Poor adherence to lifestyle recommendations in patients with coronary heart disease: results from the EUROASPIRE surveys

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ABSTRACT

Background. Despite the high use of cardioprotective medications, the risk factor control in patients with coronary heart disease (CHD) is still inadequate. Guidelines identify healthy lifestyles as equally important in secondary prevention as pharmacotherapy. Here we describe reasons for poor lifestyle adherence from the patient's perspective.

Methods. In the EUROASPIRE IV and V surveys, 16,259 CHD patients were examined and interviewed during a study visit ≥ 6 months after hospital discharge. Data gathering was fully standardized. The Brief Illness Perception questionnaire was completed by a subsample of 2,379 patients.

Results. Half of those smoking prior to hospital admission were still smoking; 37% of current smokers had not attempted to quit and 51% was not considering to do so. The prevalence of obesity was 38%. Half of obese patients tried to lose weight in the past month and 61% considered weight loss in the following month. In relation to physical activity, 40% was on target with half of patients trying to do more everyday activities. Less than half had the intention to engage in planned exercise. Only 29% of all patients was at goal for all three lifestyle factors. The number of adverse lifestyles was strongly related to the way patients perceive their illness as threatening. Lifestyle modifications were more successful in those having participated in a cardiac rehabilitation and prevention programme. Patients indicated lack of self-confidence as the main barrier to change their unhealthy behaviour.

Conclusions. Modern secondary prevention programmes should target behavioural change in all patients with adverse lifestyles.

Key words: coronary heart disease, lifestyle behaviour, secondary prevention

INTRODUCTION

Patients with established atherosclerotic cardiovascular disease (ASCVD) are at high risk for recurrent events. Still there is ample evidence that they find it difficult in daily life to self-manage and maintain secondary prevention behaviours that will benefit their health[1-6]. The European Guidelines on Prevention of Cardiovascular Disease in Clinical Practice issued by the Joint European Societies between 1994 and 2016 have increasingly stressed the importance of an adequate management based on appropriate lifestyle changes, optimal control of risk factors and the use of cardioprotective drugs[7]. If taken as prescribed, drug therapy consisting of statins along with beta-blockers, anti-platelet stabilising agents and/or anticoagulants, ACE inhibitors and/or angiotensin receptor blockers significantly reduce mortality and morbidity in patients with existing ASCVD[7]. Healthy lifestyle modification in secondary prevention for patients with ASCVD is equally important as pharmacotherapy as an independent factor to reduce cardiovascular morbidity and mortality[8].

Unfortunately, as clearly demonstrated in the series of large scale EUROASPIRE surveys, control of risk factors in patients with coronary heart disease (CHD) is still far from optimal[9-11]. In the most recent EUROASPIRE V survey, 42% of patients did not achieve the recommended blood pressure target, 46% of patients with known diabetes still presented with a HbA1c value of > 7.0% (53 mmol/mol) while the recommended target for low-density lipoprotein cholesterol of < 1.8 mmol/L was reached in 29% of patients only[11]. This very poor risk factor control despite a high use of cardioprotective medications, uncovered the substantial non-adherence to lifestyle recommendations with a majority of coronary patients failing to achieve the lifestyle goals in terms of smoking and weight related dietary factors, including sedentary behaviour[11].

The objective with this study is by the use of data from the EUROASPIRE IV and V surveys[10-11], the largest European surveys reporting the coronary risk factor profiles of patients with established CHD, to understand specific reasons for poor lifestyle adherence from the perspective of the patient. In addition, their self-reported lifestyle behaviours, illness perceptions and intentions to change their unhealthy behaviour are reported.

METHODS

Patients and data collection

The EUROASPIRE surveys (European Action on Secondary and Primary Prevention by Intervention to Reduce Events, and later referred to as the European survey of cardiovascular disease prevention and diabetes) are a series of five large cross-sectional surveys in patients with documented CHD undertaken since 1995 in several countries that adopted the European Guidelines on Cardiovascular Disease Prevention in Clinical Practice issued by the European Society of Cardiology[11]. The aim was to generate

an objective assessment of the implementation of these guidelines in CHD patients by describing their management through lifestyle modifications and use of drug therapies. The present report is based on data from the last two surveys, EUROASPIRE IV (24 countries, 2012-13) and EUROASPIRE V (27 countries 2016-17)[10,11]. A detailed description of the overall methodology has been published elsewhere[10,11]. In summary, consecutive female and male CHD patients aged 18-80 years from geographical areas within the participating countries were identified from hospital discharge lists, or diagnostic registers, and invited to participate in the study by attending a study visit. At least six months prior to this visit, all patients had been hospitalized for a first, or recurrent, diagnosis of Acute Coronary Syndrome (Acute myocardial infarction or acute myocardial ischaemia), or for revascularization with elective or emergency Coronary Artery Bypass Grafts (CABG) or Percutaneous Coronary Intervention (PCI). The visit consisted of a face-to-face interview, during which a battery of validated and investigator generated questionnaires were completed together with a comprehensive clinical examination which included anthropometric measurements. All data were collected by centrally trained research staff following a standardized protocol and methods including the use of the same devices in all participating centres.

Lifestyle factors

Data on *tobacco smoking* was based on self-report; persistent smoking was defined as currently smoking at the time of the study visit, among patients reporting to be smokers in the month prior to their recruiting event. Current smokers were asked to report the number of cessation attempts (not smoking for at least 24 hours) and indicate any intention to quit within the next 30 days, within the next 6 months, or not thinking of quitting at all. All patients were asked the question *"Which of the following steps have you taken, since the recruiting event or procedure, to reduce your risk of heart disease?'*. Possible responses were complete abstinence, a reduction in smoking, attended a smoking cessation clinic or used nicotine replacement therapy (NRT), varenicline or bupropion.

Height and weight were measured using standardized approaches with calibrated equipment to calculate Body Mass Index (BMI). *Obesity* was defined as a BMI equal to, or exceeding 30 kg/m^2; overweight as a BMI between 25 and 30 kg/m^2. All patients were asked whether they were ever told by a health care professional that they were overweight, whether they had been actively trying to lose weight in the past month, whether they intended to lose weight to reach their goal within the next month, or within the next six months, and whether they had maintained their desired weight for more than six months. Potential weight-loss activities for overweight patients to reduce their risk of heart disease since the recruiting event or procedure, were weight loss from following dietary recommendations, participation in regular physical activity or the use of weight reducing drugs. All patients were asked whether they had changed their diet since hospital discharge by indicating one or more of the following activities: reduction of fat intake, changing type of fat used, reduction of calorie intake, reduction of sugar, eating more fruit and vegetables or consuming more fish.

Physical inactivity was defined as not meeting the recommended target of taking regular physical activity of at least 30 minutes duration, on average five times a week. All patients were also asked to indicate intensive physical activity by answering the question *"During a week, how often do you engage in any regular activity long enough to work up a sweat?"* with possible answers 'never/rarely, 'sometimes' or 'often'. The level of physical activity outside work was based on replies to the question *"Which of the following four best describes your level of activity outside work?"* with possible answers 'no physical activity weekly', 'only light physical activity in most weeks', 'vigorous physical activity at least 20 minutes once or twice a week' or 'vigorous physical activity for at least 20 minutes three or more times per week'. For the present analyses, these were reclassified as 'low' for the first two answers, 'moderate' for the third answer and 'high' for the last answer. Patients were asked to indicate what activities they had undertaken, since hospital discharge for the recruiting event or procedure, to increase physical activity levels; followed specific exercise advice from a health or exercise professional, attended a fitness club or leisure centre, or simply tried to do more general everyday physical activities. Finally, we asked about preferred types of physical activity jogging, cycling, swimming, brisk walking or aerobics and intentions to increase physical activity levels by asking *"Do you take regular planned physical activity of at least 30 minutes duration on average five times a week to increase physical fitness?"*. Possible replies were "Yes, I have been for more than six months", "Yes, I have been for less than 6 months", "No, but I intend to in the next 30 days", "No, but I intend to in the next 6 months" and "No, and I do not intend to in the next six months". We combined the first two answering categories in the present analyses.

Other patient characteristics

An *educational level* was defined as low if the patient completed primary school only or less. *Comorbidities* (previous hospitalization for CABG/PCI, stroke or heart failure and diabetes) were based on self-report. Patients were asked whether they had been advised to follow a cardiac prevention and rehabilitation programme (CPRP) within 3 months of hospital discharge for the recruited event. Actual attendance at the rehabilitation programme offered, was defined as having attended at least half of the advised sessions. Symptoms of anxiety and/or depression were assessed using the Hospital Anxiety and Depression Scale (HADS)[12]. The HADS consists of 7 questions each for anxiety and depression with sum scores ranging from 0 to 21, higher scores indicating more symptoms of anxiety/depression. A threshold of 11 has been recommended for both subscales to indicate clinically meaningful symptoms.

Patient Survey

The 'Patient Survey' is a work package of the ESC Prevention of Cardiovascular Disease Programme designed to add to current knowledge by providing an international overview of cardiovascular patients' illness perceptions and views on secondary prevention (perceived barriers to lifestyle change and self-reported intentions)[13]. We approached all countries participating in the EUROASPIRE V survey,

through their local National Coordinators, to invite patients enrolled in the EUROASPIRE V survey, to complete an additional set of self-administered questionnaires. Because illness perceptions (cognitive beliefs and emotional responses) influence secondary prevention behaviours we asked patients to complete The Brief Illness Perception Questionnaire (Brief IPQ)[14]. The set of eight questions used in this tool are given in Supplementary Table 2; a scale from 0 to 10 is used to assess each dimension (consequences, timeline, personal control, treatment control, identity, illness concern, coherence, emotional representation). An overall summary score is calculated (with reverse scorings for personal control, treatment control and coherence) and represents the degree to which the illness is perceived as threatening or benign. The original evaluation of the Brief IPQ found that it demonstrated good psychometric properties, including concurrent, predictive and discriminant validity. In our study, the B-IPQ was shown to be reliable with a Cronbach's alpha of 0.71 which indicates good internal consistency. Researcher generated items were designed to evaluate patients' intentions to make lifestyle changes and a description of proposed lifestyle activities. To understand patients' perspectives on lifestyle adherence we asked them to identify their top three self-perceived barriers to quitting smoking, eating a healthy diet and taking regular physical activity from a list informed by research literature (Table 2). In total, 2,379 EUROASPIRE V patients from Egypt, Ireland, Kazakhstan, Lithuania, Netherlands, Poland, Portugal, Russian Federation, Sweden, Turkey, Ukraine and the United Kingdom completed the additional aforementioned questionnaires.

Statistical methods

Distributions of baseline characteristics were summarized using means, standard deviations and proportions. The variation in lifestyle related factors between countries was expressed by intracluster correlation coefficients and their standard errors, ICC (SE), derived from logistic models according to the threshold model method by Snijders et al[15]. This ICC statistic varies in the [0,1] interval and can be interpreted as the proportion of the total variation between individuals across countries that is actually attributable to country. The distributions of lifestyle related factors in relation to patient characteristics were evaluated by logistic regression analysis adjusting for age and gender. The age- and gender-adjusted least-squares mean scores for the 8 subscales of the Brief IPQ in groups of patients with 0, 1 and ≥ 2 unhealthy lifestyles, were obtained through general linear models (Supplementary Table 2). P-values for the comparison with the reference group of patients without any of the three unhealthy behaviours were adjusted for multiplicity according to the Dunnett-Hsu procedure[16]. In order to control for multiple testing, we chose a type I error level of α=0.01 to indicate statistical significance. All data analyses were undertaken using SAS statistical software (release 9.4) in the Department of Public Health and Primary Care, Ghent University, Belgium.

Data management

Data management was undertaken by the EURObservational Research Program (EORP), ESC, Sophia-Antipolis, France. All data were collected electronically through web-based data entry using a unique identification number for country, centre and individual. Checks for completeness, internal consistency and accuracy were run. All data were stored under the provisions of the National Data Protection Regulations.

Ethical procedures

National Coordinators were responsible for obtaining Local Ethics Committees approvals. Written, informed consent was obtained from each participating patient and stored in the patient file. The research assistants signed the Case Record Form to confirm that informed consent was obtained and stored the original signed declaration consent in the patient's file.

RESULTS

Pooling data from EUROASPIRE IV (7,998 patients) and EUROASPIRE V (8,261 patients) resulted in a complete database of 16,259 coronary patients from hospitals and cardiac centres located in 29 different countries. Patients were 63.8 years old on average (SD 9.6 years) and 4,077 (25%) were women. The average time between the hospital admission for the recruiting event or procedure and the study visit was 16 months. In relation to lifestyle related coronary risk factors at the time of the study visit, 16% of all patients were current smokers, 44% were overweight and another 38% were obese. Only 40% reached the physical activity target while 47% never or rarely engaged in intensive physical activity and 62% only performed low levels of activity outside work. The combinations of unhealthy lifestyles are illustrated in Figure 1. Less than a third (29%) of all patients was on target for all three lifestyle factors. Supplementary Tables 1a and 1b depict the prevalences of adverse lifestyles by participating country. The intracluster coefficients (standard error) were ICC=0.043 (0.012) for current smoking, ICC=0.027 (0.008) for obesity and ICC=0.136 (0.032) for physical inactivity, the latter indicating substantial heterogeneity in the level of physical inactivity between countries varying from 27% in Finland up to 87% in Germany.

In the month prior to hospitalization for the recruiting event or procedure, 31% of patients were regular smokers; half of them still smoked at the time of the study visit at least six months later. Although men and younger patients smoked more frequently, smoking cessation was not related to age or gender. It was, however, substantially more successful in patients who attended a CPRP and in those with lower levels of depression and anxiety (Table 1). Among patients still smoking at the time of the study visit, 61% tried to reduce, 6% had attended a smoking cessation clinic, 11% had used nicotine replacement therapy, 3% had used varenicline and 1% tried bupropion. Thirty-seven percent of current smokers

reported not having made a single attempt to quit smoking while 23% of them had tried to stop more than three times. The lack of any attempt to quit smoking was significantly and positively related to age and low education. Regarding their intention to quit, 17% of current smokers planned to stop within a month, 32% within the next six months while 51% was not considering quit at all, the latter being older patients, those not having attended a CPRP and those having symptoms of depression. There were 351 current smokers (including 49 women) participating in the Patient Survey who completed the questionnaire on barriers to change unhealthy lifestyle habits (Table 2). According to their responses, 60% lacked self-confidence to quit smoking while 40% simply did not want to stop and were happy with their smoking habits.

Further data from the subsample of patients (38%) found to be obese at the time of the interview about self-reported weight loss activities and intentions are shown in Table 3. Remarkably, 22% of these patients reported to have never been informed by a health care professional that their body weight was too high. This was particularly the case for those aged over 70 years, having a low educational level, not having attended a CPRP or without diabetes. Seventy-nine per cent of obese patients claimed to have had a weight measurement since hospital discharge, 91% was aware of their own weight and 77% knew their weight target. During the month prior to the study visit, only half of the obese patients had tried to lose weight; these were mostly younger patients, those having attended a CPRP, free of heart failure but with higher levels of anxiety. Self-management activities mainly focused upon following dietary recommendations (59%) and participating in regular physical activity programmes (59%). Six percent of obese patients had tried weight reducing drugs, mainly those with a higher educational level. Regarding changes in food consumption since hospital discharge, 78% of obese patients reported at the time of interview to have reduced fat intake, 69% to have changed the type of fat used, 76% to eat more fruits and vegetables, 62% to eat more fish, 66% to have reduced calorie intake and 68% to have reduced sugar. Obese patients reported that they had the intention to lose weight within the next month in 39% of cases; 55% intended to lose weight in the next six months, while 41% found their high weight as desired, the latter having lower levels of anxiety or depression. Weight loss intention was significantly stronger in younger patients with a higher educational level, in those having attended a CPRP and those with lower levels of depression. Regarding self-perceived barriers to eating a healthier diet, 896 obese patients (279 women) participated in the Patient Survey. More than half of them (54%) considered their diet as being healthy, 23% were happy with what they ate, but a quarter of obese patients indicated a lack of self-confidence to change their unhealthy dietary behaviour (Table 2).

Physical activity levels and intentions to do regular planned physical activity in all patients participating in the EUROASPIRE IV and V surveys are presented in Table 4. Those not reaching the recommendation of performing regular physical activity of at least 30 minutes duration on average five times a week, were significantly more often female, older, not having attended a CPRP, having a history of diabetes, stroke or heart failure and presenting themselves with higher levels of anxiety and depression. Precisely the same patient profile was associated with the lack of intensive physical activity

and low levels of activity outside work. Since hospital discharge, 50% of patients reported at the time of interview trying to do more general everyday physical activities, 22% were following specific exercise advice from a health or exercise professional and 12% were attending a fitness club or leisure centre. When specifically asking for their intentions to engage regularly in planned activities, half of patients (48%) reported to have no intention to do so. Of all patients not reaching the recommended level of physical activity, 1246 (358 women) participated in the Patient Survey. Thirty-eight percent considered themselves sufficiently active, 33% did not feel confident to do more exercise and become more active and 25% simply did not like exercising (Table 2).

The Brief IPQ was completed by 2,379 patients including 608 (26%) women. Mean (SD) age of these patients was 63.8 (9.4) years. Supplementary Table 2 depicts average scores for each of the eight subscales in relation to the number of unhealthy lifestyle habits (smoking, obesity and physical inactivity) as well as the overall summary score. These age- and gender-adjusted scores indicated that the number of adverse lifestyle behaviours is significantly and strongly related to the way patients perceive their illness as threatening, more specifically in relation to the severity of the symptoms, both physically and emotionally, and the chronic aspect of their condition.

DISCUSSION

After the acute phase of recovery, patients undergoing coronary revascularisation for either ACS or stable coronary disease require structured care to help them to self-manage their chronic condition and reduce the risk of recurrence and death. In this study, which investigated adherence to healthy lifestyle habits in more than 16,000 patients with CHD who participated in the EUROASPIRE IV and V surveys, at least one third had two or more unhealthy lifestyle habits at the time of the study interview about 16 months after their recruiting event. Older patients and those with symptoms of anxiety and depression were less likely to make lifestyle changes. They were more likely to have attempted change if they had attended a CPRP. The findings were consistent across countries for smoking and weight but varied quite substantially in relation to physical inactivity.

Around half of those smoking at the time of the recruiting event continued to smoke, having relapsed after up to three quit attempts or not having tried to quit at all. Few patients reported accessing effective pharmacotherapies, such as varenicline and nicotine replacement treatment (NRT), or specialist counselling, both of which are essential for success[17]. Reducing consumption without pharmacological support is unlikely to lead to complete abstinence. Nonetheless, a significant proportion reported an intention to quit and two thirds had attempted to reduce tobacco consumption. When reduction is attempted with pharmacotherapy, they can be effective in the run up to a full quit attempt[18].

Around two thirds of patients were not achieving the European physical activity goal and more than 80% were overweight or obese. Perhaps not surprisingly, older and more debilitated patients were less

likely to be physically active. Only a small majority of obese patients reported an intention to lose weight although many were aware of their high body weight and weight target, despite reporting that they had not been told by a professional that they were obese. These patients require professional support to manage their weight and to become active. Those who had attended a CPRP were more likely to be active and to have attempted weight loss, however, access to programmes was suboptimal across countries.

The results from our analyses make a significant contribution to our understanding of how people with coronary heart disease from 12 European countries perceive their illness. Although in general the average scores for the eight Brief-IPQ subscales are in line with those reported earlier, the strong graded association between the number of unhealthy lifestyles and the way patients view their illness as being threatening, is both novel and striking. More specifically, a substantial group of smoking, obese and/or inactive patients reported significantly more threatening illness perceptions (i.e. a greater negative emotional response, symptom burden (identity), timeline and perceived negative affect on daily life), compared to those with fewer unhealthy lifestyles. Importantly, higher scores on the aforementioned domains are associated with higher levels of depression, anxiety, reduced quality of life and worse blood glucose levels[19].

Key considerations for behaviour change

The principal reason given for not attempting lifestyle change to accomplish smoking cessation, weight loss and increased physical activity was a self-reported lack of confidence which was reported by 60%, 25% and 33% of smokers, obese and physically inactive patients respectively. This suggests that patients had made a negative judgement about their capability to make lifestyle change. Paradoxically, results from the Brief-IPQ indicated that patients reported a moderate level of self-reported control over their illness. Looking at it more broadly, Michie et al. characterise behaviour change as influenced by both external and internal factors explaining the importance of capacity (for example, having ability and skills), opportunity (for example accessing appropriate social support and having adequate socio-economic circumstances) as well as motivation to predict the likelihood of behaviour change[20]. Several studies have been published that describe specific techniques proven to work in behaviour change interventions for smoking cessation, physical activity, health eating and weight management.[21-23]

When considering the learning from behavioural science it is clear that individual tailoring of preventive interventions is important. Health professionals need ongoing training to assist them in supporting patients, and those close to them, to use evidence based approaches to lifestyle change. For example specialist training is available to health professionals supporting patients with smoking cessation from the UK National Centre for Smoking Cessation Training (https://www.ncsct.co.uk) which is cost effective and easily implemented. There are several key components including goal setting, action planning, monitoring and feedback that are known to be effective. Several approaches have been identified that can support patients to develop self-efficacy beliefs about their ability to perform a

specific task[24]. Teaching patients specific skills needed to make incremental lifestyle changes that are successful provides a sense of 'mastery' that builds confidence. Witnessing the success of other patients making lifestyle changes and being able to identify role-models are other useful approaches.

Intention is the starting point for initiating change but not always followed up with appropriate action. We saw in this study that one half of all smokers seriously considered quitting smoking although intention was reduced in older and depressed patients. Nearly two thirds of obese patients reported an intention to lose weight and this was affected by anxiety and depression. One half of all patients intended to do regular physical activity and this was reduced in females, older, those with a low educational level, not attending CPRP, having diabetes, being disabled (heart failure or stroke) and in anxious and depressed patients. Intention to change is not necessarily prompted by health concerns although reasonably more likely in a patient population like the present[25]. For example, patients who have suffered a myocardial infarction are more likely to attempt to quit smoking after being advised by a physician to do so[26]. The expectation of those close to the patient (significant others) is also important as is the support they can provide[27]. For example, in a couple where both are smoking and attempt to quit together, the change becomes easier to achieve[28]. When an intention is declared, it needs to be followed up with professional support using appropriate behavioural techniques as described.

Barriers to change

Some patients reported that they did not wish to make healthy lifestyle changes, either because they had too many other stresses, had already made healthy changes or were satisfied with their current lifestyle. Although patient education alone is unlikely to promote lifestyle change, it is important that patients understand the key features of CHD and the significance of prevention. Studies have shown that patients with CHD often have unmet health information needs and believe that coronary interventions have 'fixed' their CHD[29]. Patient education provides an important foundation for the development of appropriate illness perceptions which in turn influence subsequent health behaviours.

Misconceptions and erroneous beliefs can cause distress, limit coping and influence the likelihood of making healthy changes[30]. It is therefore important to correct potential misconceptions in patient and family education. In this study, patients with a greater number unhealthy lifestyle habits had more threatening illness perceptions than those with one or less. This suggests that patients had relatively realistic illness perceptions. In general, patients reported that they 'understood' their illness and reported high levels of control. This may be explained by our sample of patients who had been diagnosed for several months rather than being newly diagnosed. The illness perceptions of patients with CHD tend to alter over time to become more realistic[14].

In our patient sample psychological co-morbidities like anxiety and depression were associated with increased prevalence of sedentary behaviour, current and persistent smoking and obesity. They were also associated with less intention and attempts to make changes or for these changes to be successful. It is well established that anxiety and depression are common in patients with CHD and result in

increased mortality[31]. Patients with depression are less likely to engage in making behavioural changes or to take their medications[32, 33]. Therefore, identifying these co-morbidities in patients is important as it can then lead to appropriate management and the provision of enhanced support to help patients to make changes.

Cardiovascular prevention and rehabilitation

Patients who attended CPRP were more likely to attempt healthy changes. The optimal model for CPRP adopts an interdisciplinary approach drawing on expertise from a number of professionals like CV specialist nurses, dietitians, smoking cessation specialists, exercise specialists, psychologists amongst others. Ideally these professionals work together as an interdisciplinary team using a patient centred approach. Such a team aspires to a more profound level of collaboration (than a multidisciplinary team) in obtaining different levels of planned care. Core components have been developed by various groups in different countries[34]. These involve using a multifactorial approach to give equal emphasis to all lifestyle and biological risk factors that influence the recurrence of CHD. A systematic review and meta-analysis of contemporary trials of prevention and rehabilitation programmes demonstrated that programmes addressing six or more risk factors are associated with reducing total mortality[35]. The number of successful behaviour change attempts could be increased if programmes adhered to the standards and core components presented above and adopted interdisciplinary approaches to care. This would involve drawing on the expertise of specialist nurses and other allied professionals as well as cardiologists and other physicians. Innovation in the form of technology and remote forms of care delivery will help to improve access and adherence to CPRP and make it more affordable.

Intervening at the level of the individual with behavioural and psychosocial interventions is crucial if, after a cardiac event, patients are to successfully reduce their risk of a further event or death. However, this requires an appropriate and effective model of care which is fully integrated and properly funded by the health care system. In addition, if we are to expect patients to follow these programmes of care and make successful changes to their lives, the environment in which they are living needs also to be healthy with appropriate legislation in place and consideration given to the availability of healthy foods and a built environment that facilitates an active lifestyle and the opportunity to exercise safely. Several programme models have already been evaluated in the literature and include SCRIP and MULTIFIT from the United States, the EUROACTION programme from eight European countries, the RESPONSE programme from the Netherlands and the COACH programme from Australia[36-40]. Many of these studies went on to implement these models of care into their national health systems. For example, Stanford University rolled out the MULTIFIT programme in collaboration with the Kaiser Permanente managed care consortium in the US and the COACH programme has been rolled out throughout Australia. The EUROACTION programme was rolled out and evaluated in North-West London and in the West of Ireland[41,42]. In addition to auditing patient outcomes, the importance of measuring quality by looking at process outcomes has also been recognised[43].

Strengths and limitations

One of the strengths of the EUROASPIRE surveys is that patient recruitment was based on a wide scope of ESC member countries covering a very large geographical area. The substantial numbers made it also possible to analyse different aspects of various unhealthy lifestyles. Another strength relates to the strict protocol that was used in collecting the results through a standardized interview and clinical examination by centrally trained technicians. Among the limitations of the survey one should consider the low participation rate (56%); this may have introduced a selection bias particularly in this study since patients with an adverse lifestyle are likely to be underrepresented in epidemiological studies meaning that our estimates may if anything underestimate the true problem. Participating centres within a country may not have been representative for the existing health care infrastructure. The information on lifestyles that we used was based on patient's answers to standardized questions and these may have been interpreted differently on the basis of differences in languages and culture. Self-reported information related to adherence to lifestyle recommendations may also have been influenced by social expectations and therefore deviate from reality.

In conclusion, the majority of CHD patients still present with unhealthy lifestyle habits at least six months following hospital discharge. The need for a more intensified and structured lifestyle management is consistent throughout Europe. Modern cardiac rehabilitation and secondary prevention programmes should target behavioural change in all patients with adverse lifestyles.

Authors' Contributions

DDB, CJ, DW, NP, DDS, GDB, KK, LR and FA were responsible for the conception and design of the study. DDB was responsible for the data analysis. DDB led the interpretation of the data with input from FA and CJ. DDB drafted the article. All authors have critically revised the manuscript. All gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy. DDB is responsible for the overall content as guarantor.

Conflicts of interest

The authors declared the following potential conflicts of interest with respect to the research, authorship and/or publication of this paper: KK had grant support from the European Society of Cardiology. No other authors have financial interests that are relevant to the submitted work.

Data sharing

The database containing all individual data of patients participating in EUROASPIRE IV and V is property of the European Society of Cardiology (ESC) and cannot be shared publicly.

Declaration of transparency

DDB, affirms as principal author that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned have been explained.

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Figure legends

Figure 1.

Combinations of unhealthy lifestyles in patients with coronary heart disease, by gender (the EUROASPIRE IV and V surveys)

Tables

Table 1. Prevalence of smoking, smoking cessation attempts and intention to stop in currently smoking coronary patients participating in the EUROASPIRE IV and V surveys

		Smoking status				Current smokers					
						*Cessation attempts**			*Intention to quit smoking***		
	N	Ever	Month before hospitalization	Current smoking	Persistent smoking	0	1-3	>3	Within next month	Within next 6 months	Not thinking of quitting**
All	16259	66% (10677)	31% (4998)	16% (2588)	50% (2482)	37% (731)	40% (803)	23% (465)	17% (431)	32% (827)	51% (1329)
Men	12182	70% (8556)	33% (3966)	17% (2053)	49% (1962)	37% (578)	40% (640)	23% (364)	17% (340)	32% (660)	51% (1052)
Women	4077	52% (2121)	25% (1032)	13% (535)[b]	50% (520)	37% (153)	39% (163)	24% (101)	17% (91)	31% (167)	52% (277)
Age at interview < 50 years	1453	78% (1136)	60% (866)	31% (453)	51% (442)	31% (104)	45% (154)	24% (82)	21% (97)	31% (141)	47% (215)
50-59 years	3963	75% (2966)	47% (1853)	25% (973)	50% (932)	37% (281)	42% (318)	22% (166)	16% (158)	37% (356)	47% (459)
60-69 years	6135	66% (4059)	28% (1726)	14% (886)	49% (840)	36% (243)	39% (264)	25% (165)	16% (145)	31% (273)	53% (467)
≥ 70 years	4708	53% (2516)	12% (553)	6% (276)	48% (268)	46% (103)	30% (67)	23% (52)	11% (31)	21% (57)	68% (188)
Time since recruiting event < 1 year	10606	66% (6983)	31% (3237)	16% (1685)	50% (1611)	38% (491)	38% (481)	24% (304)	16% (267)	31% (524)	53% (893)
≥ 1 year	5653	65% (3694)	31% (1761)	16% (903)	49% (871)	33% (240)	45% (322)	22% (161)	18% (164)	34% (303)	48% (436)
Educational level: Low	2602	64% (1660)	29% (754)	16% (420)	53% (401)	43% (137)	40% (127)	17% (53)	17% (71)	29% (123)	54% (226)
Moderate or high	13552	66% (8897)	31% (4194)	16% (2139)b	49% (2054)	35% (585)[b]	40% (673)	25% (411)	17% (358)	33% (696)	51% (1084)
Attended a CRP: No	10195	65% (6647)	31% (3168)	18% (1816)	55% (1745)	38% (519)	40% (548)	22% (295)	15% (278)	30% (553)	54% (984)
Yes	5852	67% (3902)	30% (1759)	12% (726)[b]	39% (692)[b]	33% (201)	40% (243)	27% (163)	21% (149)	35% (254)	44% (323)[b]
Self-reported diabetes: No	11617	66% (7688)	33% (3826)	17% (1964)	49% (1885)	35% (537)	41% (631)	23% (356)	17% (331)	33% (640)	51% (992)
Yes	4533	64% (2914)	25% (1137)	13% (609)[a]	51% (583)	41% (192)	36% (169)	23% (107)	16% (97)	30% (183)	54% (329)
History of CABG or PCI: No	2668	59% (1582)	32% (852)	16% (438)	50% (424)	38% (123)	41% (132)	21% (67)	14% (61)	34% (148)	52% (229)
Yes	13591	67% (9095)	31% (4146)	16% (2150)	50% (2058)	36% (608)	40% (671)	24% (398)	17% (370)	32% (679)	51% (1100)
History of stroke: No	15414	66% (10150)	31% (4818)	16% (2478)	49% (2376)	36% (697)	40% (775)	23% (442)	17% (418)	32% (798)	51% (1261)
Yes	844	62% (526)	21% (179)	13% (109)	59% (105)	40% (34)	33% (28)	27% (23)	12% (13)	27% (29)	61% (67)
History of heart failure: No	15002	66% (9919)	31% (4704)	16% (2424)	49% (2327)	37% (684)	40% (744)	24% (443)	17% (404)	32% (783)	51% (1236)
Yes	1256	60% (757)	23% (293)	13% (163)	53% (154)	37% (47)	46% (59)	17% (22)	17% (27)	27% (44)	56% (92)
HADS anxiety score < 11	12434	66% (8247)	30% (3750)	15% (1904)	49% (1825)	35% (509)	42% (611)	23% (344)	17% (314)	32% (618)	51% (971)
≥ 11	1199	62% (746)	34% (408)	20% (234)[a]	56% (228)[a]	36% (71)	40% (79)	24% (48)	21% (48)	33% (78)	46% (108)
HADS depression score < 11	12451	66% (8240)	30% (3773)	15% (1919)	49% (1842)	35% (514)	42% (628)	23% (342)	17% (319)	33% (629)	51% (970)
≥ 11	794	62% (491)	32% (256)	20% (158)[b]	61% (155)[b]	44% (59)	32% (43)	23% (31)	20% (31)	24% (38)	56% (89)[a]

*Number of times having quit smoking for at least 24 hours; **Seriously thinking of quitting smoking (answer 'Don't know/Unsure' (24%) classified as 'not thinking of quitting'); Statistical significances from a logistic model adjusting for age and gender: [a]P<0.01; [b]P<0.001

Table 2. Barriers to changing unhealthy habits

	Men	Women	All
Stopping smoking: please select the 3 top things that are stopping you from quitting smoking	N=302	N=49	N=351
I don t have enough support from family and friends	18% (54)	18% (9)	18% (63)
I cannot afford to get help or buy the medicines	13% (40)	10% (5)	13% (45)
I like smoking; I am happy as I am	43% (129)	31% (15)	41% (144)
I do not want to stop smoking at the moment	41% (124)	33% (16)	40% (140)
I do not feel confident that I can quit smoking	61% (184)	57% (28)	60% (212)
I have got too many problems and I am too stressed to stop smoking	33% (99)	43% (21)	34% (120)
My partner, family members and/or friends smoke	19% (58)	27% (13)	20% (71)
Eating more healthily for obese patients: select the 3 top things that are stopping you from eating more healthily	N=617	N=279	N=896
I do not have enough support from family and friends	10% (60)	9% (26)	10% (86)
I cannot afford to buy healthy foods	14% (84)	18% (49)	15% (133)
I do not think it's necessary. I'm happy with what I eat	23% (140)	24% (67)	23% (207)
I do not have time to prepare healthy food	20% (121)	13% (35)	17% (156)
I do not feel confident that I can eat more healthily	25% (152)	24% (68)	25% (220)
I've got too many problems and I'm too stressed to worry about what I eat	11% (66)	15% (41)	12% (107)
My partner and family don't like healthy foods	6% (37)	8% (21)	6% (58)
My food is healthy	54% (336)	53% (147)	54% (483)
Becoming physically active in those not being on target*: select the 3 top things that are stopping you from being more active	N=888	N=358	N=1246
I do not have enough support from family and friends	6% (54)	9% (34)	7% (88)
I cannot afford to take exercise (eg go to the gym)	16% (139)	21% (75)	17% (214)
I do not think it's necessary. I'm happy with the way I am	20% (177)	16% (57)	19% (234)
I do not like exercising	24% (215)	27% (97)	25% (312)
I do not feel confident that I can do more exercise and become more active	31% (275)	37% (134)	33% (409)
I do not have time to take exercise	21% (186)	17% (61)	20% (247)
I have got too many problems and I'm too stressed to worry about exercising	13% (114)	22% (80)	16% (194)
I am already physically active and take exercise	39% (346)	35% (126)	38% (472)

*Regular physical activity of at least 30 minutes duration on average 5 times a week

Table 3. Prevalence of obesity, weight loss attempts and intention to lose weight in obese coronary patients participating in the EUROASPIRE IV and V surveys

			Obese patients							
					Actions to lose weight			*Intention to lose weight*		
	N	% Obese	Patient ever been told be overweight	Patients tried actively to lose weight in the past month	Following dietary recommendations	Participating in regular physical activity	Weight reducing drugs	Within next month	Within next 6 months	Weight is as desired
All	16259	38% (6054)	78% (4683)	50% (2939)	59% (2950)	59% (2950)	6% (367)	39% (2339)	55% (3338)	41% (2311)
Men	12182	36% (4387)	78% (3391)	50% (2134)	59% (2114)	60% (2173)	6% (264)	39% (1696)	55% (2430)	41% (1703)
Women	4077	42% (1667)[b]	78% (1292)	50% (805)	60% (836)	56% (777)	6% (103)	39% (643)	54% (908)	39% (608)
Age at interview < 50 years	1453	39% (565)	78% (432)	56% (308)	66% (327)	67% (326)	9% (48)	43% (245)	61% (345)	36% (195)
50-59 years	3963	41% (1607)	81% (1283)	54% (854)	63% (836)	63% (850)	8% (122)	45% (724)	62% (991)	41% (624)
60-69 years	6135	39% (2388)	80% (1889)	51% (1182)	61% (1196)	59% (1149)	6% (145)	40% (944)	56% (1341)	41% (915)
≥ 70 years	4708	32% (1494)	73% (1079)	41% (595)	50% (591)	52% (625)	4% (52)	29% (426)	44% (661)	41% (577)
Time since recruiting event < 1 year	10606	38% (3999)	79% (3139)	50% (1938)	60% (1959)	61% (1973)	7% (253)	39% (1546)	55% (2192)	40% (1509)
≥ 1 year	5653	37% (2055)	76% (1544)[b]	50% (1001)	58% (991)	57% (977)[a]	6% (114)	39% (793)	56% (1146)	42% (802)
Educational level: Low	2602	39% (1005)	70% (694)	47% (467)	55% (457)	49% (411)	4% (35)	31% (310)	43% (430)	37% (358)
Moderate or high	13452	37% (4989)[a]	80% (3950)[b]	50% (2450)	61% (2468)	62% (2515)[b]	7% (328)[a]	40% (2008)[b]	58% (2877)[b]	41% (1932)
Attended a CRP: No	10195	39% (3949)	76% (2970)	48% (1859)	57% (1881)	53% (1754)	7% (252)	37% (1464)	52% (2053)	42% (1545)
Yes	5852	35% (2036)[b]	82% (1659)[b]	52% (1051)[a]	64% (1035)[b]	72% (1167)[b]	6% (112)	42% (854)[b]	62% (1259)[b]	39% (751)
Self-reported diabetes: No	11617	33% (3812)	75% (2823)	49% (1829)	58% (1877)	60% (1926)	6% (215)	39% (1478)	56% (2125)	41% (1467)
Yes	4533	50% (2201)[b]	84% (1827)[b]	50% (1084)	62% (1055)[a]	58% (1002)	7% (151)	38% (846)	54% (1190)	40% (829)
History of CABG or PCI: No	2668	40% (1043)	77% (792)	51% (518)	60% (504)	50% (426)	7% (70)	41% (432)	55% (574)	43% (414)
Yes	13591	37% (5011)	78% (3891)	49% (2421)	59% (2446)	61% (2524)[b]	6% (297)	38% (1907)	55% (2764)	40% (1897)
History of stroke: No	15414	37% (5691)	78% (4392)	50% (2783)	60% (2826)	60% (2830)	6% (353)	39% (2215)	56% (3164)	41% (2169)
Yes	844	44% (362)[b]	81% (290)	44% (155)	48% (124)[a]	45% (120)[b]	4% (14)	34% (123)	48% (174)	41% (141)
History of heart failure: No	15002	37% (5506)	78% (4243)	50% (2716)	59% (2703)	60% (2718)	6% (323)	39% (2148)	56% (3058)	41% (2098)
Yes	1256	44% (547)[b]	81% (439)	42% (222)[b]	60% (247)	55% (232)	8% (44)	35% (190)	51% (280)	42% (212)
HADS anxiety score < 11	12434	37% (4602)	79% (3586)	49% (2208)	60% (2275)	61% (2331)	6% (280)	39% (1785)	56% (2582)	42% (1819)
≥ 11	1199	41% (488)	79% (382)	59% (280)[b]	60% (239)	54% (216)[a]	7% (31)	42% (207)	57% (280)	33% (153)[b]
HADS depression score < 11	12451	38% (4688)	79% (3663)	50% (2289)	60% (2301)	61% (2348)	6% (282)	39% (1849)	57% (2652)	41% (1824)
≥ 11	794	44% (344)[b]	76% (259)	47% (157)	56% (159)	50% (141)[b]	5% (17)	34% (118)	43% (148)[b]	30% (99)[b]

Statistical significances from a logistic model adjusting for age and gender: [a]P<0.01; [b]P<0.001

Table 4. Levels of physical activity and intention to do regular planned physical activity in patients participating in the EUROASPIRE IV and V surveys

	N	Physical activity not on target*	Intensive physical activity**			Level of activity outside work***			Intention to do regular planned physical activity****			
			Never/Rarely	Sometimes	Often	Low	Moderate	High	Doing it already	Intends to in the next month	Intends to in the next 6 months	Does NOT intend to so
All	16259	60% (9300)	47% (7664)	36% (5784)	17% (2803)	62% (9963)	20% (3136)	18% (2817)	34% (5513)	5% (914)	13% (2066)	48% (7759)
Men	12182	58% (6832)	46% (5554)	36% (4406)	18% (2218)	61% (7324)	20% (2418)	18% (2192)	35% (4294)	6% (694)	13% (1528)	46% (5662)
Women	4077	64% (2468)[b]	52% (2110)[b]	34% (1378)	14% (585)	66% (2639)[b]	18% (718)	16% (625)	30% (1219)[b]	5% (220)	13% (538)	51% (2097)[b]
Age at interview < 50 years	1453	57% (794)	36% (517)	40% (576)	25% (359)	49% (692)	24% (347)	27% (379)	37% (540)	7% (108)	17% (252)	38% (552)
50-59 years	3963	55% (2094)	40% (1588)	40% (1578)	20% (796)	57% (2201)	23% (892)	20% (776)	35% (1385)	7% (275)	16% (624)	42% (1678)
60-69 years	6135	59% (3437)	46% (2830)	37% (2260)	17% (1040)	62% (3740)	20% (1203)	18% (1056)	35% (2150)	6% (346)	13% (770)	47% (2866)
≥ 70 years	4708	66% (2975)	58% (2729)	29% (1370)	13% (608)	72% (3330)	15% (694)	13% (606)	31% (1438)	4% (185)	9% (420)	57% (2663)
Time since recruiting event < 1 year	10606	59% (5984)	47% (4983)	35% (3742)	18% (1874)	62% (6440)	20% (2082)	18% (1873)	34% (3632)	5% (544)	12% (1274)	49% (5149)
≥ 1 year	5653	61% (3316)[a]	47% (2681)	36% (2042)	16% (929)	64% (3523)[a]	19% (1054)	17% (944)	33% (1881)	7% (370)	14% (792)	46% (2610)[a]
Educational level: Low	2602	63% (1576)	58% (1509)	27% (689)	15% (401)	72% (1858)	15% (375)	13% (331)	31% (796)	3% (87)	12% (299)	55% (1417)
Moderate or high	13452	59% (7578)[a]	45% (6086)[b]	37% (4988)	18% (2376)	61% (7974)[b]	21% (2722)	19% (2466)	35% (4656)[b]	6% (805)	13% (1726)	47% (6264)[b]
Attended a CRP: No	10195	63% (6189)	51% (5174)	34% (3512)	15% (1504)	67% (6632)	18% (1786)	15% (1533)	28% (2833)	5% (559)	12% (1268)	54% (5530)
Yes	5852	53% (2984)[b]	41% (2401)[b]	37% (2180)	22% (1270)	55% (3200)[b]	23% (1317)	22% (1255)	45% (2630)[b]	6% (340)	13% (769)	36% (2113)[b]
Self-reported diabetes: No	11617	57% (6296)	43% (5011)	38% (4387)	19% (2214)	59% (6677)	21% (2433)	20% (2285)	37% (4305)	6% (666)	13% (1464)	45% (5178)
Yes	4533	67% (2930)[b]	57% (2593)[b]	30% (1363)	13% (574)	73% (3208)[b]	16% (691)	12% (520)	26% (1181)[b]	5% (241)	13% (588)	56% (2520)[b]
History of CABG or PCI: No	2668	62% (1551)	49% (1303)	36% (956)	15% (408)	65% (1674)	18% (477)	17% (429)	30% (798)	7% (175)	13% (336)	51% (1358)
Yes	13591	59% (7749)	47% (6361)	36% (4828)	18% (2395)	62% (8289)	20% (2659)	18% (2388)	35% (4715)	5% (739)	13% (1730)	47% (6401)
History of stroke: No	15414	59% (8759)	46% (7150)	36% (5573)	17% (2683)	62% (9349)	20% (3032)	18% (2716)	34% (5286)	6% (878)	13% (1994)	47% (7249)
Yes	844	67% (540)[a]	61% (513)[b]	25% (211)	14% (120)	75% (613)[b]	13% (104)	12% (101)	27% (227)[b]	4% (36)	8% (71)	60% (510)[b]
History of heart failure: No	15002	59% (8487)	47% (6980)	36% (5362)	18% (2652)	62% (9049)	20% (2959)	18% (2672)	35% (5231)	6% (858)	13% (1945)	46% (6961)
Yes	1256	68% (812)[b]	54% (683)[b]	34% (422)	12% (151)	74% (913)[b]	14% (177)	12% (145)	22% (282)[b]	4% (56)	10% (120)	64% (798)[b]
HADS anxiety score < 11	12434	59% (7017)	46% (5719)	36% (4482)	18% (2229)	61% (7488)	20% (2431)	19% (2287)	35% (4401)	5% (682)	12% (1546)	47% (5802)
≥ 11	1199	68% (779)[b]	58% (697)[b]	28% (340)	14% (162)	76% (884)[b]	14% (163)	11% (123)	24% (282)[b]	6% (68)	14% (166)	57% (683)[b]
HADS depression score < 11	12451	59% (7067)	47% (5864)	36% (4436)	17% (2147)	62% (7631)	20% (2427)	18% (2160)	35% (4323)	6% (708)	13% (1580)	47% (5837)
≥ 11	794	77% (587)[b]	65% (514)[b]	26% (210)	9% (70)	83% (649)[b]	11% (84)	7% (52)	16% (125)[b]	4% (32)	11% (91)	69% (546)[b]

*Regular physical activity of at least 30 minutes duration on average 5 times a week; **Weekly frequency of engaging in any regular activity long enough to sweat; ***Getting to and from work, sporting activity and other physical effort during leisure time, like gardening or dancing (vigorous activity causes shortness of breath, a rapid heart rate, and sweating): Low = No physical activity weekly or only light activity in most weeks, Moderate = Vigorous physical activity for at least 20 minutes once or twice a week, High = Vigorous physical activity for at least 20 minutes more than twice a week; ****Planned physical activity includes brisk walking, aerobics, jogging, bicycling, swimming, etc. performed to increase physical fitness (answer 'Don't know/Unsure' (24%) classified as 'not intending to do more regular planned physical activity); Statistical significances from a logistic model adjusting for age and gender: [a]P<0.01; [b]P<0.001

Figure

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