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THE INFLUENCE OF GUIDED MEDITATION ON THE LEVEL OF COGNITION: A STUDY ON MEDICINE COURSE STUDENTS AT A UNIVERSITY IN SOUTH BRAZIL

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Abstract: Meditation is a practice currently widespread throughout the world. People seek to meditate for different reasons, but they all have something in common, an improvement in a certain area, whether behaviorally, emotionally or even as a therapeutic option. On the other hand, a little explored aspect of the effects of meditation is the question of whether or not there is an improvement in the intellective field of the human brain. This work aims to contribute to this premise, observing the possibility of cognitive influence mediated by guided meditation. The research has an experimental, mixed, longitudinal and prospective approach. To achieve the objectives of the study, a group of medical students from a university in southern Brazil participated in the experiment. Participants underwent mindfulness meditation practice, guided by a specialized application, for a period of 20 weeks. Subsequently, they were compared to another group not exposed to the meditation technique. The way of comparing the two groups was through a test composed of specific questions from the medical field, after a class taught on the topic: primary headaches. Therefore, it was possible to analyze, in a practical way, the extent to which meditation cognitively interferes with human beings. The results showed a superior performance of the group exposed to the technique in relation to the control group, suggesting the existence of a possible cognitive improvement in meditators, even in beginner practitioners. It was also possible to evaluate the performance of each student with a meditative habit according to their level of dedication to the experiment. Another important result observed was each participant's own perception of cognitive improvement. Through a questionnaire, researchers found that 86.7% of meditators noticed an improvement in their learning during the research period. Therefore, the objective of carrying out an analysis and finding out whether there is, in fact, cognitive improvement through meditative practice was achieved, showing positive results.
Keywords: Meditation; Cognition; Neuroplasticity.

INTRODUCTION

Many discoveries about the effects of meditation on the human brain have been reported in recent years. The growing number of researches in this field offers a horizon of practical possibilities, which is seen with great enthusiasm in several areas, including medicine. However, unfortunately, in most of these studies there is a strong bias towards publishing positive or significant results. Therefore, it is easy to understand the need for serious research, with methodological quality, and without any type of bias, that can provide true results regarding such a curious and promising topic (TANG; HÖLZEL; POSNER, 2015).

This study delves into this vast and magnificent world that is still little explored, which is the human brain. The benefit of meditative practice in terms of behavioral improvement, combating stress (POKORSKI; SUCHORZYNSKA, 2018), improving sleep quality (RUSCH et al., 2019), and even successfully treating chronic pain (BRANDMEYER) is evident; DELORME; WAHBEH, 2019). However, a field that is still little explored is the questioning of the cognitive improvement offered by meditation, not only in a theoretical and speculative way, but in a practical way, observable in the population.

In this bias of uncertainty regarding the improvement of intellectual capacity influenced by meditation, we seek to know, here, whether it is possible, before applying a test on specific medical knowledge, for guided meditation to influence the cognitive capacity of students. to improve your performance in it.

The possibilities opened up after this study are immeasurable, since today medical students all over the world share common problems, such as stress related to daily pressure during the academic period, excessive caffeine consumption, sleep disorders, among others. Academics, in general, to achieve good performance in the course, harm their own health (ALSAGGAF; WALI; MERDAD, 2016).

The discussion of the results observed in the present research not only relates the group exposed to guided meditation with the control group, but also shows the levels of commitment and dedication of the participants in the group of meditators and their results and performances compared to each other.

Therefore, the researchers show the real uses of this completely natural and harmless tool that is presented not only to medical students, but to all those who want to know the true relationship of a possible cognitive improvement without side effects.

DEVELOPMENT

MEDITATION

The word meditation, derived from the Sanskrit "dhyana", a traditional Indian language, means attention or contemplation (SAMPAIO; LIMA; LADEIA, 2016).

This term does not have a single definition, as its meaning can vary according to the meditative technique practiced. Its specificities vary depending on the place of origin and culture of the people who practice a certain technique. Among some of the best-known meditation techniques, we can mention transcendental meditation, Tibetan Buddhism, Zen Buddhism, Ashtanga yoga and Indian tantra (GOLEMAN, 1998).

In general, we can characterize meditation as a set of activities that aim to highlight and expand the scope of the human mind in its possible activity, which is generated, almost always, by sensorimotor discipline through relaxation, silent remaining in a state of rest, closing your eyes and breathing consciously and adopting an object of consciousness. In short, meditation is nothing more than a way of developing consciousness (JONHSON, 1995).

Alternatively, there are also different definitions, such as those that consider meditation as a form of mental training, with the aim of improving the psychological capabilities of the individual practitioner, such as attention and emotion (TANG; HÖLZEL; POSNER, 2015).

Another point of view on the definition of meditation can be observed in the work of Cardoso et al. (2004, p 59), which says:

> To be characterized as meditation, the procedure must contain the following operational parameters: Uses a specific (clearly defined) technique, involving muscle relaxation somewhere during the process and "logical relaxation": a necessarily self-induced state, utilizing an ability to self-focus.

This simple "brain exercise" performed focusing on breathing and physical sensations over a period of time may not be so easy for beginners. In the meantime, guided meditation can be a great option for beginners. Basically, guided meditation consists of the process in which the practitioner is led by another trained practitioner or by a teacher, through verbal instruction, written text, music, audiovisual media, in the presence of the instructor or not (MORAL, 2017).

In the last decade, there has been a notable increase in the number of researches related to meditation due to the possible effects of cognitive improvements (CRESCENTINI; FABBRO; TOMASINO, 2017).

BRAIN AND COGNITION

The human brain has an average of 170 billion cells, of which half, that is, around 85 billion, are neurons (AZEVEDO at al, 2009). The construction of this neuronal network, responsible for human interaction with the world around them, involves many steps, from the proliferation of stem cells to the formation of synapses and connections for the formation of functional circuits (MURALIDHARAN, 2020).

When looking for a definition for the term social cognition, one can find some different meanings, but, without elaborating, social cognition refers to mental actions related to social interactions such as perception, interpretation and responses to social behaviors. others (GREEN at al., 2008).

EFFECTS OF MEDITATIVE PRACTICE

Several studies have demonstrated the ability to improve the cognitive process, and also a change in brain structure through meditative practice, with considerable success in clinical treatments for depression, stress and anxiety (CRESCENTINI; FABBRO; TOMASINO, 2017).

Most investigations involving the results of meditative practice show the capacity for positive effects on mental health. Randomized studies involving 190 participants showed that meditation can even have an influence on the immune and endocrine systems. Furthermore, it is known that it can improve the management of chronic pain in patients with migraines of primary origin, for example, and has shown benefits in sleep quality (BRANDMEYER; DELORME; WAHBEH, 2019).

METHODOLOGY

The present study is characterized by being experimental, qualitative, longitudinal and prospective. In this sense, researchers will act by actively participating in the conduct of the observed event and will evaluate changes in the outcome. The search for understanding this specific complex phenomenon of both a social and cultural nature characterizes it in the aforementioned concepts (FONTELLES et al., 2009).

THE PARTICIPANTS

The population corresponds to two groups of students, with 15 members in each group, selected from the UNIVALI medical course. One group of students constitutes the group exposed to the guided meditation technique and the other group of students constitutes the group not exposed to the technique.

The inclusion criteria were: Among the students participating in the fifth period, in the year 2022, of the UNIVALI medical course, who were interested in participating in the study after the presentation of the topic, 15 students were selected, completely randomly, to compose the group exposed to the meditation technique. Furthermore, in a completely random manner, among the members of the sixth period, in the year 2022, of the UNIVALI medical course, who were interested in participating in the study after the presentation of the topic, 15 students were selected to form the group not exposed to meditation technique.

The exclusion criteria were: Among the students in the fifth and sixth period, in the year 2022, of the Univali medical course, who were not interested in participating in the study after the presentation of the topic and, also, those interested who were not, randomly selected.

DATA COLLECTION PROCEDURE

As for the start of the experiment itself, in the first semester of 2022, professor Marcelo Zalli taught the class on primary headaches and applied the test (Appendix A) to the unexposed group. From that moment on, the exposed group began the guided meditation technique. The meetings for meditation practice had the opportunity to take place in a specific classroom provided by the coordination of the UNIVALI medical course. The proposed meditative practices had an average of 20 minutes per day (the exact time varies according to the theme chosen by the practitioner that day on the virtual platform). The meditation is guided with the help of a cell phone application specialized in mindfulness meditation, "ODISSEIA ®". The application is paid and the researchers covered the cost of each participant's subscription. The researchers opted for the paid version, as this version offers greater support to the user when compared to the free version. The use of the application avoids failures in the technique, because, if by chance, a participant, for major reasons, misses the meeting, they can perform the technique, later, at their home or in any place of their choice, and within their working hours. meditation performed that day can be registered in the application through the account created for each participant.

During the meetings, the researchers accompanied the participants during the meditative practice, observing the practitioners, in order to guarantee the correct practice procedure. The application used as a guide offers a detailed record during its use for meditation practice, the researchers then have access to these records in each participant's account. The level of commitment and attendance of each participant in the practices also served as a database for comparing performance between them.

At the beginning of the second half of 2022, the exposed group had already completed the practical days necessary for data analysis. Thus, the researchers enjoyed a sufficiently large workload to apply the necessary considerations regarding the results obtained. It is worth mentioning that the individuals in the exposed group, after the period of meditative practice, were already in the second half of 2022. That is, in the same period as the participants in the non-exposed group, with the aim of maintaining both the exposed and of the unexposed group, at the same level of knowledge offered by the medical course.

At this stage of the study, after completing the guided meditation course, research advisor Marcelo Zalli taught the class on primary headaches and applied the test, mentioned above, to the exposed group.

At the end of the experiment, the researchers asked participants in the group of meditators to answer a questionnaire (APPENDIX B), online, anonymously, through a link created in "GOOGLE FORMS®". The questionnaire consists of 2 objective questions, and basically asks whether the experiment, in the participant's perception, brought cognitive benefits to him.

DATA ANALYSIS

With the tests of all 30 participants in hand, the researchers finally objectively evaluated the performance of each group. The questions contained in the test are objective questions, with a summation method of alternatives. The questions are multiple propositions and contain a maximum of 5 (five) propositions identified by the numbers 01, 02, 04, 08 and 16 of which at least one is correct in relation to the statement of the question. The correct answer is the sum of the numbers corresponding to the correct propositions, which results in a whole number, between 01 and 31, including these values. In the case of only one correct proposition, the correct answer is the number

corresponding to that proposition. Questions are scored according to the following rule:

If: NCP > NPI

Therefore: $P=\frac{NP-[NTPC-(NPC-NPI)]}{NP}$

Otherwise P = 0.00

Where: P–Participant's score on the question
NP–Number of propositions in the question
NTPC–Total number of correct propositions in the question
NPC–Number of correct propositions considered correct by the participant
NPI–Number of incorrect propositions considered correct by the participant

The data with the workload of meditative practices obtained through the "ODISSEIA ®" application was tabulated in "EXCEL 2019 ®". The difference in workload among participants also served as a source of analysis in the comparison between participants. In addition to the data regarding workload, the test performances (Appendix A) were also tabulated in "EXCEL 2019®". The researchers thus placed the test results scores in graphic format for better comparative analyses.

Objectively, this way, the groups were compared and, thus, the researchers were able to observe the possible existence, and with what expression, of a cognitive difference imposed by meditative practice.

The answers to the questionnaire (APPENDIX B) were analyzed using a pie-shaped graph created in "GOOGLE FORMS®". This form of graph made it possible to compare, by percentage, the options selected by the participants.

DISCUSSION OF RESULTS

The scores of participants in the group not exposed to the guided meditation technique were calculated according to the formula described previously, the scores were added and divided, obtaining a simple arithmetic mean of 6.80.

Each participant in the group exposed to the technique received a login and password to access the "ODISSEIA ®" guided meditation application. The group then started the meditation routine according to each individual's time availability, some preferred to practice early in the morning, others identified with nighttime practice, just as some liked meditation at lunchtime. In this sense, the application brought very important freedom to the participants, as, regardless of the time of day chosen to carry out the practice, the application recorded each person's access to their account, detailing the minutes invested in each meditation performed.

The researchers had access to all accounts, and recorded the data recorded in the application in a spreadsheet in "EXCEL 2019 ®" every week. After five months, with the practice load reached by the group, the members participated in a class on primary headaches (class taught in the same way as that applied to the control group) and then performed the test (appendix A). The result of the simple arithmetic average of the scores was 7.55, making it possible to observe more specific comparisons between the participants, whose data obtained can be found in graphs 1 and 2.

The results of tests carried out with the group exposed to meditative practice reveal a tendency towards superior performance as the individual better establishes a daily meditation routine. Even with a practical experience of just a few months, and with just a few minutes a day, the practitioner can enjoy cognitive improvement. Graph 1 correlates the test score of each participant in the exposed group with the total workload obtained by each practitioner, referring to a period of 20 weeks (from 04/25/2022 to 09/25/2022) of guided meditation. The trend line (dotted line) reveals that there is a propensity to achieve a better score, whilst the meditator

has achieved a greater total number of hours meditated during the experiment period.

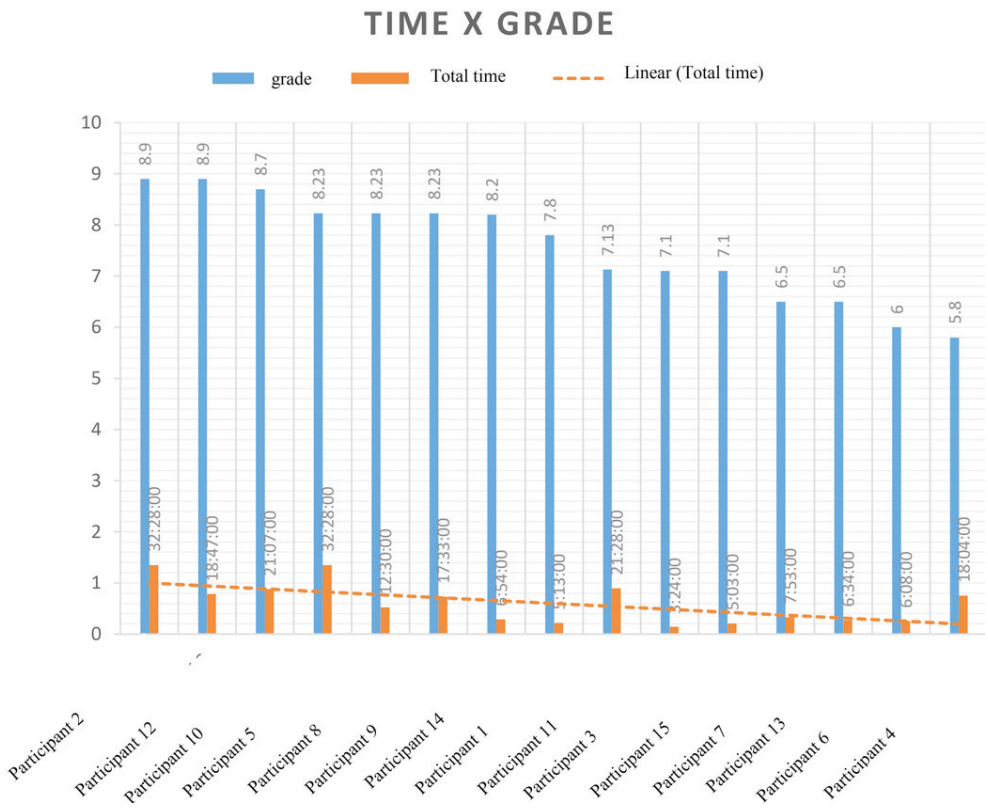
The result observed in graph 1 is in line with what was pointed out (Ding, Tang, Cao et al., 2015), when analyzing 23 students from the Dalian University of Technology and comparing a group exposed to meditation using the Body-Mind Integrative Training technique (IBMT) to a control group, exposed only to muscle group relaxation training (RT). In this Chinese study, participants practiced for 10 days, for 30 minutes a day. The researchers then measured the differences in brain activation, using Functional Magnetic Resonance Imaging (fMRI), in both groups, in a moment of insight, in which the participants tried to think of a solution to a problem proposed to them.

The study proved that before training the groups did not differ in problem-solving ability nor were significantly different activations observed in fMRI between the two groups. However, after training, it was possible to observe that short-term IBMT can produce better creative performance in problem solving compared to RT. And, in fMRI, the IBMT group increased signals in the areas of the right cingulate gyrus, insula, putamen, right inferior frontal gyrus, bilateral middle frontal gyrus, inferior parietal lobe and superior temporal gyrus, areas that are related to executive functions, emotions and memory (Machado & Hartel, 2013). This increase in signals indicates that neural activity increased during the insight event. In contrast, the RT group had decreased signals in these areas, indicating that neural activity decreased during the insight event.

In graph 2, it is possible to observe the correlation between the frequency, that is, the regularity of the meditative habit and the grades obtained in the tests of the exposed group. The graph reinforces an important point that must be highlighted, it is not enough for the practitioner to meditate for hours focused on just one moment, it is necessary for meditation to be a habit, and for the individual, even for a few minutes a day, to practice constantly. Therefore, the benefits perceived in the short term solidify as the meditator makes the practice something intrinsic to his day over the days. The trend line (dotted line) demonstrates an evident propensity to obtain higher grades according to greater assiduity to the meditation routine.

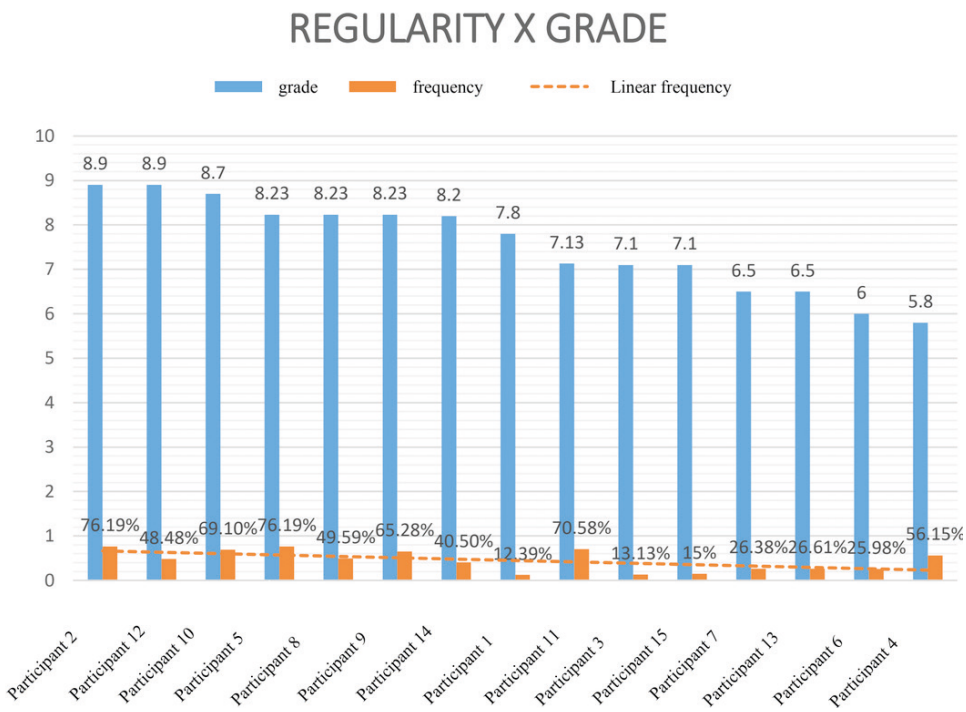
The work of (LUDERS, E. et al., 2012) highlights the data discovered in the graph. Luders' research explored brain gyrification, which is the result of an interaction between genetic factors, cell signaling mechanisms and neurogenesis, and the elasto-mechanical properties of neurons (LLINARESBENADERO; BORRELL, 2019), that is, the pattern and degree of folding of the cerebral cortex, characteristic of the geometry of the brain surface. This study compared, using magnetic resonance imaging, the brains of 50 long-term meditators with a control group, also composed of 50 non-meditating participants. The results show, even when applying stricter significance thresholds, a greater cortical gyrification in meditators, when compared to the control group, in five distinct brain regions: the left precentral gyrus, the left and right anterior dorsal insula, the fusiform gyrus right and right cuneos. The work also shows that, within the group of meditators, gyrification appears to increase as the number of years of meditation increases.

Graph 3 provides the answer to the initial question of this work. The researchers sought to clarify a relationship between a possible cognitive improvement linked to a short period of meditative practices when compared to the control group. The comparison between the two groups is made in a simplified way, comparing the simple arithmetic mean of both groups. When comparing the averages,



GRAPH 1- RELATIONSHIP BETWEEN MEDITATION TIME AND TEST GRADE

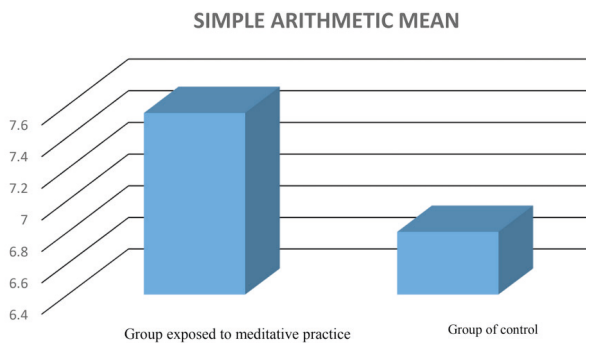
Source: Prepared by the author (2022)



GRAPH 2- RELATIONSHIP BETWEEN THE REGULARITY OF THE PRACTITIONER AND THE TEST GRADE

Source: Prepared by the author (2022)

a better performance was noted in the group exposed to guided meditation.



GRAPH 3 - THE SIMPLE ARITHMETIC AVERAGE OF ALL PARTICIPANTS IN BOTH GROUPS

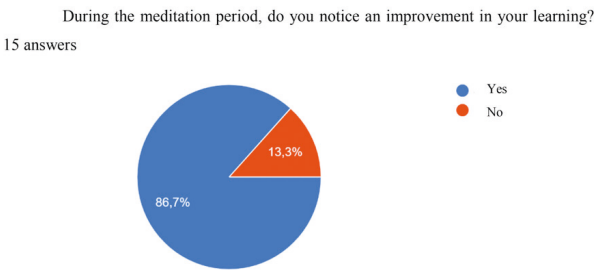
Source: Prepared by the author (2022)

It is undeniable that many stressors affect the psychology of an academic at a time of testing. According to Gonzaga and Enumo (2018, v. 38, n. 95, p. 266-277):

> Test anxiety is defined as psychological, physiological and behavioral reactions associated with excessive concern (fear, apprehension, annoyance) with negative results arising from failure or poor performance in assessment situations, whether before (anticipatory phase) or during (test phase). confrontation) and/or after a period of exams (waiting phase). Some related dimensions have been studied, such as emotionality, being upset, interference and lack of trust. Assessments are generally perceived as a personal threat, generating fear of failure. Studies indicate that there are also gender differences, as women have higher levels of test anxiety than men.

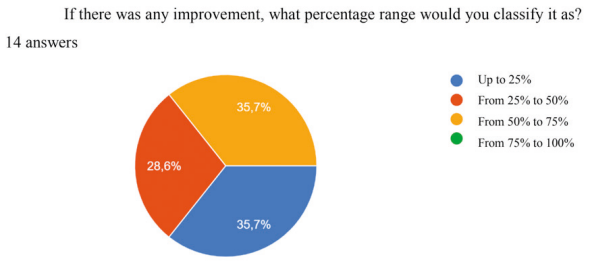
In this context of negative influence generated by stressors, the best results presented in the tests of the group of meditators can perhaps be explained, precisely, by the reduction in stress resulting from meditative practice. According to Saeed et al. (2019, p. 620) "mindfulness-based training is an effective treatment for a variety of psychological conditions and has been especially effective in reducing anxiety, depression and stress".

It is important to highlight the state of physical and mental relaxation achieved through meditation as a countermeasure to stress. The physiological effects of this state of relaxation generate in the meditator a greater feeling of subjective well-being, in addition to a decrease in the state of excitement, body temperature, adrenergic tone and muscle activity (DEEPAK, 2019). This subjective well-being and perception of cognitive improvement could be verified, in the group of meditators of the present work, through a questionnaire (APPENDIX B) applied by the researchers at the end of the experiment. The result of the questionnaire (GRAPHICS 4 and 5), carried out in a virtual environment, anonymously, consists of 2 questions, in the first, it asks whether the practitioner noticed any improvement during the period of meditative practice, the answer being 86, 7% of participants were YES. The second question asks, if there was an improvement, in what percentage range do you classify this improvement, the first option being an improvement of up to 25%, the second option between 25% and 50%, the third option between 50% and 75% and the last option, between 75% and 100%. When analyzing the responses, it was found that 35.7% of participants responded to the first option (up to 25% improvement), 28.6% responded to the second option (from 25% to 50% improvement) and, finally, 35.7% responded to the third option (50% to 75% improvement). No participant answered the fourth option (75% to 100% improvement).



GRAPH 4 - QUESTIONNAIRE. QUESTION 1

Source: Prepared by the author (2022)



GRAPH 5 - QUESTIONNAIRE. QUESTION 2

Source: Prepared by the author (2022)

The cognitive improvement, therefore, suggested in the study, both subjective (perceived in the questionnaire) and objective (verified in the test) can be supported by similar studies already published. A work carried out by Zeidan et al. (2010), in a shorter way than the study discussed here, followed a group of participants, with no previous contact with meditation, exposed to the meditative technique of mindfulness for just 4 days, during 20 minutes per day of training. The results they presented show that there was a cognitive improvement in the exposed group compared to the control group. Meditators were able to maintain sustained attention, maintaining focus and accurately retrieving information from working memory in conditions that require faster processing of stimuli. They also demonstrated an improvement in vigilance, executive process efficiency, visual-spatial processing and verbal fluency.

All this brain restructuring observed in meditators, added to the relaxation obtained with the mindfulness meditative technique and the consequent response of the autonomous system generates a paradoxical phenomenon, composed of an increase in attention (cognitive improvement) concomitant with physical relaxation (DEEPAK, 2019).

Therefore, it is known that just one test is not the best way to evaluate an academic's learning. However, within the present conditions and limits, the comparison between the groups in our study, through a test, becomes a tool of notable validity.

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APPENDIX A - TEST

PARTICIPANT NUMBER: _____

Name:
(you will not be identified, only the researcher will have access to this document)

1. In one day of emergency room care, you come across clinical cases about headaches. Read the cases carefully and then add the sum of the statements that you think are correct.

CASE 1. Young man, 21 years old, previously healthy, reports intense right temporal pulsatile pain with nausea for about 30 minutes, describes that before his pain crisis, he noticed sparkling spots in his field of vision. She states that crises occur weekly and last about 25 minutes and that sometimes there is visual phenomenology preceding the condition.

Regarding the above case, it is correct to state that:

01 - The patient in CASE 1 is diagnosed with Migraine. The classic clinical picture is described as hemicranial pain syndrome, which may be associated with Migraine Aura. Being VISUAL AURA, the most common.
02 - Migraine crisis must be treated on an outpatient basis with naproxen 550mg, with the use of triptans being possible in more intense conditions.
04 - The prophylactic treatment required in some patients can be carried out, among other medications, with Topiramate.
08 - In patients with more than 72 hours of crisis, they can receive intravenous treatment and the initial non-response to basic therapy with antiemetics, analgesics and hydration may require the use of tramadol and opioids.
16 - Botulinum toxin is recommended as prophylactic treatment, only in patients with migraine.
( )

CASE. 2. Male patient, 36 years old, arrives at the Emergency Room, reporting: intense retroocular and orbital headache on the right. Describes stabbing characteristic, describes 8 episodes in about 18 minutes. Pain woke up the patient in the early hours of the morning. He reports having drunk doses of RUM before going to sleep. Associated phenomena noticeable on physical examination: tearing of the right eye, hyperemia and unilateral nasal congestion, in addition to slight ptosis; The patient's intense agitation draws attention.

Regarding the above case, it is correct to state that:

01 The clinical picture above is characteristic of severe migraine headache.
02 Pain and dysautonomia are elements present in Headache – Trigeminal Neuralgia, present in the case above.
04 The headache described above is classified as a primary headache.
( )

CASE 3. A 34-year-old patient reports taking paracetamol, several tablets, daily for his

headaches. Her pain is described as a band in the frontal region, occipital and cervical region. Reports worsening of the condition as the day goes on. She says she massages herself to get some relief. The pain is described as pressure or heaviness in the muscles.

Regarding the above case, it is correct to state that:

01 - The clinical picture is tension headache and chronic daily headache due to analgesic abuse.
02 - The patient requires prophylactic treatment, with tricyclics being an option.
04 - The use of NSAIDs is recommended as a crisis abortifacient, as is Migranea.
( )

APPENDIX B – QUESTIONNAIRE ON THE PERCEPTION OF COGNITIVE IMPROVEMENT FROM THE POINT OF VIEW OF THE MEDITATOR PARTICIPATING IN THE EXPERIMENT

Level of Perceived Improvement in Learning

Question 01:

During the meditation period, did you notice an improvement in your learning?
( ) YES
( ) NO

Question 02:

If there was any improvement, what percentage range would you classify it as?
( ) Up to 25%
( ) From 25% to 50%
( ) From 50% to 75%
( ) From 75% to 100%