Effects of electroacupuncture on stress-related symptoms in medical students: a randomised controlled pilot study

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Abstract

Objective To assess the effects of electroacupuncture on stress-related symptoms—sleep disorders, anxiety, depression and burnout—in medical students, and provide data to inform a power analysis to determinate numbers for future trials.

Methods Twenty-five students were randomly assigned to an electroacupuncture (n=12) group or control group (n=13) that did not receive treatment. Electroacupuncture was applied at a continuous frequency 2 Hz for 20 min once a week for 8 weeks at sites on the extremities, face, ear and scalp. The outcomes of the students treated with electroacupuncture were compared with those of the control group at the endpoint, controlling the influence of baseline scores. The instruments used were self-administered questionnaires that comprised the validated Portuguese version of the mini-sleep questionnaire (MSQ), the Pittsburgh sleep quality index (PSQI), the Epworth sleepiness scale (ESS), the Beck depression inventory (BDI), the Beck anxiety inventory, the Maslach burnout inventory-student survey (MBI-SS), and World Health Organization quality of life assessment - abbreviated version (WHOQOL-bref).

Results The medical students treated with electroacupuncture showed a significant decrease compared with the control group for MSQ scores (p=0.04) and PSQI (p=0.006). After treatment, 75% students in the electroacupuncture group presented a good sleep quality, compared with 23.1% of the students in the control group. No significant difference on daytime sleepiness was shown by the ESS. The electroacupuncture group showed significant improvement on depressive symptoms (BDI), the emotional exhaustion and cynicism dimensions of burnout (MBI–SS) and physical health (WHOQOL–bref).

Conclusions Electroacupuncture was associated with a significant reduction of stress-related symptoms, but because of the study design the authors cannot say what proportion of the reduction was due to needle stimulation.

Stress has been defined in terms of stimulus, response and process. In particular, psycho-

logical stress can be defined as a state that is harmful to wellbeing when the stressors are perceived by the individual as surpassing his or her coping resources.¹ Stressors are potential threats to the homeostasis of the individual, and activate a stress response that produces physiological and behavioural changes integrated by the limbic system, hypothalamic-pituitary-adrenal axis and autonomic nervous system. The threats or stressors may be real or perceived, and may be traumatic, degenerative, infectious, autoimmune, mental and other. Moreover, the intensity and duration of the stress can trigger several heath disorders or worsen preexisting diseases.²³

Techniques such as transcutaneous nerve stimulation, acupuncture with manual or electrical (electroacupuncture) stimulation of the needles has been used to treat stress-related symptoms, including psychiatric symptoms (insomnia, depression, anxiety), disorders of visceral functions (cardiovascular, digestive, respiratory, urinary tract) and disorders of endocrine, immune and musculoskeletal systems.⁴⁻⁷

Recent publications have described the onset of burnout in medical students and resident physicians because of continuous stress. In the USA, the prevalence rate of burnout is high, affecting up to 50% of medical students and 23–76% of residents.⁸⁹ In Brazil, the prevalence rates of symptoms of stress and depression are 50% and 79% in medical students and residents, respectively.^{10 11} Similarly, the prevalence rate of sleep disorders is high in medical students.^{12 13} In a longitudinal study in progress, medical students from different academic years showed similar prevalence rates (unpublished data) in the Fluminense Federal University, Niterói, Brazil.

The objective of this study was to assess the effects of electroacupuncture on stress-related symptoms including sleep disorders, anxiety, depression and burnout in medical students. As part of this, the study will provide data to inform a power analysis to determine sample sizes for future trials.

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Original paper

 Table 1
 Target population characteristics and comparisons between acupuncture and control groups in severity ratings score and gender proportions

	Target population		Acupuncture		Control		Analysis	
Scales	N=64	%	N=12	%	N=13	%	Acupuncture×control	
Gender								
Male	29	45.3	3	25.0	5	38.5	p=0.67*	
Female	35	54.7	9	75.0	8	61.5		
Sleep quality (MSQ)							$\chi^2 = 1.10; p = 0.29^{**}$	
Good sleep quality (10-24)	24	37.5	_	_	_	_		
Mild difficulties (25–27)	10	15.6	_	_	_	_		
Moderate difficulties (28–30)	7	10.9	4	33.4	2	15.4		
Severe difficulties (>30)	23	35.9	8	66.6	11	84.6		
Sleep quality and disturbances (PSQI) >5							$\chi^2 = 0.04; p = 0.84^{**}$	
No	20	31.3	_	_	_	_		
Yes	44	68.8	12	100.0	13	100.0		
Daytime sleepiness (ESS)							G ² =3.88; p=0.14***	
No sleepiness (0–10)	22	34.9	1	8.3	4	30.8		
Excessive (11–15)	31	49.2	7	58.3	8	61.5		
High level (>15)	10	15.9	4	33.4	1	7.7		
Depressive symptoms (BDI)							G ² = 3.88; p=0.14***	
No depression-minimal (0-9)	42	65.6	4	33.4	6	46.1		
Mild-moderate (10-18)	19	29.7	8	66.6	4	30.8		
Moderate-severe (19-29)	2	3.1	0	_	2	15.4		
Severe (≥30)	1	1.6	0	_	1	7.7		
Anxiety symptoms (BAI)							G ² =3.76; p=0.29***	
No anxiety-minimal (0–9)	40	62.5	8	66.6	6	46.1		
Mild–moderate (0–18)	14	21.9	1	8.4	4	30.8		
Moderate-severe (19-29)	8	12.5	3	25.0	2	15.4		
Severe (≥30)	2	3.1	0		1	7.7		
Burn out (MBI–SS)								
Emotional exhaustion \geq 3	57	89.1	12	100.0	13	100.0	χ ² =0.04; p=0.84**	
Cynicism ≥3	19	29.7	6	50.0	7	53.8	χ ² =0.04; p=0.85**	
Academic efficacy \leq 3	6	9.4	1	8.4	3	23.1	$\chi^2 = 1.01; p = 0.31^{**}$	

*Fisher's test.

**Pearson χ².

***Likelihood ratio χ^2 .

BAI, Beck anxiety inventory; BDI, Beck depression inventory; ESS, Epworth sleepiness scale; MBI–SS, Maslach burnout inventory–student survey; MSQ, mini-sleep questionnaire; PSQI, Pittsbugh sleep quality index.

PATIENTS AND METHODS

The protocol of this study was approved by the Committee for Ethics in Scientific Research of the Medical School of the Fluminense Federal University/Antônio Pedro University Hospital, under the number 210/2010 and registered at the Brazilian Ministry of Health under the number 0169.02.258.000-10.

Participants

The target population of this study (table 1) comprised 64 students who were attending the last semester of the second year of medical school at the Fluminense Federal University in Niterói, Brazil. The exclusion criteria comprised a history of severe bleeding or the use of anticoagulants, the use of antiplatelet drugs, addiction to psychoactive substances (cocaine, crack), pregnancy and the presence of a pacemaker. No participant was excluded by these criteria.

First, the 64 students filled out the self-administered questionnaires that assessed the stress-related symptoms.

The instruments were the validated Portuguese version of the mini-sleep questionnaire (MSQ), the Pittsburgh sleep quality index (PSQI), the Epworth sleepiness scale (ESS), the Beck depression inventory (BDI), the Beck anxiety inventory (BAI), the Maslach burnout inventory–student survey (MBI–SS) and the World Health Organization quality of life assessment – abbreviated version (WHOQOL–bref).^{14–21} Moreover, the socioeconomic data were obtained through a specific questionnaire developed for this research.

Thirty students who had moderate (28–30) or severe (>30) sleep quality in the MSQ (see table 1) were invited to participate in this trial. Twenty-six accepted. These students were informed about methodological aspects and the technique that would be used, and gave written informed consent. Predetermining that 13 students would be allocated either to the treatment group or to the control group, a 'manual' randomisation technique was used, ie, the students drew pieces of paper from an opaque bag. One student from the acupuncture group dropped out of

Original paper



Figure 1 Diagram of stages of the study. EA, electroacupuncture.

treatment after the second treatment (figure 1). Only one student had previously been treated with acupuncture—2 years previously—in the treatment group.

Outcomes measures

This study assessed the effects of electroacupuncture on stress-related symptoms in medical students. We compared the scores detected by measuring instruments (that evaluated the presence or absence of these symptoms and their severity, see table 1) between the treatment and control group before intervention and 1 week after the end of treatment, statistically controlling the influence of the baseline scores. The endpoint of the study was chosen to be close to the period of the final examination of the academic year.

Interventions

The treatment consisted of eight weekly sessions per patient. Sterile, single-use stainless steel needles 40×0.25 mm (Arhon Din, Rio de Janeiro, Brazil) were inserted using a guide tube in standardised points and then connected to a Sikuro DS100C electrostimulator (Sikuro, Rio de Janeiro, Brazil). The electrostimulator generated an alternate rectangular/exponential asymmetric current of 0.6 ms duration (figure 2). Electrical stimulation was delivered at 2 Hz in continuous mode for 20 min, at an amplitude that was comfortable for the patient.

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The needles were connected to the electrostimulator in pairs: ST36 connected to ST36 (2 cm deep; manipulated to obtain muscle response); PC6 to PC6 (0.5 cm obliquely towards distal); GB14 left (inserted subcutaneously 1 cm toward the midpoint of the eyebrow) connected to *Shenmen* in the triangular fossa of the ipsilateral ear; GB14 right connected to the heart point in the centre of the ipsilateral cavum concha. Needles were inserted 0.5 cm under the scalp at GV20 and four *Shishencong* points, directed caudally or rostrally and connected to each other. The students were treated in the supine position.

All acupuncture sessions were carried out by the same physician (MD) with more than 20 years of experience. The treatment was performed in his private office.

The control group received no interventions. Participants in both groups had no additional treatment, although they have been told to see the psychiatric outpatient service if needed.

Statistical analysis

First, we generated descriptive statistics of the distribution of severity in both groups, using each scale's accepted classification (see table 1). In this comparison, the Pearson χ^2 test was mainly used. However, when the data violated the assumptions underlying its use, the likelihood ratio χ^2 and Fisher's tests were applied.

We then conducted a one-way between-groups analysis of covariance (ANCOVA) to compare the efficacy of

Original paper



Figure 2 Sikuro electrostimulator.

acupuncture and control groups for each of the outcome measures. At the endpoint, changes from baseline for outcome measures were analysed independently, with treatment as the independent variable, endpoint scores as dependent variables and baseline scores as covariates. Furthermore, we calculated the η^2 effect size for outcome measures.

Finally we used Pearson χ^2 tests to assess the difference between the proportions of acupuncture and control subjects that reached the response criteria for sleep quality scales (MSQ scores <25 and PSQI <5), according to definitions specified in the protocol (table 1).

All tests were performed at a significance level of p<0.05 and data were analysed by the statistical package SPSS 17.0 for Windows. The power analysis to determine sample size for future studies was calculated by means of the G*Power 3.1.2 software.

RESULTS

The mean age of the 64 students who filled out the selfadministered questionnaires (21.4 years, SD=2.1) was similar to the mean age of the 25 students in the treatment group (21.1 years, SD=1.8; n=12) and of the control group (21.3 years, SD=2.4; n=13). These 25 students provided data at follow-up and were included in the analysis. There was no adverse effect of the electroacupuncture treatment, but the student who dropped out felt 'distressed' with the needles after the second treatment.

Table 1 shows the distribution, by sex and severity rating scores, in the target student population and in the treatment and control groups. With regard to the target population, 30 students (46.8%) showed moderate and severe difficulties in sleep quality assessed by MSQ. Furthermore, 44 students (68.8%) reached PSQI scores greater than 5, which means a poor quality of sleep. In the ESS, 31 students (49.2%) and 10 students (15.9%) showed, respectively, excessive and a high level of daytime sleepiness. One student did not complete the ESS.

The assessment of depressive symptoms revealed that 19 students (29.7%) showed mild to moderate depression,

two students (3.1%) moderate to severe depression and one student (1.6%) severe depression in the BDI; the assessment of anxiety symptoms revealed that 14 students (21.9%) showed mild anxiety to moderate anxiety, eight students (12.5%) moderate to severe anxiety, and two students (3.1%) severe anxiety in the BAI.

The MBI–SS measures three dimensions. High scores in emotional exhaustion and cynicism (C) and low scores in academic efficacy (this is a reversed subscale) imply the occurrence of burnout. In this study, the selected cutpoint was 3. Therefore, using this cutpoint, 57 (89.1%) and 19 (29.7%) students, respectively, presented moderate to high levels of emotional exhaustion and cynicism. In contrast, only six students (9.4%) had low academic efficacy, ie, a score equal to or lower than 3.

No significant differences between the electroacupuncture and control groups were observed in severity classification measured by scales at baseline, and the predominance of women was similar in both groups (table 1).

The medical students treated with electroacupuncture showed a significant improvement in sleep quality compared with the control group (table 2). The mean scores in the MSQ decreased from 33.8 to 25.1 in the treatment group, whereas they decreased from 36.3 to 33.3 in the control group (p=0.04). Therefore, MSQ mean scores passed from the severe difficulty level to the mild difficulty level in the treatment group. Furthermore, compared with students in the control group, the students treated with electroacupuncture had a significantly greater reduction in the PSQI global score from baseline (electroacupuncture: from 9.9 to 4.8; control: from 9.1 to 7.5; p=0,006). More specifically, the students treated with electroacupuncture showed a greater improvement in subjective sleep quality (electroacupuncture: from 1.9 to 1.1; control: from 1.6 to 1.7; p=0,03) and decreased the use of sleep medication (electroacupuncture: from 1.9 to 0.0; control: from 1.6 to 0.6; p=0.02).

The ESS mean scores decreased from 14.2 to 10.4 in the treatment group, and from 11.1 to 10.0 in the control group. There was no statistically significant treatment effect at the endpoint (p=0.17).

The mean scores of depressive symptoms decreased significantly in the treatment group, whereas they increased in the control group (from 10.8 to 4.9 vs from 12.6 to 13.4, respectively; p=0.006). Although the mean score of anxiety symptoms decreased by half in the treatment group (from 10.2 to 5.7) and increased in the control group (from 13.3 to 14.0), the statistical analysis revealed a difference near the significance level (p=0.06).

In the burnout dimensions assessed by the MBI–SS, students treated with electroacupuncture improved significantly in the emotional exhaustion (from 4.8 to 3.6) and cynicism (from 3 to 2.1) when compared with the control students (from 4.5 to 4.4 and from 2.9 to 3.1; p=0.004 and p=0.02, respectively). In academic efficacy, we did not find statistical differences in the outcomes of the groups. However, the students of the electroacupuncture group improved their performance (from 3.9 to 4.2); the control students worsened their performance (from 3.7 to 3.6).

Table 2 Means scores and outcome comparisons between acupuncture and control groups

Baseline			Endpoint	Analysis (ANCOVA)			
	Acupuncture (n=12)	Control (n=13)	Acupuncture (n=12)	Control (n=13)			
Scales	μ (SD)	μ (SD)	μ (SD)	μ (SD)	F(1, 22)	р	<mark>η²</mark>
Sleep quality (MSQ) (≥28)	33.8 (4.8)	36.3 (7.33)	25.1 (6.28)	33.3 (10.29)	4.42	0.04	0.17
Sleep quality and disturbances (PSQI)							
Subjective sleep quality	1.9 (0.6)	1.6 (0.6)	1.1 (0.5)	1.7 (0.7)	5.40	0.03	0.20
Sleep latency	1.5 (1.1)	1.6 (1.1)	0.9 (0.7)	1.6 (1.0)	3.96	0.05	0.15
Sleep duration	1.4 (0.6)	1.0 (0.7)	0.9 (0.7)	0.9 (0.8)	0.16	0.69	0.007
Habitual sleep efficiency	0.4 (0.6)	0.4 (0.6)	0.0 (0.0)	0.2 (0.4)	3.34	0.08	0.13
Sleep disturbances	1.2 (0.4)	1.3 (0.6)	0.9 (0.2)	1.1 (0.5)	1.62	0.22	0.07
Use of sleep medication	1.9 (0.6)	1.6 (0.6)	0.0 (0.0)	0.6 (1.1)	5.94	0.02	0.21
Daytime dysfunction	1.5 (0.8)	1.3 (0.6)	0.9 (0.6)	1.1 (0.5)	1.16	0.29	0.05
Global score	9.9 (2.7)	9.1 (2.9)	4.8 (1.9)	7.5 (3.6)	9.40	0.006	0.30
Daytime sleepiness (ESS)	14.2 (4.2)	11.1 (2.8)	10.4 (4.5)	10.0 (4.5)	2.01	0.17	0.08
Depressive symptoms (BDI)	10.8 (4.8)	12.6 (8.4)	4.9 (4.6)	13.4 (11.5)	9.62	0.005	0.30
Anxiety symptoms (BAI)	10.2 (8.7)	13.3 (11.4)	5.7 (2.9)	14.0 (13.6)	3.79	0.06	0.15
Burn out (MBI–SS)							
Emotional exhaustion	4.8 (0.7)	4.5 (1.0)	3.6 (0.7)	4.4 (1.0)	10.68	0.004	0.33
Cynicism	3.0 (1.4)	2.9 (1.6)	2.1 (1.1)	3.1 (1.5)	5.80	0.02	0.21
Academic efficacy	3.9 (0.7)	3.7 (0.8)	4.2 (0.3)	3.6 (0.9)	3.57	0.07	0.14
Quality of life (WHOQOL-bref)							
Physical health	12.7 (1.7)	12.3 (2.8)	15.5 (1.9)	12.7 (2.2)	11.71	0.002	0.35
Psychological	13.6 (2.3)	12.9 (3.1)	15.2 (1.8)	13.5 (2.9)	2.32	0.14	0.09
Social relationships	15.4 (2.5)	14.5 (2.4)	16.8 (1.6)	15.3 (4.1)	0.59	0.45	0.03
Environment	14.2 (1.9)	14.4 (2.2)	15.2 (1.9)	14.6 (2.0)	1.33	0.26	0.06
Overall	13.8 (2.6)	13.8 (4.1)	15.0 (1.5)	13.5 (4.6)	2.42	0.13	0.1

ANCOVA, analysis of covariance; BAI, Beck anxiety inventory; BDI, Beck depression inventory; ESS, Epworth sleepiness scale; MBI-SS, Maslach burnout inventory–student survey; MSQ, mini-sleep questionnaire; PSQI, Pittsbugh sleep quality index; WHOQOL–bref, World Health Organization quality of life assessment – abbreviated version.

In the domains of quality of life measured by WHOQOL-bref, the medical students in the electroacupuncture group showed greater improvement in their physical health from baseline, compared with the control students (from 12.7 to 15.5 and from 12.3 to 12.7, respectively).

Finally, as can be seen in table 3, nine students (75.0%) treated with electroacupuncture scored under 25 (good sleep quality) in the MSQ at the endpoint, compared with only three students (23.1%) in the control group (p=0.009). With regard to the assessment of sleep quality by the PSQI, eight students (66.7%) who received treatment and four students (30.8%) of the control group, respectively, presented a score of less than 5 at the endpoint. This difference in the PSQI was near statistical significance (p=0.07).

No student used the psychiatric service of the hospital.

We considered the effect size of the emotional exhaustion of this exploratory study as representative of the stress-related symptoms. A priori analysis for ANCOVA, which used this effect size ($\hat{I} \cdot \hat{A}^2 = 0.33$), a power of 0.80, and a significance level of 0.05 as the input parameters, revealed that a sample of 19 individuals per group would be sufficient to obtain definitive results in similar trials. Using a 95% power and maintaining the other parameters the same, the required sample size would be 29.

DISCUSSION

The high prevalence of stress-related symptoms in medical students is an important problem, as previous studies and this study revealed (table 1). The MSQ, which is traditionally used as a screening instrument on sleep quality,²² was chosen to select the participants in this study because poor sleep quality is usually correlated with other stress-related symptoms such as anxiety, depression and burnout.²³⁻²⁵

The students treated with electroacupuncture had a significant improvement (or remission) in the stressrelated symptoms when compared with the control group. In our study, there is evidence of improvements in sleep quality and daytime sleepiness parameters with electroacupuncture. Both the total MSQ score and global PSQI scores decreased significantly, and we found specific improvement in the PSQI subscales of subjective sleep quality and the use of sleep medication. In addition, 75% of the students treated with electroacupuncture showed good sleep quality, versus 23% of the students in the control group (table 3). The positive correlation between sleep quality and daytime sleepiness is known,¹³ but in our study the ESS score did not decrease significantly as the sleep quality scores. The lack of effect could be due to the small sample size, or else a longer duration of good sleep quality may be necessary for the remission of daytime sleepiness.

Table 3	Sleep quality	comparisons	between	acupuncture and	
control g	groups at endpo	pint			

Scales	Acupuncture (n=12)	Control (n=13)	χ²
Sleep quality (MSQ) <25	9 (75.0%)	3 (23.1%)	χ ² =6.74, p=0.009
Sleep quality and	8 (66.7%)	4 (30.8%)	$\chi^2 = 3.22, p = 0.07$
disturbances (PSQI) ≤5			

MSQ, mini-sleep questionnaire; PSQI, Pittsbugh sleep quality index.

Besides the improvement in sleep quality, we also found evidence of the effectiveness of the electroacupuncture on depressive and anxiety symptoms, on burnout dimensions and on one domain of quality of life. Estimating the magnitude of these effects, according to Cohen criteria,²⁶ the improvements in sleep quality (η^2 =0.30), depression (η^2 =0.30), emotional exhaustion (η^2 =0.33) and physical health (η^2 =0.35) could be considered a large effect.

On the other hand, one student dropped out of treatment because he felt 'distressed' with needling. Such a situation is not infrequent in the clinical practice of an acupuncturist, and this possibility should be taken into account in research designs with the technique.

To our knowledge, this is the first study to assess the efficacy of electroacupuncture on burnout in medical students. However, the efficacy of electroacupuncture on other stress-related symptoms sucy as depression, anxiety and sleep disorders is well documented.

In a systematic review, Kalavapalli and Singareddy²⁷ identified 19 studies about the treatment of insomnia using acupuncture. Six studies were randomised clinical trials, four were open trials and the remainder were case series. With subjective assessments, the authors of the open trials and case series studies reported sleep improvement in more than 80%. We got a similar response rate (75%) in this trial. In the randomised trials that used standardised questionnaires. polysomnography or actigraphy, there has also been a significant improvement in the outcome of sleep quality. Another review²⁸ studied 46 randomised controlled trials that showed benefits with acupuncture in the treatment of insomnia compared with no treatment and sham acupuncture, as well as longer sleep duration in patients treated with acupuncture when compared with medication use. The combination of acupuncture with medication was superior to each alone.

Considering the treatment of depression with acupuncture, in a recent meta-analysis Wang *et al*²⁹ identified eight randomised trials that used sham acupuncture controls. The authors concluded that acupuncture can decrease significantly the severity of depression, although there are differences in the response rate or remission. In contrast, systematic reviews by Smith *et al*³⁰ and Leo and Ligot³¹ showed that acupuncture is as effective as medication, although they did not find differences between the real and sham acupuncture treatment.

Reviews by Samuels *et al*⁵² and Pilkington *et al*⁵³ also concluded that there may be positive benefits with acupuncture in the treatment of depression and anxiety. In particular, they found that patients undergoing surgical procedures reported decreased anxiety symptoms.

Those studies point to the efficacy of acupuncture on sleep disorders, anxiety and depression, and endorse our findings. Nevertheless, all authors underline the need for studies with larger sample sizes and proper methodology. Studies with more rigorous methodology can contribute to a better assessment and can explore the mechanisms of action. Moreover, comparison of the results may be hampered because the studies used different numbers of sessions, intervals between sessions, needle placement and stimulation techniques. On the other hand, the efficacy of acupuncture in many studies that used different points suggests the absence of specificity of points, at least with respect to the supraespinal effects.^{34–36}

Supraspinal effects of acupuncture are related to the modulation of the limbic–hypothalamic–pituitary axis. Acupuncture generates adaptive changes that prompt the body to a homeostatic state closer to the normal physiology, reflecting on mood, sleep regulation and the immune system. The positive effects on mood, sleep and immunity result from inhibition of the brain structures that maintain the continuous response to stress and the consequent release of different opioid peptides and neurotransmitters. These positive effects are more relevant using painless needling and electric currents with low frequency, as in this study.^{35 37–44}

In our trial we inserted the needles near major nerve trunks (ST36 and PC6), and in the ear points: *Shenmen*, located in the area innervated by the trigeminal nerve, and the point of the heart, located in the area innervated by the vagus nerve, sites deemed appropriate for the achievement of supraspinal effects.^{38 39 44 45-47} The territory of the trigeminal nerve, where the point GB14 was needled, and the territory of the occipital nerve, where GV20 and *Shishencong* were treated, has been used in other peripheral neural stimulation techniques such as transcranial magnetic stimulation and direct current electrical stimulation for the same purpose.⁴⁸⁻⁵¹

In this exploratory trial, the improvement in stress-related symptoms may be considered with caution because of methodological limitations. The students of the control group did not receive similar attention and so the placebo effect cannot be quantified.⁵² Therefore, we cannot say what proportion of the reduction of stress-related symptoms was due to needle stimulation. In turn, the sample size, although small, was adequate to demonstrate the effect of electroacupuncture versus no treatment, somewhere between the estimated sample sizes of 19 (SE II of 20%) and 29 (SE II of 5%).

Unlike earlier studies, the population of this trial was not sick, or at least most of the students had not sought medical assistance because of the symptoms identified by the self-administered questionnaires. In accordance with Elliot and Eisdorfer's classification of the types of stressors, referenced in¹, these medical students are healthy individuals exposed to chronic stressors linked to the medical school workload, which, in turn, requires extra hours of study, often during the night. To what extent the stress generated by the medical school can worsen the health status or learning difficulties in students and to what extent acupuncture can lessen these consequences remains uncertain.^{12 53} These questions could be answered only by longitudinal studies. **Contributors** Ana Emília Teófilo Salgado, Augusto Sergio Soares Dutra, Bernardo Cordeiro e Oliveira, Caio Silva Lodi, Márcio Amaral de Oliveira Filho, Monique Bastos Amaral, Naira Vanessa Anomal Gonzalez, Raquel Muniz da Silva Melo, Yeska Talita Maia Santos Carvalho, medical students, Fluminense Federal University, Rio de Janeiro, Brazil: Patient recruitment, data collection, databank consolidation.

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Competing interests None.

Patient consent Obtained.

Ethics approval The protocol of this study was approved by the Committee for Ethics in Scientific Research of the Medical School of the Fluminense Federal University/ Antônio Pedro University Hospital, under the number 210/2010 and registered at the Brazilian Ministry of Health under the number 0169.02.258.000-10.

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