

associated with passive smoking.⁹ However, the exact factors in cigarette smoke responsible for its detrimental health consequences are not fully understood, and such calculations are approximate.

The considerable problems with measurement imprecision, confounding, and the small predicted excess risks limit the degree to which conventional observational epidemiology can address the effects of exposure to environmental tobacco smoke. Randomised controlled trials of exposure to environmental tobacco smoke will clearly not be carried out, but understanding could be improved through Mendelian randomisation.¹⁰

Genetic polymorphisms that are associated with poor detoxification of carcinogens in tobacco smoke have been identified. The distribution of these polymorphisms in the population will not be associated with the behavioural and socioeconomic confounders that exposure to environmental tobacco smoke is. Among people unexposed to the carcinogens in environmental tobacco smoke there is no reason to believe that the detoxification polymorphisms should be related to risk of lung cancer. However, among those exposed to environmental tobacco smoke a decrease in the ability to detoxify such carcinogens should be related to risk of lung cancer, if exposure to environmental tobacco smoke is indeed responsible for increased risk of lung cancer. One study showed that a null (non-functional) variant of one such detoxification enzyme, glutathione S-transferase M1, was associated with an increased risk of lung cancer in non-smoking women exposed to environmental tobacco smoke, but not in non-exposed non-smoking women.¹¹ A later study failed to confirm this finding,¹² reflecting one limitation of

Mendelian randomisation, which is that large sample sizes are required to produce robust results. However, this is a promising strategy if we really want to know whether passive smoking increases the risk of various diseases.

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Competing interests: None declared.

- 1 Schnönherr E. Beitrag zur Statistik und Klinik der Lungentumoren. *Z Krebsforsch* 1928;27:436-50.
- 2 Davey Smith G, Phillips AN. Passive smoking and health: should we believe Philip Morris's "experts"? *BMJ* 1996;313:929-33.
- 3 Enstrom JE, Kabat GC. Environmental tobacco smoke and tobacco related mortality in a prospective study of Californians, 1960-98. *BMJ* 2003;326:1057-61.
- 4 LeVois ME, Layard MW. Publication bias in the environmental tobacco smoke/coronary heart disease epidemiologic literature. *Regul Toxicol Pharmacol* 1995;21:184-91.
- 5 Steenland K, Thun M, Lally C, Heath C. Environmental tobacco smoke and coronary heart disease in the American cancer society CPS-II cohort. *Circulation* 1996;94:622-8.
- 6 Phillips AN, Davey Smith G. How independent are independent effects? Relative risk estimation when correlated exposures are measured imprecisely. *J Clin Epidemiol* 1991;44:1223-31.
- 7 Lee PN, Forey VA. Misclassification of smoking habits as a source of bias in the study of environmental tobacco smoke and lung cancer. *Stat Med* 1996;15:591-605.
- 8 Andersen KE, Carmella SG, Bliss RL, Murphy L. Metabolites of a tobacco-specific lung carcinogen in nonsmoking women exposed to environmental tobacco smoking. *J Natl Cancer Institute* 2001;93:378-81.
- 9 Taylor R, Cumming R, Woodward A, Black M. Passive smoking and lung cancer: a cumulative meta-analysis. *Austr N Z J Public Health* 2001;25:203-11.
- 10 Davey Smith G, Ebrahim S. 'Mendelian randomization': can genetic epidemiology contribute to understanding environmental determinants of disease? *Int J Epidemiol* 2003;32:1-22.
- 11 Bennett WP, Alavanja MCR, Blomeke B, Vähäkangas KH, Castrén K, Welsh JA, et al. Environmental tobacco smoke, genetic susceptibility, and risk of lung cancer in never-smoking women. *J Natl Cancer Institute* 1999;91:2009-14.
- 12 Malats N, Camus-Radon AM, Nyberg F, Ahrens W, Constantinescu V, Mukeria A, et al. Lung cancer risk in nonsmokers and GSTM1 and GSTT1 genetic polymorphism. *Cancer Epidemiol, Biomarkers Prev* 2000;9:827-33.

The therapeutic effects of meditation

The conditions treated are stress related, and the evidence is weak

Meditation includes techniques such as listening to the breath, repeating a mantra, or detaching from the thought process, to focus the attention and bring about a state of self awareness and inner calm. There are both cultic and non-cultic forms, the latter developed for clinical or research use. The relaxation and reduction of stress that are claimed to result from meditation may have prophylactic and therapeutic health benefits, and a plethora of research papers purport to show this. However, this research is fraught with methodological problems, which I outline here, along with a short summary of the best evidence for the therapeutic effects of meditation in clinical populations. There is no Cochrane review on meditation.

Showing that certain physiological effects such as a slowed heart rate or a particular electroencephalographic pattern occur during meditation and characterise a "relaxed state" may give insight into how meditation works but does not prove its therapeutic value. Most trials of the cumulative effects of meditation have had weak designs. Trials of transcen-

dental meditation (a popular form of mantra meditation), when controlled at all, often compared self selected meditators with non-meditators or long term meditators with novices. These trials did not control for systematic differences between people who elect to learn the technique and those who do not, and between people who persist with the practice and those who abandon it. Randomised trials have often recruited favourably predisposed subjects so that expectations of benefit differ from control subjects. In trials of transcendental meditation for cognitive effects I found that positive outcome was confined to trials with subjects so recruited and to trials with passive controls such as "eyes closed rest." Trials with naive subjects and plausible controls (for example, pseudomeditation) were negative. A similar association was previously found in a meta-analysis of cognitive behavioural techniques (including meditation) for hypertension.¹ Other weaknesses have been use of multiple co-interventions, high attrition, and inadequate statistical analysis. Recent trials in clinical

populations are slightly more rigorous but are limited in number.

Controlled trials of mindfulness meditation (detached awareness of experience) have all used co-interventions such as cognitive therapy and have largely not used active controls, so that specific effects cannot be isolated or separated from non-specific effects. Sahaja meditation (passive witnessing of thoughts) improved some outcomes in patients with poorly controlled asthma, but differences were not maintained at two months.² People with epilepsy practising sahaja meditation showed a significant reduction in objective stress measures³ and frequency of seizures,⁴ but adequate intergroup comparisons are missing and there were marked differences in anxiety levels and frequency of seizures at baseline between groups. Added to a risk reduction programme for elderly men with hypercholesterolaemia, Benson relaxation response (a non-cultic form of transcendental meditation) had no significant effect on blood lipids, weight, or blood pressure,⁵ and although patients with irritable bowel syndrome reported a reduction in symptoms after six weeks of practising Benson relaxation response, the only significant difference from waiting list controls was for flatulence.⁶

Transcendental meditation has been studied extensively, but most of the research continues to be carried out by researchers directly involved in the organisation offering transcendental meditation, who seem keen to demonstrate its unique value. A meta-analysis of trials of relaxation and meditation for trait anxiety included 70 trials of meditation and showed that the 35 trials of transcendental meditation were associated with significantly larger effect sizes than other techniques.⁷ However, it included uncontrolled trials, and its assertion that outcome was not sensitive to research design, type of control, or other confounders is not supported by any data. As it excluded studies of patients with psychiatric illnesses the relevance to clinical populations is unclear. An updated and independent meta-analysis of studies of meditation for anxiety is therefore much needed.

The meta-analysis of trials of cognitive behavioural techniques for hypertension showed that effect sizes were highly sensitive to procedures used for baseline measurements.¹ Since then a trial using adequate baseline measures has reported that three months' practice of transcendental meditation significantly reduced clinic measured diastolic and systolic blood pressure over group controls given education.⁸ Progressive muscle relaxation produced an intermediate effect size. The mean adjusted changes in the transcendental meditation group were 10.7 mm Hg in systolic and 6.4 mm Hg in diastolic blood pressure. This and several other studies by authors associated with the transcendental meditation organisation indicate a positive effect on blood pressure, a claim that should be independently tested.

A trial reporting positive effects of transcendental meditation on exercise tolerance in men with coronary artery disease recruited favourably predisposed subjects, was not randomised, and had large baseline differences in exercise tolerance between groups that exceeded the reported effect sizes.⁹ The reported positive effect of transcendental meditation on the thickness of the intima media of the carotid artery, a measure of atherosclerosis, is confounded by co-intervention with diet, exercise, herbal supplements, and incomplete analysis of the data due to attrition and lack of funding.¹⁰⁻¹¹ A small trial suggesting some benefit of transcendental meditation for asthma had serious problems related to compliance with the protocol.¹² Evidence for the therapeutic effectiveness of transcendental meditation in other indications is either similarly flawed or confined to isolated small scale trials.

Overall, current evidence for the therapeutic effectiveness of any type of meditation is weak, and evidence for any specific effect above that of credible control interventions even more so. The only safety issue seems to be in seriously disturbed patients, in whom meditation may trigger psychotic episodes. The limited evidence that does exist is in indications where reduction of stress may have an important beneficial effect, and future trials with improved design may yet provide more concrete positive results in this area.

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Competing interests: None declared.

- Eisenberg DM, Delbanco TL, Berkey CS, Kaptchuk TJ, Kupelnick B, Kuhl J, et al. Cognitive behavioral techniques for hypertension: are they effective? *Ann Intern Med* 1993;118:964-72.
- Manocha R, Marks GB, Kenchington P, Peters D, Salome CM. Sahaja yoga in the management of moderate to severe asthma: a randomised controlled trial. *Thorax* 2002;57:110-5.
- Panjwani U, Gupta HL, Singh SH, Selvamurthy W, Rai UC. Effect of sahaja yoga practice on stress management in patients of epilepsy. *Indian J Physiol Pharmacol* 1995;39:111-116.
- Panjwani U, Selvamurthy W, Singh SH, Gupta HL, Thakur L, Rai UC. Effect of sahaja yoga practice on seizure control & EEG changes in patients of epilepsy. *Indian J Med Res* 1996;103:165-72.
- Carson MA. The impact of a relaxation technique on the lipid profile. *Nurs Res* 1996;45:271-6.
- Keefer L, Blanchard EB. The effects of relaxation response meditation on the symptoms of irritable bowel syndrome: results of a controlled treatment study. *Behav Res Ther* 2001;39:801-11.
- Eppey KR, Abrams AI, Shear J. Differential effects of relaxation techniques on trait anxiety: a meta-analysis. *J Clin Psychol* 1990;45:957-74.
- Schneider RH, Staggers F, Alexander CN, Sheppard W, Rainforth M, Kondwani K, et al. A randomised controlled trial of stress reduction for hypertension in older African Americans: *Hypertension* 1995;26:820-7.
- Zamarra JW, Schneider RH, Besseghini I, Robinson DK, Salerno JW. Usefulness of the transcendental meditation program in the treatment of patients with coronary artery disease. *Am J Cardiol* 1996;77:867-70.
- Fields JZ, Walton KG, Schneider RH, Nidich S, Pomerantz R, Suchdev P, et al. Effect of a multimodal natural medicine program on carotid atherosclerosis in older subjects: a pilot trial of Maharishi Vedic Medicine. *Am J Cardiol* 2002;89:952-8.
- Castillo-Richmond A, Schneider RH, Alexander CN, Cook R, Myers H, Nidich S, et al. Effects of stress reduction on carotid atherosclerosis in hypertensive African Americans. *Stroke* 2000;31:568-73.
- Wilson AF, Honsberger R, Chiu JT, Novey HS. Transcendental meditation and asthma. *Respiration* 1975;32:74-80.