ORIGINAL RESEARCH

TESTING THE BIOELECTRIC SHIELD

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A pendant was claimed to provide numerous health benefits, including reduced stress, increased strength, and protection from electromagnetic radiation from computers and mobile phones. Three experiments tested the effectiveness of this pendant's effect as a bioelectric shield. In the first experiment, 12 subjects who work with computers wore shields (6 real, 6 sham) for several weeks and were regularly tested for hand strength and mood changes. Both types of shield increased calmness, but the real shields did not have any greater effect. In 2 further studies (in each N = 40) hand strength was measured at baseline, with mobile phone, and with mobile phone and bioelectric or sham shield. The shields did not differ in their effects. Both studies showed a significant correlation between the change in strength with and without the shield and subjects' scores on a questionnaire concerning their belief in and use of alternative therapies. The shields appear to produce a measurable placebo effect but are otherwise ineffective. (Altern Ther Health Med. 2002;8(5):62-67)

Alternative therapies are widely used, widely promoted, and involve large sums of money. Exact prevalence is hard to assess but Ernst[1] reviewed estimates of use ranging from 9% to 65% of the population. He concluded that use is frequent and increasing. In another systematic literature search, Greene, Berger, and colleagues[2] examined the evidence supporting the 10 most popular alternative therapies identified in the Alternative Medical Care Outcomes in AIDS study. About half used prayer, massage, acupuncture and meditation, and a third used visualization, imagery, breathing exercises, and spiritual activities. Despite high frequencies of use, adequate clinical research to support the use of these therapies could not be found.

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Neldner[3] points to the many herbal and nonherbal remedies, therapeutic devices, and techniques that were rarely used 10 years before, and complains that the medical profession has exercised little control over production, medical recommendations, or quality control of these products. In the main, the majority of alternative practices and products are promoted in the genuine and sincere belief that they will be of benefit to those who use them. The concern is, of course, that unless scrutinized and evaluated scientifically, alternative practices can run the risk of becoming exploitative quackery.[4]

Critics of alternative medicine have pointed out that a fundamental difference between ordinary medicine and most alternative practices is that the alternative practices have not been rigorously and scientifically tested.[4-6] Such testing is needed to determine which therapies have specific effects and which have only placebo effects. We report here 3 tests of a device supposed to have widespread therapeutic and protective powers. Ethical approval for the 3 experiments was obtained from the ethical committee of the Faculty of Applied Sciences, University of the West of England, Bristol.

The BioElectric Shield® (BioElectric Company, Lavina, Mont) attracted a great deal of publicity when both Cherie Blair (well-known lawyer and wife of the British Prime Minister) and Hillary Clinton were photographed wearing them. Bestselling author Dannion Brinkley is reported as claiming that the shield has given him "more energy, greater clarity of thought and better perception."[7] The shields are attractive silver or gold pendants that hang around the neck on a fine silk cord. Among the many claims made are that "[t]he shield utilizes principles of physics to help you cope with the energy overload/stress of your daily life" and that they harness the energy of nature to improve your life.[8] Each shield "contains a composition of a matrix of precision-cut quartz and other crystals designed to balance and strengthen your natural energy field."[9] In the advertising literature the manufacturer claims that wearing the pendant increases muscular strength, reduces fatigue, nausea, and stress, and protects the wearer from both electromagnetic radiation (as emanated from computers and mobile phones) and from other people's negative energies.[10-12] At the time of writing the cheapest shield in the United Kingdom costs £119 and the most expensive £1,799.00, and in the United States, $139.95

and $2,200.00, respectively. Given the high cost of these shields, the strong claims made by the manufacturer, and the high profile the shield has had in the media, we decided that the claims ought to be tested.

First we tried to review existing tests. The manufacturer claims to have tested more than 12,000 people using applied kinesiology, a finger dynamometer, or computerized myography, though many of these tests were done informally at trade fairs. They also performed 10 research studies[12,13] between 1990 and 2000. These include a computerized acupuncture testing device that showed improvements in immune system, liver, and kidney function after 3 weeks of wearing a shield, and several tests using finger muscle strength as the dependent variable. These claimed that strength was reduced by holding a battery-powered watch close to the heart, visualizing stressful situations, and holding a mobile phone. In all cases, wearing an authentic shield even for a short time prevented the weakening, but a sham shield did not. No detailed information was given for these studies, such as subject numbers, number of trials, controls employed, or whether practice or tiredness could have affected the results.

A final experiment used computerized myography to measure a drop in muscle strength in 25 subjects who sat in front of a computer for 5 minutes. The initial drop averaged 17% and there was a 44% increase in strength after wearing the shield for a further 5 minutes.[13] The effect increased over several hours, and most of the subjects showed an increase in strength beyond their original reading before they were weakened by the computer. For this study it is not clear whether a sham shield was used. No mention of one was made and no comparative results were given. This suggests that all the results could have been due to practice, tiredness, expectation, or other nonspecific effects. Many graphs were given on a Web site and in the promotional literature, but these did not provide any of the details necessary to decide whether the study was properly carried out or not. For example, 3 traces were shown for the 3 test conditions, but they were not labeled. As far as we can tell, none of these studies has been published in a peer-reviewed journal.

We contacted the manufacturer through a distributor in the United Kingdom and tried to find out more. We received the same graphs that were in the promotional literature and were told that the studies had been submitted to journals but we could not find out which ones. We said that we would like to carry out more tests and arranged with the manufacturer to obtain both real and sham shields, a total of 6 of each. We decided to test the 2 major claims made for the shields; first, that wearing a shield would reduce a person's stress; second, that the shield would counter the muscle-weakening effects of exposure to electromagnetic radiation. In each case the experiments were designed to test the claims actually made by the manufacturers as closely as possible. For example, we screened subjects using the manufacturer's own questionnaire. After discussions with the manufacturer, we ensured that the subjects wore the shields for periods longer than the "initial balancing period" and long enough to measure changes in stress and mood, and we encouraged subjects to follow the recommended regime for caring for and recharging their shields.

EXPERIMENT 1

Method

Subjects

Subjects were obtained by advertising on the University of the West of England (UWE) e-mail system for volunteers to take part in an experiment to test the BioElectric Shield. As part of our selection process we asked those who responded to fill out a questionnaire from the advertising literature given to us by the manufacturer.[8] This questionnaire purports to determine whether or not an individual could benefit from using a shield. Twelve female subjects volunteered to participate in the experiment; all were UWE staff members and, according to their questionnaire responses, all could benefit from wearing the shield. Their average age was 41 years (range 28-52 years).

Materials

Alternative Therapies Questionnaire. A 10-item alternative therapies questionnaire was developed to obtain a broad measure of the subjects' belief in the effectiveness and use of a variety of popular alternative therapies. This questionnaire was piloted on 77 undergraduate students at UWE. Subjects' scores in this pilot had a mean of 4.7 (scores ranged from 0 to 10) and a standard deviation of 2.66. A Kolmogorov-Smirnov goodness-of-fit test confirmed that the distribution of scores was normal (K-S z score=1.13; P=.16). The questions are listed in the Appendix.

VAS Mood Scale. This standard visual analog scale (VAS) uses 18 bipolar items to obtain a subjective measure of the subject's mood. The scale had 3 main factors: alertness (eg, dreamy–attentive), calmness (eg, relaxed–tense), and happiness (eg, sad–happy).[14]

Hand Dynamometer. An analog hand dynamometer was used to measure changes in hand strength. This is similar to the measure used in the manufacturer's experiments. These devices are known to produce variable results, being susceptible to practice and tiredness effects. Therefore, in each session, the subjects had 3 attempts with the device and the 3 measurements were averaged.

BioElectric Shields. Twelve shields were made and supplied by the manufacturer. Six of the shields were genuine, the other 6 were shams. The sham shields contained no crystals. Neither of the experimenters knew which shields were which, and subjects were informed that they would not know whether they were given a real or sham shield. The shields were individually numbered and all the subjects' data were coded by letter. Thus, the experiment was double-blind throughout.

Procedure

Briefing Practice Session. Subjects were invited to attend a first session to hear more about the experiment and to sign consent forms. Subjects were allowed to see the shields for the first time and to take away and read accompanying literature given to us by the manufacturer. At this session subjects were instructed how to use the hand dynamometer and given training and practice to allow them to find a setting and technique that was comfortable and that they would be happy to use for the rest of the experiment. Subjects also filled out the alternative therapies questionnaire.

Baseline Session. Subjects had 2 weekly meetings in which baseline measurements were taken before they were randomly allocated a shield. These sessions involved the subjects' filling in a VAS mood scale and using the hand dynamometer. At the end of this session, subjects were given their shields and a leaflet with instructions on care, cleaning, and use. For example, the leaflet explains that the shield must not be shared with anyone else and must be recharged by hanging outside or in a window in natural light for 6 hours once a month. It may be taken off at night.

Weekly Sessions with the Shield. Subjects wore their shields for an average of 6 to 7 weeks (maximum 8 weeks, minimum 5 weeks) and had sessions each week to fill out a VAS mood scale and take hand-strength readings.

Debriefing. After the last testing session, subjects returned their shields. They had been told from the start that they would not receive individual results (including whether they had been issued a real or sham shield). We feared some people might be upset if they felt a strong effect of the shield and then learned that it had been a sham. Some time later (the interval varied) all subjects were contacted in person or by e-mail and given the overall results.

Data Handling and Precautions. After the end of the experimental sessions, both the UK importer and US manufacturer visited our laboratory so that we could give them the data and they could reveal which shield was which. Up to that point, neither experimenter could have known. We prepared a list of the results coded by subject letter and shield number and asked the manufacturer to prepare a list of which shields were real and which were sham. We exchanged these lists together in the presence of an independent witness. We believe that the double-blind precautions were effective and no one involved could have manipulated the data. We carried out a preliminary analysis in the representatives' presence and the complete analysis later. We also weighed the shields, which confirmed that the 6 sham shields weighed less than the 6 real ones.

Results

At the time of exchanging the codes we carried out a preliminary analysis so we could give the manufacturer some immediate feedback and explain the value of double-blind testing. For this purpose we showed them all the individual stress and mood data laid out by subjects and asked the manufacturer's representatives to choose which subjects they thought had worn the real shields. The exact probability would be significant at $P=.05$ if they correctly selected either 5 or 6 subjects, with 3 being chance. They correctly selected 4 ($P=.24$).

The results of the full analysis are shown in Tables 1 and 2. Table 1 shows the differences in hand strength and in the 3 mood measures between the baseline period and when wearing the shield (pooled for both real and sham shields). All changes are in the predicted direction. Hand strength, alertness, and happiness all increased marginally. Calmness increased significantly ($t=-2.32$, df=11, $P=.04$), showing that wearing a shield (whether real or sham) reduced self-reported tension.

Table 2 shows the results separately for real and sham shields. No difference was found either in hand strength or in any of the factors of the mood scale between the subjects who wore real shields and those who wore shams. The changes are in the predicted direction for hand strength and calmness, but in the reverse direction for alertness and happiness.

Comment

We found no evidence for the effectiveness of the shield in terms of stress reduction, improvement in mood, or improvement in physical strength. However, regardless of whether subjects had a real or sham shield, they claimed on average to feel calmer. Based on these results it appears that the real shields did not specifically improve peoples' moods or affect their muscle strength, but wearing either shield made people feel calmer.

The subjects had an average score of 4.5 on the alternative therapies questionnaire, which does not suggest that they were particularly hostile to such therapies. No significant difference was found in alternative therapy use and belief between those subjects who had a real shield and those who had a sham ($t=-1.00$, $P=.342$).

The main limitation to this experiment was the very small number of subjects. If the differences had all (or mostly) been in the predicted direction, we might have concluded that there was a real effect and that our experiment did not have enough power to detect it. In fact, however, 2 of the differences are in the expected direction (increased hand strength and calmness) but the other 2 are in the opposite direction (alertness and happiness), suggesting that a larger sample is unlikely to produce a significant effect in the predicted direction.

Obviously a larger sample is desirable, but is not easy to obtain with this method. The reason we had so few subjects was that the manufacturer initially led us to believe that the shields only reach their full effectiveness after many days or even weeks, and that they must not be shared with another

TABLE 1. Mean scores at baseline vs wearing a sham or real BioElectric shield (N=12)

	Hand Strength		Alertness		Happiness		Calmness	
	Baseline	Shield	Baseline	Shield	Baseline	Shield	Baseline	Shield
Mean	29.83	31.02	60.02	61.05	57.46	60.13	48.55	54.67
*t**	-2		-.28		-.67		-2.32	
P	.07		.79		.52		.04	

*Paired samples *t* test.

TABLE 2. Comparison of scores between sham and real BioElectric shield (N=12)

	Hand Strength		Alertness		Happiness		Calmness	
	Sham	Real	Sham	Real	Sham	Real	Sham	Real
Mean Difference*	.82	1.55	6.02	-3.97	6.11	-.476	4.76	7.48
t†	-.6		1.42		.85		-.50	
P	.56		.185		.42		.63	

*Mean differences were obtained by subtracting the mean baseline score from the mean score wearing a shield.
†Independent samples *t* test.

person. This meant that we had to do a longitudinal study and were therefore limited in the number of subjects by the number of shields we could obtain. However, after this experiment the manufacturer said that some effects of the shield are very fast, in particular the protective effects against using mobile phones.

We were particularly interested in this claim because of public concern over the possibly dangerous effects of mobile phones. In a review of the literature, Hermann and Hossmann concluded that the present state of knowledge suggests no positive evidence that pulsed or continuous microwave radiation in the nonthermal range is a risk to the health of the brain.[15] Nevertheless, subsequent claims have stated that such radiation can affect the brain's processing of acoustic stimuli and performance on visual tasks[16] and can modify the brain's responses during a memory task.[17] With more and more children now using mobile phones, some claims have stated that children's heads absorb more of the microwave radiation than do adults'. This claim has been challenged.[18] Nevertheless, there is widespread public fear that children might be especially at risk.

These concerns and claims present 2 potential dangers from a device that claims to offer protection from the harmful effects of microwave radiation. Let us first suppose that there is no real danger from mobile phones. In this case the device is pointless. Nevertheless, people may be frightened by all the publicity into wasting large sums of money that they can ill afford and that could be put to better use for them and their children. Next, let us assume that mobile phones really are dangerous. In this case we need to know whether the device really does offer any protection. If it does not then the situation is far more serious. People may buy a BioElectric shield and assume that when they are wearing it they are safe, and therefore, expose themselves to far more radiation than they otherwise would. In this case, the shield could have serious, harmful consequences. For these reasons we carried out 2 additional experiments to test the claimed strengthening effect of the BioElectric shield in the presence of a mobile phone. The manufacturer's representatives were disappointed by the results of our first experiment, were interested in more tests, and supplied us with new shields.

EXPERIMENT 2

Method

Subjects

Forty subjects (12 women, 28 men) were recruited at the International Conference of the Society for Psychical Research in Durham, England, held September 3-5, 1999. Their average age was 48 years (range 22-79 years).

Materials

The alternative therapies questionnaire and hand dynamometer were used as described in Experiment 1. Because of time constraints, subjects were allowed a brief

practice period, and only 1 reading was taken for each stage of testing. This time the manufacturer provided us with 6 new shields, 3 of which were shams. Once again, neither we nor the subjects knew which shields were which. Shields were randomly selected for each subject using a random number table.

Procedure

Subjects were asked to sign a consent form that explained the basis of the experiment and to fill out an alternative therapies questionnaire. They were instructed in using the hand dynamometer and given a short time to practice and ensure that they handled the equipment comfortably. They were seated throughout. Testing consisted of 3 stages.

Stage 1. A baseline reading was taken with the hand dynamometer (ie, with no shield or mobile phone).

Stage 2. A mobile phone was held next to the subject's ear and the subject was asked to indicate that he or she could hear the ringing tone. After approximately 30 seconds of exposure the subject was given the hand dynamometer and a reading of hand strength was recorded.

Stage 3. The subject was given a shield to wear. Once again he or she was asked to listen to the ringing tone on the mobile phone. After approximately 30 seconds the subject used the hand dynamometer to give a third reading.

Results

When exposed to the mobile phone, there was no appreciable loss in muscle strength; indeed, the average change in the dynamometer recording was a small increase of .79 kg. As shown in Table 3, strength increased marginally when wearing a shield as well, but there was no difference between the real and sham shield groups in this effect (Wilcoxon ranked sum test, U= 179.5, z = -.505, P=.61).

There was, however, a significant correlation between the effect of wearing a shield (either real or sham) and score on the alternative therapies questionnaire (r_s=.313, N=40, P=.049). That is, people with a higher score on the test also gained more strength when wearing either type of shield.

Comment

We found no evidence to support the claim that the BioElectric shield protected wearers from the negative effects of mobile phone radiation. However, people who scored higher on the measure of use and belief in alternative therapies appeared to be more prone to the suggestion that their hand strength would increase when they wore a shield (regardless of whether the shield was real or sham). In other words, they were more prone to a placebo effect.

One obvious criticism of this experiment is that the single measurements of hand strength in each stage may have been biased by practice or weakening effects and been too variable to provide a reliable measure of change. To rectify this consideration, we ran a third experiment.

EXPERIMENT 3

Method

Subjects

Forty members of the public (19 women, 21 men) were recruited as subjects at a Science Week stall set up at Cribbs Causeway shopping mall in Bristol, England in March 2000. The average age of subjects was 33 years (range 15-55 years).

Materials

The materials used were the same as those in Experiment 2.

Procedure

The same 3-stage procedure was used as in Experiment 2, the only difference being that we took 3 measurements of hand strength for each stage.

Results

The results are shown in Table 4. Once again we found no appreciable loss in muscle strength when exposed to the mobile phone. The average change in the dynamometer recording was an increase of 1.11 kg, which may suggest a small practice effect. There was no difference between the real and sham shield groups (Wilcoxon ranked sum test, U=188, z =-.33, P= .75). Again we found a significant correlation between the gain in hand strength while wearing a shield (real

TABLE 3. Effects of mobile phone on mean hand strength, single measurement (kg) (N=40)

Shield Type	Baseline	Mobile phone	Mobile phone plus shield
Sham	32.0	32.8	34.0
Real	39.7	40.4	40.8

TABLE 4. Effects of mobile phone on mean hand strength, 3 measurements (kg) (N=40)

Shield Type	Baseline	Mobile phone	Mobile phone plus shield
Sham	36.9	37.7	37.3
Real	34.4	35.8	35.5

or placebo) and scores on the alternative therapies questionnaire (r_s=.436, N=40, P=.005).

Comment

Our results suggest that 2 of the claims made for the BioElectric shield are false. That is, our research suggests no evidence that a real shield, as opposed to a sham shield, reduces stress, improves mood, or protects people from the weakening effects of mobile phones. Although some effects were in the expected direction (but not significantly so) others were in the opposite direction. We do not think that the small number of subjects is responsible for the negative findings.

On the other hand, we did find that subjects with high scores on the alternative therapies questionnaire (that is, they use alternative therapies more and believe more in their effectiveness) were more susceptible to a placebo effect induced by wearing a shield. On the basis of these results, we suggest that wearing a BioElectric shield has only a placebo effect and no specific effect.

Throughout the process of negotiating and conferring with the manufacturer and distributor we wondered whether they sincerely believed in the effectiveness of their product. The answer seems to be yes. The BioElectric Shield sells well, they receive few customer complaints or returned shields, and many letters of praise. This tends to confirm their belief that the product really works, even though we would argue that the results are entirely due to the placebo effect. We explained the purpose of the double-blind trial, and the principles on which the statistical tests were based. Nevertheless, when we showed them the preliminary results of Experiment 1, the manufacturer and distributor suggested various interpretations of the results consistent with the shields really working; for example, that some subjects were blocking the effects, that the sham shields really did work because they had been prepared with the same care and love as the real ones, or that the shields had become mixed up (inspection proved that this was not the case). They remain convinced of the shield's effectiveness while we believe our results show it is ineffective. Thus we have a situation in which well-meaning and completely convinced people are selling an ineffective product to willing customers who will obtain nothing but a placebo effect from wearing it.

One might argue that it is worth spending a considerable sum of money on an ineffective device if it can make one feel better, even though it has only a placebo effect. However, this ignores several possibilities. Some people may fail to seek appropriate treatment for stress or even serious illness because they believe the shield will protect them. People may feel better or more relaxed because of a placebo effect and therefore expose themselves to even more stressful situations, thus exacerbating their problems. They may experience social pressure to claim they feel better or to undertake more stressful tasks because of their claims to have found a successful device. Finally, if mobile phones really are damaging, people may expose themselves to higher levels of radiation than they otherwise would in the false belief that the shield will protect them from harm.

The widespread use of expensive and ineffective devices is not a trivial concern. We need research to find out which claims are true and which are false. The results should then be publicized to help people make informed choices about how to spend their money and to prevent false claims. On the basis of our results, we believe that the BioElectric shield is ineffective.

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Appendix The alternative therapies questionnaire

1. Have you ever had treatment with acupuncture?
2. Do you believe that crystals can have healing powers?
3. Have you ever had aromatherapy treatment?
4. Do you believe that color therapy can improve people's health?
5. Have you ever used homeopathic medicines?
6. Do you believe in spiritual healing?
7. Do you ever take herbal remedies?
8. Do you believe that feng shui can harmonize the energies in a house?
9. Do you wear any jewelry to bring you good luck or health?
10. Do you believe that some therapies can balance your natural energy field?