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EDITED BY

Georg Seifert,
Charité University Medicine Berlin, Germany

REVIEWED BY

M.-H. Catherine Toh,
James Cook University Singapore, Singapore
Christina Driver,
University of the Sunshine Coast, Australia

*CORRESPONDENCE

Chiara de Waure
✉ chiara.dewaure@unipg.it

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The role of a mindful movement-based program (Movimento Biologico) in health promotion: results of a pre-post intervention study

Stefano Spaccapanico Proietti¹, Manuela Chiavarini², Francesco Iorio¹, Livia Buratta³, Giancarlo Pocetta¹, Roberta Carestia¹, Camilla Gobbetti¹, Chiara Lupi¹, Antonio Cosenza³, Guglielmo Sorci¹, Claudia Mazzeschi³, Andrea Biscarini¹ and Chiara de Waure^{1*}

¹Department of Medicine and Surgery, University of Perugia, Perugia, Italy, ²Department of Biomedical Sciences and Public Health, Section of Hygiene, Preventive Medicine and Public Health, Polytechnic University of the Marche Region, Ancona, Italy, ³Department of Philosophy, Social Sciences and Education, University of Perugia, Perugia, Italy

Introduction: Mindful movement is a comprehensive approach that integrates various bodily, emotional and cognitive aspects into physical activity, promoting overall well-being. This study assessed the impact of a mindful movement program, known as Movimento Biologico (MB), on participants' psychological well-being (PWB), positive mental health (PMH), sense of coherence (SOC), and interoceptive awareness.

Methods: MB program was conducted for students attending the bachelor's degree in Kinesiology and Sport Sciences of University of Perugia over 8 weeks (from October 16 to November 27, 2022). Participants were requested to fill in four questionnaires before and after the MB program: (1) 18-item PWB scale; (2) 9-item PMH scale; (3) 13-item SOC scale; (4) 32-item scale for Multidimensional Assessment of Interoceptive Awareness (MAIA). Wilcoxon signed-rank tests were used to assess changes, with significance set at $p < 0.05$.

Results: Thirty-eight students (mean age 21.2, 60.5% male) participated. Several MAIA subscales, including noticing ($p = 0.003$), attention management ($p = 0.002$), emotional awareness ($p = 0.007$), self-regulation ($p < 0.001$), body listening ($p = 0.001$), and trusting ($p = 0.001$), showed significant improvements. PMH increased significantly ($p = 0.015$), and there was a significant enhancement in the autonomy subscale of PWB ($p = 0.036$). SOC and overall PWB also improved, though not significantly.

Conclusion: The MB program significantly improved participants' positive mental health and interoceptive awareness. This likely resulted from better recognition and management of positive physiological sensations, a stronger link between physical sensations and emotions, enhanced confidence in one's body, and increased autonomy.

KEYWORDS

mindful movement, psychological well-being, mental health, sense of coherence, interoceptive awareness, young adults, Movimento Biologico

Introduction

Young adults, also known as emerging adults, are people between the late teens and twenties (1) who experience a critical period for their individual's development, with lasting implications for their health, well-being, and economic stability. Contrary to popular belief, they can be surprisingly unhealthy, exhibiting an even worse health profile than thirty-year-olds (2). Therefore, it is crucial to support them in successfully transitioning from adolescence to adulthood (2, 3) addressing their mental health needs, and promoting both mental and physical health and well-being.

Mental health refers to a state of emotional, psychological, and social well-being in which individuals can effectively cope with the demands of everyday life (4).

It encompasses various dimensions, including cognitive functioning, emotional regulation, a sense of connection to others and interpersonal relationships, and the ability to cope with adversity (5).

Mental health and psychological well-being are fundamental to individuals' overall functioning, quality of life, and ability to adapt to the challenges they encounter. The World Health Organization (WHO) recognizes the essential role of psychological well-being and mental health promotion, describing it as "a key function for ensuring healthy lives and promoting well-being at all ages." This highlights the need for greater attention from public health in promoting mental health from a salutogenic perspective (6).

There is international evidence (7, 8) regarding feasible and effective interventions to promote mental health.

Psychoeducational and cognitive-behavioral interventions, relaxation programs, mindfulness and meditative/mindful movement (MM) practices are among the interventions found to be effective in improving mental well-being in the young adult population (9). Mindfulness is defined as intentionally directing attention to present-moment experiences in a non-judgmental way (10), with an orientation to curiosity, openness, acceptance and non-reactivity (11, 12). Mindfulness-based interventions have evolved over time and currently also include programs centered on MM (13, 14).

MM interventions (15) are practices of mindful movement that aim to dissolve the mind-body separation promoting instead their integration. They rely on theories (16, 17) that emphasize how the experience of oneself in the world as conscious being involves a complex interaction of the brain, body, and environment, and the seamless integration of interoceptive, proprioceptive (including vestibular), kinesthetic, tactile, and spatial information (18–20). These practices are indeed animated by the desire to overcome the historical Cartesian dualism of mind and body separation (21) in search of the ontological unit of an articulated multiplicity, as human being is (22).

Mind-body dualism is actually not biologically plausible (23) because the mind is not to be regarded either a disembodied internal representation of the external world, nor as a system of brain modules, neural symbols, and algorithms. On the contrary, an embodied mind manifests and integrates the current state of the entire organism as it interacts with its environment (24).

Furthermore, movement of the body can reveal effects on the structure and function of the brain (25–28). Interactions between brain, mind, body and behavior can be used to promote health, enhancing well-being, mood, sleep, cognition (29), attention, learning, emotion regulation (30) and positively impacting stress

reduction and self-regulation (31). MM practices, such as yoga, qigong, and tai chi, incorporate the purposeful regulation of movement and coordination between the breath, mind, and body (32) and are based on mental presence and a meditative attitude. Movimento Biologico® (MB) is a MM intervention characterized by the integration of formal meditation techniques (body awareness, breathing awareness, walking meditation, loving-kindness meditation) and informal meditation (during daily activities). It encompasses psycho-education on stress and emotional management, dialogic practices, breathing practices, free expressive movements, motor games, experiential anatomy practices, motor problem solving exercises, self-knowledge diaries, vocal practices and many other forms of teaching-learning mediated by movement (33, 34) harmonized with each other through the filter of body pedagogics and embodied learning. (35, 36).

MM interventions have already been shown to alleviate symptoms of various clinical conditions (37, 38) and induce measurable changes in physiological markers of stress (39, 40), cognitive functions (41, 42), and sensory motor acuity (43). Changes in several psychological outcomes were also assessed in the general adult or older adult population with positive results shown in respect to quality of life (44), depressive symptoms (44, 45), anxiety (45), and sleep quality (44, 46). Recent studies have also examined such practices in adolescents (47, 48) to investigate their impact on cognitive functions and young adults (49–51). The latter evaluated specific aspects, such as depression, stress, quality of life and affective state without considering the broad concept behind psychological well-being.

It emerges from the above that research on MM is relatively less developed in respect to that on conventional meditation and exercise and physical activity (52) and this could be due to the multifaceted nature of MM interventions, which typically involve sequences of specific movements, the particular use of breathing and the modulation of attention (53). Furthermore, despite the current interest in "mind-body medicine," the Cartesian paradigm persists, as does the continuing gap between MM and traditional medical and psychiatric theory (54).

Considering MM characteristics, it is reasonable to expect that MM can positively impact psychological, emotional, and social well-being (55, 56), namely the "Positive Mental Health" (PMH). From a salutogenic perspective, better PMH can positively impact the capacity to utilize resources, i.e., the sense of coherence (SOC), a cornerstone of the salutogenic model that relates to individuals' ability to manage life events (57). The connection between PMH, SOC, and salutogenesis is implicit in the definition of PMH as expressed by the WHO (58), which states that PMH represents the foundation of individuals' well-being and effective functioning. On the other hand, SOC expresses individuals' ability to manage and give meaning to internal and external stimuli from their environment over the course of life, valuing their capacity to use resources to cope with difficulties and maintain better physical and mental health (59, 60). Indeed, both salutogenesis (61) and PMH focus on the construction of those "positive qualities" that embody the positive vision of health on one hand and positive psychology on the other (62, 63).

Based on this foundation, the present study aims to evaluate the short-term impact of a MM program known as Movimento Biologico® (MB) on these domains in a young adult population.

Materials and methods

Study design and population

We conducted an experimental pilot study without a control group. The study population included subjects aged 18 to 26 years old, attending the 2nd and 3rd year of the bachelor's degree in Kinesiology and Sport Sciences at the University of Perugia. Individuals with pre-existing psychological disorders or those currently involved in competitive sports, mindfulness activities, or MM practices were excluded. The number of participants was set at 40 for logistical issues and the enrollment was voluntary, with applications collected during the second half of September 2022 through the project's designated contact person. Applications were considered on a first-come, first-served basis. Students were informed of the possibility to enroll in the program through the website of the Degree in Kinesiology and Sport Sciences, as well as students mailing list and WhatsApp group. The training program was advertised after the project received the approval from the Local Ethics Committee.

Intervention: the mindful movement program Movimento Biologico® (MB)

The MB program was led by an expert with a background in Kinesiology and Sports Sciences with 17 years of experience in the field of MM, neuroscience and meditation. The program lasted 8 weeks (from October 16th to November 27th, 2022) and consisted of 8 intensive sessions of 4 or 8 h, carried out in groups associated with activities to be carried out individually as homework.

It was based on a set of activities that allowed for a more meaningful and evolutionary contact with the substantial dimension of the person, namely corporeality, and through it, with the unique, creative, and spiritual depth of the personality. The program included theoretical and practical sessions, as well as self-managed activities to be carried out at home. The sessions were conducted with the whole group while the "homework" practices were carried out independently by each participant and without direct supervision.

The group sessions included moments of psycho-education, meditation and contemplation practices (such as body scan, breathing awareness, walking meditation, loving-kindness meditation), individual motor practices (such as kinesphere, floorwork, juggling, and experiential anatomy), motor games in partnering, dialogic mindfulness practices, vocal practices, creation of drawings, diaries for self-knowledge, motor problem solving exercises and other teaching-learning tools. The group activities took place in the gyms of the Degree Course in Kinesiology and Sports Sciences.

The homework practices were facilitated using supporting audio or video files and paper materials (such as diaries) that were provided to participants during the group sessions. It was not possible to systematically monitor the homework, therefore, we relied on the participants' ethics and adherence to the program. The total duration of the program was 48 h, with a maximum of 8 h of allowed absence that was set to minimize the risk of not being able to reliably assess the impact of the program for a loss of potential achievable benefits.

Table 1 provides a summary of the intervention while the detailed program is included in [Supplementary material](#).

Study procedures and data management

During the enrollment, a structured interview was conducted by the research staff to collect socio-demographic data (date and month of birth, gender, residential address, citizenship, educational qualification) and clinical-anamnestic data (self-perceived health, pre-existing medical conditions, depressed mood in the last 2 weeks, medication intake, lifestyle habits such as smoking, alcohol consumption and physical activity, sports involvement). Body mass index (BMI) was calculated considering self-reported weight and height.

The questions regarding smoking habits addressed three main aspects: the current smoking status of the person, the quantity of cigarettes smoked and the duration of smoking habit, and the length of time since they quit smoking for former smokers. The questions about alcohol habits focused on the total number of alcoholic units consumed within a 30-day period, and on consumption of 6 or more alcoholic units on a single occasion (binge drinking). An alcoholic unit is made up of a can of beer (330 mL) or a glass of wine (125 mL) or a shot of liquor (40 mL).

The questions regarding physical activity included inquiries about whether the individual had moderate/intense physical activity in the last 30 days and its weekly duration. Furthermore, in order to identify physical active people responders were requested to say if they had at least 30 min of moderate physical activity on at least 5 days a week and/or 20 min of intense physical activity on at least 3 days a week.

Measures

Additionally, participants were requested to complete four questionnaires before and after the MB program:

- 1 An 18-item questionnaire, validated in Italian, to assess the Psychological Well-Being (PWB) in terms of six dimensions, namely self-acceptance, positive relationships with others, autonomy, environmental mastery, purpose in life, personal growth. Each item of this questionnaire is rated on a 6-point Likert scale ranging from 1 to 6, where 1 represents "Completely disagree" and 6 represents "Completely agree." Higher scores indicate higher levels of well-being. The Cronbach's alpha (α) of the questionnaire is 0.52 for self-acceptance, 0.56 for positive relationships with others, 0.37 for autonomy, 0.49 for environmental mastery, 0.33 for purpose in life, and 0.40 for personal growth (64).
- 2 A 9-item questionnaire, validated in Italian, to measure Positive Mental Health (PMH). Each item of this questionnaire is rated on a 4-point Likert scale ranging from 0 (strongly disagree) to 3 (strongly agree). Higher scores indicate higher PMH. The Cronbach's alpha is 0.93 (65).
- 3 A 13-item questionnaire, validated in Italian, to evaluate the Sense of Coherence (SOC) and its three underpinning dimensions, namely the cognitive (Comprehensibility), the instrumental or behavioral (Manageability) and the motivational dimension (Meaningfulness). Each item of this questionnaire is rated on a 7-point Likert scale ranging from 1 (never) to 7 (always). Higher scores indicate greater levels of SOC. The Cronbach's alpha is 0.83 (66).

TABLE 1 MB program sessions and activities.

Session	Duration	Theoretical contents of education in conscious embodiment	Body–mind practices	Homework
1.	8 H	Reflection on expectations, anticipation, and motivations Exploration of conceptual horizons: awareness, embodiment, self-care, attention, transformative “technologies,” pillars of practice	An Mo & Do In (self-massage movements) Self-analysis and breath re-education Kinesphere [use of an imaginary sphere for movement stimulation] (KS) Body Scan	Body Scan + KS
2.	4 H	\	Sitting Meditation [breath awareness (BA)] Guided experiential anatomy Statue, Snail, Jellyfish Free exploration in floorwork (floor movements) (FEF) Dialogic practice	BA + FEF
3.	4 H	Obstacles to practice and “antidotes”	Dialogic practice Review of practices from the previous session (BA, FEF, KS)	BA + FEF + KS
4.	8 H	Modes of “doing” vs. “being” Relationship between body, emotions, and thoughts ABC model (antecedents, beliefs, consequences) Autopilot and living in the head Decentralization	Sitting Meditation (personal analysis and motivation) Body-thoughts-emotions exercise based on mindfulness Breathing Space	BA + Pleasant Events Diary + Breathing Space
5.	4 H	Stressors and stress Reaction vs. response	Dialogic practice Balance games with a partner Juggling	BA + Problem Solving Foot Block + Unpleasant Events Diary + Breathing Space
6.	4 H	Salutogenesis (promotion of health) General resources of resilience Sense of coherence	Sitting Meditation (personal resources practice) Walking Meditation	BA + Walking Meditation
7. + 8.	16 H	Opening to experience: relationship, problem-solving, expressiveness, vocalization, empathy	Sitting Meditation (Open Monitoring) (Loving Kindness, Compassion) (Equanimity) - Trust Practice Dialogic Practice Auditory and Vocal Practices Floorball Matrix Practice Steals the handkerchief Juggling Balance Practice Orchestra Conductor Guiding the other’s body with your touch Mimesis Moving the Body at a Distance Dancing each other’s dance Pass the cup of water as a group	Self-Management with Personalized Biographical Practices

A 32-item questionnaire, validated in Italian, known as the Multidimensional Assessment of Interoceptive Awareness (MAIA), to assess the perception and interoceptive awareness of the body and its dimensions (noticing, not distracting, not worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting). Each item of this questionnaire is rated on a 6-point Likert scale from 0 to 5 with ‘0’ indicating ‘Never’ and ‘5’ indicating ‘Always’. Higher scores equate to more awareness of bodily sensation. Cronbach’s alpha vary among the subscales: noticing ($\alpha = 0.69$), Not-Distracting ($\alpha = 0.66$), Not-Worrying ($\alpha = 0.67$), Attention Regulation ($\alpha = 0.87$), Emotional Awareness ($\alpha = 0.82$), Self-Regulation ($\alpha = 0.83$), Body Listening ($\alpha = 0.82$) and Trusting ($\alpha = 0.79$) (67). The total score as well subscales scores were calculated pre- and post-intervention.

Statistical analysis

A descriptive analysis was performed through absolute and relative frequencies and means (\pm standard deviation) as opportune.

The Wilcoxon signed-rank test was executed to determine whether MB program produced a significant difference in post-intervention scores. The choice of a non-parametric test was led by the small sample size. A p -value of less than 0.05 was considered statistically significant.

Effect sizes (ES) were calculated dividing the mean difference between post and pre intervention by the standard deviation of the difference. ES were categorized as small ($ES = 0.2$), medium ($ES = 0.5$), and large ($ES \geq 0.8$), according to the benchmarks proposed by Cohen (68).

A secondary analysis was also performed excluding participants who exceeded the 8-h absence limit.

All analyses were conducted using STATA 14.0 (Stata Corp Ltd, TX).

Results

Thirty-eight students (mean age 21.2 years; range 20–25; SD 1.2; 60.5% males) attended the MB program. Sociodemographic and clinical anamnestic data are presented in Table 2.

Six students (15.8%) did not reach the expected amount of attendance hours (hours of absence: min 8h30min, max 16h, mean 10h52min).

In Table 3, pre- and post-intervention scores are shown.

The majority of the MAIA subscales, including noticing ($p=0.003$), attention regulation ($p=0.002$), emotional awareness ($p=0.007$), self-regulation ($p<0.001$), body listening ($p=0.001$), and trusting ($p=0.001$), improved significantly after the MB program. A significant increase also occurred in PMH score ($p=0.015$).

On the other hand, except for the autonomy subscale of PWB ($p=0.036$), neither PWB nor SOC scores improved significantly.

Medium ESs were observed for all the scores that showed significant changes with higher values for MAIA subscales. The secondary analysis conducted excluding participants who exceeded the absence limit did not show any notable difference in the results (Table 4).

Discussion

The findings of our study provide evidence that the MB program had positive effects on interoceptive awareness and psychological mental health among young adults.

We observed significant changes in the most of MAIA subscales. Participants demonstrated improved abilities to recognize body sensations, manage attention, become more emotionally aware, engage in self-regulation, listen to their bodies, and establish trust in their bodily experiences. These findings are consistent with previous research that has found that MM practices, such as yoga and tai chi, improve interoceptive awareness (69–71) and could be interesting in the light of the known relationship between interoceptive awareness and emotional regulation (72, 73).

Furthermore, the MB program resulted in a significant increase in psychological mental health, as assessed by the PMH scale. This finding suggests that the training could have enhanced the participants' general well-being and mental functioning. In this respect MM activities have already been shown to reduce stress, anxiety, and depressive symptoms, while also fostering positive emotions and psychological resilience (74–76). The participants' engagement in MB program exercises might have provided opportunities for self-expression, stress reduction, and emotional regulation, leading to improved PMH.

As far as psychological well-being is concerned, only the PWB autonomy subscale showed significant changes. The autonomy subscale measures an individual's perception of having control over their own actions, choices, and behaviors. It reflects the extent to which a person feels independent, self-directed, and able to make decisions aligned with their own values and interests (77). Autonomy is a central aspect in the developmental process of emerging adults who face evolutionary challenges such as starting work, leaving the parental home, and engaging in stable and lasting relational experiences. Higher levels of autonomy during this phase of life are viewed as "being self-determined and independent; being able to resist social pressures in thinking and acting; being capable of self-regulating one's behavior; and evaluating oneself based on personal standards" (78). Therefore, the results shown by our study could be interesting as

TABLE 2 Population's sociodemographic and clinical anamnestic data.

Variable	N.	
Sex	Male	23 (60.5%)
	Female	15 (39.5%)
Age	Mean (\pm SD)	21.2 (\pm 1.2)
BMI	- Underweight (16–18.49)	3 (7.9%)
	- Healthy weight (18.5–24.99)	27 (71%)
	- Overweight (25–29.99)	6 (15.8%)
	- Obesity class 1 (30–34.99)	2 (5.3%)
Self-perceived health	- Very good	10 (26.3%)
	- Good	20 (52.6%)
	- Average	5 (13.2%)
	- Fragile	3 (7.9%)
	- Very fragile	0 (0%)
Depression mood	- Yes	10 (26.3%)
	Mean of days with depression mood	5.2 (SD 2.7)
	- No	28 (73.7%)
Smoke	- Smoker	17 (44.7%)
	Mean N° of cigarettes smoked weekly (\pm SD)	38.9 (\pm 43.9)
	Months of smoking, mean (\pm SD)	44.5 (\pm 25.7)
	Ex- smoker	9 (23.7%)
	\geq Six months	6 (66.7%)
	< Six months	2 (22.2%)
	Unknown	1 (11.1%)
	Non- smoker	12 (31.6%)
Alcohol (at least 1 alcohol unit) during the past 30 days	- Yes	27 (71.1%)
	Mean N° of alcohol unit during the past 30 days (\pm SD)	1.1 (\pm 0.7)
	Binge drinking	3 (11.1%)
	- No	11 (28.9%)
Physical activity (Moderate-intense physical activity during the past 30 days)	- Yes	32 (84.2%)
	Mean moderate-intense physical activity (min/week) (\pm SD)	337.7 (\pm 270.2)
	- No	6 (15.8%)
Physical active	- Yes	29 (76.3%)
	- No	9 (23.7%)

autonomy can have a positive impact on health and well-being (78, 79).

Regarding the SOC, the results of our study did not show significant improvements. The SOC refers to an individual's perception of the world as comprehensible, manageable, and meaningful, and it has been associated with better mental health and well-being (80). The lack of significant improvements in SOC may be attributed to several factors. One possibility is that the relatively short duration of the program was not enough to impact the SOC. It is possible that a longer intervention period may have

TABLE 3 Pre and post MB program scores.

		PRE			POST				
		Median	Interquartile range	SD	Median	Interquartile range	SD	<i>p</i>	ES
MAIA	Noticing	3.75	3–4	0.84	4.25	3.75–4.50	0.63	0.003	0.53
	Not-distracting	2	1.67–2.67	0.81	2.33	1.67–2.67	0.70	0.689	0.07
	Not worrying (37)	2.67	2–3.33	1.02	2.67	2–3.67	1.06	0.934	0.02
	Attention regulation	2.86	2.29–3.29	0.79	3.57	2.86–3.86	0.78	0.002	0.60
	Emotional awareness	4	3.2–4.4	0.93	4.1	3.8–4.6	0.49	0.007	0.50
	Self-regulation	2.75	2.25–3.25	1.00	3.5	2.75–4.25	1.01	<0.001	0.74
	Body-listening	2.67	1.67–3.33	1.01	3.67	2.67–4	1.07	0.001	0.67
	Trusting	3.67	2.67–4	1.18	4	3.33–5	0.82	0.001	0.60
PWB	Self-acceptance (37)	12	10–13	2.46	12	11–14	2.11	0.286	0.24
	Positive relations with others	15	12–17	3.02	14.5	12–17	2.56	0.796	0.05
	Autonomy	14	10–15	3.17	14.5	13–15	2.66	0.036	0.43
	Environmental mastery (36)	12	11–14	2.36	13	10–14	2.49	0.769	0.08
	Purpose in life (36)	12	11–13	2.14	13	10–13	1.76	0.223	0.18
	Personal growth	16	15–18	2.16	16	14–17	2.02	0.491	–0.11
	Total (34)	84.5	73.5–88.5	11.97	84	75.5–90	9.18	0.387	0.18
PMH	Total (37)	18.0	15–21	4.87	19	16–22	4.06	0.015	0.46
SOC	Comprehensibility (36)	20.5	17–22.5	5.28	21.5	19–25	4.52	0.161	0.25
	Manageability	17	13–20	4.83	15.5	12–18	4.22	0.153	–0.25
	Meaningfulness	20.5	16–23	4.62	21	17–24	3.73	0.271	0.21

Significant *p*-values are reported in bold.

allowed for a more comprehensive exploration and cultivation of participants' sense of comprehensibility, manageability, and meaningfulness but this needs to be addressed in further studies.

Additionally, it should be noted that the activities included in the intervention program were mostly directed to target the dimensions of the PWB and interoceptive awareness. Nonetheless the program also included a specific activity on salutogenesis and was expected to potentially improved SOC because it enhanced "internal" resistance resources, namely physical, psychic, relational, emotional, mental, cognitive, intellectual and spiritual potential of the individual.

To the best of our knowledge our study is rather unique in terms of type of intervention proposed and broadness of outcomes assessed. In fact, other studies on the same target population, namely young adults, have mostly investigated mindfulness-based interventions that gave priority to the mindfulness practices. Systematic reviews of studies evaluating mindfulness-based interventions in university students have shown improvements in respect to stress and mindfulness (81–83) mental health and well-being (81–83) but also coping capacities (82).

The unprecedented integration that MB proposes among the multiple dimensions of motor skills (sensory, perceptive, expressive, symbolic, communicative, relational, playful, creative, cognitive, spiritual) is meant to constitute a pragmatic "bridge" of interaction between body, mind, and emotions in line with the emerging mind–body medicine. In this context, the body, mind, and emotions are

regarded as working in unity (84). Furthermore, MB is characterized as a tool for enriching "body awareness," a term frequently used (67, 85–87) to define a mental function characterized by a keen sensitivity to bodily signals, which leads to conscious identification of states deriving from subtle bodily reactions to internal and external conditions (88). In this respect MB focuses on the quality of movement, on "how" movements are experienced in relation to space, time and energy (89). The "embodiment" of experience constitutes a potential pillar for a deeper and more fruitful bodily awareness and could be a tool for improving the functional quality of specific neural processes, allowing the cultivation of an attentional ability that may be transferred to multiple contexts and areas (90, 91).

This is a rather "new" approach since the evaluations done by clinicians and researchers is still driven by anatomical, biomechanical and physiological parameters, despite the large spectrum of psychological, social and humanistic dimensions that the movement contains (92).

It is important to note some limitations of this research. Firstly, a control group was not foreseen, and the study population was relatively small and selected from a specific university context. These limits prevent to assess the efficacy of the program in a robust way and to generalize the results, but it should be observed that the purpose of this study was exploratory.

Another limit is due to the fact that the impact of the program was evaluated just in a short-term horizon and only in healthy

TABLE 4 Pre and post MB program scores in subjects who had not exceeded the limit of hours of absence.

		PRE			POST				
		Median	Interquartile range	SD	Median	Interquartile range	SD	<i>p</i>	ES
MAIA	Noticing	3.88	3.13–4.25	0.73	4.25	3.75–4.50	0.50	0.009	0.51
	Not-distracting	2	1.67–2.83	0.82	2.33	1.67–2.67	0.74	0.881	0.04
	Not worrying (31)	2.67	1.67–3.33	1.02	2.67	1.83–3.33	1.06	0.617	0.09
	Attention regulation	2.86	2.29–3.21	0.76	3.57	2.86–3.93	0.72	0.001	0.70
	Emotional awareness	4	3.3–4.4	0.87	4.1	3.8–4.6	0.46	0.008	0.51
	Self-regulation	2.75	2.25–3.13	0.96	3.5	2.75–4.25	0.98	<0.001	0.84
	Body-listening	2.83	2.17–3.5	0.97	3.67	2.5–4	1.08	0.004	0.61
	Trusting	3.67	2.5–4	1.26	4	3.33–5	0.83	0.002	0.63
PWB	Self-acceptance	11.5	10–14	2.61	12	11–14	2.18	0.552	0.20
	Positive relations with others	14.5	12–16	3.07	15	12–17	2.66	0.247	0.28
	Autonomy	14	10.5–15.5	3.30	15	13–16	2.43	0.017	0.54
	Environmental mastery (30)	12	10–14	2.50	13	10–15	2.45	0.498	0.22
	Purpose in life (31)	11	10–13	2.13	12.5	10–13	1.80	0.135	0.28
	Personal growth	16	14.5–18	2.29	16	14–17.5	2.06	0.663	0.06
	Total (29)	84	72–88	12.69	84	75–91	9.60	0.108	0.31
PMH	Total (31)	18	14–21	4.81	19	16–23	4.22	0.013	0.51
SOC	Comprehensibility (30)	21	16–23	5.37	21.5	19–25.5	4.75	0.108	0.31
	Manageability	16	13–19.5	4.96	15	11.5–18.5	4.40	0.167	–0.24
	Meaningfulness	20	16–23	4.58	21	18–24	3.80	0.110	0.31

Significant *p*-values are reported in bold.

students not affected by any psychological disorder. In particular, the exclusion of students with pre-existing psychological disorders was reasoned by the evidence (93) that psychological disorders might influence sensory perception and subjective evaluation of environmental stimuli and physical activities and, subsequently, the impact of the intervention. It should also be considered that, because of the small sample size, stratified analyses were inconclusive (results not shown). Nevertheless, in future studies it would be important to address if socio-demographic variables, such as sex, as well as personal lifestyles could influence the impact of the program. Finally, we need to consider that the low Cronbach's alpha value of the domains of the PWB questionnaire could impair results in terms of their reproducibility but it should be also considered that the 18-item questionnaire is widely used in research because of its validity.

Our study has also some strengths, including the use of validated tools for evaluating the program impact and the good level of engagement of participants that was demonstrated by the absence of dropouts and by the high level of questionnaire completion. Furthermore, the positive results issued by our pilot study provide the basis for planning further studies also including a control group and a longer follow up.

Our results provide preliminary evidence of the potential of MB as a mean to promote well-being and physical and mental health during the critical period of young emerging adulthood. The positive preliminary results showed could be attributed to a positive physiological sensation recognition and management, a

deeper connection between physical sensations and emotional states, and a greater perception of one's own body. Further research with different study designs and larger and diverse study populations are envisaged to confirm and expand upon these preliminary findings and to explore the mechanisms underlying the observed effects.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Comitato Etico Regionale dell'Umbria. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SSP: Writing – review & editing. MC: Writing – review & editing. FI: Writing – review & editing. LB: Writing – review &

editing. GP: Writing – review & editing. RC: Writing – original draft. CG: Writing – original draft. CL: Writing – original draft. AC: Writing – review & editing. GS: Writing – review & editing. CM: Writing – review & editing. AB: Writing – review & editing. CdW: Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2024.1372660/full#supplementary-material>

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