Lifestyle management of blood pressure

Lifestyle modifications are an essential initial approach to the management of blood pressure. To review the current evidence in this area, *The British Journal of Cardiology* recently convened a round table meeting to look at the lifestyle management of raised blood pressure. It considered the role of dietary changes, exercise, alcohol and weight, and ways of changing patients' behaviour, on blood pressure. The meeting, held at The Royal Society of Medicine, London, and supported by an unrestricted educational grant from Unilever, was attended by investigators involved in the EUROACTION study. EUROACTION is a European Society of Cardiology demonstration project in preventive cardiology which has just been completed in eight countries in both hospital and primary care. It is evaluating whether a nurse-led multidisciplinary team can help patients and families achieve recommended lifestyle and risk factor reduction targets for cardiovascular disease prevention.

The round table meeting delegates

Chairman	
Dr Jonathan Morrell	*General Practitioner, Hastings, and National Co-ordinator (primary care), EUROACTION*
Participants	
Dr Susan Connolly	*Consultant Cardiologist, Hammersmith NHS Trust*
Ms Catriona Jennings	*EUROACTION Research Nurse Co-ordinator, Imperial College, London*
Mrs Jennifer Jones	*Superintendent Physiotherapist, EUROACTION, Imperial College London, and Lecturer in Physiotherapy, Brunel University*
Dr Thea Koning	*Project Leader Cardiovascular Health, Unilever, The Netherlands*
Ms Alison Mead	*EUROACTION Dietetic Coordinator, Imperial College London*
Professor David Wood	*Professor of Cardiovascular Medicine and Principal Investigator, EUROACTION, Imperial College London*
Discussants	
Professor Simon Thom	*International Centre for Circulatory Health, Imperial College London*
Dr Henry Purcell	*Royal Brompton Hospital, London*
Dr Sarah Jarvis	*General Practitioner, London*

Exercise is one of several possible lifestyle modifications to help in the management of blood pressure

Introduction

High blood pressure causes more deaths worldwide than any other risk factor. World Health Organisation data from the year 2002 show that blood pressure is the leading risk factor for mortality, more powerful even than tobacco and raised cholesterol. Raised blood pressure also makes an enormous contribution to the burden of disease around the world.

Even blood pressure in the so-called 'normal' range is associated with cardiovascular risk and, at a population level, small reductions in blood pressure will lead to an enormous reduction in morbidity and mortality. A decrease of 3–5 mmHg in systolic blood pressure is associated with a decrease in risk for coronary heart disease of approximately 10%, for example. Over the course of several years, patients with blood pressure in the so-called 'high normal' and 'normal' categories have a higher cumulative incidence of cardiovascular events compared with those in the 'optimal' category (< 120/< 80 mmHg) (see table 1 and figure 1).

Lifestyle interventions to help reduce blood pressure are important, and are recommended in all the latest guidance. The British Hypertension Society recommends that any patient with a borderline or 'high normal' blood pressure should receive advice on lifestyle modifications. The latest updated guidance (2006) from the National Institute for Health and Clinical Excellence (NICE), developed in conjunction with the British Hypertension Society and the National Collaborating Centre for Chronic Conditions, includes guidance on lifestyle interventions, which is summarised in table 2.

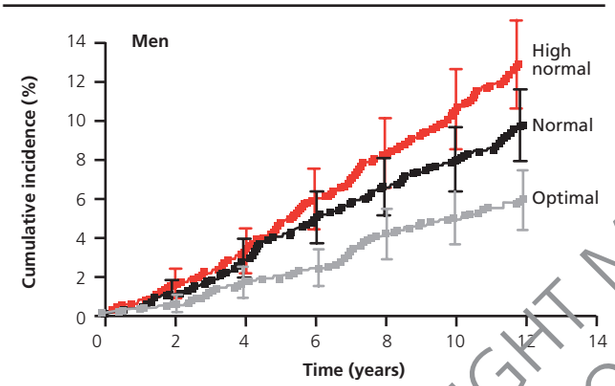
> ***'High blood pressure causes more deaths world-wide than any other risk factor'***

Blood pressure has historically been poorly managed in the UK – 1998 figures show only 6% of patients in England with hypertension had blood pressure controlled to less than

Table 1. British Hypertension Society classification of blood pressure

Classification	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)
Optimal	< 120	< 80
Normal	< 130	< 85
High normal	130–139	85–89
Mild hypertension	140–159	90–99
Moderate hypertension	160–179	100–109
Severe hypertension	> 180	> 110

Figure 1. Graphs showing cardiovascular events in men with high normal, normal and optimal blood pressure



Adapted from Vasan *et al. N Engl J Med* 2001;**345**:1291-7

Table 2. NICE recommendations (2006) on lifestyle interventions to reduce blood pressure

- Ask patients about their diet and exercise patterns, and offer guidance and written or audiovisual information
- Ask about alcohol consumption and encourage patients to cut down if they drink excessively
- Discourage excessive consumption of coffee and other caffeine-rich products
- Encourage patients to reduce their salt intake or use a substitute
- Offer smokers advice to stop smoking
- Tell patients about local initiatives (for example, run by healthcare teams or patient organisations) that provide support and promote lifestyle change

Table 3. Exercise training in the management and treatment of hypertension

Meta-analysis	RCTs included	Number of subjects	Decrease in SBP (mmHg)	Decrease in DBP (mmHg)
Halbert *et al.* 1997	29	1,553	4.7	3.1
Fagard 2001	44	2,674	3.4	2.4
Whelton *et al.* 2002	54	2,419	4.0	2.5
Cornelissen and Fagard 2005	72	3,936	3.0	2.4
Dickenson *et al.* 2006	105	6,805	4.6	2.4

Key: RCT = randomised clinical trial; SBP = systolic blood pressure; DBP = diastolic blood pressure

140/90 mmHg. These figures are improving but still 34% of men and 30% of women in England have hypertension. The importance of the management and treatment of blood pressure to target is shown by it carrying nearly a quarter of all the clinical points in the Quality and Outcomes Framework of the new General Medical Services contract.

The effect of weight loss on blood pressure

Obesity is an increasing phenomenon in the UK, with levels now estimated at 24% of the population with a body mass index (BMI) > 30 kg/m^2. Having a raised blood pressure has been shown to be directly related to being overweight or obese. Conversely, a reduction in weight has been shown to reduce blood pressure. This reduction is achieved with any amount of weight reduction, irrespective of whether a person's ideal body weight is achieved.

A meta-analysis (Neter *et al*. 2003) has shown that approximately a 1 mmHg reduction in blood pressure can be achieved per 1 kg weight loss. This meta-analysis included 4,874 participants of different ethnicity from 25 randomised controlled trials (RCTs) of greater than eight weeks' duration. In these trials, there was an average weight loss of 5 kg, achieved by energy reduction in the diet, an increase in physical activity, or both. This 5 kg weight loss was associated with significant reductions in both systolic and diastolic blood pressure (-4.44/-3.57 mmHg).

There is less evidence for the long-term effects of weight loss in relation to blood pressure but one study (He *et al*. 2000) investigated the long-term effect of weight loss on hypertension and found that beneficial effects were still apparent seven years after the study ended. Participants with a high-normal blood pressure had individual and group sessions with dietary and activity advice, 14 weekly sessions followed by fortnightly then monthly sessions for 18 months in all. Seven years later they brought back 181 of the original 208 participants. The incidence of hypertension was found to be 19% in the weight loss group compared with 40% in the control group. Interestingly, this effect was seen despite there being an equal amount of weight gain in both the control and weight loss intervention groups.

The type of diet that people use to lose weight appears to have some additional effect on reduction in blood pressure. One study (Nowson *et al*. 2005) compared findings in patients following a low-fat diet and those following a 'WELL' diet (moderate sodium, high calcium, high potassium and low fat). There was significant weight loss for both

Table 4. Recommendations for exercise for people with high blood pressure

- Frequency – most, preferably all, days of the week
- Intensity – moderate i.e. 40–60% VO_2R i.e. oxygen uptake reserve (since there is a lack of association between intensity of exercise and blood pressure response, and moderate exercise is associated with less risk)
- Time – 30 minutes or more of continuous activity, alternatively three bouts of no less than 10 minutes accumulated during the day
- Type – the evidence points principally towards aerobic exercise using large muscle groups. This can be supplemented by resistance training

Adapted from American College of Sports Medicine. *Med Sci in Sports*

Table 5. Key messages on alcohol and blood pressure

- There is a dose-dependent relationship between alcohol and blood pressure
- Reduction in alcohol consumption may reduce blood pressure levels by an average 3/2 mmHg and is an important therapeutic approach to hypertension
- There should be two alcohol-free days per week
- There is probably no safe alcohol limit but consumption should certainly be less than 14 units per week for women and 21 units per week for men
- One bottle of wine (12% volume) = 9 units of alcohol. One pint of beer (5.3% volume) = 3 units of alcohol
- Binge drinking is now defined as more than three units of alcohol in a day

groups but for a comparable 5 kg weight loss, there was a greater blood pressure reduction in those following the WELL diet of -5/-4 mmHg. This would suggest that irrespective of weight loss, dietary patterns have an additional effect on blood pressure.

Physical activity and blood pressure

Exercise programmes that primarily involve aerobic endurance-based activity reduce resting blood pressure in adults with normal blood pressure and in those with hypertension. Aerobic exercise places demands on the cardiovascular system and is typically characterised by repetitive movement of large muscle groups, for example in brisk walking, cycling or swimming. Several meta-analyses consistently demonstrate that aerobic exercise can reduce systolic blood pressure by between -3.0 and -4.7 mmHg and diastolic blood pressure by -2.4 to -3.1 mmHg (see table 3).

Changes in resting systolic blood pressure are more pronounced in patients with high blood pressure (-6.5 mmHg) compared to patients with normal blood pressure (-2.1 mmHg), with reductions lasting for up to 22 hours after an endurance exercise bout (ACSM, 2004).

The meta-analysis by Whelton *et al.* (2002) demonstrated that blood pressure reductions as a result of exercise are independent of weight loss, with further reductions seen in lifestyle programmes that include exercise, weight and dietary management. Evidence suggests that exercise of any type, frequency, duration and intensity positively influences blood pressure, thus implying that even low-level activity is of benefit. With a growing sedentary proportion of the population, encouraging low-level physical activity is both achievable and effective in reducing blood pressure.

'Approximately a 1 mmHg reduction in blood pressure can be achieved per 1 kg weight loss'

A key element in the success of exercise intervention is the use of a patient-centred approach, where assessment findings are synthesised into safe and effective exercise and physical activity plans, sensitive to each individual patient's physical, psychosocial (cognitive and behavioural) capabilities and needs. Although the general recommendations for exercise in people with hypertension are summarised in table 4, it is important to adapt this message to fit the individual's lifestyle. When providing physical activity advice it is essential to identify perceived barriers and interests and subsequently to encourage activities that are both realistic and enjoyable. For example, 30 minutes of physical activity divided into 10-minute bouts is a more achievable suggestion in the highly sedentary individual.

The contribution of alcohol to blood pressure

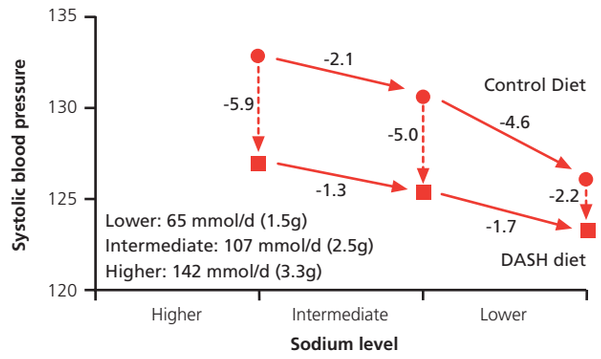
The association between alcohol and hypertension was seen as long ago as 1915 in a study of French soldiers where 'tres grands buveurs' (loosely translated as very big drinkers) were found to be more likely to be hypertensive than those who were 'sobres'.

Subsequently, a landmark cross-sectional survey in nearly 84,000 patients in 1977 found that blood pressure levels increased (both systolic and diastolic) once alcohol consumption reached three drinks per day, with evidence of a dose-dependent relationship (Klatsky 1977). A similar, though less marked, effect was found in women. Alcohol's direct pressor effect was subsequently confirmed in an elegant controlled clinical study of both alcohol consumption and withdrawal in men with hypertension (Beevers 1984).

Interestingly, the pattern of alcohol consumption has also been found to be important, with daily drinking and drinking without food being more likely to be associated with higher blood pressure levels. Furthermore, the type of alcohol consumed appears to be largely irrelevant, with wine, spirits and beer having similar hypertensive effects. Binge drinking is associated with rapid increases in blood pressure and appears to be associated with increased cardiovascular risk.

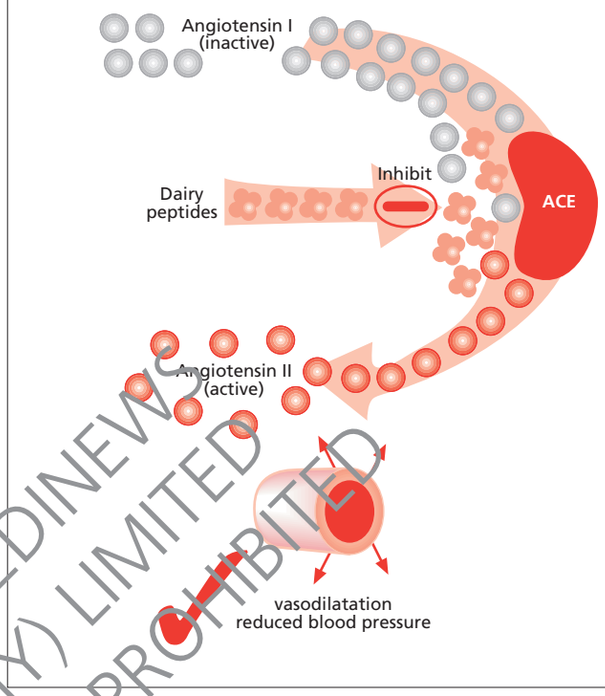
Reduction in alcohol consumption (through either counselling or substitution with non-alcoholic beer) has been found, in a meta-analysis of 14 studies, to be associated with a significant reduction in

Figure 2. The relationship between dietary sodium levels and blood pressure



Adapted from Sacks *et al. N Engl J Med* 2001;**344**:3-10.

Figure 3. Proposed mechanism by which dairy peptides help to reduce blood pressure



blood pressure in the order of 3.1 mmHg for systolic and 2.0 mmHg for diastolic blood pressures, respectively (Xin 2001).

But what about alcohol's cardioprotective effect found in multiple observational studies? Recently, it has been argued that this finding may be due to confounding (Jackson 2005) and therefore we should probably not blithely assume that a window of benefit exists for alcohol consumption. Take-home messages that can be given to patients are summarised in table 5.

Minerals and other dietary factors

There is clear evidence that an individual's dietary pattern can affect blood pressure. The DASH trial compared three diets: a control American diet, a diet rich in fruit and vegetables, and the DASH combination diet (more than eight portions daily of fruit and vegetables, reduced sodium and low-fat dairy produce). There was a reduction in blood pressure in the fruit and vegetable group but a greater reduction (-8 to -14 mmHg) was seen in the DASH diet group.

A reduction in dietary sodium (salt) intake has the most established relationship with reducing hypertension. The INTERSALT study on 10,000 subjects in 52 countries concluded that an increase in sodium of 100 mmol/day was associated with an increase in systolic and diastolic blood pressure of 3–6 mmHg and 0–3 mmHg respectively, across all subjects. African Americans, the elderly and people with hypertension tended to be particularly salt-sensitive. A follow-on study (DASH-sodium trial) from the DASH trial showed the additional benefits from reducing the sodium intake in the diet (figure 2): the lower the sodium intake, the lower the blood pressure.

'Make the message fit the lifestyle'

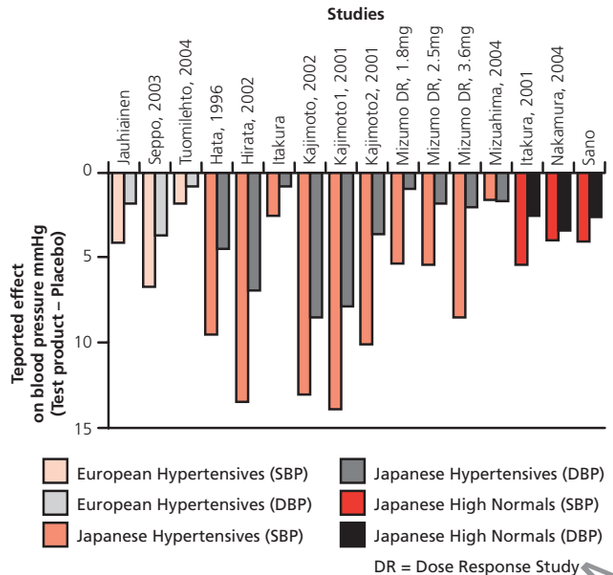
Reducing salt intake could have a significant impact on public health risk reduction of cardiovascular disease. Although the recommended salt intake in the UK is 6 g/day (2.5 g sodium), it is estimated that the average intake is 9.5 g/day, with three quarters of sodium intake generally coming from processed foods.

Potassium has been shown to have beneficial effects on blood pressure, with a greater reduction (-4.4/2.5 mmHg) seen in hypertensive patients compared to normotensive patients (-1.8/1.0 mmHg). Observational studies also show a link between both calcium and magnesium and their effects on blood pressure but clinical studies have been inconsistent. Therefore there is not enough evidence to support supplementation but patients should be encouraged to ensure an adequate dietary intake of potassium, calcium, magnesium and zinc. This would be achievable by following a varied, healthy diet.

Other dietary components with inconsistent evidence in reducing blood pressure are omega-3 fatty acids, vitamins C, E and B6, folate and flavonoids.

The challenge is to change population dietary habits. A reduction in processed foods and replacement with fresh produce will help to reduce sodium intake and hence blood pressure. A healthy varied diet which includes low fat, reduced saturated fat and a greater intake (at least five portions daily) of fruit and vegetables, as in the DASH trial, will enable people to meet their daily recommendations for minerals and vitamins as well as reduce their blood pressure. It may help patients to know that one portion of

Figure 4. Overview of reported effects on systolic blood pressure (SBP) and diastolic blood pressure (DBP) of IPP- and VPP-containing drinks, grouped by origin and baseline blood pressure of subjects studied



fruit or vegetable represents 80 g (i.e. one apple, one orange, one banana, two satsumas, two plums, three heaped tablespoons of peas or carrots). A single glass of fruit juice can replace one portion. Excessive consumption of coffee (five or more drinks per day) is discouraged in the latest NICE clinical guideline on hypertension since it may be associated with a rise in blood pressure of 2/1 mmHg.

Dairy peptides and blood pressure

Certain dairy peptides have been shown to lower blood pressure in clinical studies and these peptides are now being incorporated into food products.

Dairy peptides are derived from the milk protein casein either through fermentation or through enzymatic hydrolysis. Preclinical studies in 1996 showed that fermented milk could affect blood pressure. Fractionation studies showed that the tripeptides isoleucine-proline-proline (IPP) and valine-proline-proline (VPP) were responsible for this effect. *In vitro* studies suggest that IPP and VPP can inhibit the angiotensin-converting enzyme (ACE) which helps to regulate blood pressure in the body (figure 3).

Overall, 20 clinical studies have been conducted over the past 10 years with the IPP and VPP peptides (see figure 4). Among European studies, the effect of consuming 6–7 mg daily of these two peptides showed reductions in systolic and diastolic blood pressures of between -2 to -7 mmHg and -1 to -4 mmHg, respectively. The effects seem to be greater in Japanese populations, with an average difference compared to placebo of -10 mmHg and -6 mmHg for systolic and diastolic blood pressures, respectively, although population and background diet differences, and the individual study designs may be responsible for this discrepancy.

The effect of IPP and VPP seems to be greater in subjects with higher blood pressure (> 160/100 mmHg) levels. A modest effect is seen in patients with high-normal blood pressure and no effect is detected when the blood pressure is optimal.

Unilever studies with dairy drinks that contain IPP and VPP also show blood pressure reduction. A dose-response study on subjects with mild hypertension > 140/90 mmHg showed that after eight weeks of intervention (using three different doses of peptides) there were dose-dependent effects in the reduction of both systolic and diastolic blood pressures, although the group sizes were too small for these effects to obtain statistical significance. Further studies are required to confirm the effect of dairy peptides in various populations, including subjects taking antihypertensive medication, and to investigate further the mechanism of action of the peptides.

No adverse events have been seen in safety studies conducted by Unilever and the product is believed to be safe for pregnant and breastfeeding women. There are no indications to date that the drink compromises the effects of antihypertensive drugs. Drinks containing dairy peptides are intended for people who have high-normal blood pressure or mild hypertension and are not to be seen as a replacement for antihypertensive medication.

Changing people's behaviour

Successful integration of lifestyle modifications into people's daily routines means making healthy choices easy choices. This may mean overcoming preconceived beliefs and misconceptions that the patient may have about his condition, which can all adversely affect compliance and cause distress.

Patients need to be empowered to act in the interests of their health. This can be achieved by:

- Developing a helping partnership between patients and health professionals
- Sharing information, sharing agenda setting and jointly planning
- Helping people to achieve the objectives that they have set for themselves
- An awareness of the limits to freedom of choice, such as poverty and inequality
- Helping people making lifestyle choices in the context of their environment
- Offering freedom of choice, not coercion.

'The challenge is to change population dietary habits'

In the limited time available to health professionals, motivational techniques have been shown to be effective and to improve with increased intensity. Motivational interviewing is superior to traditional advice: it helps patients to change their behaviour by facilitating the exploration and resolution of their ambivalence with regard to the changes they wish to make.

First, a rapport must be established with the patient

and an agenda should be jointly discussed and set, assessing both the patient's readiness to change, the value he or she places on the change and his or her motivation. The patient's decision should be respected at all times. Resistance may be a sign that the patient is not yet ready to change a given behaviour.

Goals should be set, with a contract agreed between the health professional and the patient. Tools to help the patient prepare for change within the next month are:

- Keeping diaries such as food or smoking diaries
- Setting realistic, time-limited and specific goals
- Planning for relapse – having a specific contingency plan
- Identifying the triggers that will lead him or her back to his or her old behaviours (and finding ways to avoid these triggers)
- Identifying useful positive social support for the patient
- Arranging follow-up so that the patient is not left on his own.

Drawing the elements together

It is important to remember that classifying people into two groups, those who have so-called hypertension and those who have so-called normal blood pressure, does not fit with the epidemiology. The European Society of Hypertension/European Society of Cardiology 2003 guideline states: "the continuous relationship between the level of blood pressure and cardiovascular risk makes any numerical definition and classification of hypertension arbitrary. In consequence, it would be appropriate to use a classification of blood pressure without the term hypertension…the real threshold for blood pressure treatment must be based on total cardiovascular risk".

Blood pressure viewed in isolation does not give the full picture: the importance of any given level of blood pressure is a function of the presence of other risk factors. The primary goal of treatment is to achieve the maximum reduction in the long-term total risk of mortality and morbidity from cardiovascular disease. This requires treatment of all the reversible risk factors, including smoking, overweight, raised blood glucose and total cholesterol, in addition to blood pressure. In Europe the level of risk chosen for treatment is 5% for fatal CVD, which is equivalent to the 20% (non-fatal and fatal CVD combined) cardiovascular risk as defined in the Joint British Societies 2 (JBS2) guidelines.

The lifestyle goals – stopping smoking, eating healthily and being physically active – are the foundation of any preventive cardiology programme but they represent the greatest challenge for patients and their families and the greatest professional challenge for those working in health care. Table 6 summarises the effects of lifestyle modifications in the management of blood pressure.

Beyond these lifestyle aims, other risk factors such as body mass index, waist circumference, blood pressure, total cholesterol, blood lipids and glucose levels, should be targeted – with drugs where appropriate – to reach goals for prevention of cardiovascular disease.

Table 6. The effect of lifestyle modifications on blood pressure

Modification	Recommendation	SBP reduction
Weight reduction	Maintain normal weight (BMI 18.5–24.9 kg/m^2)	1 mmHg/kg
DASH eating plan	Diet rich in fruit and vegetables, low-fat dairy products, low saturated and total fat	8–14
Reduce sodium intake	< 100 mEq/L (2.4 g sodium/day)	2–8
Physical activity	Regular aerobic activity - e.g. brisk 30-minute walk most days	4–7
Moderate alcohol	Not more than 2 drinks men, 1 drink women daily	2–3

Key: SBP = systolic blood pressure; BMI = body mass index

Studies are currently underway to evaluate the most effective ways of managing blood pressure. These include the large nurse-led preventive cardiology programme, EUROACTION. This European Society of Cardiology initiative is unique in this family-based approach and the study includes all three priority groups defined in JBS2. Altogether, 10,000 people have been recruited: coronary patients and their families, the relatives of patients with premature CHD and people at high risk of developing CVD. EUROACTION is being conducted as a cluster randomised controlled trial in eight European countries where a pair of hospitals or a pair of general practices has been randomised to receive the EUROACTION programme or to be monitored with usual care.

'Make healthy choices easy choices'

The aim is to demonstrate that the European guidelines on lifestyle and risk factor management and use of drug treatment can be achieved in everyday clinical practice. Multi-disciplinary hospital and primary care teams are led by cardiovascular prevention nurses, supported by dietitians and physiotherapists, working alongside cardiology and GP colleagues, and other health professionals.

Early results from the hospital arm of the study show this approach is successful. The 16-week results of the hospital programme show considerable improvements in the dietary habits of both patients and their families, they also became more physically active, many smokers have been encouraged to quit and cardioprotective drug therapies were widely prescribed. The final one-year results from the whole study in hospital and primary care were announced at the World Congress of Cardiology in September 2006, and a full description of the study can be found on www.escardio.org/euroaction and also on page 324–5 of this issue.

References

These are available from the editorial office on request.