Physical activity status in patients with coronary heart disease: results from the cross-sectional EUROASPIRE surveys

Journal:	*Journal of Physical Activity & Health*
Manuscript ID	JPAH.2016-0088.R1
Manuscript Type:	Article
Keywords:	cardiovascular health, physical activity

TITLE PAGE

Title:

"Physical activity status in patients with coronary heart disease: results from the cross-sectional EUROASPIRE surveys".

~~**Physical activity in coronary patients and the association with risk factor profile and CHD management: findings from the cross-sectional EUROASPIRE IV survey**~~

Running title: Physical activity in coronary patients

Original research

Keywords: coronary risk profile; cardiac rehabilitation, preventive cardiology

Abstract word count: 200

Manuscript word count: 4293

ABSTRACT

Background: The studyaim was to assess the physical activity levels as well as the intention to become physically active in patients with stable coronary heart disease (CHD) with a special focus on the association with their risk profile.

Methods: Analyses are based on the cross-sectional EUROASPIRE IV surveys. Information was available on 8966 patients in EUROASPIRE III and on 7998 coronary patients was available in EUROASPIRE IV. Physical activity level according to patients risk profile and medical management was assessed, the intention to become physically active was investigated and a time trend analysis was performed.

Results: A better cardiovascular risk profile as well as receiving physical activity advice or weight loss advice was associated with better physical activity levels. The physical activity status improved significantly over time, the proportion of patients reporting vigorous physical activity for at least 20 minutes $\geqslant$ 3 times/week increased from 14.1% to 20.2% ($p<0.001$). Similarly, a significantly greater proportion of patients are in the maintenance stage (36.6% vs. 27.4%) and a smaller proportion in the precontemplation stage (43.2% vs. 52.3%.).

Conclusion: Although an increase was seen in the proportion of patients being adequately physical active, physical activity levels remain suboptimal in many CHD patients. ~~**Background:** The aim of this study was to assess the physical activity levels as well as the intention to become physically active in patients with stable coronary heart disease (CHD)~~

~~**Methods:** Analyses are based on the EUROASPIRE IV (EUROpean Action on Secondary and Primary Prevention through Intervention to Reduce Events) survey. Information on 7998 coronary patients was available. Physical activity level according to patients risk profile and medical management was assessed, and a time trend analysis was performed (vs. EUROASPIRE III).~~

Results: A better cardiovascular risk profile as well as receiving physical activity advice or weight loss advice was associated with better physical activity levels. The physical activity status improved significantly over time, the proportion of patients reporting vigorous physical activity for at least 20 minutes ≥ 3 times/week increased from 14.1% to 20.2% ($p<0.001$). Similarly, a significantly greater proportion of patients are in the maintenance stage (36.6% vs. 27.4%) and a smaller proportion in the precontemplation stage (43.2% vs. 52.3%.).

Conclusion: Although an increase was seen in the proportion of patients being adequately physical active, physical activity levels remain suboptimal in many CHD patients. A better risk profile and adequate CHD management are associated with higher physical activity levels.

INTRODUCTION

Even though mortality rates due to cardiovascular disease (CVD) have dropped substantially during the last decades, CVD remains the major cause of premature death in Europe.[1] Unhealthy lifestyle, such as smoking, physical inactivity and unhealthy eating habits, is strongly related with the development of CVD. According to the WHO, alcohol, tobacco, hypertension, obesity, hypercholesterolemia, unhealthy diet and physical inactivity account for 61% of all cardiovascular deaths.[2] Several guidelines on CVD prevention have stressed the importance of healthy lifestyle behaviour.[3-5] Physical activity is recommended in the prevention and treatment of coronary heart disease (CHD) because of its beneficial effect on blood pressure, lipids, body mass index, HbA1c and inflammatory markers.[4,6] Furthermore, a direct effect on the vascular wall is found (myocardial oxygen demand; improved myocardial perfusion and antithrombotic effect).[4] Regular physical activity is associated with a reduced risk for fatal and non-fatal cardiovascular events, both in healthy persons as well as in CHD patients. A risk reduction between 30% and 35% for developing fatal or non-fatal coronary or cardiovascular disease in the most active versus least active persons has been reported.[7] Similarly, leisure time physical activity in CHD patients is associated with a decreased all-cause and cardiovascular mortality risk, with sedentary patients having a 20% increased long term (15 years) and a 60% increased short-term (5 years) all-cause mortality risk.[8] The ESC guidelines advise healthy adults to spend 2.5 to 5 hours a week on physical activity of at least moderate intensity or 1 to 2.5 hours a week on physical activity of at least vigorous intensity. Patients with a history of CHD are advised to perform moderate to vigorous intensity aerobic exercise training at least 3 times a week, 30 min per session.[4] It is not well-known how the guidelines on physical activity are being followed by CHD patients. Historically, patients have been advised to keep bed rest and limit their mobility after a coronary event.[9] Although the positive impact of physical activity is well studied over the years, there still might be some misconception among patients. Furthermore, due to the older age of CHD patients, it is not always easy to ensure they are adequately physically active. Hence, the aim of the

current study is to assess the physical activity levels as well as the intention to become physically active in patients with stable coronary heart disease using data from the EUROASPIRE (EUROpean Action on Secondary and Primary Prevention through Intervention to Reduce Events) surveys. Finally, a special emphasis was put on the association between the physical activity level and their risk profile and CHD management in order to determine the coronary profile of inactive patients. Furthermore, trends regarding physical activity level in CHD patients were investigated by comparing results from EUROASPIRE III and EUROASPIRE IV.

METHODS

Study population and data collection

The EUROASPIRE surveys are multicentre European cross-sectional studies developed to assess how clinical guidelines on cardiovascular disease prevention are implemented throughout Europe. Analyses were based on data gathered during the recent EUROASPIRE IV survey~~, performed in~~ (2012-2013), including 7998 patients.[10] Trend analyses included the results from centres that participated both in the EUROASPIRE III (2006-2007, including 8966 patients) and EUROASPIRE IV survey. Patients eligible for inclusion were men or women, aged ≥18 years and <80 years at the time of identification. They were hospitalized for a first or recurrent coronary event, further called the recruiting event, including elective or emergency coronary artery bypass graft surgery (CABG) (with the exclusion of surgery in the context of valve replacement, or when the primary diagnosis is not coronary artery disease); elective or emergency Percutaneous Coronary Intervention (PCI), both stents or other devices; first or recurrent acute myocardial infarction (AMI), ST elevation and non ST elevation myocardial infarction; and acute myocardial ischemia with no evidence of infarction (troponin negative). Patients were retrospectively identified from diagnostic registers, hospital discharge lists or other sources at 78 different hospital

centres in 24 European countries in EUROASPIRE IV: Belgium, Bosnia Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Finland, France, Germany, Greece, Ireland, Latvia, Lithuania, Netherlands, Poland, Romania, Russian Federation, Serbia, Slovenia, Spain, Sweden, Turkey, Ukraine, United Kingdom and from 76 different hospitals in 22 european countries in EUROASPIRE III: Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Romania, Russian Federation, Slovenia, Spain, Turkey, United Kingdom. Within each country one or more geographical areas with a defined population were selected and all hospitals serving these populations were identified. A sample of one or more hospitals, or all hospitals, was taken so that any patient presenting within the area had an approximately equal chance of being included. Patients admitted to a hospital outside this geographical area were not included in the sample.[10] Ethics approval was given by Local Research Ethics Committees. Written informed consent was obtained from each patient. The research was done in accordance with the Declaration of Helsinki.

Patients were examined ~~(waist, weight, height, blood pressure, cholesterol, and HbA1c (blood sample analysed centrally))~~ and interviewed ~~(self-reported information on lifestyle, other risk factor management and medication)~~ 6 months to 3 years following the recruiting event. At the time of the interview, a physical examination was performed, assessing height and weight (in light indoor clothes without shoes using a SECA 701/220 [SECA, Hamburg, Germany]), blood pressure (measured at least twice in sitting position with an automatic digital sphygmomanometer [Omron Healthcare, Kyoto, Japan]), breath carbon monoxide using a smokerlyser [Bedfont Scientific, Kent, UK]), and serum cholesterol. Blood analyses were performed in one central laboratory (National Institute for Health and Welfare, Helsinki, Finland). Sociodemographic variables such as age, educational level, and gender were collected. Furthermore, during the interview patients were asked about their current risk factors including medical management, diabetes, and smoking. In addition, patients were asked if they were offered any personal advice by a doctor or other health professional on the following: smoking cessation,

healthy diet, weight loss, physical activity and cardiac rehabilitation. Self-reported physical activity level of the patients was assessed as follows:

First, patients were asked to describe their self-perceived physical activity level outside work (getting to and from work, sporting activity and other physical effort during leisure time like gardening or dancing) on the following scale:

- no physical activity
- light physical activity
- vigorous physical activity for 20 minutes once or twice a week
- vigorous physical activity for at least 20 minutes ≥3 times a week

Vigorous activity was described as activity causing shortness of breath, a rapid heart rate, and sweating. In this study, adequate physical activity outside work was defined as vigorous physical activity for at least 20 minutes ≥3 times a week according to the guidelines on cardiovascular prevention.[4]

Secondly, patients were also asked if they perform regular physical activity of a least 30 minutes duration on average 5 times a week with a yes/no response option (not included in EUROASPIRE III).

Finally, patients were also asked about their intention to change their physical activity level using the transtheoretical model of Prochaska et al., differentiating in 5 behavioural stages of change: [11]

- I do not exercise regularly and I do not intend to in the next 6 months (precontemplation stage)
- I do not exercise regularly, but I intend to in the next 6 months (contemplation stage)
- I do not exercise regularly but I intend to in the next 30 days (preparation stage)
- I exercise regularly for less than 6 months (action stage)
- I exercise regularly for more than 6 months (maintenance stage).

Statistical analyses

Descriptive analyses were used to describe the physical activity level according to patient demographics.

Time trend analysis was based on the comparison of EUROASPIRE IV (2012-2013) with EUROASPIRE III (2006-2007) using multilevel logistic regression analyses adjusted for gender, age, educational level and recruiting event. Only countries that were included in both surveys, 20 in total, were taken into account (Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Finland, France, Germany, Greece, Ireland, Latvia, Lithuania, Netherlands, Poland, Romania, Russian Federation, Slovenia, Spain, Turkey and United Kingdom). Analyses of the physical activity level according to patients' risk factor profile was also done with multilevel logistic regression adjusted for gender, age, educational level and recruiting event. Analyses were performed using IBM SPSS statistical software (version 21.0). Significance level was set at $p<0.05$. The STROBE statement for reporting on observational studies was followed.[12]

RESULTS

A total of 7998 coronary patients were examined and interviewed in EUROASPIRE IV. The mean age was 62.5 (9.6) years old, and 24.4% were females. The question on self-perceived physical activity outside work was completed by 7877 patients (98.5%) and 7469 patients (93.4%) completed the question on regular physical activity. Information on the stages of change was available for 7299 patients (91.3%). Table 1 shows the physical activity level according to patient demographics. Overall, 19.5% (1536/7877) of patients reported to perform vigorous physical activity for at least 20 minutes three or more times a week (hereafter referred to as adequate physical activity) and 42.9% (3203/7469) reported to perform regular exercise of at least 30 minutes on average 5 times a week (hereafter referred to as regular exercise). Analyses of the stages of change showed that ~~5.6% and 35.6% of~~4 out of 10 patients were in the action or maintenance phase~~ respectively~~, ~~12.3% and 5.1%~~a minority of patients were in the contemplation and preparation phase respectively whereas a ~~majority of patients: 41.5% was still in the~~large proportion of patients (4 out of 10) were in the precontemplation phase having no intention to

exercise regularly in the next 6 months. Males, younger patients and higher educated patients were more likely to report higher physical activity.

Physical activity trend EUROASPIRE III vs. EUROASPIRE IV

As shown in table 2, the physical activity status improved significantly over time ($p<0.05$) both in males and in females (based on data from countries included in both surveys). The proportion of patients reporting adequate physical activity increased ~~(14.1% vs. 20.2%;~~ (p<0.001). Similar results were shown for the analyses of the stages of change. Compared to the EUROASPIRE III patients, a significantly greater proportion of EUROASPIRE IV patients are in the maintenance stage ~~(36.6% vs. 27.4%)~~ and a smaller proportion in the precontemplation stage ~~(43.2% vs. 52.3%).~~. The proportion of patients in the in-between phases remained more or less the same. Stratification by gender showed similar results.

Physical activity and the association with CVD risk factors

A better cardiovascular risk profile was associated with a larger proportion of patients being physically active (see table 3). In males, the proportion of physically active patients was higher in non-smokers compared to smokers ($p<0.001$), in patients without diabetes compared with patients with diabetes ($p<0.001$) and in non-obese versus obese patients ($p<0.001$). Furthermore, patients being treated with blood pressure lowering medication having a blood pressure on target were more likely to exercise regularly and were more likely to be in the maintenance/action phase. No association between physical activity and raised LDL-cholesterol in patients being treated with lipid lowering medication was seen.

Finally, substantial differences in physical activity level were seen between patients with 3 of more risk factors versus patients with less than 3 risk factors (risk factors included: smoking, obesity, elevated LDL-cholesterol, hypertension and having diabetes or an HbA1c>7%) ($p<0.001$) .

Physical activity and association with advice received

Since the index event, 66.3% of patients reported to have received advice to increase their physical activity level. Those who reported to have received advice, were more often males (76.8% vs. 72.7%), were younger (61.7 years vs. 63.7 years), had a higher education (primary education: 15.8% vs 20.9%), and suffered less often from ischaemia (7.9% vs. 14.3%). Receiving physical activity advice was associated with a greater proportion of patients exercising regularly (~~48.0% vs. 32.3%;~~ p<0.001) and a greater proportion of patients being in the action/maintenance phase (~~47.2% vs. 34.4%~~ p<0.001) (see table 4). Similarly, patients receiving weight loss advice were also more likely to exercise regularly (~~38.5% vs. 35.0%;~~ p<0.001) and to be in the action/maintenance phase (~~44.1% vs.34.4%;~~ p<0.001). Smoking advice and healthy diet advice was not associated with the physical activity level. Furthermore patients who received the advice to follow cardiac rehabilitation, as well as patients who attended at least half of the cardiac rehabilitation sessions were more likely to have a higher physical activity level (p<0.05).

DISCUSSION

The aim of this study was to investigate the physical activity status in patients with a history of CHD, and to assess the association with their risk profile ~~and their CHD management~~. Adequate physical activity is associated with a reduced all cause and cardiovascular mortality risk both in healthy persons[13-14] as well as in CHD patients[7,8,15]. Guidelines on cardiovascular prevention stress the importance of physical activity. CHD patients are advised to perform moderate to vigorous intensity aerobic exercise training at least 3 times a week, 30 min per session.[4] Our analyses have shown that the physical activity level of CHD patients across Europe has increased between 2007 and 2013. A 43% increase was seen in the proportion of patients performing vigorous physical activity for at least 20 minutes ≥3 times a week. Likewise a 32.5% increase and a 17.5% decrease was seen in the proportion of patients being in the maintenance and the precontemplation phase respectively. This trend was seen in both genders and could not be explained by the changes in risk factor profile between both surveys. Part of this

improvement might be caused by the increased advice of health care professionals to participate in a cardiac rehabilitation program (44.8% in EUROASPIRE III and 50.7% in EUROASPIRE IV received the advice to participate in a rehabilitation program).[10,16] Despite the significant increase in exercise, the physical activity in many CHD patients remains suboptimal with a substantial room for improvement.

Based on the large, multicentre international STABILITY (Stabilisation of Atherosclerotic Plaque By Initiation of Darapladib Therapy) study including 15,828 CHD patients from 39 countries, Stewart and colleagues investigated the factors associated with low activity levels in patients with stable CHD.[17] STABILITY is a large international trial. Our EUROASPIRE IV study results confirmed the STABILITY findings showing a better risk factor profile in physically active CHD patients. Stewart et al. found that a lower education and poorer general health was associated with lower physical activity levels.[17] In contrast with our findings and the general population findings,[2] they reported male gender being associated with lower physical activity. These contrasting findings might be associated with the way their physical activity level was questioned. In the EUROASPIRE survey, physical activity questions focus on regular physical activity and vigorous physical activity increasing the breathing rate and causing to break a sweat, whereas in the STABILITY study, the CHD patients have listed all physical activity during the past week, including household chores, which are more often performed by females, especially in that age category (≥60 years). The association between the physical activity stage and the risk factors profile was also seen in the general population.[18]

The WHO PREMISE (WHO study on Prevention or Recurrences of Myocardial Infarction and StrokE) study including 10,000 Myocardial infarction and stroke patients from 10 different countries, found that 48.5% of patients engaged in at least 30 min of physical activity per day. The main reasons for being insufficiently physically active were: the belief that physical activity has negative effects on health , lack of time, and lack of facilities. They also found a significant relationship between education and physical

activity levels.[19] The association with educational level was also reported by the PURE (Prospective Urban Rural Epidemiology) study. This study, including 7519 patient with a cardiovascular disease showed high levels of work or leisure time related physical activity levels in about one in three patients.[20]

Within EUROASPIRE we have also seen that active patients were more likely to have been advised to increase their physical activity; to lose weight if they were obese; or to follow a cardiac rehabilitation programme. Similar to the STABILITY study, EUROASPIRE patients who attended at least half of the cardiac rehabilitation sessions were more likely to be physically active.[17]

Some patients might have contra-indications to perform heavy exercise. CHD patients may suffer from symptoms hampering them to be physically active. Additional analyses (results not shown) on the characteristics of low active patients indicated some relevant findings. Some patients feel that they are bothered by being physically restricted or limited in doing sports or exercise which could explain the low physical activity status. In those patients being regular physically active, 22.8% of patients reported being limited in their physical activities due to a long standing illness, disability or infirmity, whereas in those not being physically active this proportion rose to 31.0%. Likewise, 23.7% of regular active patients reported their heart problem has bothered them to walk more than 100 yard at a brisk pace, whereas 36.5% felt bothered by this in those not regular active. Furthermore, 15.9% and 21.0% of regular active patients versus 28.0% and 35.9% in patients not being regular active, was bothered by being physically restricted and being limited in doing sports respectively. Similar findings were reported in the STABILITY study.[17] Indeed a larger proportion of the physically inactive patients report physical restriction due to their heart disease, however the majority of patients did not suffer from symptoms preventing them to exercise. Furthermore, these data do not report on causality. It might be that lower physical activity results in a poorer overall fitness resulting in more discomfort when walking around or doing exercise. Patients reporting to be bothered by their heart problem might also suffer from anxiety or depression or

insufficient social support resulting in a more negative attitude towards their heart disease.[21] Previously, a bidirectional association between anxiety or depression and physical activity has been observed in the Whitehall II study,[22] which might also be the case for the more general self-perceived health status, where low physical activity results in more self-reported health status problems, and low health status results in lower physical activity levels. Furthermore, it can be assumed that patients who are not compliant in following the physical activity recommendations, will be more likely to have a lower medication compliance or adherence resulting in a worse risk factor profile.

There are some limitations to this study. The most important one being the self-reported nature of the physical activity outcomes resulting in recall bias. Individuals have a tendency to over report on their healthy lifestyle activities.[18] Furthermore, low levels of recall might result in underreporting of the variable "advice received since their coronary event". Also, motivated patient with higher levels of physical activity might me more aware of the advice they received since their recruiting event. Hence the results, especially regarding the association between physical activity and advice received should be interpreted with caution. However, as the association was only seen with physical activity advice and weight advice and not with smoking advice and healthy diet advice, the findings suggest that physical activity advice might result in better activity levels. Furthermore, although a great effort was done in order to standardize data collection, by trained research personnel using standardized questionnaires and measuring methods, interpersonal and intercultural differences between study nurses from different countries and centres could potentially have an influence on the results.

CONCLUSION

In conclusion, physical activity levels in CHD patients have increased but there is still ample room for improvement. A promising time trend in the stages of change was observed with more patients being located in later stages of the transtheoretical model of behavioural stages of change. Nonetheless, a

substantial proportion of patients has no intention to become physically active. Patients who received advice on how to increase their physical activity level were more likely to be physically active. Patients who were advised to follow cardiac rehabilitation and patients who attended at least half of the rehabilitation sessions had also a better physical activity level. Furthermore, physically inactive patients are also more likely to score worse on risk factors such as smoking cessation, BMI, hypertension and LDL-cholesterol.

COMPETING INTEREST

The authors report no competing interest.

ACKNOWLEDGEMENT

The authors thank the administrative staff, physicians, nurses, and other personnel at the hospitals in which the study was carried out, and all the patients who participated in the EUROASPIRE studies. The EUROASPIRE IV survey was carried out under the auspices of the European Society of Cardiology, EURObservational Research Programme.

FUNDING SOURCES

Unrestricted educational grants to the European Society of Cardiology were obtained from Amgen, AstraZeneca, Bristol-Myers Squibb and AstraZeneca, F. Hoffman-La Roche, GlaxoSmithKline, and Merck Sharp & Dohme. The sponsors of the EUROASPIRE surveys had no role in the design, data collection, data analysis, data interpretation, decision to publish, or writing the manuscript. Delphine De Smedt is financially supported by the Research Foundation Flanders.

REFERENCES

1. Nichols M, Townsend N, Scarborough P, Rayner M. Cardiovascular disease in Europe 2014: epidemiological update. *Eur Heart J.* 2014; 35(42):2950-2959.
2. World Health Organization. Global health risksmortality and burden of disease attributable to selected major risks. Geneva: World Health Organization; 2009. http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf . Accessed January 14, 2016.
3. Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Houston MN, Hubbard VS, Lee IM, Lichtenstein AH, Loria CM, Millen BE, Nonas CA, Sacks FM, Smith SC, Jr., Svetkey LP, Wadden TA, Yanovski SZ. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardio.l* 2014; 63(25 Pt B):2960-2984.
4. Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren M, Albus C, Benlian P, Boysen G, Cifkova R, Deaton C, Ebrahim S, Fisher M, Germano G, Hobbs R, Hoes A, Karadeniz S, Mezzani A, Prescott E, Ryden L, Scherer M, Syvanne M, Scholte Op Reimer WJ, Vrints C, Wood D, Zamorano JL, Zannad F. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). *Eur Heart J.* 2012 ;33(13):1635-1701.
5. Smith SC, Benjamin EJ, Bonow RO, Braun LT, Creager MA, Franklin BA, Gibbons RJ, Grundy SM, Hiratzka LF, Jones DW, Lloyd-Jones DM, Minissian M, Mosca L, Peterson ED, Sacco RL, Spertus J, Stein JH, Taubert KA. AHA/ACCF secondary prevention and risk reduction therapy for patients with coronary and other atherosclerotic vascular disease: 2011 update: a guideline from the American Heart Association and American College of Cardiology Foundation endorsed by the

World Heart Federation and the Preventive Cardiovascular Nurses Association. *J Am Coll Cardiol*. 2011; 58(23):2432-2446.

6. Mora S, Cook N, Buring JE, Ridker PM, Lee IM. Physical activity and reduced risk of cardiovascular events: potential mediating mechanisms. *Circulation.* 2007; 116(19):2110-2118.
7. Shiroma EJ, Lee IM. Physical activity and cardiovascular health: lessons learned from epidemiological studies across age, gender, and race/ethnicity. *Circulation.* 2010; 122(7):743-752.
8. Apullan FJ, Bourassa MG, Tardif JC, Fortier A, Gayda M, Nigam A. Usefulness of self-reported leisure-time physical activity to predict long-term survival in patients with coronary heart disease. *Am J Cardiol.* 2008; 102(4):375-379.
9. Mampuya WM. Cardiac rehabilitation past, present and future: an overview. *Cardiovasc Diagn Ther.* 2012; 2(1):38-49.
10. Kotseva K, Wood D, De Bacquer D, De Backer G, Ryden L, Jennings C, Gyberg V, Amouyel P, Bruthans J, Castro CA, Cifkova R, Deckers JW, De SJ, Dilic M, Dolzhenko M, Erglis A, Fras Z, Gaita D, Gotcheva N, Goudevenos J, Heuschmann P, Laucevicius A, Lehto S, Lovic D, Milicic D, Moore D, Nicolaides E, Oganov R, Pajak A, Pogosova N, Reiner Z, Stagmo M, Stork S, Tokgozoglu L, Vulic D. EUROASPIRE IV: A European Society of Cardiology survey on the lifestyle, risk factor and therapeutic management of coronary patients from 24 European countries. *Eur J Prev Cardiol*. 2015. doi: 10.1177/2047487315569401
11. Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: toward an integrative model of change. *Journal of Consulting and Clinical Psychology.* 1983; 51(3):390-395.
12. STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement. http://www.strobe-statement.org/. Accessed January 14, 2016.

13. Nocon M, Hiemann T, Muller-Riemenschneider F, Thalau F, Roll S, Willich SN. Association of physical activity with all-cause and cardiovascular mortality: a systematic review and meta-analysis. *Eur J Cardiovasc Prev Rehabil*. 2008; 15(3):239-246.

14. Samitz G, Egger M, Zwahlen M. Domains of physical activity and all-cause mortality: systematic review and dose-response meta-analysis of cohort studies. *Int J Epidemiol.* 2011; 40(5):1382-1400.

15. Heran BS, Chen JM, Ebrahim S, Moxham T, Oldridge N, Rees K, Thompson DR, Taylor RS. Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database Syst Rev.* 2011; (7):CD001800.

16. Stewart R, Held C, Brown R, Vedin O, Hagstrom E, Lonn E, Armstrong P, Granger CB, Hochman J, Davies R, Soffer J, Wallentin L, White H. Physical activity in patients with stable coronary heart disease: an international perspective. *Eur Heart J.* 2013; 34(42):3286-3293.

18. Grossschadl F, Titze S, Burkert N, Stronegger WJ. Moderate- and vigorous-intensity exercise behaviour according to the Transtheoretical Model: associations with smoking and BMI among Austrian adults. *Wien Klin Wochenschr.* 2013; 125(9-10):270-278.

19. Mendis S, Abegunde D, Yusuf S, Ebrahim S, Shaper G, Ghannem H, Shengelia B. WHO study on Prevention of REcurrences of Myocardial Infarction and StrokE (WHO-PREMISE). *Bull World Health Organ.* 2005; 83(11):820-829.

20. Teo K, Lear S, Islam S, Mony P, Dehghan M, Li W, Rosengren A, Lopez-Jaramillo P, Diaz R, Oliveira G, Miskan M, Rangarajan S, Iqbal R, Ilow R, Puone T, Bahonar A, Gulec S, Darwish EA, Lanas F, Vijaykumar K, Rahman O, Chifamba J, Hou Y, Li N, Yusuf S. Prevalence of a healthy lifestyle among individuals with cardiovascular disease in high-, middle- and low-income countries: The Prospective Urban Rural Epidemiology (PURE) study. *JAMA.* 2013; 309(15):1613-1621.

21. Ronda G, Van AP, Brug J. Stages of change, psychological factors and awareness of physical activity levels in The Netherlands. *Health Promot Int.* 2001; 16(4):305-314.

22. Azevedo Da SM, Singh-Manoux A, Brunner EJ, Kaffashian S, Shipley MJ, Kivimaki M, Nabi H. Bidirectional association between physical activity and symptoms of anxiety and depression: the Whitehall II study. *Eur J Epidemiol.* 2012; 27(7):537-546.

Table 1: Physical activity status according to patient demographics

	Adequate physical activity	Regular exercise	Stages of change				
			Precontemplation	Contemplation	Preparation	Action	Maintenance
All	19.5%(1536/7877)	42.9%(3203/7469)	41.5%(3028/7299)	12.3%(897/7299)	5.1%(369/7299)	5.6%(406/7299)	35.6%(2599/7299)
Gender							
Male	21.6%(1287/5967)	44.7%(2532/5665)	39.3%(2180/5546)	12.5%(691/5546)	5.4%(298/5546)	5.8%(323/5546)	37%(2054/5546)
Female	13%(249/1910)	37.2%(671/1804)	48.4%(848/1753)	11.8%(206/1753)	4.1%(71/1753)	4.7%(83/1753)	31.1%(545/1753)
	P<0.001	**P<0.001**			**P<0.001**		
Age							
<60 years	24.1%(619/2564)	48%(1165/2426)	33.4%(798/2386)	6.9%(164/2386)	16.8%(401/2386)	8.3%(198/2386)	34.6%(825/2386)
60-69 years	19.8%(581/2937)	43.8%(1226/2801)	40%(1087/2719)	4.6%(126/2719)	11.9%(324/2719)	4.9%(133/2719)	38.6%(1049/2719)
≥70 years	14.1%(336/2376)	36.2%(812/2242)	52.1%(1143/2194)	3.6%(79/2194)	7.8%(172/2194)	3.4%(75/2194)	33%(725/2194)
	P<0.001	**P<0.001**			**P<0.001**		
Recruiting diagnosis							
CABG	20%(203/1015)	43.6%(423/970)	42.8%(411/960)	11.6%(111/960)	3.3%(32/960)	4.6%(44/960)	37.7%(362/960)
PCI	20.2%(862/4260)	43.9%(1792/4084)	41.9%(1682/4016)	11.8%(472/4016)	5.1%(203/4016)	6.1%(245/4016)	35.2%(1414/4016)
AMI	19%(340/1787)	44.3%(728/1644)	38.5%(621/1613)	13.1%(212/1613)	6.4%(104/1613)	6.3%(101/1613)	35.6%(575/1613)

Ischaemia	16.1%(131/815)	33.7%(260/771)	42.8%(411/960)	11.6%(111/960)	3.3%(32/960)	4.6%(44/960)	37.7%(362/960)
	P=0.185	**P=0.017**			**P=0.007**		
Educational level							
Primary	14.6%(200/1368)	40.3%(524/1301)	44.5%(554/1244)	12.9%(160/1244)	3.5%(44/1244)	4.9%(61/1244)	34.2%(425/1244)
Secondary	19.8%(930/4707)	42%(1862/4434)	42.8%(1856/4340)	11.7%(508/4340)	5.3%(228/4340)	5.5%(238/4340)	34.8%(1510/4340)
High	22.5%(393/1748)	47.3%(793/1676)	35.8%(596/1663)	13.5%(225/1663)	5.7%(95/1663)	6.2%(103/1663)	38.7%(644/1663)
	P<0.001	**P<0.001**			**P<0.001**		

Multilevel analyses accounting for country differences

Table 2: Time trends

	Adequate physical activity	Stages of change				
		Precontemplation	contemplation	preparation	Action	Maintenance
All						
EAIII	14.1% (1099/7788)	52.3%(3826/7313)	10.9%(800/7313)	4.6%(340/7313)	4.7%(345/7313)	27.4%(2002/7313)
EAIV	20.2% (1279/6331)	43.2%(2548/5901)	11.7%(691/5601)	4.6%(269/5601)	4.3%(251/5901)	36.3%(2142/5901)
	P<0.001			**P<0.001**		
Men						
EAIII	15.6%(914/5865)	49.2%(2722/5534)	11.3%(623//5534)	4.8%(268/5534)	5.0%(279/5534)	29.7%(1642/5534)
EAIV	22.3%(1074/4814)	41.1%(1851/4507)	11.9%(536/4507)	4.8%(216/4507)	4.6%(207/4507)	37.7%(1697/4507)
	P<0.001			**P<0.001**		
Women						
EAIII	9.5%(185/1923)	62.1%(1104/1779)	9.9%(177/1779)	4.0%(72/1779)	3.7%(66/1779)	20.2%(360/1779)
EAIV	13.5%(205/1517)	50.0%(697/1394)	11.1%(155/1394)	3.8%(53/1394)	3.2%(44/1394)	31.9%(445/1394)
	P=0.006			**P<0.001**		

Only centres participating in both surveys are included in the analyses (20 countries)

p-value adjusted for gender, age, recruiting diagnosis, educational level

Table 3: Physical activity and the association with the CVD risk factor profile

		Adequate physical activity	Regular exercise	Action/Maintenance
Hypertension[a]	No	38%(1112/2930)	44.9%(1815/4040)	42.8%(1686/3941)
	Yes	17.4%(555/3195)	39.3%(1175/2990)	38%(1112/2930)
		P=0.420	**P=0.001**	**P=0.010**
Raised LDL-cholesterol[b]	No	20.2%(263/1302)	45.2%(566/1253)	42%(516/1228)
	Yes	20%(970/4847)	41.7%(1921/4602)	41.4%(1857/4490)
		P=0.278	**P=0.375**	**P=0.207**
Smoking	No	20.2%(1334/6619)	43.9%(2772/6308)	42.8%(2641/6171)
	Yes	16.1%(202/1258)	37.1%(431/1161)	32.3%(364/1128)
		P<0.001	**P<0.001**	**P<0.001**
Diabetes	No	21.6%(1239/5736)	46.1%(2505/5435)	44.2%(2363/5352)
	Yes	13.8%(291/2104)	34.3%(686/2000)	32.8%(629/1915)
		P<0.001	**P<0.001**	**P<0.001**
Obesity[c]	No	21.8%(1068/4893)	46.2%(2154/4660)	45%(2052/4563)
	Yes	15.7%(464/2951)	37.5%(1041/2777)	35%(948/2705)
		P<0.001	**P<0.001**	**P<0.001**

Number of risk factors[d]	<3	22.5%(1081/4811)	46.3%(2133/4603)	45.5%(2053/4517)
	≥3	14.9%(332/2231)	33%(687/2083)	31.1%(628/2017)
		P<0.001	**P<0.001**	**P<0.001**

[a] Blood pressure >140/90 (140/80 in patients with diabetes) in patients on Blood pressure lowering medication; [b] LDL-cholesterol ≥1.8 mmol/L in patients on lipid lowering medication; [c] BMI>30 kg/m²; [d] risk factors included are smoking, obesity, blood pressure >140/90 (140/80 in patients with diabetes), LDL-cholesterol ≥1.8 mmol/L, and having diabetes or an HbA1c >7%.

p-value adjusted for gender, age, recruiting diagnosis, educational level

Table 4: Lifestyle advice received (advice since index event, versus never advice received)

		Adequate physical activity	Regular exercise	Action/Maintenance
Lifestyle advice received (advice since index event, versus never advice received)				
Smoking advice if smoking at hospitalisation	Yes	18.9%(358/1893)	42.1%(757/1796)	42.9%(112/261)
	No	19%(55/289)	41%(114/278)	38.1%(666/1750)
		P=0.900	**P=0.325**	**P=0.525**
Healthy diet advice	Yes	19.4%(1246/6439)	44%(2670/6069)	41.4%(2456/5939)
	No	19.8%(144/727)	41.6%(294/707)	41.7%(283/678)
		P=0.755	**P=0.165**	**P=0.388**
Weight loss advice if obese	Yes	15.5%(389/2502)	38.5%(902/2342)	44.1%(2110/4787)
	No	15.3%(31/202)	35%(69/197)	34.4%(668/1944)
		P=0.381	**P<0.001**	**P<0.001**
Physical activity advice	Yes	20.9%(1026/4910)	48%(2233/4652)	47.2%(2184/4625)
	No	16.4%(405/2473)	32.3%(762/2357)	28%(623/2228)
		P=0.240	**P<0.001**	**P<0.001**
Cardiac rehabilitation advised	Yes	20.9%(826/3956)	47.7%(1772/3718)	47.4%(1770/3732)
	No	18%(691/3836)	38.2%(1406/3676)	34.6%(1210/3502)

		P<0.001	**P=0.001**	**P<0.001**
Cardiac rehabilitation attended	Yes	21.8%(702/3221)	49.5%(1492/3016)	41.7%(282/676)
	No	16.9%(124/735)	39.9%(280/702)	48.7%(1488/3056)
		P=0.015	**P<0.001**	**P<0.001**

p-value adjusted for gender, age, recruiting diagnosis, educational level