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INVESTIGATING THE EFFECTS OF INTEGRAL MEDITATION USING PSYCHOPHYSIOLOGICAL INDICATORS

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Chapter 1

INTRODUCTION

1.1 State of Art

Mindfulness meditation and its potential impact have been the focus of the scientific community in recent years. This fascination has been further fueled by technological and methodological advances, allowing for a deeper exploration of these practices. This collective interest has given rise to a burgeoning field known as "contemplative neuroscience." In the 1990s, publications focusing on mindfulness meditation [38] increased significantly. According to the scientific literature, meditation practices have the potential to influence cognitive processes by promoting neuroplasticity and connectivity within regions of the brain closely related to emotion regulation and attention control [37]. The concrete effects of meditation mainly include structural and functional changes in the brain, improved immune responses, mental well-being, chronic pain management, and improved sleep quality [4].

Although there is consensus regarding the basic definitions and mechanisms of mindfulness meditation, substantial variations emerge among different types of meditation. This leads to a diverse range of interventions tailored to specific contexts and goals. The predominant forms of meditation often involve focused attention or open-ended monitoring processes [26]. According to Vago and Silbersweig's conceptual framework [37], mindfulness practice promotes increased metacognitive self-awareness, self-regulation and self-transcendence. This model identifies six mechanisms underlying mindfulness practice:

1. Intention and motivation
2. Regulation of attention

3. Emotion regulation
4. Extinction and reconsolidation of memory
5. Prosociality
6. Non-attachment and decentering

Mindfulness meditation produces beneficial effects on several psychological and behavioral dimensions, contributing to overall well-being. Mindfulness can be perceived both as a state of presence and as a stable trait innate in individuals even without experience of mindfulness. Mindfulness-based interventions designed to cultivate a state of mindfulness have led to the recognition of mindfulness as an inherent human attribute. Consistent changes in awareness, known as dispositional awareness, are associated with mindfulness training. Beyond mindfulness itself, mindfulness-based practices such as mindfulness-based interventions (MBIs) are consistently correlated with anxiety and stress reduction, improved emotional regulation, self-compassion, and various other benefits including depression management, work-related stress mitigation, and improved sleep quality. Numerous authors confirm these associations through their studies [2] [36] [29] [25] [33] [20] [3] [7] [21].

Interestingly, mindfulness meditation not only benefits mental and physical processes, but also integrates these two aspects, resulting in greater adaptive body awareness, which includes interoception and proprioception [28]. By teaching people to pay attention to their body experiences in an open, welcoming and curious way, MBIs can promote adaptive body awareness [23] [32].

Randomized controlled trials (RCTs) have found a positive impact of mindfulness exercise on interoception as measured by the Multidimensional Assessment of interoceptive awareness (MAIA) scale in workers [10], individuals with comorbidities of chronic pain and depression [22], women in the third semester of pregnancy [6], and people with depression [13]. These findings from the self-assessment tools are also supported by neuroscientific studies that have shown an increase in insular activation, the region of the brain associated with interoception [5] [24] [39] after MBI both in the general population [8] and in experienced meditators [17].

1.2 Integral Meditation

Our program, called "Integral Meditation", shares the following key features with the "Mindfulness-Based Programs."

a) It uses mindfulness practices as a tool for systematic training of the mind, aimed at developing greater awareness of self and others. This approach is based on theories and practices that draw inspiration from contemplative traditions, but without including religious, esoteric or mystical elements.

b) It is based on a model of human experience that explores the causes of human distress and ways to alleviate it.

c) It promotes a new relationship with experience, characterized by focusing on the present moment and "decentering," that is, considering thoughts and feelings as mental events that come and go, similar to clouds in the sky. This training enables participants to radically transform their thoughts, feelings and bodily sensations, as well as external circumstances.

d) It fosters the development of self-regulation of attention, emotions and behavior, as well as promoting positive qualities such as compassion, wisdom and equanimity. This is done through the cultivation of an internal climate of friendliness toward experiences, whether pleasant or unpleasant.

e) Training promotes understanding of the mind and body and the realization that attention can be adjusted and improved through training, similar to physical training. The program progresses gradually and sequentially.

The uniqueness of our program lies in the following aspects:

a) The use of imagination to enhance concentration and change brain waves from beta to alpha/theta, inducing a different state of consciousness (Alpha waves occur when the brain is in a relaxed but still awake state. They are typically associated with a calm, focused mind. Alpha waves occur at a frequency of about 8-12 cycles per second (Hz). Beta waves occur when the brain is in a state of high mental activity, such as when one is focused, awake and mentally active. Beta waves are faster and occur at a frequency higher than 12 Hz. Theta waves occur in a slightly altered state of consciousness, such as during the transition phase between wakefulness and sleep, or in a deep meditative

state. They are associated with heightened creativity, intuition and often occur at a frequency of about 4-8 Hz.).

b) The use of Tibetan Bowls, which generate a deep state of relaxation, facilitating entry into meditation. These bowls are fundamental to meditation and are found on private altars, in temples, monasteries and meditation halls around the world. By meditating on the subtle sound of Tibetan bowls, one connects to the inner and outer universal sound. Each meditation session from phase 1 to phase 4 was accompanied by this sound.

c) The program is structured in 12 weekly guided sessions, each lasting 60 minutes. The 12 sessions are organized into 4 cycles, each of which includes three consecutive meditation sessions. Each cycle focuses on a specific skill, as illustrated below:

   - Cycle 1: Conscious diaphragmatic breathing, maintaining posture.
   - Cycle 2: Body scanning and awareness of body sensations.
   - Cycle 3: Exploration and acceptance of emotions and thoughts.
   - Cycle 4: Visualization activities to change the state of consciousness.

   Each cycle also includes the skills learned in the previous cycles, thus creating a progression. The last cycle, or Cycle 4, includes all the skills learned in the previous cycles and is structured into six final steps:

   1. Maintaining posture during meditation, focusing on mindful diaphragmatic breathing, body scanning and awareness of sensations to induce bodily relaxation and inner emotional calmness, linked to the calmness of the physical body. (Skills learned in Cycle 1 and 2) Duration: 10 minutes.
   2. Awareness and examination of emotions and thoughts. (Skills learned in Cycle 3) Duration: 5 minutes.
   3. Visualization of images (such as a sphere of light), colors and relaxing landscapes (such as a garden). Visualization enhances concentration and alleviates negative and disturbing emotions. This is not yet a meditative state, but a state that prepares for the actual meditative experience. (Skills learned in Cycle 4) Duration: 20 minutes.

4. A moment of silence to enjoy the new state of consciousness. After Step 4), the person is free from bodily sensations, emotions and mental processes, ready to expand his or her consciousness and confidently open to union with the higher self and the unified universal field, thus entering a state of deep meditation to enjoy personal experience. (Skills learned in Cycle 4) Duration: 15 minutes.

5. Reconnection to the perception of bodily sensations. (Skills learned in Cycle 4) Duration: 5 minutes.

6. Awareness of the new mental and physical state (well-being, happiness, tranquility, serenity, etc.). (Skills learned in Cycle 4) Duration: 5 minutes.

7. Sharing the experience: at the end of each meditation session, the instructor asks participants how they feel, allowing them to freely share their feelings and impressions of the meditation experience.

8. Individual practice at home: participants were strongly encouraged to practice independently, following audio recordings of meditations lasting 30 minutes each.

Regarding the theoretical part of the intervention, the program included five lectures on the neuroscience of meditation, given by different university professors.

1. The first lecture constituted a general introduction to meditation, starting from religious, literary and artistic perspectives to scientific and neuroscience approaches.

2. The second lecture dealt with emotions and the brain, explaining what a "Mindfulness-Based Programs" emotion is and how they work, as well as examining the different strategies people use to regulate emotions, including mindfulness.

3. The third lecture explored the stress circuit and the influence of mindfulness on it, presenting the concept of MBSR (Mindfulness-Based Stress Reduction).

4. The fourth lecture delved into the biological correlates of meditation, such as neurotransmitters, hormones and neurotrophic factors, as well as their role in providing scientific evidence to support various types of meditation.

5. The fifth lecture introduced statistical methods used in meditation research.

1.3 Rationale

Within a large body of literature, integral meditation treatment has been associated with mental and physical health benefits. However, the presence of mixed results and uncertainty about the underlying mechanisms still raise questions. Recent advances in contemplative neuroscience have provided useful information, but the understanding of brain mechanisms related to mindfulness meditation and its effects remains incomplete. It was desired to conduct a suitably rigorous randomized controlled trial to strengthen the existing literature with reliable data. In this study, the effects of a short-term, i.e., 12-week, whole-brain meditation (MBI) intervention were tested. Its effect on multiple variables, including physiological, psychological and behavioral measures, was studied to obtain a broader picture. An attempt was made to investigate and explore the mechanisms related to the changes that appear during a non-meditative state induced by an intervention based on mindfulness meditation. Specifically, our full meditation intervention is an original intervention developed by our research group and previously tested in other studies by analyzing questionnaire data on different target populations [12] [9] [10] [11]. We aimed to describe and characterize our specific Integral Meditation (MI) intervention in comparison with other types of mindfulness meditation-based interventions that have already been described in the literature. We aimed to confirm previous findings through a more in-depth investigation including data on breathing activity and interoception, as well as those related to each individual's anxiety and mindfulness. Specifically, it was hypothesized that the MI intervention would lead to improvements in psychological and behavioral measures collected through self-assessment questionnaires. Specifically, it would have led to improvements in adaptive interoception as measured by the MAIA questionnaire and the Heartbeat Tracking Task, and the above improvements were expected to be more pronounced in individuals who attended more classes and did more individual meditation practice.

Chapter 2

MATERIALS AND METHODS

2.1 Partecipants

The target population for this study is young adults between 19 and 35 years. Participants were recruited through digital (social media advertising, e-mail) and non-digital channels (word of mouth, posters and flyers). Individuals who show interest in joining the study and meet the inclusion criteria were contacted by email and received an informed consent and privacy policy, which they signed and agreed to in order to participate in the study. Each eligible participant received a brochure that briefly describes the research design, objectives, and timeline of the study.

The inclusion and exclusion criteria are listed below.

Inclusion criteria:

- Being a native Italian speaker or being able to understand and speak Italian fluently
- Age between 19 and 35 years
- Not suffering at the time of the study and/or not having suffered in the previous 3 years from any serious psychiatric illness or other major medical condition

Exclusion criteria:

- Having experienced at least one severe episode of anxiety, depression or other psychological disorders (hypomanic, psychotic) in the past 6 months
- Suffer or have suffered from seizures

- Being under drug treatment or having any drug addiction
- Be engaged in a meditation practice in the past year (at least one meditation session per week for more than two months)

These criteria were clearly stated during the recruitment call and were further evaluated by asking direct questions on these issues.

About the sample size, we initially enrolled and subsequently randomized 89 individuals: 46 were allocated to the treated group and 43 to the control group. Later, 16 treated and 10 controls were excluded because they did not meet the inclusion criteria or because of voluntary dropouts. Analyses were conducted on 23 treated and 29 controls due to the fact that some individuals did not complete the final measures required by the study (see Figure 2.1).

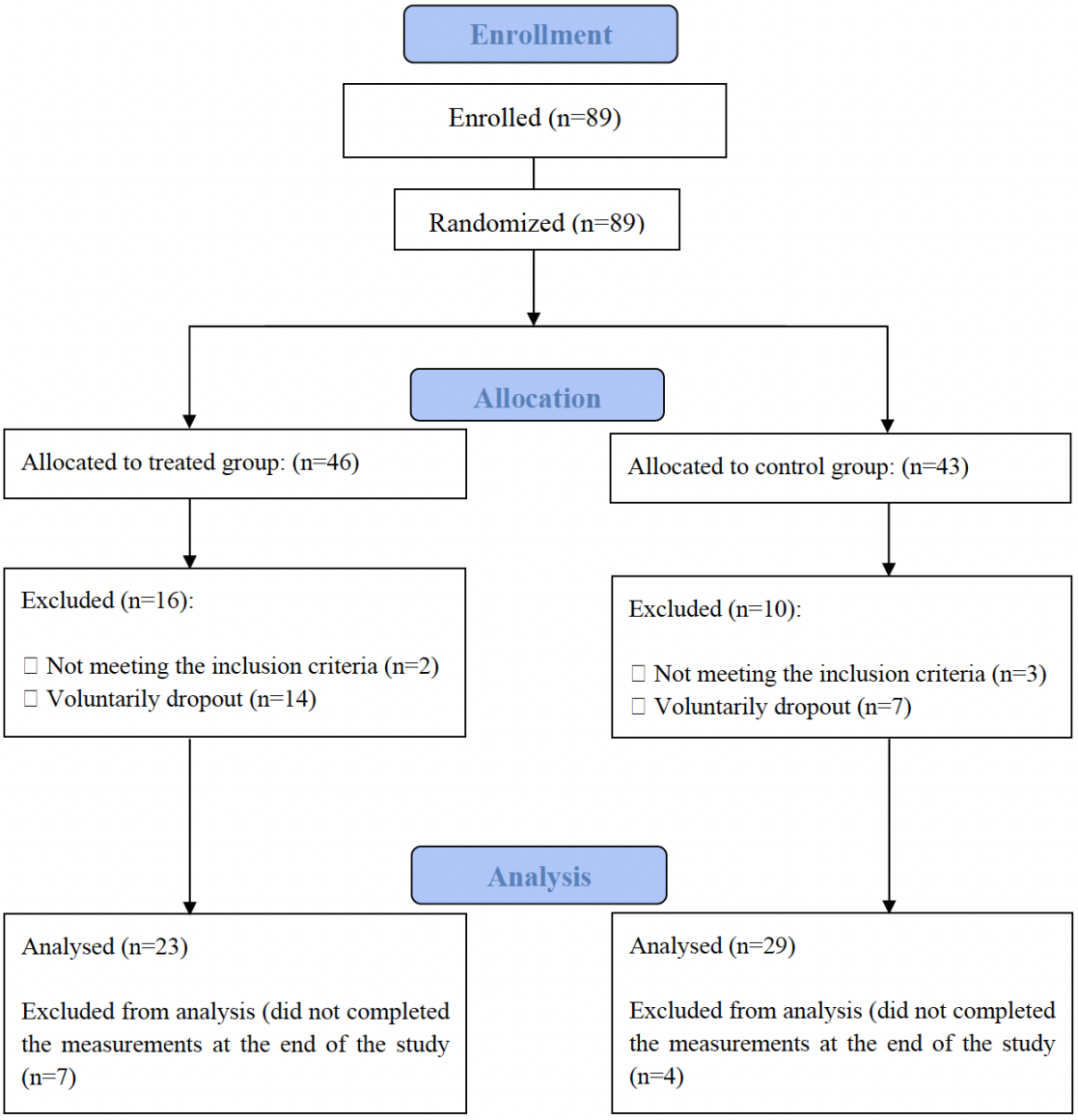

FIGURE 2.1: Flow-chart population

2.1.1 Descriptive Analysis

Our population consists of 63 individuals who have an average age of 22.2 years. There are 41 females and 22 males and for the majority are italians. The 88.9% of the population has right hand as dominant hand. (Table 2.1)

	Total (N=63)	**Controls (N=32)**	**Treated (N=31)**	**P-value[1]**
Age				**0.0711**
Mean (SD)	22.2 (2.71)	21.7 (2.68)	22.6 (2.69)	
Median [Min, Max]	22.0 [18.0, 30.0]	21.0 [18.0, 29.0]	22.0 [20.0, 30.0]	
Sex				**1**
Female	41 (65.1%)	21 (65.6%)	20 (64.5%)	
Male	22 (34.9%)	11 (34.4%)	11 (35.5%)	
Nationality				**0.113**
Not italian	3 (4.8%)	0 (0%)	3 (9.7%)	
Italian	60 (95.2%)	32 (100%)	28 (90.3%)	
Dominant hand				**0.708**
Rigth	56 (88.9%)	29 (90.6%)	27 (87.1%)	
Left	7 (11.1%)	3 (9.4%)	4 (12.9%)	

[1] Wilcoxon test for numeric variables and Fisher test for factor

TABLE 2.1: Descriptive statistics of Master Data

About half of those who responded to the questionnaire question about sports, play them and the majority of the individuals read books. Nearly 50% of the population is part of an association e 85.7% are not religious. 73% of the individuals do not follow any diet, while 13% follow a certain diet, and 4% are forced to follow a diet because of serious intolerances or allergies. 47.6% is mainly satisfied with their sex life. (Table 2.2)

Almost 75% of the population before this study had no a prior knowledge about meditation. Practically the same proportion of people do not receive psychological therapy. Nearly 68% of the individuals in the study are regular sleepers. (Table 2.3)

90.5% are students, 44.4% of them are medicine students and 71.4% completed their exams in time. Almost 70% are not workers and nearly the same percentage of individuals have sufficient or comfortable budgets. 43% are mainly in a shared apartments, 22% in college, 17.5% mainly in family and the others are alone or

	Total (N=63)	Controls (N=32)	Treated (N=31)	P-value[1]
Sport				**0.756**
No	19 (30.2%)	8 (25.0%)	11 (35.5%)	
Yes	22 (34.9%)	11 (34.4%)	11 (35.5%)	
Missing	22 (34.9%)	13 (40.6%)	9 (29.0%)	
Book				**1**
No	15 (23.8%)	8 (25.0%)	7 (22.6%)	
Yes	29 (46.0%)	15 (46.9%)	14 (45.2%)	
Missing	19 (30.2%)	9 (28.1%)	10 (32.3%)	
Association				**1**
No	32 (50.8%)	16 (50.0%)	16 (51.6%)	
Yes	31 (49.2%)	16 (50.0%)	15 (48.4%)	
Religious				**0.148**
No	54 (85.7%)	25 (78.1%)	29 (93.5%)	
Yes	9 (14.3%)	7 (21.9%)	2 (6.5%)	
Diet				**0.163**
No	46 (73.0%)	25 (78.1%)	21 (67.7%)	
Yes	13 (20.6%)	7 (21.9%)	6 (19.4%)	
Heavily affected by allergies, intolerances	4 (6.3%)	0 (0%)	4 (12.9%)	
Sex life				**0.471**
Predominantly unsatisfactory	26 (41.3%)	14 (43.8%)	12 (38.7%)	
Predominantly satisfactory	30 (47.6%)	15 (46.9%)	15 (48.4%)	
I prefer not to answer	5 (7.9%)	1 (3.1%)	4 (12.9%)	
Missing	2 (3.2%)	2 (6.3%)	0 (0%)	

[1] Fisher test

TABLE 2.2: Descriptive statistics of Sport, Books, Associations, Religion, Diet and Sex Life

with a partner. In particular, in Table 2.4 we can see that the economic budget is significantly different in the two groups of controls and treated.

To the question "Do you make frequent use of," where more than one positive answer could be given, 25.4% selected alcohol, 3% energizing drinks, 71.4% coffee or tea, 20.6% soft drugs, 31.7% cigarettes, 1% other frequent uses and 12.7% have no frequent uses (See Table 2.5). In this case we can see that the use of coffee or tea differs significantly in the two groups.

We also tried to figure out how many people were taking more than one of the

	Total (N=63)	Controls (N=32)	Treated (N=31)	P-value[1]
Prior knowledge of meditation				**0.235**
No	47 (74.6%)	26 (81.3%)	21 (67.7%)	
Yes	15 (23.8%)	5 (15.6%)	10 (32.3%)	
Missing	1 (1.6%)	1 (3.1%)	0 (0%)	
Psychological therapy				**0.774**
No	47 (74.6%)	23 (71.9%)	24 (77.4%)	
Yes	16 (25.4%)	9 (28.1%)	7 (22.6%)	
Regular sleep				**0.595**
Predominantly no	20 (31.7%)	9 (28.1%)	11 (35.5%)	
Predominantly yes	43 (68.3%)	23 (71.9%)	20 (64.5%)	

[1] Fisher test

TABLE 2.3: Descriptive statistics of Prior knowledge of Meditation, Psiychological Therapy and Regular Sleep

previously indicated items at the same time (See Table 2.6). It can be seen that people who takes coffee or tea only or coffee or tea and also energizing beverages are differently presents in controls and treated groups.

	Total (N=63)	Controls (N=32)	Treated (N=31)	P-value[1]
Student				**0.672**
No	6 (9.5%)	4 (12.5%)	2 (6.5%)	
Yes	57 (90.5%)	28 (87.5%)	29 (93.5%)	
Medicine student				**1**
No	35 (55.6%)	18 (56.3%)	17 (54.8%)	
Yes	28 (44.4%)	14 (43.8%)	14 (45.2%)	
Exams in time				**0.103**
No	12 (19.0%)	3 (9.4%)	9 (29.0%)	
Yes	45 (71.4%)	25 (78.1%)	20 (64.5%)	
Missing	6 (9.5%)	4 (12.5%)	2 (6.5%)	
Work				**0.71**
No	44 (69.8%)	23 (71.9%)	21 (67.7%)	
A couple of days a week	10 (15.9%)	5 (15.6%)	5 (16.1%)	
Every day part-time	2 (3.2%)	0 (0%)	2 (6.5%)	
Every day, full-time	7 (11.1%)	4 (12.5%)	3 (9.7%)	
Economic budget				**0.00357 ***
Poor	8 (12.7%)	6 (18.8%)	2 (6.5%)	
Sufficient	23 (36.5%)	5 (15.6%)	18 (58.1%)	
Comfortable	20 (31.7%)	12 (37.5%)	8 (25.8%)	
More than comfortable	12 (19.0%)	9 (28.1%)	3 (9.7%)	
Housing				**0.165**
Mainly with my partner	4 (6.3%)	1 (3.1%)	3 (9.7%)	
Mainly with my family	11 (17.5%)	8 (25.0%)	3 (9.7%)	
Mainly alone	7 (11.1%)	5 (15.6%)	2 (6.5%)	
Mainly in a shared apartment	27 (42.9%)	10 (31.3%)	17 (54.8%)	
Mainly in college	14 (22.2%)	8 (25.0%)	6 (19.4%)	

[1] Fisher test

TABLE 2.4: Descriptive statistics of Student variables, Work, Economic Budget and Housing

	Total (N=63)	Controls (N=32)	Treated (N=31)	P-value[1]
Alcohol				**0.774**
No	47 (74.6%)	23 (71.9%)	24 (77.4%)	
Yes	16 (25.4%)	9 (28.1%)	7 (22.6%)	
Energizing drinks				**0.613**
No	60 (95.2%)	31 (96.9%)	29 (93.5%)	
Yes	3 (4.8%)	1 (3.1%)	2 (6.5%)	
Coffee or Tea				**0.05 ***
No	18 (28.6%)	13 (40.6%)	5 (16.1%)	
Yes	45 (71.4%)	19 (59.4%)	26 (83.9%)	
Soft drugs				**0.763**
No	50 (79.4%)	26 (81.3%)	24 (77.4%)	
Yes	13 (20.6%)	6 (18.8%)	7 (22.6%)	
Cigarettes				**0.595**
No	43 (68.3%)	23 (71.9%)	20 (64.5%)	
Yes	20 (31.7%)	9 (28.1%)	11 (35.5%)	
Other frequent use				**1**
No	62 (98.4%)	31 (96.9%)	31 (100%)	
Yes	1 (1.6%)	1 (3.1%)	0 (0%)	
No frequent use				**0.257**
No	55 (87.3%)	26 (81.3%)	29 (93.5%)	
Yes	8 (12.7%)	6 (18.8%)	2 (6.5%)	

[1] Fisher test

TABLE 2.5: Descriptive statistics related to frequent uses of Alcohol, Energy Drinks, Coffee or Tea, Soft Drugs, Cigarettes, Other frequent uses

	Total (N=63)	Controls (N=32)	Treated (N=31)	P-value[1]
Alcohol Only, Alcohol + Tea/Coffee, Alcohol + Energizing Drinks				**0.492**
No	61 (96.8%)	30 (93.8%)	31 (100%)	
Yes	2 (3.2%)	2 (6.3%)	0 (0%)	
Coffee/Tea Only, Coffee/Tea + Energizing Beverages				**0.0211 ***
No	38 (60.3%)	24 (75.0%)	14 (45.2%)	
Yes	25 (39.7%)	8 (25.0%)	17 (54.8%)	
Drugs + Other, Drugs + Tea				**0.492**
No	61 (96.8%)	30 (93.8%)	31 (100%)	
Yes	2 (3.2%)	2 (6.3%)	0 (0%)	
Cigarettes Only, Cigarettes + Coffee/Tea				**0.492**
No	62 (98.4%)	32 (100%)	30 (96.8%)	
Yes	1 (1.6%)	0 (0%)	1 (3.2%)	
Cigarettes+Alcohol+Coffee/Tea, Cigarettes+Alcohol+Light Drugs, Cigarettes+Light Drugs+Coffee/Tea				**0.708**
No	56 (88.9%)	29 (90.6%)	27 (87.1%)	
Yes	7 (11.1%)	3 (9.4%)	4 (12.9%)	
Cigarettes+Other+Light Drugs+Coffee/Tea, Cigarettes+Other+Light Drugs+Energy Drinks				**0.0528**
No	59 (93.7%)	32 (100%)	27 (87.1%)	
Yes	4 (6.3%)	0 (0%)	4 (12.9%)	
No Frequent Use				**0.257**
No	55 (87.3%)	26 (81.3%)	29 (93.5%)	
Yes	8 (12.7%)	6 (18.8%)	2 (6.5%)	

[1] Fisher test

TABLE 2.6: Descriptive statistics related to frequent use of multiple psychoactive substances simultaneously

2.2 Procedures

Participants were recruited through digital and non-digital advertising. The opportunity to join the study was promoted on social media (Facebook groups, Instagram, Linkedin, Whatsapp) and posted on dedicated web pages of the University of Pavia; it was also promoted through mailings and via email lists. Flyers and posters were placed around different hubs of the University of Pavia. Participants who showed interest in participating in the study and met the inclusion/exclusion criteria were randomly assigned to either the treated group or the active control group. Different measures were acquired for both groups at two different times: at the beginning of the study and after the intervention. Before the intervention (t0), the sociodemographic and anamnestic information of the participants by filling out a background questionnaire, EEG data on resting state, electrocardiogram (ECG) and respiration, measurement of interoception, and four self-report questionnaires to investigate psychological parameters were collected. The questionnaires were submitted online, via Google Form. In this thesis, however, we will focus only on the general information of the patients and the results related to the 4 questionnaires and the interoception task (from the breathing data). The treated group took part our 12-meeting MI intervention, while the control group in the same time period did not have to perform any task or follow any intervention. During the intervention, participants in the treatment group were asked to record their individual mindfulness meditation practice in a diary. After the intervention (t1), the same measures taken at t0 were collected again except for sociodemographic and medical history information. The experiment was recorded at `https://www.isrctn.com`.

2.3 Measures

EEG, heart rate, heart rate variability and respiration, as well as interoception data and questionnaires submitted to each participant were collected in this study. As it has been anticipated, regarding this analysis we focus on the measures derived from the interoception task and questionnaires.

2.3.1 Heartbeat Tracking Task

The Heartbeat Tracking Task (HBT) (Schandry, 1981) is to assess the participant's interoceptive accuracy. During the task, participants were focused on their heartbeat and tried to estimate their heartbeats.

Procedure: each subject were asked to sit in a comfortable position with their arms placed on the table in front of them and count their heartbeats over a given time interval. At the same time, the subject's actual beats were measured by the experimenter using a pulse oximeter, placed on the participant's index finger. The task were repeated by each participant for a total of six trials with different time intervals for each of them (25s, 30s, 35s, 40s, 45s and 50s); these time intervals were presented in random order to each subject. After each individual trial, the subject was asked to provide a response on the number of beats perceived, and to press a key at any time to start the next trial. An audible cue indicated the start and end of each trial. To derive a value of interoceptive accuracy, the collected data were analyzed with three different formulas, derived from the literature:

1. $\frac{1}{6}\sum(1 - \frac{|BR-BC|}{(BR+BC)/2})$;
2. $\frac{1}{6}\sum(1 - \frac{|BR-BC|}{BR})$;
3. $1 - \frac{|\sum BR - \sum BC|}{\sum BR}$.

Where BR corresponds to the actual beats recorded during each trial and BC corresponds to the beats counted by the subject in each trial. Notably, the first formula is proposed by Hart et al. (2013) [18], while the second and third are both commonly reported to Schandry (1981) [30](e.g., in Forkmann et al., 2016 [15]; Schulz et al., 2013 [31]), although they lead to slightly different results. The values obtained are usually distributed between 0 and 1, where 1 refers to perfect performance on the task; negative values are rare, but can be obtained when the difference between BR and BC is very high.

2.3.2 Questionnaires

Participants completed (twice) four self-assessment questionnaires described below. The scores obtained from the self-assessment questionnaires represent measures of the psychological factors investigated and were used as dependent variables in statistical models to assess the effectiveness of the intervention. It is worth noting that all questionnaires are on a Likert scales.

2.3.2.1 Likert Scale

The Likert scale was devised by Rensis Likert, an american psychometrician, in 1932. He wanted to develope a new instrument, simpler than others, for measuring opinions and attitudes.

This scale is widely used because it is easy to construct. It consists of a series of items semantically related to the attitudes is intended to investigate: each item captures the same underlying concept, which is why it is a one-dimensional scale. It is asked to the respondent to express his or her degree of agreement/disagreement with each statement by choosing from 5/7 response mode ranging. Each response mode is given a score and the sum (or the average) of the scores to each individual's responses on the entire battery represents the individual's position on the concept being investigated. For this reason, the Likert scale is an additive scale.

The construction of a Likert scale consists of four steps:

1. item formulation,
2. item classification,
3. item selection and internal consistency,
4. application of the scale.

1. Item formulation: the items referring to the different aspects of the attitude to be detected are formulated. Items should be worded clearly and concisely, in order to reduce the risk of biases.

2. Item classification: to each item response modes are assigned numerical values and in the case of negative monotone items, category values are reversed. This means that, if in that item the response is 1, in reality the response is the higher value of response (for example 5, if the scale goes from 1 to 5).

3. Item selection and internal consistency: the items to be included in the final scale are selected. The items selected by the researcher are subjected to a pilot sample so that it assesses that all items in the scale are related to each other, i.e., to preliminarily check their internal consistency and validity; this will avoid redundancies and eliminate ambiguous questions. Internal consistency of scales is used to check whether there are scale items that are inconsistent with each other. The tools used are the scale-element correlation and Cronbach's alpha coefficient

(Cap. 2.4.2.4). Cronbach's coefficient is based on the correlation matrix between all elements and their number. We proceed by removing each item, one at a time, taking into account the item-scale correlation and alpha coefficient at each step. Based on the results obtained, one can understand whether or not to keep that item within the questionnaire. Next, a score is assigned for each selected item equal to the mean of the responses given by the subjects. The standard deviation is then calculated and items are weighted according to their deviation from the item-mean score of all items. The "weights" thus derived provide a criterion for assigning greater value to a 1 response on an extreme item than to an identical 1 response on a less extreme item. Subjects receive a score equal to the average of all their responses and are ordered according to this score from least favorable to most favorable. Then 25% (or other arbitrary fraction) of the least favorable and 25% of the most favorable are taken, and the items that best discriminate between the two groups of subjects are chosen as the best. With the selected items, the final scale is constructed.

4. Application of the scale: the respondent has to pay attention to all the questions and place a check mark on the response that seems most appropriate to him or her. At the end, the researcher has to reverse some items, sum (or average) all the responses values and getting the final score.

In general, attention should be paid to the length of the questionnaire and the way the questions are asked. In fact, if the questionnaire is too long, the respondent will tend to answer mechanically and meaninglessly after a certain number of questions. For this reason, there is a tendency not to make questionnaires too long and also to put inverted items so as to increase the respondent's attention span. Also, should be tried to ask questions clearly, in simple terms, and use only one statement referring to one subject (should not put two statements in the same sentence).

2.3.2.2 STAIX1 - STAIX2 (State Trait Anxiety Inventory)

The STAI-X [35] questionnaire consists of two parts: the X1 scale assesses state anxiety to investigate how the patient feels at the time of the assessment while the X2 scale assesses trait anxiety reflecting how a person generally feels. Each consists of 20 questions and the answers are given in a 4-point Likert scale (see Cap. 2.3.2.1). Participants were asked to rank themselves with respect to certain statements on the STAI-X1 scale from "not at all" (1) to "very much so" (4), and on the STAI-X2 scale from: "almost never" (1) to "almost always" (4). The values

obtained in each of the scales range from 20 to 80 points, with the range 20-40 described as low anxiety, 41-60 as moderate anxiety, and 61-80 as high anxiety. We used the STAI-X1 questionnaire as the dependent variable to measure the effect of treatment on it. The STAI-X2 questionnaire was used to measure the baseline level of anxiety for traits only before the intervention and was used in the later analysis as a covariate. The questionnaires have good psychometric properties in both the English and Italian versions [34].

2.3.2.3 FFMQ (Five Facet Mindfulness Questionnaire)

It is a 39-question multidimensional assessment instrument designed to measure a person's level of mindfulness [1]. Specifically, it aims to measure five interrelated components of mindfulness, which are:

1. observing (3 items),
2. describing (3 items),
3. acting mindfully (3 items),
4. non-judgment of inner experiences (3 items),
5. non-reactivity to inner experience (3 items).

A higher overall score in the FFMQ scale as well as in its sub-scales reflects a higher level of mindfulness. The questionnaire showed good psychometric properties in both the English and Italian versions, which also shows a similar factorial structure compared to the original version [16].

2.3.2.4 MAIA (Multidimensional Assessment of Interoceptive Awareness)

It is a multidimensional questionnaire with 32 questions in which answers are given on a scale of 1 to 5. This questionnaire investigates various aspects of both positive and negative interoception, that is, the perception of the internal state of one's body. The MAIA scale is divided into eight sub-scales, conceptually organized into five dimensions:

a. awareness of bodily sensations (sub-scale noticing),

b. emotional reaction and attention response to sensations (sub-scales non-distracting and non-worrying),

c. ability to regulate attention (sub-scale attention regulation),

d. awareness of mind-body integration (sub-scales emotional awareness, self-regulation and body listening),

e. physical feelings of trust (sub-scale trusting).

Also this questionnaire has good psychometric properties [27].

2.4 Statistical Analysis

R software was used to analyze the results of the questionnaires and the interoception task.

2.4.1 Data Cleaning

The questionnaires were submitted through google form (Appendix A) and the results were saved in an excel file. After the questionnaires were administered, two excel files were obtained, one at PRE and one at POST. In the PRE file there were both personal data questions and responses related to the questionnaires, before the meditation intervention; in the POST file there were only responses to the questionnaires, following the meditation intervention. With respect to the task on interoception, however, two other different files were created, again one related to PRE and one to POST. Specifically, within one table were the actual and perceived beats and the various intervals in seconds in which they were detected.

Only the first two files underwent a thorough dataset cleanup. These two files were cleaned and rearranged to facilitate the analysis. For the registry part, to each question was assigned a keyword, then transformed into levels, and in some cases certain variables were re-coded according to analysis needs. These registry-type questions, were coded as factors and used as covariates in the analyses.

Regarding the questions in the questionnaires, STAIX1 and FFMQ had text-type answers and STAIX2 and MAIA had numerical-type answers. In the case of STAIX1, a number from 1 to 4 was assigned to each of the 4 possible answers (Not at all, Somewhat, Moderately so, Very much so), while in the case of FFMQ, a number

from 1 to 5 was assigned to each of the 5 possible answers (Never happens to me or very rarely, Happens to me rarely, Happens to me sometimes, Happens to me often, Happens to me often or always). Next, to each question in the questionnaire was given a much simpler name to deal with: to each item was given the name of the questionnaire to which it belonged and the number of the question to which it referred. For example, as can be seen on page 8 of Appendix A, the first question in the STAIX1 questionnaire is as follows: "1. I feel calm". This question was transformed into the variable "STAIX1_1" for simplicity.

2.4.1.1 Management of Missing Data

In our data there are some missing data, as we can see in the follow table:

	Number of missing data
Degree program	6
Degree field	7
Year Degree Course	8
Exams in order	6
Profession	37
Sport	18
Sex Life	6
Meditate Currently	1
Menstruation (Pre)	20
Sleep Hours (Pre)	1
Drank Coffee (Pre)	3
Task Interoception (Pre)	2
Questionnaires (Pre)	4
Task Interoception (Post)	1
Sleep Hours (Post)	1
FFMQ-*Observe* (Post)	1
FFMQ-*Describe* (Post)	1
MAIA-*Not Distracting* (Post)	1

TABLE 2.7: Missing Data description

For this reason, imputation of missing covariates used in subsequent analyses was made. In particular, the **mice function**, of the **mice package**, was used on R (Figure 2.2).

```
mice::mice(dataWide[, c("Sex_Life", "Meditate_currently","Drank_Coffee_Pre",
                        "Drank_Coffee_Post","Sleep_hours_Pre","Sleep_hours_Post")],
           method = "pmm", m = 5, maxit = 10, seed = 123)
```

FIGURE 2.2: R code for imputation of covariates

As we can see in the code in Figure 2.2, the "Sex_Life", "Meditate_currently", "Drank_Coffee_Pre", "Drank_Coffee_Post","Sleep_hours_Pre" and "Sleep_hours_Post" variables of the dataWide dataset were considered. The option *maxit=10* sets the maximum number of iterations to 10. The imputation process will be performed iteratively up to a maximum of 10 times. The option *method = "pmm"* specifies the method used for imputation, which is "pmm" (Predictive Mean Matching). This method imputes missing values by finding observed values that are similar to the missing values and then randomly choosing one of those observed values to replace the missing one. The option *m=5* indicates the number of datasets with imputed missing values that will be created. In this case, 5 datasets will be generated, each with different imputed values. Finally, the option *seed = 123* sets the seed for random number generation, ensuring reproducibility. The same seed will produce the same results in different runs. In summary, this code uses the 'mice' package to perform multiple imputation using the Predictive Mean Matching (PMM) method on the specified columns of the 'dataWide' dataset. Five datasets with imputed missing values will be created, and the imputation process will be iterated up to 10 times. The random number generation is initialized with a seed value of 123 for reproducibility.

It was decided not to impute any scores from any questionnaire, as it was too risky for analysis. In fact, imputing the Y values of a model may lead to biased values of the results.

2.4.2 Reverse Item and Final Scores

As mentioned earlier, in order to reach the final score of each questionnaire, it is necessary to proceed with the inversion of some items and the final calculation of the mean or sum of the scores of each individual item.

2.4.2.1 STAIX1

For STAIX1 we have reversed the following items: 1, 2, 5, 8, 10, 11, 15, 16, 19, 20 (to understand precisely which items these are, go to Appendix A). To find

the final score, we summed the scores of each individual item.

2.4.2.2 STAIX2

For STAIX2 we have reversed the following items: 1, 6, 7, 10, 13, 16, 19 (Appendix A). And also in this case we found the final score by summing the scores of all items.

2.4.2.3 FFMQ

For FFMQ questionnaire, we have reversed these items: 3, 5, 8, 10, 12, 13, 14, 16, 17, 18, 22, 23, 25, 28, 30, 34, 35, 38, 39. We also found the scores for each individual scale, as well as the total score.

- The items on the "Observe" scale are: 1, 6, 11, 15, 20, 26, 31, 36;
- the items on the "Describe" scale are: 2, 7, 12 (R), 16 (R), 22 (R), 27, 32, 37;
- the items on the "Act with awareness" scale are: 5 (R), 8 (R), 13 (R), 18 (R), 23 (R), 28 (R), 34 (R), 38 (R);
- the items on the "Non-judgemental" scale are: 3 (R), 10 (R), 14 (R), 17 (R), 25 (R), 30 (R), 35 (R), 39 (R);
- the items on the "Non-reactionary" scale are: 4, 9, 19, 21, 24, 29, 33.

In this case we summed the scores of the items belonging to each subscale and averaged them. Finally we added up all 39 items and averaged them together to find the total score.

2.4.2.4 MAIA

In MAIA questionnaire only items 5, 6, 7, 8, 9 were reversed. Similar to what we did with the FFMQ questionnaire, we found the individual score of each subscale and eventually the total score.

- The items on the "Noticing" scale are: 1, 2, 3, 4;
- the items on the "Not-Distracting" scale are: 5, 6, 7;
- the items on the "Not-Worrying" scale are: 8, 9, 10;
- the items on the "Attention Regulation" scale are: 11, 12, 13, 14, 15, 16, 17;

- the items on the "Emotional Awareness" scale are: 18, 19, 20, 21, 22;
- the items on the "Self-Regulation" scale are: 23, 24, 25, 26;
- the items on the "Body Listening" scale are: 27, 28, 29;
- the items on the "Trusting" scale are: 30, 31, 32.

Again, the average of each score was found.

2.4.3 Cronbach's Alpha

Cronbach's alpha is a statistical index widely used nowadays to measure the internal consistency or reliability of a questionnaire consisting of quantitative questions (items) on Likert scales. It owes its name to the American educationalist Lee Cronbach, who devised it in 1951.

When we talk about the internal consistency of a questionnaire, we are talking about analyzing whether the answers given to this questionnaire are consistent with each other, that is, they follow a consistent thread among them, relating to each other.

If the items are highly correlated with each other, there is a high internal consistency and thus a good measure of reliability; a low correlation, on the other hand, is synonymous with low reliability or low internal consistency.

The formula for calculating Cronbach's alpha is as follows:

$\alpha = K \cdot \frac{\overline{r}}{1+(K-1)\cdot\overline{r}}$, where:

- K=number of items
- r-medio=mean of correlations calculated before.

This coefficient is always between 0 and 1 and if it is close to 1, it means that the credibility is high, in particular:

- $0.0 <$ alpha < 0.4 : low
- $0.4 <$ alpha < 0.6 : mediocre
- $0.6 <$ alpha < 0.8 : good
- $0.8 <$ alpha < 0.9 : excellent

- $0.9 <$ alpha < 1.0 : to check (because in practise is very difficult to find this values, maybe there are redundant items)

2.4.4 Pre-Post Comparison

2.4.4.1 Linear Mixed Models

Linear Mixed Models (LMMs) [14] are valuable tools for analyzing longitudinal data. The term "mixed" indicates that these models include both fixed and random effects. Specifically, fixed effects are related to characteristics shared by all individuals in a population, while random effects account for individual-specific variations. This approach enables the consideration of inherent diversities within the population. By incorporating random effects, the relationships between repeated measurements can be expressed based on time. Linear mixed models distinctly address variations between subjects and variations within subjects. They not only estimate parameters that describe average changes in the response across the population of interest, but also predict how individual responses evolve over time. Linear mixed models are versatile in handling imbalances in longitudinal data and effectively capturing correlations among repeated measurements with efficiency. They do not demand the same number of observations for each subject or measurements taken at identical time points. An illustration of such models is the "random intercept model".

Random Intercept Model:

This represents the most basic scenario of a linear mixed model. It is a linear model in which there is a subject-specific effect that varies randomly. Each individual has an inherent response baseline that remains stable across various time instances. The model can be expressed as follows:

$$Y_{ij} = X'_{ij}\beta + b_i + \epsilon_{ij}, \tag{2.1}$$

where b_i is the random subject effect and the ϵ_{ij} are measurement or sampling errors. In this case, the response for the i^{th} subject at the j^{th} occasion is assumed to differ from the population mean ($X'_{ij}\beta$), by a subject effect (b_i) and a within-subject measurement error (ϵ_{ij}). Both the impact of the subject and the potential errors in measurements are regarded as random factors, and they are both assumed to average out to zero, and with variances $Var(b_i) = \sigma_b^2$ and $Var(\epsilon_{ij} = \sigma^2)$, respectively. Also, b_i and ϵ_{ij} are independent of one another. This model depicts the average

pattern of response changes over time for any given individual ($E(Y_{ij}|b_i) = X'_{ij}\beta + b_i$: conditional mean of Y_{ij}), in addition to the mean response profile in the population ($E(Y_{ij}) = X'_{ij}\beta = \mu_{ij}$: marginal mean of Y_{ij}), this averaging is done across all members within the population.

It can be considered the interpretation of the parameters in the model given by (2.1). The regression parameters β underline how the average response changes over time in the population of interest, alongside their correlation with covariates. So, b_i portrays how the temporal pattern for the i^{th} individual differs from the general population trend. In essence, b_i signifies the individual's divergence from the average starting point, once the influence of covariates is considered. When integrated with fixed effects, b_i delineates the expected response trajectory over time for a specific individual. We can express the model in (2.1) as:

$$Y_{ij} = (\beta_1 + b_i) + \beta_2 X_{ij2} + ... + \beta_p X_{ijp} + \epsilon_{ij}, \tag{2.2}$$

where $X_{ij1} = 1$ for all i and j, and $beta_1$ is then the fixed effect intercept term in the model. So, it can be observe that the intercept for the i^{th} individual is $\beta_1 + b_i$ and varies randomly from one individual to another. b_i is assumed to be zero, because the mean of the random effect and represents the deviation of the i^{th} individual's intercept ($\beta_1 + b_i$) from the population intercept, β_1.

For a clearer comprehension of a linear mixed effects model, refer to Figure 2.3. In this visual, you will notice that the average response over time across the population changes linearly with time (depicted by the solid line). Moreover, the conditional average responses for two specific individuals diverge from this population trend (illustrated by dashed lines). To elaborate further, individual A exhibits a response "above" the population average, leading to a positive b_i. Instead, individual B displays a response "below" the population average, which results in a negative b_i. It's worth noting that the mixed effects model, with its randomly varying intercepts, doesn't propose that the repeated measurements for individual A and B precisely follow their individual response paths. To accommodate for this variability, the introduction of measurement errors ϵ_{ij} permits responses at each occasion to randomly deviate both above and below their respective individual trajectories (visualized by the data points in the figure).

Now it can be considered the covariance between repeated measurements taken

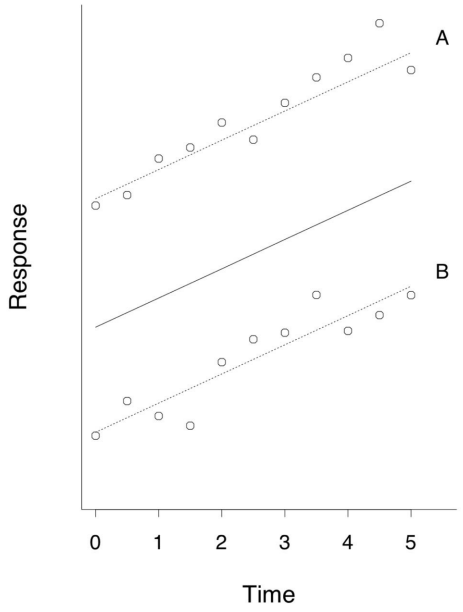

FIGURE 2.3: Graphical representation of the marginal and conditional mean responses over time, plus measurement errors [14]

from the same individual. The marginal covariance among the Y_{ij} is defined in terms of deviations of Y_{ij} from the marginal mean μ_{ij}.

The marginal variance of each response is given by:

$$Var(Y_{ij} = Var(X'_{ij}\beta + b_i + \epsilon ij) = Var(b_i) + Var(\epsilon_{ij}) = \sigma_b^2 + \sigma^2. \tag{2.3}$$

Similarly, the marginal covariance between any pair of responses is given by:

$$\begin{aligned} Cov(Y_{ij}, Y_{ik}) =& Cov(X'_{ij}\beta + b_i + \epsilon ij, X'_{ik}\beta + b_i + \epsilon ik) = \\ & Cov(b_i + \epsilon_{ij}, b_i + \epsilon_{ik}) = Cov(b_i, b_i) = Var(b_i) = \sigma_b^2. \end{aligned} \tag{2.4}$$

Thus, the correlation is:

$$Corr(Y_{ij}, Y_{ik}) = \frac{\sigma_b^2}{\sigma_b^2 + \sigma^2}. \tag{2.5}$$

It becomes evident that incorporating a random subject effect (b_i) leads to correlations among the repeated measurements.

The covariance structure of randomly varying intercepts models is not usually appropriate for longitudinal data, so the basic ideas can be generalized to provide a very versatile model for analyzing longitudinal data.

The typical covariance structure of models involving randomly varying intercepts often is not appropriate for longitudinal data analysis. Therefore, these fundamental concepts can be extended in a more flexible way to create a highly adaptable model for studying longitudinal data.

Generalization: Linear Mixed Effects Models

In this scenario, certain portions of the regression coefficients vary randomly from one individual to another. By allowing this variation, a very flexible, and yet quite parsimonious, class of random effects covariance structures emerges.

The situation is illustrated in the graph in figure

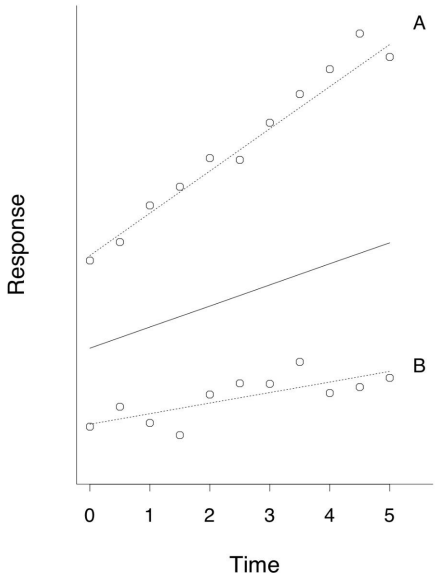

FIGURE 2.4: Graphical representation of the marginal and conditional mean responses over time, plus measurement errors [14]

The model, for the i^{th} subject at the j^{th} measurement occasion, is as follows:

$$Y_{ij} = \beta_1 + \beta_2 t_{ij} + b_{1i} + b_{2i} t_{ij} + \epsilon_{ij}, j = 1, ..., n_i. \tag{2.6}$$

In this model, each individual not only differs in their initial response level but also in terms of how their responses change over time (refer to Figure 2.4).

The linear mixed effects model can be shown using vector and matrix notation:

$$Y_i = X_i\beta + Z_i b_i + \epsilon_i, \tag{2.7}$$

where β is a $(p$ x 1) vector of fixed effects, b_i is a $(q$ x 1) vector of random effects, X_i is a $(n_i$ x p) matrix of covariates, and Z_i is a $(n_i$ x q) matrix of covariates, with $q \leq p$. For many models, the columns of Z_i are a subset of the columns of X_i.

$R_i = Cov(\epsilon_i)$ characterizes the covariance among longitudinal observations when focusing on the conditional mean response profile of a specific individual. That is, it is the covariance of the i_{th} individual's deviations from her mean response profile,

$$E(Y_i|b_i) = X_i\beta + Z_i b_i. \tag{2.8}$$

R_i is a diagonal matrix, $\sigma^2 I_{n_i}$, where I_{n_i} denotes an n_i x n_i identity matrix.

In this type of model it can be seen the conditional mean of Y_i, given b_i (equation 2.8), from the marginal or population-averages mean of Y_i,

$$E(Y_i) = X_i\beta, \tag{2.9}$$

where averaging is over the distribution of the random effects, b_i. Likewise, we can differentiate between conditional and marginal covariances. The conditional covariance of Y_i, given b_i, is

$$Cov(Y_i|b_i) = Cov(\epsilon_i) = R_i, \tag{2.10}$$

while the marginal covariance of Y_i, averaged over the distribution of b_i, is

$$Cov(Y_i) = Cov(Z_i b_i) + Cov(\epsilon_i) = Z_i Cov(b_i) Z_i' + Cov(\epsilon_i) = Z_i G Z_i' + R_i. \tag{2.11}$$

From equation 2.11, it is evident that the linear mixed effects model enables a clear examination of variations in responses resulting from both between-subject factors (represented by G) and within-subject factors (represented by R_i). Furthermore, it

is notable that even if R_i is diagonal, the covariance of Y_i does not necessarily yield a diagonal matrix.

It is crucial to keep in mind that the covariance structure involving random effects does not require a balanced layout in longitudinal designs. Moreover, the count of covariance parameters remains constant, regardless of the quantity and timing of measurements. In contrast to numerous covariance pattern models, which assume consistent variance over time, the random effects covariance structure permits variance and covariance to fluctuate based on the measurement timings. For instance, in the context of the random intercepts and slopes model, the variance follows a quadratic pattern in relation to the measurement times.

2.4.4.2 Mediation Analysis

Mediation analysis [19] is a statistical technique used to assess evidence from studies that are designed to test hypotheses about how a causal precursor variable X conveys its impact on a subsequent variable Y. The simple mediation model is illustrated in a conceptual diagram in Figure2.5.

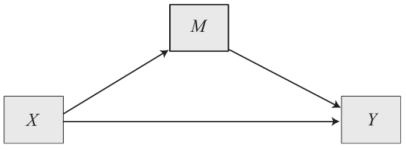

FIGURE 2.5: A conceptual diagram of a simple mediation model. [19]

In this model, there are two subsequent variables (M) and (Y), and two preceding variables, represented by (X) and (M). In this context, X has a causal impact on both Y and M, while M also causally affects Y. A simple mediation model is essentially a causal system in which there's at least one causal precursor variable X that is suggested to affect an outcome Y through an intermediary variable M. In particular, there are two paths through which the influence of X on Y can take place. These paths are identified by tracing possible paths from X to Y, always adhering to the direction indicated by arrows. One path leads directly from X to Y without involving M, and this is referred to as the *direct effect* of X on Y. The second path from X to Y involves the intermediary M and is called the *indirect effect* of X on Y through M. This indirect effect involves a sequence where X's influence on M, which then influences Y, is established, passing through both antecedent X to consequent M and antecedent M to consequent Y. This indirect effect illustrates

how Y is impacted by X through a causal chain wherein X's influence is transmitted to Y via its influence on M.

In a mediation model, (M) is commonly referred to as a *mediator variable*, but also terms like *intermediary variable*, *surrogate variable*, and *intermediate endpoint* are used to defined it.

Mediation analysis is performed when it has been effectively shown that X and Y are associated. This reasoning relies on one of the three commonly mentioned criteria for establishing a cause-and-effect relationship: the correlation between X and Y. However, contemporary mediation analysis no longer requires a direct demonstration of a basic association between X and Y as a prerequisite.

It is important to remember that mediation aims to provide a causal explanation. The underlying assumption is that the connections within the system are driven by causality. Particularly, it is assumed that the mediator variable (M) holds a causal position between variables X and Y. This assumption necessitates, if not empirically validated, that X leads to M, and subsequently, M leads to Y. Essentially, for M to convey X's impact on Y, it's essential that M is situated in a causal sequence between X and Y.

Estimation of the Direct, Indirect, and Total Effects of X:

When conducting empirical tests on a causal process that includes a mediation element, the main focus is the estimation and interpretation of the direct and indirect effects, and subsequently conducting tests to infer their significance. To calculate these effects, it's necessary to also estimate the individual parts of the indirect effect. This involves understanding how X affects M and how M affects Y. However, these specific parts of the indirect effect are not typically the main focus in modern mediation analysis. In addition, many researchers often calculate the overall impact of X on Y, although this is not mandatory for the purpose of interpretation.

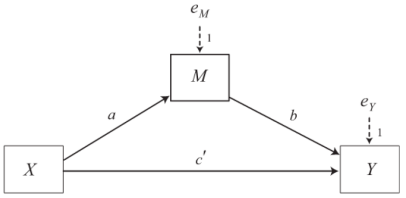

FIGURE 2.6: A statistical diagram of the simple mediation model [19]

In Figure 2.6 it can be seen the simple mediation model represented in the form of a statistical diagram. Within this diagram, there are two subsequent variables. To analyze this, two linear models are essential—one for each subsequent variable. Essentially, this statistical diagram corresponds to the representation of two equations.

$$M = i_M + aX + e_M, \tag{2.12}$$

$$Y = i_Y + c'X + bM + e_Y, \tag{2.13}$$

where i_M and i_Y are regression constants, e_M and e_Y are errors in the estimation of M and Y, respectively, and a, b and c' are attributed to the antecedent variables in the model when estimating the subsequent variables. These coefficients essentially serve as estimations of the presumed causal influences that each variable within the system has on the others. The primary analytical objective is to estimate these coefficients, integrate them, and provide interpretation. To estimate these coefficients, two Ordinary Least Squares (OLS) regression analyses are typically conducted. In the context of a simple mediation model, the choice between these analyses generally doesn't make a significant difference. However, it's worth noting that using just the OLS regression procedures provided by most statistical software might not yield all the necessary information for performing certain preferred inferential tests without additional computational assistance.

The Direct Effect of X on Y

In equation 2.13, c' estimates the direct effect of X and Y. The direct effect can be interpreted in this way: two cases that differed by one unit on X but are equal on M are estimated to differ by c' units on Y. More formally,

$$c' = [\hat{Y}|(X = x, M = m)]0[\hat{Y}|(X = x - 1, M = m)], \tag{2.14}$$

where m is any value of M, | means *conditioned on* or *given*, and the hat over Y means *estimated* or *expected* from the model.

In other words, considering two cases with $M = m$ that differ by one unit on X, c' means the estimated difference in the value of variable Y between the estimated value of Y for $X = x$ and the estimated value of Y when $X = x - 1$. This distinction

in c' can be explained by referring to equation 2.14. If c' is positive, it indicates that the case with one unit higher value of X is estimated to be higher in Y. Conversely, if c' is negative, it implies that the case with a higher X value is estimated to be lower in Y. For a specific scenario where X is dichotomous (e.g., X=1 and X=0), the estimated value $\hat{Y}$ can be interpreted as a mean for a group. In this case, c' reflects the difference between these two group means while keeping variable M constant: $c' = [\hat{Y}|(X = x, M = m)]0[\hat{Y}|(X = x - 1, M = m)]$. Essentially, c' captures the change between the two group averages when accounting for the effect of M. This aligns with the concept known as an *adjusted mean difference* in the context of analysis of covariance.

The Indirect Effect of X on Y

Before define the indirect effect, it's essential to clarify the interpretation of a and b. The coefficient a indicates the extent by which two cases, varying by one unit in X, are estimated to vary in M. The sign of a reveals whether the case with a higher X value is projected to be higher (+) or lower (-) in M. In simpler terms, a helps to understand how changes in X relate to changes in M. That is,

$$a = [\hat{M}|(X = x)] - [\hat{M}|(X = x - 1)]. \tag{2.15}$$

When X is a dichotomous variable and the two groups differ by one unit on X (e.g., X=0 and X=1), a represents the difference between the two group means on M: $a = [\overline{M}|(X = x)] - [\overline{M}|(X = x - 1)]$. The interpretation of b is analogous to c', except with M as the antecedent. Two cases that differ by one unit on M but that are equal on X are estimated to differ by b units on Y. Also in this case, the sign of b determines whether the case higher on M is estimated as higher (+) or lower (-) on Y:

$$b = [\hat{Y}|(M = m, X = x)] - [\hat{Y}|(M = m - 1, X = x)].$$

The product of a and b represents the indirect effect of X on Y through M. In particular, this type of effect indicates that two cases that differ by one unit on X are estimated to differ by ab units on Y as a result of the effect of X on M which, in turn, affects Y. The indirect effect will be positive if a and b are both positive or both negative, while it will be negative if either a or b, but not both, is negative. An indirect effect can be understood even without considering whether the values

of variables a and b are positive or negative. However, it's important to note that the sign of the product ab depends on how the signs of a and b interact.

The Total Effect of X on Y

The direct and indirect effects serve to divide and explain how variations in variable X are connected to variations in variable Y. The overall impact of X on Y, known as the "total effect" and represented as c reveals how much we can anticipate the difference in Y when X changes by one unit. In essence, it quantifies the extent of the difference in Y that is attributed to a unit change in X between two cases. That is,

$$c = [\hat{Y}|(X = x)] - [\hat{Y}|(X = x - 1)].$$

In a simple mediation model, c can be derived by estimating Y from X alone:

$$Y = i_{Y*} + cX + e_{Y*}. \tag{2.16}$$

When X is a dichotomous variable coded by a single unit difference, c is the difference between the group means on Y: $c = [\overline{Y}|(X = x)] - [\overline{Y}|(X = x - 1)]$. Irrespective of whether X has two distinct values or not, the total influence of X on Y is equivalent to combining the direct impact of X on Y with the additional impact that is mediated through other variables.:

$$c = c' + ab.$$

This relationship can be restated as $ab = c - c'$, offering an alternative way to define the indirect effect. The indirect effect represents the distinction between the complete influence of X on Y and the influence of X on Y while considering the influence of M. In essence, it captures the portion of impact that is channeled through the intermediary variable M.

If equation 2.12 is substituted into equation 2.13, it can be seen the equivalence between the total effect of X and the sum of the direct and indirect effects:

$$Y = i_Y + c'X + b(i_M + aX + e_M) + e_Y$$

which can be equivalently written as

$$Y = (i_Y + bi_m) + (ab + c')X + (e_Y + be_M). \tag{2.17}$$

Equation 2.17 is a simple linear function of X, just as is equation 2.16. Making this substitutions: $c = ab + c', i_{Y*} = i_Y + bi_M$, and $(e_Y + be_M)$, the equations are identical. So $ab + c'$ has the same interpretation as c. The combination of the direct and indirect effects measures the extent by which we anticipate two cases, varying by one unit on X, to exhibit a difference in their Y outcomes.

Chapter 3

RESULTS

3.1 Preliminary results

As preliminary results, Cronbach's alpha coefficients, descriptive analyses of values at PRE and POST, and finally, basic descriptives of "change" values obtained from the difference between POST and PRE values are reported.

3.1.1 Cronbach's Alpha

In our analysis, the alphas of the 4 questionnaires were analyzed at the pre and the post.

	PRE	**POST**
STAIX1	0.913	0.928
STAIX2	0.887	0.920
FFMQ	0.887	0.921
MAIA	0.878	0.894

TABLE 3.1: Cronbach's Alphas of the variables of interest

As we can see, all the alpha are between 0.87 and 0.93, so we have really good values and an excellent credibility, both in pre and post questionnaires.

3.1.2 PRE-POST Descriptive

Our initial population, as anticipated, consists of 63 individuals. In these individuals the mean value of state anxiety (STAIX1) is about 42.2 (Table 3.2), very

	PRE				POST			
	Total (N=63)	**Controls (N=32)**	**Treated (N=31)**	**P-value[1] (PRE)**	**Total (N=52)**	**Controls (N=29)**	**Treated (N=23)**	**P-value[1] (POST)**
STAIX1				**0.945**				**0.346**
Mean (SD)	42.2 (9.36)	42.0 (9.93)	42.4 (8.98)		41.0 (9.69)	42.3 (10.3)	39.4 (8.79)	
Median [Min, Max]	42.0 [28.0, 69.0]	38.5 [29.0, 65.0]	44.0 [28.0, 69.0]		40.0 [22.0, 66.0]	41.0 [24.0, 66.0]	39.0 [22.0, 54.0]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
STAIX2				**0.952**				**0.441**
Mean (SD)	46.7 (10.1)	46.7 (9.60)	46.7 (10.7)		45.3 (10.6)	46.2 (10.7)	44.0 (10.5)	
Median [Min, Max]	46.0 [24.0, 65.0]	46.0 [30.0, 65.0]	45.0 [24.0, 65.0]		45.0 [22.0, 64.0]	48.0 [27.0, 64.0]	43.0 [22.0, 60.0]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	

[1] Wilcoxon test

TABLE 3.2: Descriptive statistics of STAIX1 and STAIX2 at PRE and POST

similar in both controls and treated individuals. This value was taken prior to the meditation intervention and indicates moderate anxiety. On the other hand, the mean value of trait anxiety (STAIX2) is the same for the overall mean and both reference groups: 46.7. Again, this is moderate anxiety.

It seems that after meditation (in this case there are only 52 individuals), state anxiety (STAIX1) decreased in the treated, while it remained about the same in the controls. Trait anxiety (STAIX2) is also decreased in the treated, while in the controls it is again very similar to the baseline value. However, there is not enough evidence to say that the two groups differ statistically (p-value greater than 0.05). Attention must be paid to the fact that the population at POST has decreased compared to that at PRE, in which case we have 52 total individuals.

In Table 3.3 we can see the values related to mindfulness of individuals enrolled in the study. It can be seen that they are all very similar between treated and controls. In particular, the first value, is an average of all subgroups in the FFMQ questionnaire and is 3.03 overall (3.05 in controls and 3.01 in treated). From the second to the sixth value, however, are various aspects of mindfulness, thus subgroups of the initial value. They are more or less similar to each other, around 3. The scale that differs most from the others is the last one, related to "NonReactionary."

After the meditation intervention, it can be seen that the values of FFMQ and its subscales have increased somewhat, a sign of increased self-awareness. Also, it can be seen that the last subscale, has significantly different values in the two groups (p-value less than 0.05).

Instead, in Table 3.4 we see the values at PRE of MAIA, i.e., interoceptive awareness, and its subscales. Here again we see how there are no significant differences between controls and treated, and the values are around 2/3. However, it

	PRE				POST			
	Total (N=63)	**Controls (N=32)**	**Treated (N=31)**	**P-value[1] (PRE)**	**Total (N=52)**	**Controls (N=29)**	**Treated (N=23)**	**P-value[1] (POST)**
FFMQ				**0.715**				**0.177**
Mean (SD)	3.03 (0.460)	3.05 (0.393)	3.01 (0.519)		3.17 (0.516)	3.10 (0.505)	3.26 (0.527)	
Median [Min, Max]	2.97 [1.97, 4.33]	2.95 [2.28, 3.95]	3.08 [1.97, 4.33]		3.00 [2.23, 4.31]	2.95 [2.23, 4.31]	3.21 [2.26, 4.28]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
FFMQ-*Observe*				**0.873**				**0.155**
Mean (SD)	3.19 (0.666)	3.23 (0.609)	3.16 (0.722)		3.45 (0.631)	3.34 (0.622)	3.59 (0.630)	
Median [Min, Max]	3.25 [1.62, 4.38]	3.25 [1.88, 4.38]	3.38 [1.62, 4.38]		3.38 [1.75, 5.00]	3.38 [1.75, 5.00]	3.62 [2.25, 4.75]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
FFMQ-*Describe*				**0.994**				**0.725**
Mean (SD)	3.23 (0.782)	3.26 (0.781)	3.21 (0.796)		3.29 (0.929)	3.25 (0.975)	3.33 (0.884)	
Median [Min, Max]	3.25 [1.25, 5.00]	3.25 [1.50, 5.00]	3.38 [1.25, 4.75]		3.25 [1.12, 5.00]	3.00 [1.12, 5.00]	3.62 [1.12, 4.88]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
FFMQ-*Act Awareness*				**0.553**				**0.689**
Mean (SD)	3.02 (0.715)	3.09 (0.778)	2.96 (0.660)		3.04 (0.713)	3.02 (0.723)	3.06 (0.716)	
Median [Min, Max]	3.00 [1.50, 4.62]	3.00 [1.50, 4.62]	3.00 [1.62, 4.25]		3.00 [1.38, 4.38]	2.88 [1.62, 4.38]	3.00 [1.38, 4.25]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
FFMQ-*Non Judgement*				**0.676**				**0.481**
Mean (SD)	2.95 (0.968)	2.92 (0.922)	2.97 (1.02)		3.13 (1.00)	3.05 (1.05)	3.23 (0.945)	
Median [Min, Max]	2.88 [1.00, 4.88]	2.75 [1.00, 4.75]	3.12 [1.00, 4.88]		3.00 [1.00, 5.00]	2.88 [1.00, 5.00]	3.38 [1.38, 4.75]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
FFMQ-*Non Reactionary*				**0.909**				**0.042 ***
Mean (SD)	2.64 (0.640)	2.61 (0.590)	2.67 (0.690)		2.89 (0.623)	2.75 (0.636)	3.07 (0.569)	
Median [Min, Max]	2.57 [1.29, 4.71]	2.57 [1.29, 4.00]	2.57 [1.57, 4.71]		2.86 [1.86, 4.57]	2.71 [1.86, 4.14]	3.00 [2.14, 4.57]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	

[1] Wilcoxon test

TABLE 3.3: Descriptive statistics of FFMQ and its subscales at PRE and POST

can be seen that both the overall MAIA score and the SelfRegulation subscale, are significantly different in the two groups and furthermore, the values are increased from the PRE, symbolizing a more present interoception.

	PRE				POST			
	Total (N=63)	**Controls (N=32)**	**Treated (N=31)**	**P-value[1] (PRE)**	**Total (N=52)**	**Controls (N=29)**	**Treated (N=23)**	**P-value[1] (POST)**
MAIA				**0.549**				**0.0105 ***
Mean (SD)	2.46 (0.569)	2.52 (0.485)	2.41 (0.639)		2.73 (0.578)	2.55 (0.563)	2.97 (0.517)	
Median [Min, Max]	2.56 [1.06, 3.97]	2.59 [1.53, 3.62]	2.53 [1.06, 3.97]		2.81 [1.44, 4.03]	2.66 [1.44, 3.75]	2.97 [1.91, 4.03]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Noticing*				**0.361**				**0.121**
Mean (SD)	2.95 (1.04)	3.15 (0.888)	2.77 (1.14)		3.18 (0.866)	3.02 (0.874)	3.40 (0.826)	
Median [Min, Max]	3.00 [0.500, 4.75]	3.00 [1.50, 4.75]	3.00 [0.500, 4.50]		3.25 [0.750, 4.50]	3.25 [0.750, 4.25]	3.50 [0.750, 4.50]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Not Distracting*				**0.921**				**0.946**
Mean (SD)	2.50 (0.840)	2.51 (0.745)	2.48 (0.930)		2.45 (0.756)	2.49 (0.726)	2.39 (0.808)	
Median [Min, Max]	2.33 [0.330, 4.33]	2.33 [1.00, 4.33]	2.33 [0.330, 4.33]		2.33 [0.330, 4.33]	2.67 [1.00, 4.33]	2.33 [0.330, 3.67]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Not Worrying*				**0.187**				**0.297**
Mean (SD)	2.34 (1.10)	2.11 (1.10)	2.55 (1.07)		2.43 (1.13)	2.26 (1.25)	2.65 (0.924)	
Median [Min, Max]	2.33 [0.330, 4.67]	2.17 [0.330, 4.00]	2.67 [0.330, 4.67]		2.33 [0, 4.67]	2.33 [0, 4.33]	2.84 [1.00, 4.67]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Attention Regulation*				**0.704**				**0.0932**
Mean (SD)	2.29 (0.955)	2.38 (0.860)	2.22 (1.04)		2.59 (0.839)	2.40 (0.816)	2.84 (0.819)	
Median [Min, Max]	2.29 [0, 4.71]	2.36 [0.430, 4.14]	2.29 [0, 4.71]		2.71 [0.860, 4.57]	2.43 [0.860, 4.00]	2.93 [1.43, 4.57]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Emotional Awareness*				**0.193**				**0.316**
Mean (SD)	3.01 (1.13)	3.20 (0.971)	2.84 (1.25)		3.25 (1.01)	3.16 (0.934)	3.36 (1.12)	
Median [Min, Max]	3.20 [0, 5.00]	3.50 [1.00, 5.00]	2.80 [0, 5.00]		3.20 [0.400, 4.60]	3.00 [1.00, 4.60]	3.70 [0.400, 4.60]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Self Regulation*				**0.343**				**<0.001 ***
Mean (SD)	2.07 (0.801)	1.96 (0.754)	2.16 (0.843)		2.52 (1.04)	2.01 (0.937)	3.19 (0.756)	
Median [Min, Max]	2.25 [0.250, 3.75]	2.00 [0.750, 3.25]	2.25 [0.250, 3.75]		2.75 [0.500, 4.50]	1.75 [0.500, 4.50]	3.13 [2.00, 4.50]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Body Listening*				**0.562**				**0.204**
Mean (SD)	1.97 (1.08)	2.08 (1.05)	1.86 (1.11)		2.35 (1.18)	2.15 (1.18)	2.62 (1.16)	
Median [Min, Max]	2.00 [0, 4.67]	2.00 [0.330, 4.67]	2.00 [0, 3.67]		2.67 [0, 5.00]	2.33 [0, 4.33]	2.84 [1.00, 5.00]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	
MAIA-*Trusting*				**0.703**				**0.647**
Mean (SD)	2.37 (1.12)	2.44 (1.26)	2.31 (0.985)		2.86 (1.29)	2.76 (1.41)	3.00 (1.14)	
Median [Min, Max]	2.00 [0, 5.00]	2.50 [0, 5.00]	2.00 [1.00, 5.00]		3.00 [0, 5.00]	3.00 [0, 5.00]	2.67 [1.00, 5.00]	
Missing	4 (6.3%)	4 (12.5%)	0 (0%)		1 (1.9%)	0 (0%)	1 (4.3%)	

[1] Wilcoxon test

TABLE 3.4: Descriptive statistics of MAIA and its subscales at PRE and POST

	PRE				POST			
	Total (N=63)	**Controls (N=32)**	**Treated (N=31)**	**P-value[1] (PRE)**	**Total (N=52)**	**Controls (N=29)**	**Treated (N=23)**	**P-value[1] (POST)**
Task Interoception 1				**0.601**				**0.464**
Mean (SD)	0.358 (0.437)	0.408 (0.363)	0.306 (0.502)		0.371 (0.445)	0.349 (0.409)	0.399 (0.496)	
Median [Min, Max]	0.461 [-0.855, 0.914]	0.471 [-0.738, 0.871]	0.418 [-0.855, 0.914]		0.479 [-0.917, 0.938]	0.435 [-0.917, 0.886]	0.550 [-0.728, 0.938]	
Missing	2 (3.2%)	1 (3.1%)	1 (3.2%)		1 (1.9%)	0 (0%)	1 (4.3%)	
Task Interoception 2				**0.641**				**0.387**
Mean (SD)	0.557 (0.222)	0.576 (0.193)	0.538 (0.250)		0.556 (0.251)	0.529 (0.248)	0.591 (0.257)	
Median [Min, Max]	0.577 [0.0389, 0.908]	0.586 [0.0763, 0.871]	0.559 [0.0389, 0.908]		0.595 [-0.157, 0.934]	0.567 [-0.157, 0.887]	0.644 [0.0735, 0.934]	
Missing	2 (3.2%)	1 (3.1%)	1 (3.2%)		1 (1.9%)	0 (0%)	1 (4.3%)	
Task Interoception 3				**0.533**				**0.5**
Mean (SD)	0.562 (0.233)	0.581 (0.201)	0.542 (0.265)		0.588 (0.249)	0.571 (0.229)	0.610 (0.277)	
Median [Min, Max]	0.577 [0.0426, 0.987]	0.600 [0.0766, 0.968]	0.560 [0.0426, 0.987]		0.604 [0.0240, 0.990]	0.571 [0.0240, 0.990]	0.656 [0.0741, 0.983]	
Missing	2 (3.2%)	1 (3.1%)	1 (3.2%)		1 (1.9%)	0 (0%)	1 (4.3%)	

[1] Wilcoxon test

TABLE 3.5: Descriptive statistics of the scores obtained from the three formulas of the Task related to Interoception at PRE and POST

The second and third formulas of the calculation of the interoception task have more similar values to each other than the first formula. Again, however, at both PRE and POST (Table 3.5) there are no significant differences between controls and treated. In addition, the values at PRE and POST are quite similar to each other. Thus, it seems that there is no greater accuracy in the proposed Task between PRE and POST.

3.1.3 Change

The following tables show the raw values of the differences between the values measured before the meditation intervention (PRE) and the values measured at the end of the study (POST).

	STAIX1		Interoception Task 1		Interoception Task 2		Interoception Task 3	
	Controls	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**
Minimum	-18.00	-18.00	-0.834	-0.871	-0.671	-0.209	-0.455	-0.353
First Quartile	-7.00	-6.75	-0.181	-0.112	0.007	-0.028	-0.082	-0.088
Median	0.00	-0.50	-0.045	0.030	0.097	0.234	0.003	0.032
Mean	1.16	-1.23	-0.033	0.014	0.136	0.216	0.001	0.036
Third Quartile	7.00	3.00	0.182	0.214	0.325	0.365	0.141	0.153
Maximum	30.00	21.00	0.706	0.413	0.838	0.929	0.367	0.462

TABLE 3.6: Descriptive statistics of the differences between POST and PRE of STAIX1 and scores related to the Interoception Task

Regarding STAIX1 (Table 3.6), it can be seen that the minimum value coincides for controls and treated, while the maximum is 9 points higher in controls. The median and mean are positive for controls and negative for treated. Instead, with regard to the values obtained from the interoception task, there are no substantial differences between controls and treated.

	FFMQ		FFMQ-*Observe*		FFMQ-*Describe*		FFMQ-*Act Awareness*		FFMQ-*Non Reactionary*		FFMQ-*Non Judgement*	
	Controls	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**
Minimum	-0.410	-0.390	-0.50	-0.760	-1.130	-1.130	-1.120	-0.880	-1.000	-1.000	-0.430	-0.710
First Quartile	-0.130	-0.103	-0.12	0.000	-0.500	-0.213	-0.370	-0.408	-0.380	-0.340	-0.150	0.000
Median	-0.050	0.190	0.12	0.500	-0.120	0.125	0.000	0.120	0.000	0.315	0.000	0.215
Mean	-0.008	0.225	0.12	0.368	-0.106	0.180	-0.165	0.090	0.038	0.192	0.103	0.351
Third Quartile	0.080	0.555	0.25	0.627	0.130	0.470	0.120	0.470	0.380	0.627	0.430	0.675
Maximum	0.380	0.790	0.76	1.500	1.000	2.130	0.870	1.620	1.620	1.120	0.710	1.430

TABLE 3.7: Descriptive statistics of the differences between POST and PRE of FFMQ and its subscales

Values for FFMQ and its subscales (Table 3.7) differ most in mean and median values, which are mostly negative or close to zero in controls and positive, often around 0.2, in treated. Maximum values are also often quite different between the two groups.

In relation to MAIA and its subscales (Table 3.8-3.9), it can be seen that the values for differences in MAIA, MAIA-*Attention Regulation* and MAIA-*Self Regulation* tend to be somewhat different between controls and treated. In other cases, however, differences are noticeable but less pronounced.

	MAIA		**MAIA-*Noticing***		**MAIA-*Not Worrying***		**MAIA-*Not Distracting***	
	Controls	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**
Minimum	-0.62	-0.62	-1.75	-0.75	-1.66	-2.00	-2.33	-1.67
First Quartile	-0.28	0.15	-0.25	0.00	-0.66	-0.92	-0.67	-0.67
Median	0.03	0.52	0.00	0.25	0.00	0.33	0.00	0.00
Mean	0.01	0.46	-0.02	0.36	-0.08	-0.02	-0.08	0.12
Third Quartile	0.28	0.75	0.50	0.69	0.34	0.67	0.66	0.67
Maximum	0.59	1.41	1.50	2.00	1.33	1.67	1.67	2.00

TABLE 3.8: Descriptive statistics of the differences between POST and PRE of MAIA and some of its subscales

	MAIA-*Emotional Awareness*		**MAIA-*Attention Regulation***		**MAIA-*Body Listening***		**MAIA-*Self Regulation***		**MAIA-*Trusting***	
	Controls	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**	**Controls**	**Treated**
Minimum	-1.29	-1.29	-3.00	-2.80	-1.25	-0.75	-1.67	-2.67	-1.67	-1.33
First Quartile	-0.43	0.04	-0.40	0.00	-0.50	0.50	-0.33	0.33	-0.33	-0.25
Median	-0.14	0.57	0.20	0.20	0.00	0.75	0.33	0.67	0.00	0.67
Mean	-0.03	0.49	0.03	0.39	-0.03	0.92	0.17	0.67	0.19	0.65
Third Quartile	0.43	0.82	0.60	0.95	0.25	1.38	0.66	1.00	0.66	1.00
Maximum	1.00	1.71	2.00	2.60	2.00	2.75	2.67	2.33	3.00	2.67

TABLE 3.9: Descriptive statistics of the differences between POST and PRE of the remaining subscales of MAIA

In general, it can be seen that the reported values of controls sometimes differ from those of treated. However, this will have to be proven by subsequent analysis.

3.2 Linear Mixed Models

Several mixed-effects models were used to analyze our data and see if there were significant differences between the groups and between PRE and POST meditation treatment. In fact, these are longitudinal data and there is the presence of a random component related to each individual in the analysis.

These models were done considering as Y the variables of our interest (STAIX1, FFMQ, MAIA, and the subscales of FFMQ and MAIA), and considering as covariates those that are shown in the following tables (time, group membership, gender, age, whether or not the individuals had previous meditation experience, STAIX2 score at pre, attendance at meditation classes, economic budget, whether they took tea and/or coffee and/or Energizing Drink). The main effect of interest is the interaction between time and group. If this effect is present then there is a significant difference in the score considered, between the treated group and the control group, between before and after meditation treatment.

The ***lme*** function of R was used to obtain this models. For example, the following code was used to obtain the table in Figure 3.10:

```
lme(FFMQ ~ Time*Group + Sex + Age + Previous_meditation_experiences +
           STAIX2_2Pre + Attendance + Economic_Budget + mixCoffee,
    random = ~1|ID, data=dataLong, na.action=na.exclude)
```

FIGURE 3.1: R script for Mixed-Effects Model

It can be seen that before the tilde symbol there is the variable of interest (Y), in this case the mindfulness score, while after the tilde are listed the covariates of interest and the interaction to be studied. Next there is the *"random"* part of the code that specifies the random effect of the subjects (ID) in the dataset. It indicates that random effects are being included for each subject to account for variations between subjects, which may not be explained by the independent variables in the model. Then, the reference dataset is specified, which must be in long format. This is a dataset with a specific structure, in which each row represents a single observation, and the variables are organized into columns. Thus there will be multiple rows relating to the same individual, in our case one row relating to PRE and one relating to POST meditation data. Finally, how to deal with missing data is specified. More specifically, it is told to disregard rows with missing data.

	Value	Std.Error	DF	t-value	p-value
(Intercept)	4.2304	0.4747	45	8.9124	0.0000 *
Time (Post)	-0.0084	0.0580	45	-0.1448	0.8855
Group (Treated)	0.1889	0.1973	37	0.9576	0.3445
Sex (Male)	-0.0241	0.0965	37	-0.2497	0.8042
Age	0.0208	0.0175	37	1.1873	0.2427
Previous Meditation experiences (Yes)	0.1739	0.0896	37	1.9409	0.0599
STAIX2-Pre	-0.0325	0.0045	37	-7.2550	0.0000 *
Attendance	-0.0461	0.0287	37	-1.6079	0.1164
Economic Budget (Sufficient)[1]	-0.1798	0.1569	37	-1.1459	0.2592
Economic Budget (Comfortable)[1]	-0.2220	0.1531	37	-1.4496	0.1556
Economic Budget (More than comfortable)[1]	-0.2157	0.1682	37	-1.2825	0.2076
Coffee and/or Tea and/or Energizing Drink (Yes)	0.0528	0.0938	37	0.5628	0.577
Interaction: Time x Group	0.2344	0.0846	45	2.7696	0.0082 *

[1] Ref: Poor

TABLE 3.10: Results of the Linear Mixed Model with FFMQ as Y

In Table 3.10 it can be seen that STAIX2-Pre and the interaction are significant, and, as mentioned earlier, the variable of interest Y in this case is the mindfulness score (FFMQ). Thus, it can be said that STAIX2-Pre contributes significantly to the explanation of FFMQ and that there is a significant difference in the FFMQ score, between treated and untreated individuals and, particularly, between before and after meditation sessions. The coefficient is 0.2344 and can be interpreted as follows: the mindfulness score in individuals treated at POST is 0.2344 higher than the relative score of controls at PRE. This means that indeed individuals who participated in the meditation courses benefited from the treatment, as they have higher mindfulness scores.

In Table 3.11 the variable of interest is now the MAIA score, related to the individual's interoception. It can be seen that again STAIX2-Pre has a significant coefficient (p-value$<$0.05), as does that related to the interaction between time and group. In this case, the covariate related to previous meditation experience is also significant. Thus, it can be said that an individual's prior meditation experiences and their STAIX2 score at Pre significantly contribute to explaining the MAIA score. In addition, the interaction-related coefficient is 0.4486, i.e., in individuals treated at POST, the interoception score increases by 0.4486 compared with the corresponding score in individuals not treated at PRE.

Another model (Table 3.12) in which the interaction of interest is significant

	Value	Std.Error	DF	t-value	p-value
(Intercept)	3.5098	0.7098	45	4.9449	0.0000 *
Time (Post)	0.0100	0.0843	45	0.1186	0.9061
Group (Treated)	0.2235	0.2947	37	0.7586	0.4529
Sex (Male)	0.0805	0.1443	37	0.5580	0.5802
Age	-0.0135	0.0262	37	-0.5159	0.609
Previous Meditation experiences (Yes)	0.3826	0.1340	37	2.8559	0.0066 *
STAIX2-Pre	-0.0169	0.0067	37	-2.5315	0.0324 *
Attendance	-0.0569	0.0429	37	-1.3262	0.1929
Economic Budget (Sufficient)[1]	0.1085	0.2347	37	0.4624	0.6465
Economic Budget (Comfortable)[1]	-0.2022	0.2290	37	-0.8830	0.3829
Economic Budget (More than comfortable)[1]	-0.1240	0.2515	37	-0.4930	0.6249
Coffee and/or Tea and/or Energizing Drink (Yes)	0.0157	0.1403	37	0.1117	0.9117
Interaction: Time x Group	0.4486	0.1229	45	3.6491	0.0007 *

[1] Ref: Poor

TABLE 3.11: Results of the Linear Mixed Model with MAIA as Y

	Value	Std.Error	DF	t-value	p-value
(Intercept)	4.9228	1.2279	45	4.0091	0.0001 *
Time (Post)	-0.0332	0.1360	45	-0.2441	0.8083
Group (Treated)	0.1702	0.5085	37	0.3348	0.7397
Sex (Male)	0.4787	0.2496	37	1.9177	0.0629
Age	-0.0577	0.0453	37	-1.2713	0.2116
Previous Meditation experiences (Yes)	0.2813	0.2318	37	1.2138	0.2325
STAIX2-Pre	-0.0247	0.0116	37	-2.1319	0.0397
Attendance	-0.0420	0.0742	37	-0.5662	0.5747
Economic Budget (Sufficient)[1]	-0.3680	0.4060	37	-0.9063	0.3707
Economic Budget (Comfortable)[1]	-0.5480	0.3963	37	-1.3829	0.175
Economic Budget (More than comfortable)[1]	-0.5056	0.4352	37	-1.1616	0.2528
Coffee and/or Tea and/or Energizing Drink (Yes)	0.0986	0.2427	37	0.4061	0.687
Interaction: Time x Group	0.5217	0.1984	45	2.6289	0.0120 *

[1] Ref: Poor

TABLE 3.12: Results of the Linear Mixed Model with MAIA-*Attention Regulation* as Y

is with the Attention Regulation subcategory of the MAIA score. In this model, the interaction score is 0.5217, thus the score for the MAIA subscale referring to the ability to regulate attention increases by 0.5217 when moving from a control at PRE to a treated at POST.

Finally, in the model (Table 3.13) with MAIA's subscale related to awareness of mind-body integration and more specifically to self-regulation there are the same

	Value	Std.Error	DF	t-value	p-value
(Intercept)	3.2751	0.9229	45	3.5488	0.0009 *
Time (Post)	-0.0300	0.1569	45	-0.1912	0.8492
Group (Treated)	0.5230	0.3911	37	1.3372	0.1893
Sex (Male)	0.3495	0.1877	37	1.8617	0.0706
Age	-0.0199	0.0340	37	-0.5842	0.5626
Previous Meditation experiences (Yes)	0.3556	0.1742	37	2.0417	0.0403 *
STAIX2-Pre	-0.0220	0.0087	37	-2.5241	0.0255 *
Attendance	-0.0786	0.0557	37	-1.4115	0.1665
Economic Budget (Sufficient)[1]	0.3496	0.3045	37	1.1479	0.2584
Economic Budget (Comfortable)[1]	-0.0572	0.2970	37	-0.1927	0.8482
Economic Budget (More than comfortable)[1]	-0.2600	0.3262	37	-0.7972	0.4304
Coffee and/or Tea and/or Energizing Drink (Yes)	-0.0563	0.1820	37	-0.3093	0.7588
Interaction: Time x Group	0.9330	0.2285	45	4.0837	0.0002 *

[1] Ref: Poor

TABLE 3.13: Results of the Linear Mixed Model with MAIA-*Self Regulation* as Y

significances as in the model with the MAIA score as Y. As for covariates, similar conclusions can be drawn: STAIX2-Pre and "Previous meditation experiences" contribute significantly to the explanation of MAIA-*Self Regulation*. On the other hand, in terms of interaction, its score is 0.9330, the largest encountered so far. Thus, it can be said that individuals treated at POST have a MAIA-*Self Regulation* score greater than that of controls at PRE by 0.9330.

3.3 Mediation Analysis

We performed mediation analysis to see if there was any mediation between the analyzed scores, in particular it was analyzed whether FFMQ or MAIA (and their subscales) could be possible mediators.

The mediation analysis was studied through the ***mediate*** function of the R ***mediation*** library. As can be seen from the code in Figure 3.2, outcome (Y), mediator (M) and treatment variable (X) were defined, as well as the covariates for which to adjust the model (c1-c8). Furthermore, two linear models were considered, one with the mediator as the outcome and one with the independent variable of interest (Y) as the outcome, considering the mediator as a covariate within this model. Subsequently, the ***mediate()*** function performs a mediation analysis that considers model *b* (effect of treatment on M) and model *c* (effect of treatment and mediator on Y). *sims* indicates how many bootstrap simulations are run to calculate the confidence intervals. *treat* denotes the treatment variable (X) and *mediator* denotes the mediation variable (M). In this particular code we studied the possible mediation of FFMQ in a model with state anxiety (STAIX1) as outcome and Group as treatment. Scores at POST were used for both the Y and the mediator. The variable used as the outcome (STAIX1), but at PRE, was introduced as a covariate to correct the model.

```
Y <- dataWide$STAIX1_Post
X <- dataWide$Group
M <- dataWide$FFMQ_Post
c1 <- dataWide$Sex
c2 <- dataWide$Age
c3 <- dataWide$Previous_meditation_experiences
c4 <- dataWide$STAIX2_Pre
c5 <- dataWide$Attendance
c6 <- dataWide$mixCoffee
c7 <- dataWide$Economic_Budget
c8 <- dataWide$STAIX1_Pre

b <- lm(M ~ X + c1 + c2 + c3 + c4 + c5 + c6 + c7 + c8, data=dataWide)
c <- lm(Y ~ M + X + c1 + c2 + c3 + c4 + c5 + c6 + c7 + c8, data=dataWide)

contcont <- mediate(b, c, sims=50, treat="X", mediator="M")
summary(contcont)
```

FIGURE 3.2: R script for Mediation Analysis

In the table resulting from the mediation analysis on R, 4 different values are noted:

- ACME (Average Causal Mediation Effect): indicates the average causal mediation effect. That is, it measures the change in outcome that can be attributed to mediation through the path mediated by the mediation variable. Having a negative value of ACME means that the effect of independent variable X on dependent variable Y is reduced due to mediation through M.
- ADE (Average Direct Effect): on the other hand, represents the average direct effect of X on Y, not mediated by the mediating variable M. A negative value of ADE expresses the presence of a negative direct effect of X on Y, which does not go through M.
- Total Effect: represents the total effect of X on Y, either through mediation or directly. If a negative value is present then X has an overall negative effect on Y, either through mediation or directly.
- Prop. Mediated (Proportion Mediated): this value identifies the proportion of the total effect of X on Y mediated by the mediation variable relative to the total effect. A value close to 1 shows that most of the effect of X on Y is mediated through M.

  Four models were obtained in which ACME was significant.

In the first model (Table 3.14) it was investigated whether mindfulness (FFMQ) could be a possible mediator in the relationship between trait anxiety (STAIX2) and treatment, adjusting for all previously reported covariates. As it can be seen, the p-value related to ACME is significant, so mindfulness is a mediator between treatment and trait anxiety. It can also be observed that the value related to ACME is negative (-3.938), meaning that when the mediator (FFMQ) increases, the change in the explicator (treatment) tends to cause a decrease in the dependent variable (STAIX2). In other words, moving from the control group to the treated group results in a decrease in the STAIX2 score. Moreover, although the confidence interval is very wide, it can still be seen that about 63% of the total effect is mediated.

In the second model (Table 3.15) it can be seen again the significance of ACME and the fact that the coefficient is negative. This leads to the conclusion that MAIA-*Self Regulation* is a mediator in the relationship between the treatment and

	Estimate	95% CI Lower	95% CI Upper	p-value	
ACME	-3.938	-8.123	-0.50	0.04	*
ADE	-0.813	-7.634	6.34	1.00	
Total Effect	-4.751	-13.845	2.21	0.16	
Prop. Mediated	0.627	-2.471	8.24	0.20	

TABLE 3.14: Results of Mediation Analysis with FFMQ as mediator, STAIX2 as Y and Group as X

STAIX2. In particular, when MAIA-*Self Regulation* subscale increases, moving from the control group to the treated group leads to a decrease in trait anxiety. In this case, despite the non-significance, as much as 98% of the total effect is mediated.

	Estimate	95% CI Lower	95% CI Upper	p-value	
ACME	-5.857	-10.849	-0.96	<2e-16	***
ADE	1.033	-5.556	8.36	0.84	
Total Effect	-4.824	-14.432	2.47	0.28	
Prop. Mediated	0.984	-14.045	3.51	0.28	

TABLE 3.15: Results of Mediation Analysis with MAIA-*Self Regulation* as mediator, STAIX2 as Y and Group as X

In the third case (Table 3.16) the p-value relative to ACME is less than 2e-16, so it is significant. In this case, however, the coefficient is positive and equal to 0.2049. This result leads to the conclusion that the Observe subscale of FFMQ is a mediator in the relationship between MAIA interoception score and treatment. Specifically, as FFMQ-*Observe* increases, moving from the control group to the treated group results in an increase in MAIA score. Here about 35% of the total effect is mediated, although not significant.

	Estimate	95% CI Lower	95% CI Upper	p-value	
ACME	0.2049	0.0386	0.39	<2e-16	***
ADE	0.2511	-0.2535	0.67	0.32	
Total Effect	0.4560	-0.0281	0.82	0.12	
Prop. Mediated	0.3551	-4.2983	3.49	0.12	

TABLE 3.16: Results of Mediation Analysis with FFMQ-*Observe* as mediator, MAIA as Y and Group as X

In much the same way as the previous case, in this last case (Table 3.17) it can be seen that FFMQ-*Observe* is also a mediator in the relationship between

treatment and the Attention Regulation subscale of the MAIA score. Again, as FFMQ-*Observe* increases, moving from controls to treated, there is an increase in the MAIA-*Attention Regulation* score. Finally, it can be seen that 57% of the total effect is mediated, although the p-value is not significant.

	Estimate	95% CI Lower	95% CI Upper	p-value	
ACME	0.3277	0.0677	0.63	<2e-16	***
ADE	-0.0949	-0.8947	0.57	0.96	
Total Effect	0.2329	-0.5443	0.81	0.52	
Prop. Mediated	0.5721	-5.6197	7.28	0.52	

TABLE 3.17: Results of Mediation Analysis with FFMQ-*Observe* as mediator, MAIA-*Attention Regulation* as Y and Group as X

Chapter 4

CONCLUSION

The primary objective of our study was to demonstrate whether engagement in comprehensive meditation programs could lead to improvements in measures of state and trait anxiety, mindfulness, and interoception for treated participants compared to their respective control counterparts. The study included a review of preliminary results, the use of linear mixed models, and the incorporation of mediation analysis as a means of understanding the various relationships among different factors.

To answer our primary question, four different questionnaires were administered to a population of college students with an average age of about 22 years. The questionnaires were structured to assess the various aspects of interest described above. The scores obtained from these four questionnaires were then derived and analyzed through the use of mixed-effects models.

Anxiety values were expected to decrease (STAIX), while those of mindfulness (FFMQ) and interoception (MAIA, task) were expected to increase. However, the responses from the questionnaires emphasized the presence of actual improvement only in mindfulness (total FFMQ) and interoception (total MAIA score and subcategories Attention Regulation and Self Regulation) in the subjects undergoing the whole meditation treatment, compared with the controls. Thus, this result corresponds in part to what was expected; however, other significances were also expected that did not occur. For example, it can be noted that the task related to interoception did not yield significant results, while interoception studied through the MAIA score was significant in both the total score and two subscales. This can be explained: the task investigates interoceptive accuracy, while the MAIA questionnaire studies the presence of interoceptive awareness. Thus, two different aspects

of interoception are investigated, the first of which was found to be non-significant, while the second was found to be well present.

A second question then arose that we wanted to investigate further, regarding the possible presence of mediators within our analysis. It was expected that FFMQ and/or MAIA might be mediators within the relationship between the group variable (treatment) and the remaining scores. In this case, it was obtained that FFMQ is a mediator in the relationship between STAIX2 and treatment, just as the Autoregulation subscale of MAIA is a mediator in the same relationship. In addition, FFMQ-*Observe* is a mediator in the relationship between MAIA and treatment and also between the Attention Regulation subscale of MAIA and treatment.

We are quite satisfied with the results obtained as they allow us to expand the existing literature on integral meditation, to state with a high level the existence of a relationship between integral meditation and both interoception and mindfulness, and also to identify the presence of mediators in some relationships present among our variables. We would also have liked to obtain significant results in relation to anxiety and other subscales of mindfulness, but these can be obtained in a later study based on a larger sample of students. Indeed, a bigger sample size could lead to more satisfactory results and thus give rise to a more precise analysis.

In addition to the aspect related to sample size, another factor that may have influenced the results of the analysis is the fact that self-reported questionnaires were used. Thus, bias may be present for example to the user's possible distraction or lack of concentration after a certain number of questions.

In conclusion, this study highlights the positive effects of meditation interventions on psychological and interoceptive well-being, shedding light on the potential pathways through which the effects manifest. The results underscore the importance of mindfulness practices in improving overall mental and bodily awareness.

Appendix A

Questionnaires

The questionnaire proposed to the individuals included in the study can be seen below. For simplicity, only the part on the questionnaires was introduced and not the part on biographical and general descriptives of individuals.

STAI X-1

Di seguito sono riportate alcune frasi che le persone usano spesso per descriversi. Legga ciascuna frase e contrassegni con una crocetta la risposta che riflette come Lei si sente ADESSO, cioè in questo preciso momento, mentre sta iniziando a compilare questo test.

27. 1. Mi sento calmo *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

28. 2. Mi sento sicuro *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

29. 3. Sono teso *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

30. 4. Ho dei rimpianti *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

31. 5. Mi sento tranquillo *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

32. 6. Mi sento turbato *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

33. 7. Sono attualmente preoccupato per possibili disgrazie *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

34. 8. Mi sento riposato *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

35. 9. Mi sento ansioso *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

36. 10. Mi sento a mio agio *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

37. 11. Mi sento sicuro di me *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

38. 12. Mi sento nervoso *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

39. 13. Sono agitato *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

40. 14. Mi sento molto teso *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

41. 15. Sono rilassato *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

42. 16. Mi sento contento *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

43. 17. Sono preoccupato *

Contrassegna solo un ovale.

- ◯ Per nulla
- ◯ Un poco
- ◯ Abbastanza
- ◯ Moltissimo

44. 18. Mi sento sovraeccitato e scosso *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

45. 19. Mi sento allegro *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

46. 20. Mi sento bene *

Contrassegna solo un ovale.

- Per nulla
- Un poco
- Abbastanza
- Moltissimo

STAI-X2

Legga ciascuna frase e contrassegni con una crocetta la risposta che riflette come lei si sente ABITUALMENTE. Risponda pensando a come lei è di solito, non al momento attuale. Risponda a tutte le domande scegliendo la risposta tra le seguenti:

1 = Quasi mai: 2 = Qualche volta; 3 = Spesso; 4 = Quasi sempre

47. 1. Mi sento bene. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

48. 2. Mi stanco facilmente. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

49. 3. Mi sento come se dovessi piangere. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

50. 4. Vorrei poter essere felice come sembrano essere gli altri. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

51. 5. Spesso perdo delle occasioni perché non riesco a decidermi abbastanza in fretta. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

52. 6. Mi sento riposato. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

53. 7. Io sono calmo, tranquillo e padrone di me. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

54. 8. Sento che le difficoltà si accumulano tanto da non poterle superare. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

55. 9. Mi preoccupo troppo di cose che in realtà non hanno importanza. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

56. 10. Sono felice. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

57. 11. Tendo a considerare «difficili» le cose. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

58. 12. Manco di fiducia in me stesso. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

59. 13. Mi sento sicuro. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

60. 14. Cerco di evitare di affrontare crisi o difficoltà. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

61. 15. Mi sento stanco e depresso. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

62. 16. Sono contento. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

63. 17. Pensieri di scarsa importanza mi passano per la mente e mi infastidiscono. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

64. 18. Vivo le delusioni con tanta partecipazione da non poter togliermele dalla testa. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

65. 19. Sono una persona costante. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

66. 20. Divento teso e turbato quando penso alle mie attuali preoccupazioni. *

Contrassegna solo un ovale.

1	2	3	4
◯	◯	◯	◯

Five Facet Mindfulness Questionnaire (FFMQ)

Scelga l'opzione che meglio descrive la sua opinione o quello che risulta di solito vero per lei.

67. 1. Mentre cammino, sto attento/a alle sensazioni del mio corpo che si sta muovendo *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

68. 2. Sono bravo/a a trovare parole che descrivano i miei sentimenti *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

69. 3. Mi rimprovero di avere emozioni irrazionali o inappropriate *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

70. 4. Percepisco i miei sentimenti e le mie emozioni senza essere costretto/a a reagirvi *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

71. 5. Quando faccio delle cose la mia mente tende a vagare e mi distraggo facilmente *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

72. 6. Quando faccio il bagno o la doccia, cerco di prestare attenzione alle sensazioni prodotte dall'acqua sul mio corpo *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

73. 7. Riesco facilmente a trovare le parole per esprimere le mie credenze, le mie opinioni e le mie aspettative *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

74. 8. Non presto attenzione a quello che faccio perché sogno ad occhi aperti, sono preoccupato/a o comunque distratto/a *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

75. 9. Osservo i miei sentimenti senza perdermi in essi *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

76. 10. Dico a me stesso/a che non dovrei sentirmi nel modo in cui mi sento *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

77. 11. Mi accorgo di come i cibi e le bevande influenzino i miei pensieri, le mie sensazioni corporee e le mie emozioni *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

78. 12. Per me è difficile trovare le parole per descrivere quello a cui sto pensando *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

79. 13. Mi distraggo facilmente *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

80. 14. Credo che alcuni dei miei pensieri siano anormali o cattivi e che non dovrei * pensarla in questo modo

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

81. 15. Presto attenzione alle sensazioni, come il vento nei capelli o il sole sul viso *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

82. 16. Per me è un problema trovare le parole giuste per esprimere quello che penso *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

83. 17. Tendo a giudicare i miei pensieri come buoni oppure come cattivi *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

84. 18. Trovo difficile rimanere concentrato/a su quello che accade nel presente *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

85. 19. Quando i miei pensieri o immagini mi turbano, “faccio un passo indietro” e sono consapevole del pensiero o dell’immagine senza esserne sopraffatto/a *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

86. 20. Presto attenzione ai rumori, come ad esempio il ticchettio dell’orologio, il cinguettio degli uccelli, o il passaggio delle macchine *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

87. 21. Nelle situazioni difficili riesco a fermarmi senza reagire immediatamente *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

88. 22. Quando provo una sensazione sul mio corpo, mi risulta difficile descriverla perché non trovo le parole giuste *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

89. 23. Mi sembra di “funzionare in automatico” senza troppa consapevolezza di quello che sto facendo *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

90. 24. Quando i miei pensieri o immagini mi turbano, riesco a calmarmi in poco tempo *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

91. 25. Dico a me stesso/a che non dovrei pensare nel modo in cui penso *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

92. 26. Noto gli odori e gli aromi delle cose *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

93. 27. Anche quando mi sento molto turbato/a, posso trovare il modo di tradurlo in parole ed esprimerlo *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

94. 28. Svolgo frettolosamente le mie attività senza prestarvi davvero attenzione *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

95. 29. Quando i miei pensieri o immagini mi turbano, sono in grado di accorgermene senza reagire *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

96. 30. Ritengo che alcune delle mie emozioni siano cattive o inappropriate e che non dovrei sentirle *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

97. 31. Noto gli aspetti visivi nell'arte e nella natura, come i colori, le forme, le trame, o i giochi di luce e ombre *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

98. 32. La mia inclinazione naturale è quella di tradurre le mie esperienze in parole *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

99. 33. Quando i miei pensieri o immagini mi turbano, li noto soltanto e “li lascio andare” *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

100. 34. Svolgo dei lavori o dei compiti automaticamente senza essere consapevole di quello che sto facendo *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

101. 35. Quando i miei pensieri o immagini mi turbano giudico me stesso come buono o come cattivo, a seconda del contenuto del pensiero o dell’immagine *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

102. 36. Presto attenzione a come le mie emozioni influenzano i miei pensieri e il mio comportamento *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

103. 37. Di solito sono capace di descrivere abbastanza dettagliatamente come mi sento in un dato momento *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

104. 38. Mi trovo a fare cose senza prestarvi attenzione *

Contrassegna solo un ovale.

- Non mi accade mai o molto raramente
- Mi accade raramente
- Mi accade a volte
- Mi accade spesso
- Mi accade spesso o sempre

105. 39. Sono fortemente critico con me stesso/a quando mi vengono delle idee irrazionali *

Contrassegna solo un ovale.

- ◯ Non mi accade mai o molto raramente
- ◯ Mi accade raramente
- ◯ Mi accade a volte
- ◯ Mi accade spesso
- ◯ Mi accade spesso o sempre

Questionario MAIA

Di seguito troverà una lista di affermazioni. Per favore indichi quanto spesso ciascuna affermazione si riferisce a lei generalmente nella vita quotidiana.

106. 1. Quando sono teso noto in che punti del mio corpo è localizzata la tensione. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

107. 2. Noto quando sono a disagio nel mio corpo *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

108. 3. Noto i punti del mio corpo in cui mi sento a mio agio. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

109. 4. Noto i cambiamenti nel mio respiro, per esempio se rallenta o accelera. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

110. 5. Non noto la tensione fisica o il disagio fino a quando questi non diventano più seri. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

111. 6. Mi distolgo dalle sensazioni di disagio. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

112. 7. Quando provo dolore o disagio, cerco comunque di andare avanti con quello che stavo facendo nonostante ciò. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

113. 8. Quando sento un dolore fisico, mi agito. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

114. 9. Inizio a preoccuparmi che ci sia qualcosa che non va, se percepisco un disagio. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

115. 10. Posso notare una sensazione corporea spiacevole senza preoccuparmene. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

116. 11. Posso prestare attenzione sul mio respiro senza farmi distrarre dalle cose che succedono attorno a me. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

117. 12. Posso mantenere la consapevolezza delle mie sensazioni fisiche interiori anche se attorno a me avvengono molte cose. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

118. 13. Quando sto conversando con qualcuno, riesco a prestare attenzione alla mia postura. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

119. 14. Posso ritrovare la consapevolezza del mio corpo se sono distratto. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

120. 15. Riesco a ridirezionare l'attenzione dall'atto di pensare all'atto di percepire il mio corpo. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

121. 16. Riesco a mantenere la consapevolezza del mio corpo nella sua interezza anche quando una parte di me è dolorante o a disagio. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

122. 17. Sono capace di focalizzarmi intenzionalmente sul mio corpo nella sua interezza. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

123. 18. Noto in che modo il mio corpo cambia quando sono arrabbiato. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

124. 19. Quando qualcosa va storto nella mia vita, riesco a percepirlo nel mio corpo. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

125. 20. Noto di sentire il mio corpo diverso dopo un'esperienza serena. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

126. 21. Noto che il mio respiro diventa libero e agevole quando mi sento a mio agio. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

127. 22. Noto come il mio corpo cambia quando mi sento felice/gioioso. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

128. 23. Quando mi sento sopraffatto, riesco a trovare dentro di me un posto tranquillo. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

129. 24. Quando rivolgo la consapevolezza sul mio corpo, provo un senso di calma. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

130. 25. Riesco ad utilizzare il mio respiro per ridurre la tensione. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

131. 26. Quando mi assalgono i pensieri, posso calmare la mente concentrandomi sul mio corpo/respiro. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

132. 27. Ascolto le informazioni provenienti dal mio corpo riguardanti i miei stati emotivi. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

133. 28. Quando sono agitato, prendo il tempo necessario per indagare come sta il mio corpo. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

134. 29. Ascolto il mio corpo per sapere cosa fare. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

135. 30. Nel mio corpo mi sento a casa. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

136. 31. Sento che il mio corpo è un posto sicuro. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

137. 32. Mi fido delle sensazioni del mio corpo. *

Contrassegna solo un ovale.

	0	1	2	3	4	5	
Mai	◯	◯	◯	◯	◯	◯	Sempre

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