Research Article

The Effect of the Pythagorean Self-Awareness Intervention on Psychological, Lifestyle and Cognitive Measures of a Community Sample

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Abstract

Background: The aim of this study was to evaluate the effect of a novel cognitive-behavioral stress management intervention, termed "Pythagorean Self-Awareness Intervention" (PSAI). Materials and Methods: The PSAI was applied to a community sample for eight weeks. Measurements included demographic characteristics, daily habits, sleep quality, fatigue, perceived stress levels and depressive symptoms. Cognitive function was measured by the Symbol Digits Modality Test (SDMT), the California Verbal Learning Test (CVLT) and the Brief Visuospatial Memory Test-Revised (BVMT-R). Results: The high-compliance group showed statistically significant differences in healthy lifestyle and personal control choices (HLPCQ; p=0.006), sleep quality (PSQI; p=0.007), self-regulation eating behavior (SREBQ; p=0.009), perceived stress (PSS; p=0.001) and depressive symptoms (p=0.003). Conclusions: Frequent practice of the PSAI had a positive effect on the psychological, lifestyle, and cognitive measures of the community sample. Larger studies are needed to establish the PSAI as an effective stress management method.

Introduction

Stress is a state in which our internal balance is threatened by unpleasant and difficult circumstances or stimuli (Tsigos & Chrousos 2002). The stress system consists of the hypothalamus-pituitary-adrenal (HPA) axis and the locus caeruleus/norepinephrine-autonomic nervous system (Chrousos 2009, Nicolaides *et al.* 2015). Upon exposure to a stressor, the body may react spontaneously in different ways: fight, flight or freeze. The response option certainly depends on previous ancestral or personal empirical and practical recordings and/or experiences; nevertheless, the organism must return to the previous harmonious state, termed "homeostasis" (Bruce & Wingfield 2003).

Any excessive or prolonged activation of the stress system results in the development of several pathologic conditions, including anxiety,

depression, obesity, and metabolic syndrome (Tsigos *et al.* 2000). In addition to the increased activation of the HPA axis, the two parts of the autonomous nervous system (sympathetic and parasympathetic) are unbalanced; therefore, the human body swifts or alters its allostatic load and the organism is under distress (McEwen & Seeman 1999). However, the human body is cannot distinguish between physical or psychological distress, so it is important for people to understand when they are stressed or not and how stressed they are.

Cognitive-based techniques are among the most common and well-adopted practices can be used as stress management methods (Lorenzo *et al.* 2016). Their implementation enables an individual to recognize which everyday situations or thoughts are disturbing the harmony of the body and the mind (and/or the soul) and to take action to solve the problems mentally (Esch & Stefano 2010a, Esch & Stefano 2010b, Bougea *et al.* 2013). In the present study, we implemented a stress management technique, termed the "Pythagorean Self-Awareness Intervention" (PSAI), in a community sample. The technique integrates daily lifestyle habits (diet, exercise, eating and sleeping hours) into daily cognitive recall before bedtime. Changes in stress, anxiety and other emotional states were evaluated at the beginning and end of the intervention via self-report questionnaires.

Materials and Methods

Trial design

A one-armed pilot study was conducted in a community sample of adult men and women. The study was consistent with the Declaration of Helsinki and was approved by the Scientific and Ethics Committee of the National and Kapodistrian University of Athens, Greece. Written informed consent was obtained for all participants at the beginning of the study.

Participants

Adult men and women, aged 18 to 85 years old, were recruited by means of advertisements with a snowball method in the Attica basin. The inclusion criteria were as follows: i) age over 18 years; ii) adequate knowledge of the Greek language; and iii) ability to reach the venue of meetings autonomously for eight weeks. The exclusion criteria were as follows: i) participation in other stress management programs; ii) experience of a major stressful event in the past 3 months or during the study; and iii) drug addiction. The intervention's timetable included a first and last individual meeting, interviews and subjects' measurements and a weekly three-hour group meeting session that occurred continually for six weeks. The group meetings consisted of evidence-based lectures about stress and the influence of modern lifestyle habits on human health (sleep duration, exercise, nutritional behavior etc.). A record of each week's lifestyle habits and a summary of the participants experiences were documented.

Pythagorean Self-Awareness Intervention (PSAI)

The Pythagorean Self-Awareness Intervention (PSAI) is a cognitive and behavioral stress management technique that has been developed and implemented over the last eight years in clinical and not clinical populations, by the postgraduate program ''The Science of Stress and Health Promotion'' of the Medical School of the National and Kapodistrian University of Athens. The PSAI has been previously evaluated as having beneficial results, in patients with multiple sclerosis (Anagnostouli *et al.* 2018), mild cognitive impairment (Darviri *et al.* 2016b), chronic insomnia (Tsoli *et al.* 2018), ache vulgaris (Tsoli *et al.* 2018).

The content of the technique is based on the Pythagorean philosophy (founded at the Kroton of South Italy, 2500 years ago) and the ''Golden Verses'' of Pythagoras (URL: https://en.wikipedia.org/wiki/The_golden_verses_of_Pythagoras). According to our knowledge, introspection and memory practicing were two of the most crucial tools, for the Pythagorean students in order to assess self-mastery and self-awareness.

Each participant was trained to recall the events of the day crossed and to evaluate his or her behavior in relation to four main parameters, i.e. daily activity (exercise and achievement of 10000 steps/day), nutrition (in terms of quality, quantity and time of food intake), sleep time and duration (circadian synchronization) and interpersonal relationships, especially in terms of anger and non-harm (moral framework). Through this multidimensional (holistic) process, which involved simultaneous body training (exercise, nutrition, sleep) during the day and mind training (recall of events of the day) at night before sleep, participants entered a process of introspection and self-observation. The behavioral self-examination was performed after the recall procedure at night,

with three questions: "What have I done wrong?", "What have I done right?", "What have I omitted that I ought to have done?". The participants were reminded to avoid emotional burden throughout the process, and use passive voice for critical assessment. The implementation of the technique in the morning included an early brief recall of the previous day's events and organization of the upcoming day, before the start of daily activities. All participants were also trained to perform diaphragmatic breathing and were advised to practice it twice a day, especially before practicing the PSAI.

Measurements

Stress and physical fatigue during the past week were measured on a visual analog scale, rate from zero to ten points on a 10 (cm) straight line. The higher responses on the scale were, the higher the associated perception. Cognitive function was measured by the Symbol Digits Modality Test (SDMT), the California Verbal Learning Test (CVLT), and the Brief Visuospatial Memory Test-Revised (BVMT-R).

Daily habits and the perception of stress, depression, positive or negative emotions, and sense of coherence were measured with the self-report questionnaires listed below:

• Healthy Lifestyle and Personal Control Questionnaire (HLPCQ) (Darviri *et al.* 2014): This questionnaire compiles data on healthy lifestyle choices and assesses the adoption of everyday healthy lifestyle habits. It consists of 26 items (12 on nutrition, 8 on daily management of time, 2 on organized physical activity and 4 on social support, positive thinking practices, and evacuation of the mind during bedtime). Each item is rated on a four-point Likert scale from 1=rarely or never to 4=always. High scores indicate empowerment of the individual's health.

• Pittsburgh Sleep Quality Index (PSQI) (Kotronoulas *et al.* 2011): The PSQI consists of 19 self-report questions categorized into seven sub-areas. Questions refer to the following issues occurring during the previous month: subjective sense of sleep quality, latency of sleep time (i.e., how long it usually takes to fall asleep each night), duration of sleep, usual sleep efficiency (i.e. the percentage of time spent in bed sleeping), sleep medication, and malfunction during the day. The response options range from 0-3 and the overall ranking score is from 0 (high sleep quality) to 21 (low sleep quality). Lower scores suggest a healthier sleep quality.

• Self-Regulation Eating Behavioral Questionnaire (SREBQ) (Simos *et al.* 2018): This questionnaire consists of two sections. The first scale refers to the preference of consuming tempting foods such as chocolate, pizza, pastries and sweets. It also includes two more questions regarding intentions to adopt healthier dietary choices. The second scale consists of five questions about nutritional behavior. The response options are on a Likert-type rating scale, and questions two and four are scored-reversed.

• Perceived Stress Scale (PSS-14) (Andreou *et al.* 2011): The PSS is a fourteen-item self-report questionnaire. It rates emotions and thoughts that are perceived as stressful, on a 5-point Likert scale (0 = never to 4 = very often). Higher scores indicate a higher level of a person's perceived stress during the past month.

• Beck Depression Inventory (BDI-II) (Giannakou *et al.* 2013): This questionnaire is a self-report scale of 21 items, and is scored from 0 to 3. the questionnaire measures the severity of depression in adults and adolescents. Unlike the BDI, it evaluates the specific symptoms corresponding to the diagnostic criteria for depression disorders, according to DSM-IV.

• Positive and Negative Affect Scale (PANAS) (Daskalou & Sigkollitou 2012): This scale measures positive and negative emotions. Twenty randomly distributed words are used to describe 10 negative and 10 positive emotional situations, each rated from 1 (very little) to 5 (very much). As noted by the authors, low grades in positive emotions may indicate a state of regret or apathy, while in contrast, high grades of negative emotions, indicate a person likely to experience anger, nervousness, fear or lack of satisfaction. The scale has shown satisfactory validity of conceptual construction confirming the two distinct negative and positive emotional subclasses. The Cronbach's reliability alpha (a) is .71 for positive emotion and .79 for negative emotion. The rating of the total scale is derived from the individual subscale averages.

• Sense of Coherence Questionnaire (SOC) (Anagnostopoulou & Kioseoglou 2002): This scale was created by Aaron Antonovsky (1993) and assesses the ability of a person to sense, to understand the circumstances and to be able to manage them. The internal coherence (the feeling of cohesion) is considered a relatively stable feature of an individual. It consists of 13 items rated from 1-7 (1=Very often and 7=Very rarely or never). The scale has high reliability and validity,

compared to other scales that measure the same personality trait.

• Symbol Digits Modality Test (SDMT) (Sheridan *et al.* 2006): This test examines attention and speed of information possessing. During the test, the participant is called to combine nine symbols with nine numbers. After practicing in writing and in ten consecutive combinations, the examiner has 90 seconds to finish the test verbally. A count of the correct answers provides the total score of the scale.

• California Verbal Learning Test (CVLT) (Stegen *et al.* 2010): This test examines verbal memory. Four conceptual groups of sixteen words are randomly included in a list. The examiner reads each word to the examinee, in one-second interval from the previous word. After listening to all of them, the participant is asked to recall as many words as possible. The procedure is repeated five times and the score is calculated from a count of the remembered words. (the maximum score of correct answers is 90).

• Brief Visuospatial Memory Test-Revised (BVMT-R) (Benedict 1997): This test is commonly used to measure visuospatial learning and memory. The participant has ten seconds to memorize six different shapes placed in 6 different frames and then to copy them onto a black sheet of paper in the same position (2X3 frames). Two points are given when both the shape and position are correct, but only one point is given when only the shape or the position is sketched correctly. The final score (maximum 36 points) is the total count of the three ongoing efforts.

Statistical analyses

A High Compliance Group (HCG) (N=25), practicing twice a day (morning and evening) five to seven times per week and a Low Compliance Group (LCG) (N= 9) (less than 5 times a week) were obtained from the sample data. Data also included the following demographic variables (gender, age, marital status, cohabitation, children, education, employment, smoking habit), Body Mass Index (BMI) and scores on the Healthy Lifestyle and Personal Control Questionnaire (HLPCQ), Pittsburg Sleep Quality Index (PSQI), Regulation Eating Behavioral Questionnaire (SERBQ), Perceived Stress Scale (PSS), Positive and Negative Affect Scale (PANAS), Beck Depression Index (BDI-II), Sense of Coherence (SOC), Symbol Digits Modality Test (SDMT), California Verbal Learning Test (CVLT) and Brief Visuospatial Memory Test-Revised (BVMT-R). Measurements were performed at baseline and 8 weeks after. Due to the small sample size, the analysis was conducted using nonparametric tests, namely, Mann-Whitney U tests for the between group comparisons and Wilcoxon Matched Pair Test for the between time comparisons. The level of significance between group and time periods was 0.05. Statistical analyses were conducted using IBM SPSS Statistics Version 25 software.

Results

Flow chart of the study

Forty-two people had been recruited to participate in the study. Ultimately, forty people proceeded for evaluation. Three individuals were excluded because they could not consistently attend the weekly meetings for the entire eight-week period. One participant dropped out of attendance after having completed the baseline measurements and before the program started, due to a serious family-related health problem. Among the rest of the participants, two more stopped attending after the second meeting due to business trips.

Demographic data of participants

Of the 34 participants in the intervention group, the majority were female (79.4%). The participants ages varied, with most being over forty years old (64.6%). A total of 83.3% of the sample had moderate (47.1%) to high (41.7%) educational levels. Seventeen subjects were married (50.0%), and 35.3% had two children. Table 1 shows the demographic characteristics of the sample.

The study sample was divided into two compliance groups according to the frequency of application of the technique in the morning and in the evening, during the week. A high-compliance group (N=25) included those participants who practiced the PSAI at a frequency of five to seven times per week, and a low-compliance group (N=9) was formed that included subjects who practiced the technique less than 5 times per week or not twice a day. The information was collected by filling in a weekly calendar and responding to a questionnaire, at the end of the intervention. At the same time, participants were asked to record any difficulties they faced.

PSAI improved several health components in the high-compliance group

The high-compliance group (which practiced twice-a-day and for more than five times per

Table 1. Demographic sample data (n=34)

Categories	Descriptive	N (%)
Gender	Male	7(20.6)
	Female	27(79.4)
Age group	21-30	9(26.5)
	31-40	3(8.8)
	41-50	8(23.5)
	51-60	8(23.5)
	61-70	5(14.7)
	>70	1(2.9)
Marital status	Single	11(32.4)
	Married	17(50.0)
	Divorced	4(11.8)
	Widower	2(5.9)
Cohabitation	Alone	22(64.7)
	Cohabit	11(32.4)
Children	Yes	19(55.9)
	No	15(44.1)
Education	Basic	2(5.9)
	Low	2(5.9)
	Moderate	16(47.1)
	High	14(41.2)
Employment	Employee	25(73.5)
	Unemployment	4(11.8)
	Retired	5(14.7)
Smoking Habit	Yes	6(17.6)
	No	20(58.8)
	Ex-smoker	8(23.5)
BMI	Under weight	2(5.9)
	Normal	10(29.4)
	Overweight	13(38.2)
	Obese	9(26.5)

Values refer to frequencies (N) and percentages (%).
Educational level was categorized as basic (high school graduates), low (technical school graduates), moderate (Technological Educational Institution graduates), high (University graduates, Master and PhD holders).

week) (N=25) showed statistically significant differences at post-intervention in healthy lifestyle and personal control choices [HLPCQ] (p=.006), sleep quality [PSQI] (p=.007), self-regulation eating behavior [SREBQ] (p=.009), perceived stress [PSS] (p=.001) and depressive symptoms (p=.003). Statistically significant differences were also recorded in cognitive tests. Table 2 demonstrates the statistically significant differences between the scores on the self-report questionnaires (e.g, healthy lifestyle scales, sleep quality, self-regulation of eating behavior, stress, perceived stress, depression, positive and negative emotions, and sense of coherence) and the cognitive tests (processing speed, information retrieval, and visual memory) at post-intervention, for both groups. Moreover, a statistically significant improvement was recorded over time for stress (p=.003) and physical fatigue (p=.012) in the high-compliance group.

Certain qualitative outcomes were recorded during all sessions and at the end of the program. Some of the participants' comments are quoted: *"The technique helped me to identify stressful conditions"*, *"I do not allow anyone to tear me down"*, *"I am more resilient to negative behaviors now"*, *"I can cope with the quarrels now"*, *"I am so much more efficient at work"*, *" My sleep is rejuvenating"*, *"I have stopped forgetting what I had to do during the day"*.

Discussion

The use of everyday lifestyle choices as a therapeutic non-pharmaceutical model and for a holistic approach to human well-being has been proposed by the World Health Organization (WHO) and other international standard recommendations (ELMO, 2018, WHO, 7th Global Conference on Health Promotion, n. d,, WHO | Track 2, n.d., WHO | Track 3, n.d). Furthermore, lifestyle choices are included in many different techniques and are recommended by many researchers addressing stress management programs. In 2010, Erch and Stefano (Esch & Stefano 2010a) formally unified a "BERN" model on stress management programs, arguing that the mode of action of such combinatorial programs appears to work through the release of hormones, such as dopamine, endorphin, and morphine, beyond other biological molecules (opioid receptor agonists, endocannabinoids, oxytocin or serotonin). However, since these latter effects are clearly undefined and because of their nature, it is important that actions are repeated. Thus, endogenous hormone secretion on a daily basis is a crucial need for self-regulation of the body and endogenous dynamic stress regulation (Habib *et al.* 2001). Neurobiologically, the common point between different ap-

Table 2. Group and time comparisons in the study sample (n=34)

		0 week	8 week	Significant by time (p value)
HLPCQ	HCG	68(41-92)	77(56-88)	0.006**
	LCG	66(42-82)	77(42-82)	ns
	Significant by group (p value)	ns	ns	
PSQI	HCG	5(1-11)	2(1-12)	0.007**
	LCG	4(1-13)	1(0-7)	0.042*
	Significant by group (p value)	ns	ns	
SREBQ	HCG	17(7-25)	19(14-25)	0.009**
	LCG	17(9-22)	17(14-21)	ns
	Significant by group (p value)	ns	ns	
PSS	HCG	40.5(21-63)	34(19-46)	0.001**
	LCG	36(26-46)	31.5(22-50)	ns
	Significant by group (p value)	ns	ns	
BDI II	HCG	1.5(1-5)	1(1-4)	0.003**
	LCG	2(1-4)	1(1-4)	ns
	Significant by group (p value)	ns	ns	
PANAS positive	HCG	37.5(31-45)	39(25-46)	0.025*
	LCG	38(36-48)	43(28-46)	ns
	Significant by group (p value)	ns	ns	
PANAS negative	HCG	21.5(11-38)	17(10-34)	0.027*
	LCG	20(13-32)	20(14-26)	ns
	Significant by group (p value)	ns	ns	
SOC	HCG	67(37-79)	72(37-84)	0.049*
	LCG	63(33-77)	63(28-81)	ns
	Significant by group (p value)	ns	ns	
SDMT	HCG	52(24-95)	69.5(74-89)	<0.001**
	LCG	55(35-68)	70(50-95)	0.008**
	Significant by group (p value)	ns	ns	
CVLT	HCG	69(41-79)	72(54-79)	0.020*
	LCG	66(38-74)	68(45-80)	ns
	Significant by group (p value)	ns	ns	
BVMT-R	HCG	28(10-36)	30(20-34)	ns
	LCG	24(2-34)	28(12-36)	0.041*
	Significant by group (p value)			

Values represent medians (min-max).
BDI-II: Beck Depression Index; BVMT-R: Brief Visuospatial Memory Test-Revised; CVLT: California Verbal Learning Test; HCG: High Compliance Group; HLPCQ: Healthy Lifestyle and Personal Control Questionnaire; LCG: Low Compliance Group; PANAS: Positive and Negative Affect Scale; PSQI: Pittsburg Sleep Quality Index; PSS: Perceived Stress Scale; SDMT: Symbol Digits Modality Test; SOC: Sense of Coherence; SREBQ: Regulation Eating Behavioral Questionnaire;
ns: no significant
*Level of significance p<0.05 **Level of significance p<0.01

proaches and therapeutic practices for stress management seems to be the common self-regulatory circuits of rewards and motives of the human central nervous system (Esch & Stefano 2010b). The overlap between forms of neurological self-regulation and self-healing makes cognitive-behavioral interventions extremely useful therapeutic practices that support the medicine of the mind and body through the modification of the behavioral column (King *et al.* 1996, Reijnders *et al.* 2017).

The "PSAI" technique is one such combinational approach, that aims to improve an individual's everyday lifestyle, memory, and well-being. This goal accomplished through a multidimensional process, which includes the following: i) body training through daily exercise; ii) particular eating behaviors, in terms of the food quality and fixed meal times; iii) early evening sleep for better circadian rhythms; iv) mnemonic/memory education through the daily recall of the events of the completed day; and v) evaluation of the behaviors and actions (activities) of the completed day and planning of the day that begins. The main advantage of the PSAI technique is the one-time training, and the ability to be practiced by training at home with no extra cost. As a difficulty in applying the technique, the trainees reported fatigue at bedtime, hence, many fell asleep (especially those reporting going to bed late at night), and did not have sufficient time in the morning, as they needed to hurry to work.

The limitations of the study include the small sample size and the group diversity in terms of compliance with the PSAI. Furthermore, interventions in community samples in which the collection method does not involve randomization but rather accidental or convenience sampling, as well as collection through advertising or in the form of snowball sampling, have the peculiarity that, beyond diversity, there is limited ability to control bias and avoid systematic errors (Neuman 2005). However, a key advantage of these methods is the low cost of conducting the study, the ease of accessing the sample and the reduced time for obtaining the necessary data.

In our days, the most prevalent trend for the stress management techniques is the motivation for the individual to change the control center of his or her desires and priorities (Nutbeam 2000; Sørensen *et al.* 2013). It is argued that through this methodology the person modifies the choices of his/her lifestyle and gradually his/her behavior whenever he/she is empowered for a new start (wellness restart). Gradually, self-empowerment and self-efficacy can be seen as part of individuals development towards improving their quality of life, from a eustress situation to a state of well-being (ευ ζην) (Crocq 2015).

In conclusion, the frequent practice of the "Pythagorean Self-Awareness Intervention" had a positive and significant effect on the psychological, lifestyle and cognitive measures, i.e, healthy lifestyle and personal control choices, sleep quality, self-regulation eating behavior, perceived stress and depressive symptoms, of the community sample studied. Further studies in larger population samples are needed to establish the PSAI as an effective stress management method.

Conflicts of interest

There is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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