Effect of *Rosmarinus officinalis* on mental disorder symptoms in incarcerated people and prison workers

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ABSTRACT

Introduction: common mental disorders whose symptoms are not early identified can turn into more serious illnesses, such as depression, anxiety, and mood disorder. The literature presents the use of rosemary as a form of treatment of physical and mental illnesses, including depression.
Objective:the objective of this study was to evaluate the effects of treatments with different doses of rosemary (Rosmarinus officinalis) extract on symptoms of Common Mental Disorders (CMD) in incarcerated people and prison workers.
Methods: this is a randomized, double-blind, placebo-controlled clinical trial study. The intervention was carried out using rosemary extract doses at 100, 500, and 1000 mg day-1 in groups composed of 10 participants, for 3 months. A 20-item self-reporting questionnaire (SRQ-20) was used to assess the presence of CMD. The project was submitted and approved by the Research Ethics Committee under the number 4,973,589.
Results: the treatments with rosemary extract at 500 and 1000 mg day-1 showed statistically significant results for reducing CMD symptoms when compared to the those found at the beginning of the research.
Conclusion: the use of rosemary extract was effective to reduce CMD in the evaluated prison staff and incarcerated people, especially when used at doses of 500 and 1000 mg day-1, and presented safety, as the participants did not experience side effects.

Keywords: Rosemary, Mental health, Incarcerated persons.

1. INTRODUCTION

Common mental disorders (CMD) have several symptoms, such as irritation, anxiety, trouble sleeping, and difficulty concentrating, which last around 7 days. Illnesses such as depression, anxiety, phobia, panic disorder, and obsessive-compulsive disorder can be early diagnosed through an adequate evaluation of CMD [1]. These illnesses are somatic complaints that indicate mental distress, but are not described in the diagnostic criteria of international classifications [2].

Currently, the number of people with CMD complaints and symptoms who seek help from Primary Health Care has intensified. The characteristic CMD symptoms are nonspecific, often causing difficulties for medical professionals to assess and identify them, as well as the distress expressed by people affected by CMD, often contributing to create stereotypes, such as complaining, problematic, and hysterical people [3].

Rates of CMD and work-related disorders have increased in workplaces [4]. According to the World Health Organization, 30% of active workers are affected by minor mental disorders, with 5-10% reaching the lowest levels of serious illness [5].

Regarding incarcerated people, there is a lack of published studies about presence of CMD. Health professionals who care prisoners with no confirmed diseases have received from them several complaints of physical or mental symptoms.

According to [6], it is necessary to seek for other therapeutic measures to promote health and bring new alternatives for improving physical and psychological distress, considering that medicalization has been used as the only alternative to alleviate these symptoms; the use of rosemary *(Rosmarinus officinalis*) extract is one of the alternatives for complementary

treatment. The literature has presented the use of rosemary for treatments of physical and mental illnesses, such as fatigue, inflammation, memory disorders, nervous agitation, hysteria, and depression [7-10].
Phenolic, rosmarinic, and caffeic acids are among active compounds of rosemary essential oil, and has shown antidepressant effect, according to the [11]. The antidepressant effect of rosemary essential oil was confirmed at pre-clinical level in tests in mice [12], reinforcing the ethnopharmacological use of extract of *R. officinalis*.
The objective of this study is to evaluate the effects of treatments with different doses of *R. officinalis* on CMD symptoms in incarcerated people and prison workers.

2. MATERIAL AND METHODS

1. MATERIALS AND METHODS

And the main section ought to be numbered as per the journal style, and ease of comprehension at glance.
Study design
This is a randomized, double-blind, placebo-controlled clinical trial.

2.1 Participants

A total of 50 participants were evaluated: 25 prison workers with at least one year of work, and 25 incarcerated people with conviction and *res judicata*, who agreed to participate in the research, from two prisons linked to the 3rd Regional Penitentiary Police Station (DPR/Susepe), which belongs to the Department of Justice and Criminal and Socio-Educational Systems (SJSPS) of the state of Rio Grande do Sul, Brazil.
The exclusion criteria applied were: people with medical diagnosis of mental illness, which would make it difficult to understand the questions that compose the instruments used for data collection; those using diuretics, laxative, and hypotensive medications; those with prostatic disease, gastroenteritis, dermatoses, and history of seizures, as recommended in the literature; and chemically dependent persons, according to local medical records.

2.2 *Rosmarinus officinalis*

R. officinalis capsules were produced from a standardized dry extract purchased from a supplier authorized by national health agencies. The manipulation of the herbal and placebo capsules was carried out at the Pharmacy of the Regional University of the Northwest of the State of Rio Grande do Sul - UNIJUÍ, with good handling practices. Starch was the excipient used to produce the capsules of *R. officinalis* and placebo. The quality control recommended by the Brazilian Pharmacopoeia and required by the RDC 67/2007 was carried out for each batch of capsules produced; mean weight, upper and lower limits, and coefficient of variation were calculated.
All groups were informed that the capsules should be administered once a day for a period of three months. The capsules were delivered by a main researcher directly to each participant, at the beginning of the research, in a single delivery.
Interventions
The study was carried out in two similar prisons of small size and minimum security, called EP1 and EP2.
Participants were randomly divided into 5 groups, with 10 participants each, as follows:
Control group: group that received placebo capsules.

Intervention group: subdivided into 4 subgroups, as follows:
Group A: treatment with 100 mg day^{-1} of *R. officinalis* in capsules.
Group B: treatment with 500 mg day^{-1} of *R. officinalis* in capsules.
Group C: treatment with 1000 mg day^{-1} of *R. officinalis* in capsules.
Group D: treatment with 500 mg day^{-1} of *R. officinalis* in capsules to participants who use psychotropic medication to treat anxiety and depression.

2.3 Outcomes

The primary outcome of this study was the reduction of CMD symptoms.

2.4 Data collection instruments

The beneficial effects of rosemary extract were evaluated by collecting data at the beginning and end of the period established for administration of the capsules.

The instruments used for data collection were: an identification form with sociodemographic and clinical data, and a 20-Item Self-Reporting Questionnaire (SRQ-20) to assess CMD. The SRQ-20 was developed by the World Health Organization - WHO in the 1970s and reformulated in the 1980s to screen for mental disorders; it was validated in Brazil by Mari and Willian in 1985 [13]. It consists of 20 Yes-or-No questions designed to screen for non-psychotic CMD [14].

The data was collected through interviews with the participants at two times, before and after use of rosemary extract capsules: the first was in October and November 2021, and the second in February and March 2022. All data collection instruments were applied by a main researcher, and all health safety measures related to the Covid-19 Pandemic situation were applied.

2.5 Data analysis

The screening for CMD through the SRQ-20 attributes a value of 1 for each affirmative answer. A score 0 indicates no probability of non-psychotic mental disorders and a score 20 indicate extreme probability. The cut-off point is 7 points; therefore, a score equal to or higher than 7 indicates presence of some common mental disorder.

2.6 Sample size and randomization

The 50 participants were randomly divided into control and intervention groups using the Microsoft Excel 2016 program. A number was assigned to each one, which was allocated using the command 'random between'; for repeated numbers, a new number was generated by the command. Each selected participant was allocated among the groups, according to a simple randomization table generated by the program. The groups were stratified as incarcerated people or prison workers and the level of anxiety was assessed before the randomization to minimize research bias. The sequence of random allocation was generated by one of the proponent researchers, who did not participate in the intervention, i.e., the main researcher who applied the instruments and conducted the interviews did not participate in the randomization process, participating blindly, as the other participants.

2.7 Statistical analysis

All analyzes were carried out using the Statistical Package for the Social Science software 23.0 (SPSS Inc., Chicago, USA). Data normality was tested using the Kolmogorov-Smirnov test. Continuous data were described as mean ± standard deviation (SD), and categorical data as absolute and relative frequency. The correlation between two qualitative variables was verified through the McNeman test. Test of comparison of means was used for quantitative variables, and the t test for dependent variables. All tests were carried out considering a 5% significance.

3. RESULTS

A total of 50 participants were included in the present study. However, during the period of use of rosemary extract in capsules, six participants discontinued its use, and one did not even start using it, thus, he was withdrawn from the research. The group of participants not using psychotropic medication, and treated with 500 mg day^{-1} of rosemary (500a mg day^{-1}) presented the highest losses, with 4 dropouts.

The number of the participants is very low. Six participants that withdrawn should have replaced since the main authors would have known about it from the start.

Table 1 shows the results of CMD in the intervention groups. A total of 16 (37.20%) people with indication of CMD, i.e., with a score equal to or higher than 7 (cut-off point), was found at the beginning of the study. This number reduced to 6 participants (13.05%) at the end of the study (Why did the number of the participant were reduced6 participants. It dampened the credibility of the study. That's a huge number compare the the total starting number.). The dose of 500 mg day^{-1} was the most effective in reducing diagnoses of CMD, and at the 100 mg day^{-1} dose, no participant had CMD at the baseline.

Table 1. Presence ~~and absence~~ of common mental disorder (CMD) in prison workers and incarcerated people treated with rosemary extract for three months, and a control group (placebo).

Dose (mg day^{-1})	**CMD**				
	Initial		*Final*		*P*
	Mean	SD	Mean	SD	
0	4.33	3.16	2.56	2.24	0.125
100	3	2	2.67	5.12	0.858
500a	5.14	4.63	4	3.87	0.436
500b	8	3.05	4.4	3.2	0.003*
1000	6.38	4.95	3.5	3.74	0.009*
X	5.45		3.18		0.001*
SD	3.76		3.57		
X+1SD	9.21		6.75		
X-1SD	1.69		-0.39		

Each group was composed of 10 participants; mg: milligrams; CMD: common mental disorders; SD: standard deviation; X+1SD: mean plus 1 standard deviation; X-1SD: mean minus 1 standard deviation; 500a: treatment with rosemary extract at 500 mg day^{-1} for participants not using psychotropic medication; 500b: treatment with rosemary extract at 500 mg day^{-1} for participants who use anxiolytic medication. Presence of CMD was considered for scores equal to or higher than 7.

The rosemary extract doses of 500 and 1000 mg day^{-1} presented statistically significant results for reduction of CMD symptoms when compared to those at the beginning of the study (Table 2). A non-significant reduction of CMD symptoms was found for the other doses and the placebo group. (This can be put under table 2 instead of standing alone).

Table 2. Of CMD symptoms in participants at the beginning and end of the study, who used rosemary extract for three months.

Dose (mg day^{-1})	CMD				
	Initial		*Final*		*P*
	Mean	SD	Mean	SD	
0	4.33	3.16	2.56	2.24	0.125
100	3	2	2.67	5.12	0.858
500a	5.14	4.63	4	3.87	0.436
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X-1SD	1.69		-0.39		

Each group was composed of 10 participants; mg: milligrams; P: probability; *: significant at p<0.05 by the t teste; X: mean; SD: standard deviation; X+1SD: mean plus 1 standard deviation; X-1SD: mean minus 1 standard deviation; 500a: treatment with rosemary extract at 500 mg day^{-1} for participants not using psychotropic medication; 500b: 500b: treatment with rosemary extract at 500 mg day^{-1} for participants who use anxiolytic medication.

Table 3 shows the symptoms screened using the 20-item self-reporting questionnaire (SRQ-20), with scores obtained before and after the administration of the different doses of rosemary extract. The final evaluation showed reductions in most symptoms for the doses of 500 and 1000 mg day^{-1}, with satisfactory results for 16 of the 20 symptoms. The 100 mg day^{-1} dose reduced almost half of the symptoms, as well as its placebo, both with no statistical significance. Considering the symptom pain (head and stomach), the rosemary extract doses presented positive results at the final evaluation, including the dose 100 mg day^{-1}, but with no statistical significance. None of the initial and final evaluations showed statistically significant reductions in the symptoms evaluated with SRQ-20.

(Table 3 isn't showing above as the stamen indicated. Rather, the table 3 is below. There should be proper rearrangements of tables and summary of results either below or above each.

Table 3. Common mental disorder (CMD) symptoms, in prison workers and incarcerated people treated of rosemary extract for three months

Dose (mg day^{-1})	***Headache***			***Shortness of breath***		
	Initial *n (%)*	*P*	*Final* *n (%)*	*Initial* *n (%)*	*P*	*Final* *n (%)*
0	2 (22)	0.95	1 (11)	1 (11)	0.95	2 (22)
100	4 (40)	-	0	0	-	0
500 a	2 (28.5)	0.5	4 (57)	1 (14)	-	1 (14)

500 b	5 (50)	0.625	3 (30)	2 (20)	-	2 (20)
1000	1 (13)	-	0	2 (25)	-	0
Dose (mg day^{-1})	***Poor sleep quality***			***Easily scared***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	5 (55)	0.25	2 (22)	1 (11)	-	1 (11)
100	1 (10)	0.95	2 (20)	1 (10)	-	1 (10)
500 a	2 (28.5)	-	0	3 (43)	-	0
500 b	4 (40)	0.5	2 (20)	3 (30)	0.5	1 (10)
1000	3 (38)	0.5	1 (13)	4 (50)	0.25	1 (13)
Dose (mg day^{-1})	***Hand tremor***			***Nervousness***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	1 (11)	0.95	2 (22)	1 (11)	0.95	2 (22)
100	1 (10)	-	1 (10)	4 (40)	0.5	2 (20)
500 a	2 (28.5)	0.95	1 (14)	5 (71)	0	3 (43)
500 b	7 (70)	0.25	4 (40)	8 (80)	-	8 (80)
1000	3 (38)	0.95	2 (25)	7 (88)	0.5	5 (63)
Dose (mg day^{-1})	***Poor digestion***			***Trouble thinking clearly***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	0	-	0	2 (22)	0.95	1 (11)
100	2 (20)	-	0	3 (30)	-	0
500 a	3 (43)	-	3 (43)	1 (14)	0.95	2 (28.5)
500 b	7 (70)	0.125	2 (20)	5 (50)	-	5 (50)
1000	1 (13)	-	0	2 (25)	-	2 (25)
Dose (mg day^{-1})	***Sadness***			***Cry***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	4 (44)	0.25	1 (11)	0	-	1 (11)
100	2 (20)	-	0	0	-	0
500 a	3 (43)	0.95	2 (28.5)	1 (14)	-	1 (14)
500 b	5 (50)	0.25	2 (20)	2 (20)	0.95	1 (10)
1000	5 (63)	0.5	3 (38)	1 (13)	-	1 (13)
Dose (mg day^{-1})	***Satisfaction in daily activities***			***Difficulty in making decisions***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	1 (11)	-	0	3 (33)	0.95	2 (22)
100	1 (10)	-	1 (10)	4 (40)	0.95	3 (30)
500 a	2 (28.5)	0.95	1 (14)	1 (14)	-	0

500 b	4 (40)	0.95	3 (30)	7 (70)	0.25	3 (30)
1000	2 (25)	0.95	1 (13)	3 (38)	0.5	1 (13)
Dose (mg day^{-1})	***Difficulties at work***			***Incapable and useful***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	1 (11)	-	1 (11)	1 (11)	-	0
100	2 (20)	0.95	1 (10)	0	-	0
500 a	0	-	0	0	-	0
500 b	2 (20)	-	0	0	-	0
1000	3 (38)	0.5	1 (13)	0	-	0
Dose (mg day^{-1})	***Loss of interest in everyday life***			***Uselessness***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	0	-	1 (11)	1 (11)	-	1 (11)
100	1 (10)	-	0	0	-	0
500 a	1 (14)	0.5	3 (43)	1 (14)	-	0
500 b	3 (30)	0.5	1 (10)	1 (10)	-	1 (10)
1000	4 (50)		2 (25)	1 (13)	-	1 (13)
Dose (mg day^{-1})	***Suicidal thoughts***			***Fatigue***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	1 (11)	-	0	2 (22)	0.95	1 (11)
100	0	-	0	0	-	0
500 a	1 (14)	-	0	1 (14)	-	1 (14)
500 b	1 (10)	-	1 (10)	2 (20)	0.95	1 (10)
1000	2 (25)	0.95	1 (13)	3 (38)	-	3 (38)
Dose (mg day^{-1})	***Stomachache***			***Get scared easily***		
	Initial	*P*	*Final*	*Initial*	*P*	*Final*
0	2 (22)	0.95	3 (33)	2 (22)	-	0
100	2 (20)	-	2 (20)	1 (10)	-	0
500 a	2 (28.5)	-	2 (28.5)	4 (57)	0.95	3 (43)
500 b	6 (60)	0.25	3 (30)	6 (60)	0.25	2 (20)
1000	2 (25)	-	0	2 (25)	0.95	3 (38)

mg: milligrams; P: probability; N: number of participants (each group was composed of 10 participants); *: significant at $p<0.05$ by the t test; 500a: treatment with rosemary extract at 500 mg day^{-1} for participants not using psychotropic medication; 500b: treatment with rosemary extract at 500 mg day^{-1} for participants who use anxiolytic medication.

No presence of side effects was found due to the use of the product for any of the doses evaluated. This result is from data evaluated through a final interview, at the second stage, when participants were asked about presence or absence of characteristic symptoms

that could have make them to stop the use of the rosemary capsules. Moreover, the participants were monitored during the whole period of intervention, in which the participants did not report any side or adverse effects.

4. DISCUSSION

The results of the present study showed a significant reduction in CMD symptoms for the doses of 500 and 1000 mg day^{-1} of rosemary extract. Thus, the use of rosemary extract was a viable alternative for reducing symptoms related to a hectic daily life, such as trouble sleeping, difficulty concentrating, and memory disorders, which are common problems in the general population, and in the population evaluated in the present study.

A significant number of subjects with CMD was found in the evaluated population (37.20% at the beginning of the research). [13] investigated minor mental disorders, and burnout syndrome in a sample of prison workers in Rio Grande do Norte, Brazil. The found a high prevalence of low-moderate mental disorders, feelings of emotional tension and depression, and presence of a state of alert related to the burnout syndrome. They also showed that those who had worked longer in prison had more severe psychological disorders, which suggests that psychological conditions tend to worsen over the years when working in such environments.

[1] reported that CMD affects people all over the world, and that a high prevalence of CMD is found in 174 studies in 63 countries. In Brazil, it has been varied from 28.7 to 50%, presenting prospects of becoming one of the most disabling disorders, mainly for female and elderly populations and individuals under unfavorable socioeconomic and educational conditions. According to [4], data provided by the Brazilian Social Security Institute (INSS) indicate that mental disorders correspond to the third largest granting of social security benefits to workers due to disability, in Brazil.

According to the World Health Organization, it is not only the absence of diseases that must be considered to confirm that a person is healthy, but a integrality status, which considers a state of complete physical, mental, and social well-being [14]. Mental health is not associated only to absence or presence of psychic distress or mental alterations, but also to biological, psychosocial, cultural, and economic factors, among others [15]. Many symptoms evaluated in the present study are characteristic of physical and mental discomforts, such as headache and stomachache, poor digestion, hand tremor, nervousness, poor sleep quality, and fatigue, whereas others are psychological symptoms, such as sadness, difficulties at work and in decision-making, daily dissatisfaction, and even being easily scared.

A prison environment can affect the physical and mental health of those who live or work there, as shown by the results found in the present study. The work routine of prison staff and the state of confinement of prisoners are conditions that can trigger CMD symptoms due to a constant state of tension and risks to which they are subjected [16]. A study showed that CMD occurred in 23.57% of prison staff and the associated factors were: type of prison unit and double-shift work. The present study identified a peculiar

characteristic in the prisons where the data were collected: they are small, and have few workers and incarcerated people.

Depression, anxiety, and mood disorder are among the possible outcomes for CMD symptoms. Use of rosemary to treat depression was evaluated by [17] in tests in mice; they assessed the antidepressant effect of rosemary crude extract, isolated compounds, and essential oil; statically significant results were found through tail suspension and forced swimming models, proving that rosemary can be used to treat depression when compared to the drug Fluoxetine. Another double-blind study evaluated 68 students that randomly received 500 mg day^{-1} of rosemary or placebo twice a day for one month, and found that memory disorders (prospective and retrospective), depression, and anxiety significant decreased in the rosemary group when compared to the control group [18].

According to [16] the choice of rosemary essential oil for their study was based on its ethnopharmacological properties, which indicate a versatile use, and that its actions vary from sedation to stimulation. In addition, [19] reported its use for relieving headaches and epilepsy in Mexico, for treatment of depression, and as a relaxant in Spain. Thus, all results corroborate and reinforce the results found in the present research.

The results of reduction of CMD symptoms (Table 3) showed that both physical and psychological symptoms reduced after using rosemary extract, relieving anxiety and pain and, consequently, the CMD scores. Such symptoms were also pointed out by [20] who evaluated the effects of this plant species in humans. A behavioral study carried out with mice showed that daily oral administration of rosemary tea significantly reduced behaviors characteristic of depression and anxiety and mood disorders, concluding that the regular intake of rosemary infusion has antidepressant and anxiolytic benefits [21].

In view of the above, it is noteworthy that no studies evaluating common mental disorders as outcomes were found, which is the differential of the present study. The importance of these findings is highlighted considering that conventional treatments are based on drugs with potential risks and side effects, in addition to the good prospects for using rosemary extract in patients with CMD.

5. CONCLUSION

The results of the present study show that the use of extract of rosemary (*Rosmarinus officinalis*) at doses of 500 and 1000 mg day^{-1} was effective to reduce common mental disorder symptoms in prison workers and incarcerated people. The use of this product proved to be also safe, as it did not cause side effects in the participants.

In this sense, the use of rosemary to complement therapies for treatment of symptoms related to psychic distress can be viable, denoting a good prospect for further studies to evaluate other actions of this medicinal plant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

Author 1 and Author 7 designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript, Author 2, Author 3, Author, Author 5 managed the analyses of the study and Author 6 managed the literature searches. All authors read and approved the final manuscript.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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