil as Generally Recognized as Safe (GRAS) (Keifer et al., 2008). Peppermint essential oil is one of the most popular oil extracted from the flowering plant fresh parts with menthol and menthone being the major components. Menthol is extensively used in many products including perfumes, toothpaste, mouth fresheners, chewing gums, analgesic balms, cough drops, and candies. Menthol was found to possess mild antibacterial and anti-inflammatory effects (Kamatou et al., 2013), used for the relief of cold symptoms such as nasal congestion and cough (Eccles, 1994), exhibit antispasmodic effects (Johns, 1997), to enhance the absorption of topical skin medications (Pattnaik et al., 1997), and have a moderate oral sensation of warmth and coldness (Balakrishnan, 2015). In the last few years, many scientific research has been carried out to study the effect of peppermint and its essential oil on the central nervous system (CNS). Multiple studies suggested that peppermint is a CNS stimulant. Antinociceptive effects of the peppermint ethanolic extract in mice were studied, with the peppermint extracts found to increase the latency of response to thermal stimulation when using a hot plate test (Atta and Alkofahi, 1998). Peppermint oil has also been reported to elicit a strong antinociceptive activity on neuropathic pain when applied to the skin in a case study of a single patient suffering from postherpetic neuralgia (Davies et al., 2002). The aqueous extract of peppermint leaves was found to have antinociceptive activity against thermal stimulation induced by hot plate and writhing induced by acetic acid in mice (Taher, 2012).

The effects of peppermint oil for headache treatment has been investigated in thirty-two healthy subjects in a study by Göbel et al. (1994). A significant antinociceptive activity associated with relieving of headache pain was produced when topically applying peppermint oil combined with ethanol to the forehead and temples areas.

Raudenbush et al. (2009) investigated the effect of the scent of peppermint on alertness and mood of drivers and found that and peppermint in combination with cinnamon odor decreased frustration and perceived time pressures and increased alertness of drivers. The peppermint odor was also found to reduced fatigue and anxiety in this situation. Additionally, nasal inhalation of peppermint oil was found to decrease the mental fatigue effect in mice (Liang et al., 2015).

Stress, sleep disorders, anxiety, and depression are mental health complaints that usually affect many university students and can cause adverse side effects. For example, poor sleeping habits may negatively affect academic performance and increase mental health problems (Orzech et al., 2011). Depression is associated with harmful habits including smoking, lack of exercise, poor diet, and poor sleeping patterns and may cause as well some physical health problems (Doom and Haeffel, 2013). People with anxiety disorders have been reported to have a poor quality of life compared to people with low levels of anxiety (Barrera and Norton, 2009). In order for students to deal with these mental problems and try to enhance their memory performance and attention, they may use stimulant drugs, which may cause serious adverse effects (Nematolahi et al., 2018).

The use of medicinal plants for dealing with many health problems has increased in many parts of the world due to their effectiveness and fewer side effects. Based on the above, peppermint may be used as an alternative to stimulant drugs with less adverse effects in healthy people. This study

aimed to evaluate the impact of peppermint on anxiety, stress, memory, and sleep quality in science students at Taibah University.

MATERIAL AND METHODS

Ethical considerations

The current study was approved by the ethical committee of the Deanship of Scientific Research, Taibah University, and registered with identity number 144086982. Prior to completing the study, all the participating students signed a consent form and were approved to participate in this study. Participants were allowed to ask any questions about the study, all data from the study were deidentified to ensure confidentiality, and participants were informed of their right to quit at any time should they wish from the study, and the right to know the results of the study.

Participants

A total of 129 science students aged 19 to 23 years were included and agreed to take part in this study, but it was completed by 124 students. Students with any health problems or mental disorders, using any medications, or who were pregnant or lactating were excluded from the trial.

Study design

The current double randomized controlled trial was performed at Taibah University, Al-Madinah Al-Munawarah, Saudi Arabia from February to April 2019. A computerized random allocation method was performed to assign the eligible participating students either to the control group or to the experimental group, and then subject numbers were randomly assigned.

Each participating student was asked to attend two sessions (pre and post-trial) held at the Chemistry Department of Taibah University. All participants received an introductory letter and four types of questionnaires (STAI, PSS, PRMQ, and PSQI) to measure the effects of peppermint on anxiety, stress, memory performance (prospective and retrospective), and the sleep quality in science students. In the first session pre-trial testing (baseline) all participating students were asked to fill the four questionnaires and to record their demographic data. The second session post-trial testing was performed four weeks later, and the participating students were asked to fill the four questionnaires after being treated with peppermint. Two sets of test scores were collected in person and analyzed to assess for any change in test performance.

Interventions

The participating students were allocated randomly into two groups (62 students in each group). The peppermint (experimental) group was asked to drink the infusion of 250 mg (socked for 10 min in hot water) of fresh aerial parts of the peppermint plant 30 min before bedtime daily for 30 days. The control group was asked not to drink any peppermint or any other herbs during the study period. The fresh aerial parts of the peppermint plant were purchased from herbal markets located in Al-Madinah Al-Munawarah. The plants were identified by Dr. Nabila Hamed (Department of Biological Sciences, Faculty of Science, Taibah University). A voucher specimen (MP) has been deposited in the author's research laboratory at the Department of Chemistry, Faculty of Science, Taibah University.

Measurements

Anxiety, stress, memory performance, and sleep quality of the participating student were assessed by self-reported questionnaires before and after the peppermint treatment. The Statistical Package of Social Science (SPSS) version 20 for Windows (IBM Corporation, Armonk, NY, USA) was used for all analyses. P values of less than 0.05 were considered statistically significant.

Anxiety in the students was assessed by the State-Trait Anxiety Inventory (STAI). The STAI questionnaire contains 21 items with a score from 1 to 4 for each item. A score of 1 meant that the situation was not relevant to the students, while a score of 4 indicated that the situation was definitely as much, or most of the time was relevant to them. Total scores vary between 20 and 80 with

higher scores indicating signs of greater anxiety (Julian, 2011).

Stress Perceived Stress Scale (PSS) was used to evaluate the stress of the students. PSS is considered to be the most psychological method for assessing the stress perception. It is an indicator of the degree to which situations are considered stressful. This questionnaire has 10 items, each item has a 5-point scale with a score from 0 to 4. A score of 0 meant that the situation was not related to the students, while a score of 4 indicated that the situation was very much related to them (Cole, 1999).

Memory performance was evaluated using the Prospective and Retrospective Memory Questionnaire (PRMQ). Retrospective memory involves the content to be recalled from the past (people, events, words, among others), while the prospective memory requires remembering to make an action in the future (appointments). The PRMQ is a self-reported assessment of daily prospective and retrospective deficiencies. This questionnaire has 16 elements (8 concerning about prospective memory and 8 concerning retrospective memory) scored from 5 (very often) to 1 (never) for each item resulting in a minimum of a total score of 18 (indicating poor memory) and a maximum of 80 (indicating good memory) (Crawford et al., 2006).

The Pittsburgh Sleep Quality Index (PSQI) was used to assess the sleep quality and patterns in students. This questionnaire contains seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep performance, sleep disturbances, sleeping medication usage, and daytime dysfunction. Students with a total score of or above five were classified as poor sleepers (Moghaddam et al., 2012).

RESULTS

At the end of the study data from 124 students, 62 students in the peppermint group, and 62 students in the control group were collected and analyzed. The consort flow diagram is shown in Fig. 1.

The mean age of 124 participating students was 22.1 years. Among the participants, 16 (12.9%) were male, and 108 (87.1%) were female. The demographic data (Table 1) between the two groups were not significantly different. Some side effects within the peppermint group, such as heartburn and mouth sores, were reported.

The results for anxiety, stress, prospective and retrospective memory, and sleep quality in the peppermint and control groups at baseline and after four weeks of the students are summarized in Table 2. The results for both STAI and PSS scales revealed that peppermint reduced anxiety and stress in participating students. At baseline, the mean scores in the anxiety scale were 42.3 for the students in the peppermint group and 41.5 for students in the control group. After four weeks, the mean score observed in the peppermint group was significantly reduced ($p<0.05$). In the PSS scale, the results obtained as mean scores was 18.55 and 17.32 in the peppermint and control groups, respectively. After four weeks, the mean score observed was significantly decreased only in the peppermint group ($p<0.05$). Table 2 also shows the results for the PRMQ scale and subscales and for each scale in peppermint and control groups at baseline and after four weeks. The analyses revealed that for all the scales and subscales, the main effect of time factor was significant. Compared to the control group after four weeks, the scores of all the scales and subscales were significantly reduced in the peppermint group.

Table 3 classifies the status of PSQ scale. The results showed that 46 (74.19%) students were classified as poor sleepers at baseline, and this decreased to 22 (35.48%) students after the peppermint treatment ($p<0.05$).

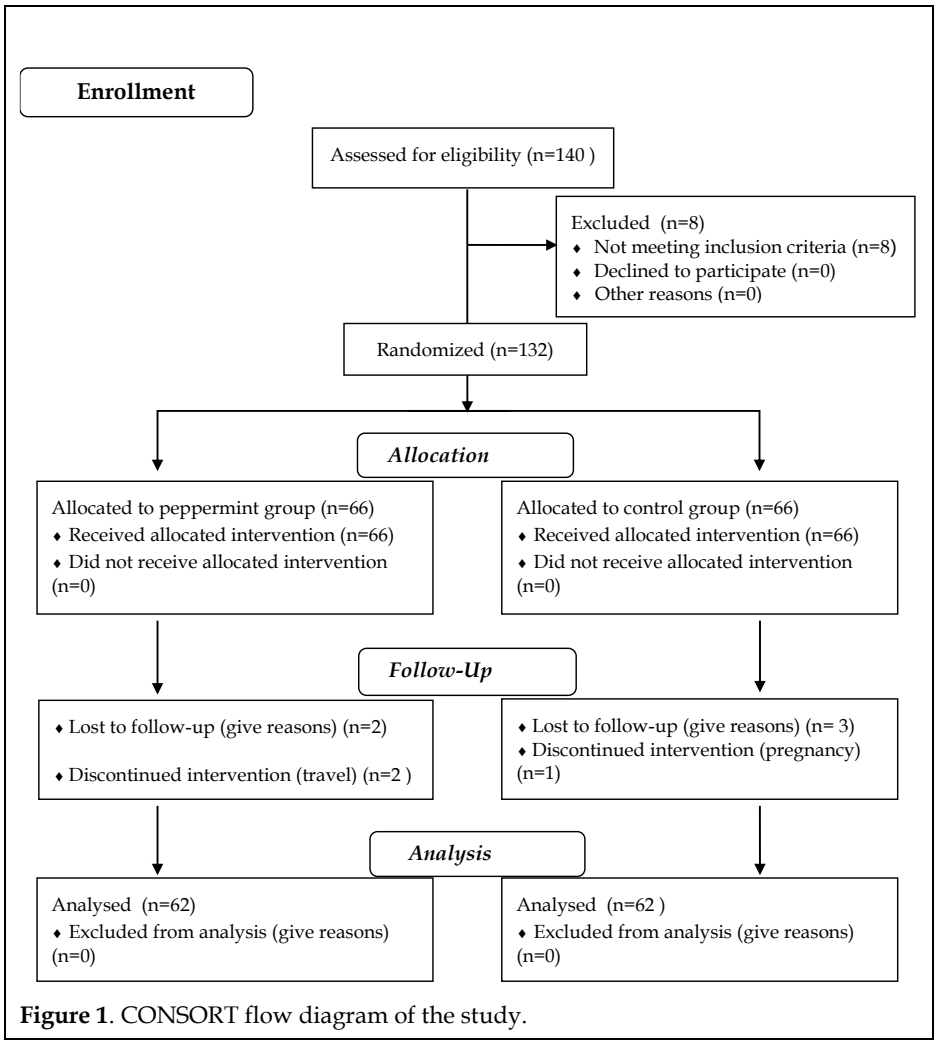

Figure 1. CONSORT flow diagram of the study.

Table 1. Baseline characteristics of patients.

Variable	Peppermint [N (%)]	Control [N (%)]	*P-value
Age	21.6 ± 1.6	22.3 ± 1.8	0.233
Sex			0.087
Male	7 (11.29 %)	9 (11.29 %)	
Female	55 (88.71) %	52 (88.71) %	
Marital status			0.126
Single	46 (74.19 %)	42 (67.74 %)	
Married	16 (25.81 %)	20 (32.26 %)	
Year in school			0.065
Second	13 (20.97 %)	13 (20.97 %)	
Third	15 (24.19 %)	9 (14.52 %)	
Forth	35 (56.45 %)	40 (64.52 %)	

* Based on chi-square

Table 2. Changes in scores of STAI, PSS, PSQI, and PRMQ scales and subscales in peppermint and control groups at baseline and after four weeks.

Variable	Group	Baseline (Mean ± SD)	After four weeks (Mean ± SD)	[a]P-value	[b]P-value Time by group interaction
State-Trait Anxiety Inventory (STAI)	Peppermint	42.3 ± 3.24	39.82 ± 4.75	0.011	0.001
	Control	41.5 ± 5.12	40.75 ± 3.24	0.570	
Stress Perceived Stress Scale (PSS)	Peppermint	18.55 ± 3.67	16.02 ± 2.35	0.041	0.024
	Control	17.32 ± 2.67	18.25 ± 2.73	0.728	
Pittsburg Sleep Quality Inventory (PSQI)	Peppermint	7.16 ± 3.49	4.58 ± 2.37	0.001	0.007
	Control	7.27 ± 3.40	7.40 ± 3.44	0.117	
Prospective and Retrospective Memory Questionnaire (PRMQ)	Peppermint	44.79 ± 11.73	35.15 ± 9.99	0.001	0.005
	Control	45.71 ± 11.54	45.21 ± 11.85	0.508	
Prospective Memory subscale	Peppermint	23.90 ± 6.51	18.37 ± 5.56	0.000	0.006
	Control	24.10 ± 6.43	24.10 ± 6.43	1.000	
Retrospective Memory subscale	Peppermint	20.89 ± 5.82	16.78 ± 4.89	0.001	0.008
	Control	21.61 ± 6.15	21.11 ± 5.91	0.456	

SD: Standard Deviation. [a]Paired t-test. [b]Mixed model analyses of variance.

Table 3. The students sleep quality status at baseline and after four weeks.

Measurement	Group	Baseline N (%)	After four weeks N (%)
Good sleeper (<5)	Peppermint	16 (25.80%)	40 (64.52%)
	Control	19 (30.65%)	18 (29.03%)
Poor sleeper (≥5)	Peppermint	46 (74.19%)	22 (35.48%)
	Control	43 (69.35%)	44 (70.97%)

DISCUSSION

The findings of this study showed that peppermint had positive effects on improving memory performance, decreasing anxiety and stress conditions, and enhancing the quality of sleep in science students.

In several studies, the effect of peppermint on different aspects of memory has been reported. The effect of the oil on the cognitive function was investigated in 32 healthy volunteers in a controlled study. It was found that peppermint oil, when combined with ethanol and eucalyptus oil, enhanced cognitive performance and possessed a mentally relaxing effect (Göbel et al., 1994). Exposure to the odor of peppermint was found to modulate mood and to increase cognitive performance in healthy subjects. In another study by Moss et al. (2008), peppermint has been found to boost the overall quality of memory, positively affecting cognitive performance and mood with a small increase in alertness during a computerized cognitive drug research assessment battery. The oral administration of peppermint was found to enhance memory and memory regaining recovery effects in Wistar albino rats in a study by Jasira et al. (2013). Furthermore, peppermint oil with high concentrations of menthol and menthone was

found to modulate demanding cognitive tasks performance and to reduce the rise in mental fatigue associated with prolonged cognitive testing in 24 healthy participants (Kennedy et al., 2018). The finding of this study provides further evidence supporting the effects of peppermint on improving memory performance.

The antistress and antianxiety effects of oral peppermint were also demonstrated in the current study, which have previously been reported in human and animal studies. Parveen et al. (2012) reported that the administration of peppermint extract produced anxiolytic effects in rats subjected to restraint stress. Additionally, the ethanolic extract of peppermint was found to possess antidepressant properties in the forced swimming test in mice (Abbasi-Maleki et al., 2017). In another study on the effect of peppermint odor on stress, groups of healthy volunteers were exposed to peppermint oil and had experienced a positive effect on reducing the stress (Toda and Morimoto, 2011).

Peppermint has also been reported to reduce anxiety in healthy volunteers (Dunnigan, 2013). Additionally, in the present, we have shown that peppermint can enhance the quality of sleep in the students. Inhaling peppermint odor has also been studied in relation to sleep and found to significantly decreased daytime sleepiness (Norrish and Dwyer, 2005) and has a stimulating and sedating effect when inhaled before bedtime with total sleep and more slow-wave sleep when compared with a no-odor control (Goel and Lao, 2006).

After one month, the students in the peppermint group were asked to share their notes and comments about the study. Almost half the students (48.4 %) felt an improvement in the quality of their sleep, with and 9.7% reporting less insomnia, 17.7% noticed that the peppermint had a beneficial impact on their memory and 20.9% reported experiencing less stress. Students mentioned other comments such as peppermint had a carminative and laxative effect. The reported side effects in the present study were consistent with reported studies, for example, peppermint was found to cause heartburn (Cappello et al., 2007) and mouth sores (Cosentino et al., 2009).

The limitations of this study are the small sample size, short duration, and the lack of comparative studies that have investigated the major constituents of peppermint. Hence further clinical studies on larger sample size and longer duration are required as well as determining the major active constituents of peppermint.

CONCLUSIONS

This study has shown that the administration of an infusion of peppermint can improve the quality of sleep and enhance memory in students. Additionally, peppermint showed a considerable putative beneficial effect on anxiety, stress, and insomnia.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTION:

Contribution	Abdelhalim AB
Concepts or ideas	x
Design	x
Definition of intellectual content	x
Literature search	x
Experimental studies	x
Data acquisition	x
Data analysis	x
Statistical analysis	x
Manuscript preparation	x
Manuscript editing	x
Manuscript review	x

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