ESC European Society of Cardiology

European Heart Journal - Quality of Care and Clinical Outcomes (2021) **00**, 1–10 **ORIGINAL ARTICLE**
doi:10.1093/ehjqcco/qcab043

Potential for optimizing management of obesity in the secondary prevention of coronary heart disease

Dirk De Bacquer [1,*], Catriona S. Jennings[2,3], Erkin Mirrakhimov [4,5], Dragan Lovic[6], Jan Bruthans[7], Delphine De Smedt[1], Nina Gotcheva[8], Maria Dolzhenko[9], Zlatko Fras[10,11], Nana Pogosova [12], Seppo Lehto[13], Hasan Hasan-Ali[14], Piotr Jankowski[15], Kornelia Kotseva[2,3], Guy De Backer[1], David Wood[2,16], and Lars Rydén[17], for the EUROASPIRE IV and V surveys of the European Observational Research Programme - European Society of Cardiology

[1]Department of Public Health and Primary Care, Ghent University, C. Heymanslaan 10–6K3, entrance 42, B-9000 Ghent, Belgium; [2]National Institute for Prevention and Cardiovascular Health, National University of Ireland - Galway, Croí Heart & Stroke Centre, Croí House, Moyola Lane, Newcastle, Galway H91 FF68, Ireland; [3]Imperial College Healthcare NHS Trust, Praed Street, London W2 1NY, UK; [4]Department of Cardiology and Internal Diseases, Kyrgyz State Medical Academy, Akhunbaev str. 92, 720020, Bishkek, Kyrgyzstan; [5]National Centre of Cardiology and Internal Medicine Named After Academician Mirrakhimov MM, Togolok Moldo str. 3, 720040, Bishkek, Kyrgyzstan; [6]Cardiology Department, Singidunum University, School of Medicine, Clinic for Internal Disease Intermedica, Jovana Ristica str. 20/2, 18000 Nis, Serbia; [7]Centre for Cardiovascular Prevention, First Faculty of Medicine and Thomayer Hospital, Charles University, Videnska 800, Prague 4, 140 59, Czech Republic; [8]National Heart Hospital, Department of Cardiology, Konjovitza str. 65, 1309 Sofia, Bulgaria; [9]Shupyk National Medical Academy of Postgraduate Education, Dorohozhytska 9, 04112, Kyiv, Ukraine; [10]Department of Vascular Medicine, Division of Medicine, University Medical Centre Ljubljana, Zaloška 7, SI-1525 Ljubljana, Slovenia; [11]Medical Faculty, University of Ljubljana, Vrazov trg 2, 1000 Ljubljana, Slovenia; [12]National Medical Research Centre of Cardiology of the Ministry of Healthcare of the Russian Federation, 3-rd Cherepkovskaya str. 15A, 121552 Moscow, Russia; [13]Department of Internal Medicine, Lapland Central Hospital, Ounasrinteentie 22, 96400 Rovaniemi, Finland; [14]Cardiovascular Medicine Department, Assiut University Heart Hospital, Assiut University, Assiut University Campus, 71515 Assiut, Egypt; [15]Department of Cardiology, Interventional Electrocardiology and Hypertension, Jagiellonian University Medical College, 2 Jakubowski Str., 30-688 Kraków, Poland; [16]National Heart and Lung Institute, Imperial College London, Guy Scadding Building, Dovehouse St, London SW3 6LY, UK; and [17]Department of Medicine, Solna, Karolinska Institutet, FoU - Tema Hjärta och Kärl, S1:02, Karolinska Universitetssjukhuset/Solna, SE-171 76, Stockholm, Sweden

Received 11 May 2021; revised 28 May 2021; editorial decision 3 June 2021; accepted 4 June 2021

Aims Prevention guidelines have identified the management of obese patients as an important priority to reduce the burden of incident and recurrent cardiovascular disease. Still, studies have demonstrated that over 80% of patients with coronary heart disease (CHD) fail to achieve their weight target. Here, we describe advice received and actions reported by overweight CHD patients since being discharged from hospital and how weight changes relate to their risk profile.

Methods and results Based on data from 10 507 CHD patients participating in the EUROASPIRE IV and V studies, we analysed weight changes from hospital admission to the time of a study visit ≥6 and <24 months later. At hospitalization, 34.9% were obese and another 46.0% were overweight. Obesity was more frequent in women and associated with more comorbidities. By the time of the study visit, 19.5% of obese patients had lost ≥5% of weight. However, in 16.4% weight had increased ≥5%. Weight gain in those overweight was associated with physical inactivity, non-adherence to dietary recommendations, smoking cessation, raised blood pressure, dyslipidaemia, dysglycaemia, and lower levels of quality of life. Less than half of obese patients was considering weight loss in the coming month.

Conclusions The management of obesity remains a challenge in the secondary prevention of CHD despite a beneficial effect of weight loss on risk factor prevalences and quality of life. Cardiac rehabilitation programmes should include weight loss interventions as a specific component and the incremental value of telehealth intervention as well as recently described pharmacological interventions need full consideration.

Keywords Coronary heart disease • Obesity • Secondary prevention

* Corresponding author. Tel: +32 93323683, Email: dirk.debacquer@UGent.be

Introduction

The Joint European Societies (JES) guidelines on cardiovascular disease prevention published since 1994, most recently in 2016, have defined lifestyle and risk factor goals for patients with coronary heart disease (CHD)[1]. Weight loss in those overweight and obese is strongly recommended in order to improve the levels of blood pressure and lipids and to reduce the risk of type 2 diabetes and thereby the risk of recurrent cardiovascular events[1]. Despite these recommendations, the European Surveys of Cardiovascular Disease Prevention and Diabetes (EUROASPIRE) revealed very high prevalences of both obesity and central obesity, which have further increased during the past two decades to an alarming level[2,3]. Comprehensive evidence on the management of obese patients with CHD in daily clinical practice is welcome to further understand this epidemic in order to develop more effective preventive strategies[4]. Based on pooled data from the EUROASPIRE IV and V surveys, we report on the specific management of CHD patients found overweight and obese at the time of hospitalization for their event in relation to the professional lifestyle advices they received, the specific actions taken and how weight changes relate to their risk factor profile as assessed at the time of a study visit at least 6 months following hospital discharge.

Methods

Patients and data collection

The EUROASPIRE surveys is a series of 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[2,3,5]. 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 EUROASPIRE IV (2012–13) and EUROASPIRE V (2016–17)[2,5]. A detailed description of the overall methodology has been published elsewhere[2,5]. In summary, a total of 16 259 consecutive female and male CHD patients (EUROASPIRE IV 7998 patients; EUROASPIRE V 8261 patients) aged 18–80 years from different areas within 29 participating countries were identified from hospital discharge lists or diagnostic registers and invited to participate by attending a study visit. At least 6 months prior to this visit, all patients had been admitted to hospitals or cardiac centres for a first or recurrent diagnosis of an acute myocardial infarction or acute myocardial ischaemia, or for treatment with elective or emergency coronary artery bypass graft surgery (CABG) or percutaneous coronary intervention (PCI). The average time between the hospital admission for the recruiting event or procedure and the study visit was about 16 months. The visit consisted of an interview, filling out a number of questionnaires and a comprehensive clinical examination including anthropometric measurements. All these data were collected by centrally trained research staff according to standardized methods including the use of similar devices in all centres.

Anthropometric and other characteristics

Body mass index (BMI) at the time of hospitalization for the recruiting event was based on measurements abstracted from the medical hospitalization notes. At the time of the study visit, height and weight were measured in light indoor clothes without shoes (SECA scale model 701 and measuring stick model 220). Waist circumference was measured using a metal tape horizontally in the mid-axillary line midway between the lowest rim of the rib cage and tip of the hip bone with the patient standing. *Obesity* was defined as a BMI ≥30 kg/m^2 and *overweight* as a BMI between 25 and 30 kg/m^2. Patients with a BMI ≥40 kg/m^2 were considered *morbidly obese*. In case body height at hospitalization was unavailable from the medical records (<1%), height obtained at the study visit was used to calculate BMI at the time of hospitalization retrospectively. *Abdominal overweight* at the study visit was defined as a waist circumference of ≥80 to <88 cm for women and ≥94 to <102 cm for men and central obesity as a waist circumference of ≥88 cm for women and ≥102 cm for men. *Educational level* was considered low if the patient reported to have completed primary school only at the study visit. *Smoking* was defined as self-reported smoking and/or a breath CO exceeding 10 ppm; breath CO was measured using a Smokerlyzer device (Micro + Bedfont Scientific, UK). *Persistent smoking* was defined as smoking at time of the study visit among those who smoked in the month prior to the recruiting event. *Physical activity* was considered on target if the patient was taking regular physical activity for ≥30 min on average five times a week. *Raised blood pressure* was defined as systolic/diastolic blood pressure of ≥140/90 mmHg (≥140/85 mmHg in patients with diabetes); *severely raised blood pressure* as systolic/diastolic blood pressure of ≥160/100 mmHg. Fasting blood samples were transferred to a central laboratory (Biochemistry Laboratory, National Institute for Health and Welfare, Helsinki, Finland) for determination of LDL cholesterol (LDL-C) and HbA1c with a level of <7% as the target in patients with self-reported diabetes. Patients who did not report a history of diabetes were invited to participate in an oral glucose tolerance test (OGTT) using 75 grams of glucose in 200 mL of water in the morning after at least 10 h of fasting. Plasma glucose was analysed locally in the fasting state (FPG) and 2 h after the glucose load (2hPG) with a point-of-care technique (Glucose 201RT, HemoCue©, Ängelholm, Sweden)[6]. Newly detected diabetes was defined as FPG ≥7.0 mmol/L or 2hPG ≥11.1 mmol/L; dysglycaemia was defined as FPG ≥7.0 mmol/L and/or 2hPG ≥7.8 mmol/L, hence including impaired glucose tolerance. During the interview, patients were asked whether they had been advised to follow a cardiac prevention and rehabilitation programme within 3 months of hospital discharge. Attendance at such programmes was defined as attending at least half of the recommended sessions. Patients were also asked whether they were offered any personal advice by a doctor or other health professional since hospital discharge and which steps they had taken to reduce their risk of heart disease. Patients self-completed the HeartQoL questionnaire to assess health-related quality of life levels at the time of the study visit[7].

Statistical methods

Distributions of baseline characteristics were summarized using means, standard deviations, and proportions. Characteristics of patient were compared according to their weight status at hospitalization as well as their weight change by means of the Chi-square or Fisher's exact test for categorical variables and the Kruskal–Wallis test for continuous variables. A type I error level of $\alpha = 0.05$ was used 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), European Society of Cardiology, European Heart House, 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 participant 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

Valid anthropometric data at the time of hospitalization for the recruiting event were found in the medical records of 10 507 (64.6%) of the 16 259 participants. Their mean (SD) age at the time of hospitalization was 62.5 (9.6) years and a quarter of them were females (24.8%). The distributions of BMI calculated from the medical record entries are shown in *Figure 1*. Less than 20% of CHD patients had BMI within normal limits. Female patients were more frequently obese than male patients. The prevalence of morbid obesity was 2.2% (men 1.8%; women 3.6%). The BMI status at hospitalization varied substantially across centres with age-standardized prevalences of obesity ranging from 8% to 46% in men and from 18% to 57% in women (*Figure 2*). Waist circumference was available in the medical records in 17.0%, 18.6%, and 19.5% of patients with normal weight, overweight, and obesity, respectively ($P = 0.079$). Overweight and particularly obese patients had significantly higher rates of diabetes, hypertension, dyslipidaemia, and heart failure prior to hospital admission (*Table 1*). These patients smoked less frequently and no relation between educational level and BMI was found. In 78% of obese patients and 27% of overweight patients a note about their weight status was made in the discharge letter. Patients were interviewed and examined after an average period of 1.3 years (16 months) following hospital discharge. At that time, 36.9% of all patients were obese (men 34.6%; women 43.7%), 10.4% had a BMI ≥35 kg/m^2 (men 8.4%; women 15.9%) while 2.5% suffered from morbid obesity (men 1.8%; women 4.4%). Obesity rates were higher in younger patients with a prevalence of 40.1% in patients aged <55 years (men 38.3%, women 48.4%). Overall, 14.5% of patients had lost more than 5% of weight while 21.1% had gained more than 5% of weight since the time of their hospitalization.

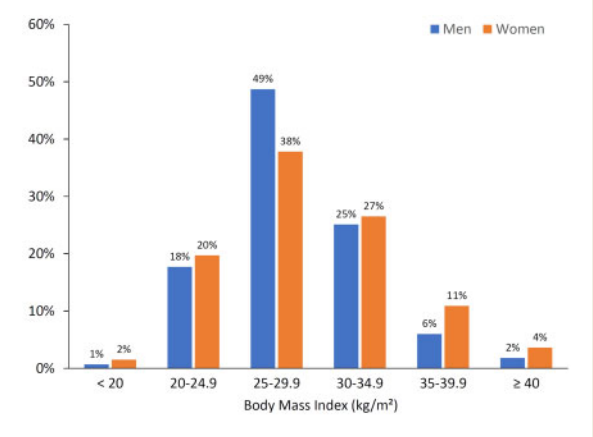

Figure 1 Distribution of body mass index at the time of hospitalization for the recruiting event.

Table 2 depicts weight changes since hospital discharge, the distributions of BMI and waist circumference and advice already given according to weight status at index hospitalization. Obese patients had lost 0.5 kg on average with 19.5% (men 20.7%, women 16.6%) losing ≥5% of body weight and 7.5% (men 8.1%, women 6.2%) losing ≥10% of body weight. However, in 16.4% of them body weight had increased ≥5% (men 15.9%, women 17.5%) and in 5.0% even ≥10% (men 4.8%, women 5.6%). Overweight patients gained 0.8 kg on average with almost a quarter gaining ≥5%. At the time of the study visit, 86.1% of patients obese at the index hospitalization were still obese with 89.5% having central obesity. Of patients being overweight at hospitalization, 14.0% had become obese by the time of the study visit. Despite of their high body weight, 18.7% of obese patients at the time of hospitalization self-declared they had not been informed by a healthcare professional to be overweight. Half of all patients had been advised to follow a cardiac prevention and rehabilitation programme and there was no difference in advice according to their weight status. Obese patients were advised to follow dietary recommendations in 63.7%, to participate in regular physical activity in 64.2% and to do more general everyday physical activities in 58.3%. Weight reducing drugs were advised in 6.7% of obese patients.

In patients who were overweight or obese at hospitalization, those having lost ≥5% of body weight by the time of the study visit had significantly lower levels of physical inactivity, uncontrolled diabetes, raised blood pressure, and dyslipidaemia and demonstrated higher levels of both physical and emotional quality of life (*Table 3*). The prevalence of severely raised blood pressure was almost doubled in patients with a weight gain of ≥5% in comparison to those who lost ≥5% of body weight and nearly three times as many of them had an HbA1c level exceeding 6.5% in those without history of diabetes. According to the OGTT, a quarter of patients who gained ≥5% of body weight were newly diagnosed with diabetes and over half of them were dysglycaemic. Weight gain was significantly associated with smoking cessation. In patients who were overweight or obese at hospitalization, those who quitted smoking gained 1.8 kg of body weight on average in contrast to the 0.4 kg average weight gain observed in persistent smokers ($P < 0.0001$). As shown in *Table 4*, significant weight loss was associated with the attendance at a cardiac rehabilitation and prevention programme and by professional advice to follow dietary recommendations. Patients who lost ≥5% of body weight had more frequently reduced their fat and sugar intake and consumed more fruit, vegetables, and fish. Doing more regular and everyday physical activities and following specific exercise advice from a health professional was also significantly associated with weight loss. Less than half of the patients showing a weight gain of ≥5% followed dietary guidelines; a third of them had not tried to reduce calorie intake and less than half engaged in more physical activity. *Figure 3* depicts patients' weight loss attempts and intentions to

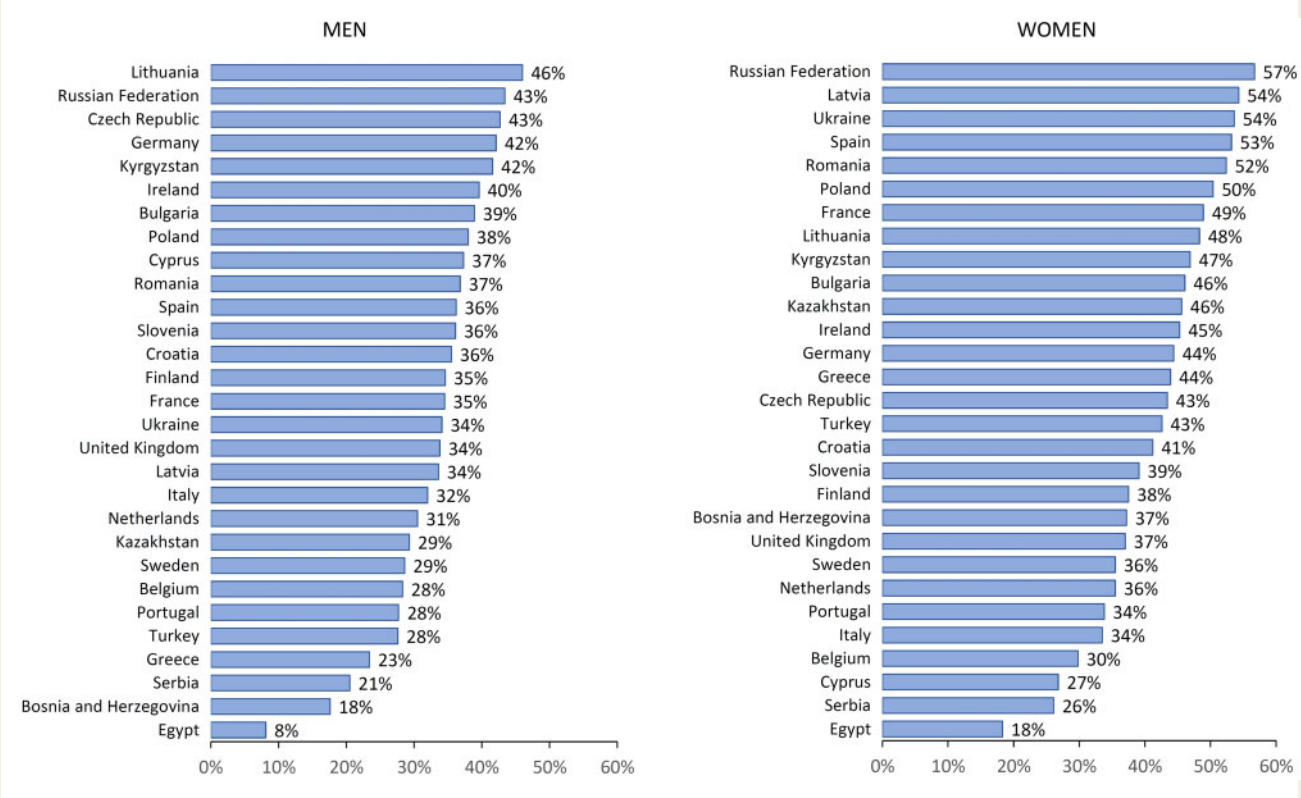

Figure 2 Age-standardized prevalences of obesity at the time of interview by centre.

Table 1 Information from medical records and discharge letters according to weight status at the time of the hospitalization

	Weight status at hospitalization			Significance
	Normal weight (*N* = 2007)	Overweight (*N* = 4834)	Obese (*N* = 3666)	
Medical history prior to hospitalization				
Stroke	3.2% (64)	4.1% (195)	4.6% (164)	*P* = 0.054
Heart failure	4.0% (78)	4.4% (206)	6.2% (219)	*P* < 0.0001
Diabetes	16.7% (288)	25.0% (1055)	37.2% (1237)	*P* < 0.0001
Hypertension	64.4% (1142)	74.7% (3278)	85.2% (2905)	*P* < 0.0001
Dyslipidaemia	61.4% (969)	66.1% (2609)	69.9% (2114)	*P* < 0.0001
Smoking in month before hospitalization	36.8% (738)	30.3% (1464)	26.9% (986)	*P* < 0.0001
Low education[a]	14.0% (279)	14.1% (672)	14.8% (538)	*P* = 0.58
Information from discharge letter				
Diabetes	16.1% (269)	24.5% (1001)	37.2% (1175)	*P* < 0.0001
Hypertension	66.1% (1175)	77.5% (3365)	87.7% (2980)	*P* < 0.0001
Dyslipidaemia	69.0% (1142)	76.1% (3074)	80.1% (2504)	*P* < 0.0001
Overweight or obesity	2.9% (46)	27.2% (978)	78.2% (2216)	*P* < 0.0001
Aspirin or other antiplatelets prescribed	96.9% (1944)	96.5% (4663)	96.1% (3524)	*P* = 0.36
Blood pressure lowering drugs prescribed	94.3% (1891)	95.4% (4609)	96.2% (3525)	*P* = 0.0048
Lipid-lowering drugs prescribed	89.9% (1795)	90.0% (4343)	88.7% (3245)	*P* = 0.10

Cell entries are mean (SD) or % (*n*).
[a]As reported by the patients at the time of the study visit.

Table 2 Weight change, BMI, waist circumference, and advice offered by the time of the study visit according to weight status at hospitalization

	Weight status at hospitalization			Significance
	Normal weight (*N* = 2007)	Overweight (*N* = 4834)	Obese (*N* = 3666)	
Body weight at hospitalization (kg)	67.5 (8.7)	81.0 (9.1)	97.0 (13.9)	*P* < 0.0001
Body weight at study visit (kg)	69.6 (10.3)	81.8 (10.4)	96.5 (14.7)	*P* < 0.0001
Weight change (kg)[a]	+2.2 (+1.9 to +2.4)	+0.8 (+0.6 to +0.9)	-0.5 (-0.8 to -0.3)	*P* < 0.0001
Weight loss ≥5%	8.5% (170)	14.1% (680)	19.5% (715)	*P* < 0.0001
Weight loss ≥10%	2.0% (40)	4.1% (196)	7.5% (275)	*P* < 0.0001
Weight gain ≥5%	28.0% (562)	21.7% (1050)	16.4% (601)	*P* < 0.0001
Weight gain ≥10%	15.6% (314)	7.8% (376)	5.0% (184)	*P* < 0.0001
BMI at study visit (kg/m^2)				
<25 kg/m^2	76.7% (1540)	8.5% (411)	0.5% (17)	*P* < 0.0001
25–29.9 kg/m^2	21.3% (427)	77.5% (3747)	13.4% (491)	*P* < 0.0001
≥30 kg/m^2	2.0% (40)	14.0% (676)	86.1% (3158)	*P* < 0.0001
Waist circumference at study visit				
<94 cm in men; <80 cm in women	55.3% (1050)	16.6% (770)	2.4% (84)	*P* < 0.0001
94–101.9 cm in men; 80–87.9 cm in women	28.6% (544)	32.1% (1491)	8.2% (291)	*P* < 0.0001
≥102 cm in men; ≥88 cm in women	16.1% (306)	51.3% (2383)	89.5% (3178)	*P* < 0.0001
Weight measured since hospital discharge	74.8% (1461)	78.2% (3702)	81.3% (2916)	*P* < 0.0001
Waist circumference measured since hospital discharge	28.3% (535)	30.1% (1378)	33.1% (1162)	*P* = 0.0004
Ever been told by a healthcare professional to be overweight	10.9% (217)	42.4% (2017)	81.3% (2949)	*P* < 0.0001
Been told by a healthcare professional since the event to have an unhealthy diet	32.6% (642)	45.9% (2179)	64.6% (2331)	*P* < 0.0001
Advised to follow a cardiac prevention and rehabilitation programme[b]	51.1% (1025)	49.8% (2406)	48.7% (1785)	*P* = 0.23
Personal advice from a health professional to				
Follow dietary recommendations	33.0% (653)	48.2% (2283)	63.7% (2302)	*P* < 0.0001
Participate in regular physical activity	43.9% (873)	54.9% (2614)	64.2% (2322)	*P* < 0.0001
Try to do more general everyday physical activities	49.7% (988)	53.7% (2570)	58.3% (2114)	*P* < 0.0001
Follow-specific exercise advice from a health or exercise professional	34.8% (686)	36.0% (1720)	38.2% (1373)	*P* = 0.025
Attending a fitness club or leisure centre	19.0% (376)	18.2% (867)	19.1% (690)	*P* = 0.49
Use weight reducing drugs	3.2% (64)	5.3% (254)	6.7% (244)	*P* < 0.0001

Cell entries are mean (SD) or % (*n*).
[a]Mean (95% confidence interval).
[b]Within 3 months of hospital discharge.

lose weight according to their BMI status at the time of the study visit. Half of the obese patients had not attempted to lose weight in the past month while 42% were seriously considering to lose weight in the coming month; 60% in the next 6 months. Half of overweight patients and 41% of obese patients perceived their weight as desirable.

Discussion

Our data confirm the very high prevalence of overweight and obesity in patients with established CHD, particularly in females. This pattern was most apparent in younger patients with almost half of females <55 years being obese. Obesity was known in about 80% of these subjects at the time of hospitalization for their recruiting event and a large majority of them had comorbidities such as hypertension, dyslipidaemia, and diabetes. Despite the adverse risk profile of obese patients, the discharge letter did not record the weight status in a quarter of them and a substantial proportion reported to have never been told by a healthcare professional to be overweight. It seems that obesity is not considered by physicians as a serious medical problem, which requires attention, recommendations and obvious advice on personal weight targets. This fully applies to patients after myocardial infarction, unstable angina, PCI, CABG, who are at especially high rich for recurrent events in cases of uncontrolled risk factors profiles. Furthermore, the present data reveal a significant opportunity to improve lifestyle management of obese patients among whom a third declared not having received dietary advice or recommendations to participate in regular physical activity since hospital discharge. Similar disappointing observations were made in a

Table 3 Risk factor profile at the time of the study visit according to weight change in patients found overweight or obese at hospitalization

	Weight change in patients found overweight or obese at hospitalization			Significance
	Weight loss ≥5% (*N* = 1395)	Weight change <5% (*N* = 5454)	Weight gain ≥5% (*N* = 1651)	
Age (years)	64.0 (9.8)	64.2 (9.3)	62.3 (9.6)	*P* < 0.0001
Male gender	77.6% (1083)	75.8% (4135)	74.3% (1226)	*P* = 0.10
Current smoking	14.3% (199)	15.8% (862)	16.8% (277)	*P* = 0.16
Persistent smoking[a]	50.7% (182)	55.2% (791)	38.3% (252)	*P* < 0.0001
Physical activity level not on target[b]	57.7% (754)	64.0% (3247)	69.2% (1063)	*P* < 0.0001
History of diabetes	32.9% (455)	30.2% (1635)	28.9% (476)	*P* = 0.06
HbA1c ≥7% in patients with history of diabetes	31.9% (132)	46.5% (718)	58.7% (267)	*P* < 0.0001
HbA1c ≥6.5% in patients with no history of diabetes	2.6% (22)	5.3% (191)	6.9% (77)	*P* = 0.0001
FPG ≥7.0 mmol/L or 2hPG ≥11.1 mmol/L in patients with no history of diabetes	21.1% (142)	22.3% (638)	25.9% (229)	*P* = 0.042
FPG ≥7.0 mmol/L or 2hPG ≥7.8 mmol/L in patients with no history of diabetes	44.6% (300)	47.1% (1349)	54.9% (486)	*P* < 0.0001
Systolic/diastolic blood pressure ≥140/90 mmHg[c]	34.7% (484)	44.2% (2404)	45.1% (742)	*P* < 0.0001
Systolic/diastolic blood pressure ≥160/100 mmHg	7.4% (103)	12.5% (681)	14.1% (232)	*P* < 0.0001
Use of blood pressure lowering drugs	96.8% (1341)	96.1% (5210)	96.0% (1576)	*P* = 0.46
LDL-C ≥1.8 mmol/L	71.6% (882)	75.1% (3718)	77.3% (1155)	*P* = 0.0030
Use of lipid-lowering drugs	87.3% (1209)	86.5% (4684)	86.6% (1422)	*P* = 0.72
LDL-C ≥1.8 mmol/L in patients using lipid-lowering drugs	69.5% (739)	73.0% (3107)	75.3% (972)	*P* = 0.0071
HeartQol, global score	2.22 (0.64)	2.18 (0.66)	2.10 (0.67)	*P* < 0.0001
HeartQol, physical score	2.24 (0.68)	2.21 (0.68)	2.14 (0.69)	*P* < 0.0001
HeartQol, emotional score	2.16 (0.70)	2.10 (0.72)	2.02 (0.72)	*P* < 0.0001

Cell entries are mean (SD) or % (*n*).
[a]Smoking at time of the study visit among patients who smoked in the month prior to the index event.
[b]Taking regular physical activity of at least 30 min duration on average 5 times a week.
[c]≥140/85 mmHg for patients with diabetes.

Norwegian sample of 707 patients with stable CHD among whom those with obesity had not discussed weight reduction with their general practitioner during the past year[8].

Our observations on changes in body weight are in line with those from a group of 1706 post-myocardial infarction patients from the US participating in the Enhancing Recovery in Coronary Heart Disease (ENRICHD) trial[9]. At a 6 months follow-up visit, 18% had gained >5% of body weight, which corresponds with 21% gaining >5% weight in the present study during an average of 1.3 years following hospital discharge. Even in patients, who were obese during hospitalization a substantial weight increase of >5% was seen in as many as 16%, and 5% of them had gained >10% of body weight. The 0.8 kg average weight increase in patients with overweight (BMI 25–29.9 kg/m^2) at the time of hospitalization is most worrying. The weight gain observed in patients who quit smoking since their coronary event is reasonably only part of the explanation[9–11].

Unlike the detrimental health effects of obesity in primary prevention, several studies and meta-analyses have documented an 'obesity paradox', i.e. better prognosis in overweight and obese patients with cardiovascular illness[12,13]. However, our study confirms earlier reports of the beneficial effects of weight loss in overweight and obese CHD patients in relation to control of major cardiovascular risk factor[14–16]. Those who lost ≥5% of body weight demonstrated substantially lower proportions of hypertension, dyslipidaemia, and previously unrecognized diabetes despite being equally treated with blood pressure and lipid lowering medications. Moreover, glycaemic control improved markedly in patients with known diabetes who lost ≥5% weight as demonstrated by the almost halved prevalence of HbA1c levels of ≥7% in comparison with patients with diabetes who gained weight. This favourable cardiovascular risk profile of overweight and obese CHD patients who lose weight should confer a better prognosis and this needs to be evaluated over the longer-term because improved risk factor control takes time to impact outcomes. Indeed, a meta-analysis of 89 studies in over a million CHD patients revealed that the obesity paradox was more evident during early follow-up and seemed to disappear after 5 years especially in those with moderate to severe obesity[17]. This is further supported by analyses from the ENRICHD trial in which propensity score matching revealed that the association between obesity and lower mortality seems to be modulated by comorbidities and risk factor profiles[8]. Also, in patients with coronary artery disease (CAD) it is important to discriminate between observed weight loss associated with increased adverse cardiovascular events, and intentional weight loss occurring in the context of lifestyle programmes, the latter being associated with lower clinical events as convincingly demonstrated in a meta-analysis of weight loss in CAD[18].

Table 4 Actions taken by overweight and obese patients following hospital discharge according to their weight change

	Weight change in patients found overweight or obese at hospitalization			Significance
	Weight loss ≥5% (*N* = 1395)	Weight change <5% (*N* = 5454)	Weight gain ≥5% (*N* = 1651)	
Attended a cardiac rehabilitation/prevention programme[a]	43.9% (613)	34.5% (1882)	38.8% (640)	*P* < 0.0001
Followed dietary recommendations by health professional	57.8% (796)	46.0% (2440)	41.8% (670)	*P* < 0.0001
Personal actions taken to improve diet				
Reduced fat intake	82.0% (1135)	74.0% (3983)	74.9% (1224)	*P* < 0.0001
Reduced calorie intake	72.4% (985)	61.6% (3234)	62.4% (996)	*P* < 0.0001
Reduced sugar intake	73.2% (1011)	63.6% (3418)	63.9% (1039)	*P* < 0.0001
Consumed more fruits and vegetables	80.6% (1117)	73.2% (3943)	74.2% (1212)	*P* < 0.0001
Consumed more fish	66.6% (922)	59.4% (3190)	61.5% (997)	*P* < 0.0001
Participated in regular physical activity	51.6% (713)	45.9% (2451)	42.3% (690)	*P* < 0.0001
Tried to do more general everyday physical activities	58.0% (803)	49.8% (2682)	46.1% (754)	*P* < 0.0001
Followed specific exercise advice from a health professional	28.4% (393)	22.3% (1203)	21.0% (343)	*P* < 0.0001
Attended a fitness club or leisure centre	13.6% (189)	11.3% (612)	10.6% (174)	*P* = 0.026
Used weight reducing drugs	2.5% (35)	3.1% (167)	2.7% (44)	*P* = 0.43

Cell entries are % (*n*).
[a]At least half of the advised number of sessions.

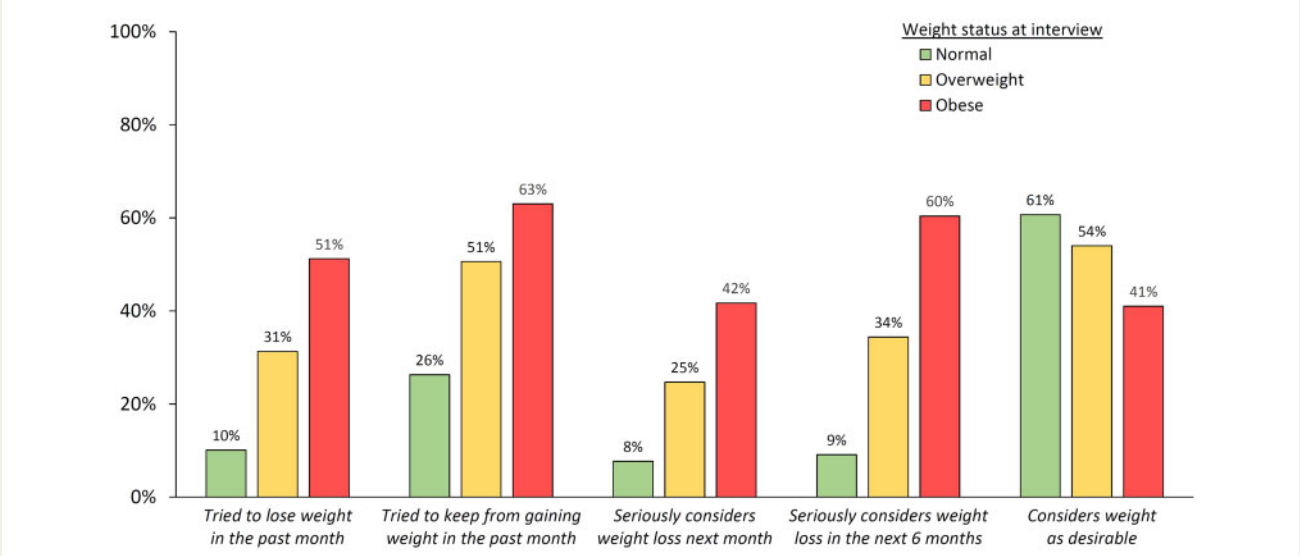

Figure 3 Weight loss attempts and intentions to lose weight according to their body mass index status at the time of the study visit.

Reducing body weight in overweight CHD patients should continue to be a priority given the impact on cardiovascular risk and the wider consideration that obesity is also an independent risk factor for many other chronic disorders such as cancer, neuromuscular, and skeletal disorders and, moreover, that weight loss is associated with substantially improved levels of both physical and emotional quality of life, as clearly demonstrated in our study[19–21].

Bariatric interventions in obese patients have been associated with a lower incidence of cardiovascular events[22]. However, a recent study has revealed a significant and independent higher risk of major adverse cardiovascular events in morbidly obese CAD patients who underwent bariatric surgery in comparison to those without existing CAD[23]. The safest and most effective approach for managing body weight in obese coronary patients is adopting a healthy eating pattern and increasing levels of physical activity. This is supported by our findings in patients who reported reducing their fat and sugar intake, consuming more fruit, vegetables, and fish and doing more regular physical activity, had significant weight loss. A combination of a low

energy diet with high-calorie expenditure exercise, such as aerobic interval training at peak heart rate, has been demonstrated to be most effective in achieving weight loss in obese coronary patients[16,24]. Comprehensive multidisciplinary secondary prevention programmes incorporating both aspects of lifestyle modification are hence warranted in obtaining lifestyle targets in obese and non-obese CHD patients[25]. Although weight loss was clearly higher in overweight patients who attended a secondary prevention programmes since hospital discharge, the fact that only a minority of EUROASPIRE patients had participated in such a programme indicates the large potential for improving the management of obese CHD patients. Interestingly, our data seem to indicate that cardiac rehabilitation throughout Europe is still mainly focusing on physical exercise. Patients who attended a cardiac rehabilitation and prevention programme following hospital discharge reported substantially higher levels of physical exercise than those who did not, while differences in favourable dietary changes were far less pronounced (Supplementary material online, *Table S1*).

Self-care by obese patients and the development of individually tailored computer-based support systems, may all play a role in long-term self-management of weight alongside the usual organized group-based prevention and rehabilitation programmes[26]. The usefulness and feasibility of a 12-week telehealth weight management intervention on weight loss were demonstrated in a randomized controlled trial in 43 overweight and obese cardiac patients[27]. Interestingly, according to the results from two recent randomized clinical trials, it seems that lifestyle advice supplemented by the administration of the glucagon-like peptide-1 receptor agonist semaglutide may further help to achieve a meaningful weight reduction both in patients with and without type 2 diabetes[28,29].

One of the most striking findings of our study was the apparent lack of motivation of obese patients to lose weight. Half of them had not attempted weight loss in the month prior to the study visit and the majority did not intend to do so in the coming month. Adding behavioural weight loss counselling in the setting of cardiac rehabilitation has been shown to be an effective strategy[14]. An important aspect of behavioural modification techniques for weight management is goal setting. In a recent study in 317 overweight and obese cardiac patients, setting a weight loss goal led to a much greater weight loss than not setting a weight loss goal[30]. In our study, 7% of the patients found to be obese at the study visit did not know their actual body weight and 21% of them declared to be unaware of any weight target.

The EUROASPIRE surveys have the advantage that patient recruitment was based on a large number of ESC member countries covering a very large geographical area. However, the relatively small number of participating hospitals may not be representative of healthcare services in those countries. The main strength of EUROASPIRE is a function of the standardized protocol used in collecting data through a face to face interview and clinical examination by centrally trained staff all using the same instruments together with central laboratory analysis of blood samples. Among the limitations of the survey is the relatively low participation rate (56%) which may have introduced a selection bias, and particularly in this study because patients with an unhealthy lifestyle are less likely to participate in epidemiological studies. Prevalences of obesity may therefore be underestimated and weight losses overestimated here. Body weight at the time of hospital admission was retrieved from hospital medical records and maybe less precise than the measurements taken at the time of interview using standardized scales, measuring rod, and metal tape measure. However, systematic measurement bias seems unlikely. Self-reported information related to advice and adherence to lifestyle recommendations may have been influenced by social expectations and therefore reported more favourably than the reality. Also, we did not ask the patient to what extent self-reported steps taken in relation to diet and exercise since the recruiting event, were prescribed by clinicians or other health professionals as part of a structured weight management programme. As body weight naturally fluctuates over time, observed weight changes in initially overweight and obese patients may to some extent have been prone to regression-to-the-mean bias due to statistical within-person variation producing greater weight losses in those exceeding the obesity threshold on discharge from hospital. Finally, as we did not have anthropometric information on the patients prior to enrolment into the study with a coronary event, we were not able to evaluate the cumulative impact of obesity nor could we study the effect of large body weight fluctuations on risk factor profiles.

In conclusion, the prevalence of obesity and its management in the secondary prevention of CHD is a major challenge for a majority of patients and especially so in women and those who are younger. Yet the benefits for patients who lost weight in our study, resulting in a healthier cardiovascular risk profile, are really worthwhile. Although similarly treated with antihypertensive and lipid-lowering drugs, they had lower prevalences of hypertension, dyslipidaemia, and diabetes compared to patients who gained weight and this is likely to translate into improved prognosis on the long term. In addition to a better risk factor profile, weight loss also leads to a better quality of life. Cardiovascular prevention and rehabilitation programmes should include weight loss intervention, including different forms of self-support, as a specific component of a comprehensive intervention to reduce total cardiovascular risk, extend life expectancy, and improve quality of life.

Supplementary material

Supplementary material is available at *European Heart Journal – Quality of Care and Clinical Outcomes* online.

Acknowledgements

EORP Oversight Committee, Registry Executive and Steering Committees of the EURObservational Research Programme (EORP). Data collection was conducted by EORP with M. Glemot and E. Fiorucci and as Project Officers, and M. Konte, F. Larras, and V. Missiamenou as Data Managers. The authors are grateful to the administrative staff, physicians, nurses, and other personnel in the hospitals in which the survey was carried out and to all participating patients.

Funding

The EUROASPIRE IV and V surveys were performed under the auspices of the European Society of Cardiology, EURObservational Research Programme. The surveys were supported through research grants to the European Society of Cardiology from Amgen, AstraZeneca, Bristol–Myers Squibb/Emea Sarl, GlaxoSmithKline, Hoffmann–La Roche and Merck, Sharp & Dohme (EUROASPIRE IV) and Amarin, Amgen, Daiichi Sankyo, Eli Lilly, Pfizer, Sanofi, Ferrer, and Novo Nordisk (EUROASPIRE V). The sponsors had no role in the design, data collection, data analysis, data interpretation, writing the manuscript, and the decision to publish.

Conflict of interest: The authors declared the following potential conflicts of interest with respect to the research, authorship and/or publication of this paper: K.K. had grant support from the European Society of Cardiology. J.B. had grant support from the Agency for Medical Research, Ministry of Health of the Czech Republic (grant No 17-29520A). No other authors have financial interests that are relevant to the submitted work.

Data availability

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

D.D.B., 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.

References

1. Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL *et al.*; Authors/Task Force Members. 2016 European Guidelines on cardiovascular disease prevention in clinical practice. The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice. *Eur Heart J* 2016;**37**:2315–2381.
2. Kotseva K, De Backer G, De Bacquer D, Rydén L, Hoes A, Grobbee D *et al.*; EUROASPIRE Investigators. Lifestyle and impact on cardiovascular risk factor control in coronary patients across 27 countries: results from the European Society of Cardiology ESC-EORP EUROASPIRE V registry. *Eur J Prev Cardiol* 2019;**26**:824–835.
3. Kotseva K, De Bacquer D, Jennings C, Gyberg V, De Backer G, Rydén L *et al.* Trends in lifestyle, risk factor control, and use of evidence-based medications in patients with coronary heart disease in europe: results from 3 EUROASPIRE Surveys, 1999-2013. *Glob Heart* 2017;**12**:315–322.
4. De Bacquer D, Dallongeville J, Heidrich J, Kotseva K, Reiner Z, Gaita D *et al.*; EUROASPIRE III Study Group. Management of overweight and obese patients with coronary heart disease across Europe. *Eur J Cardiovasc Prev Rehabil* 2010;**17**:447–454.
5. Kotseva K, Wood D, De Bacquer D, De Backer G, Rydén L, Jennings C *et al.*; on behalf of the EUROASPIRE Investigators. 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 Cardiolog* 2016;**23**:636–648.
6. Segerhag E, Gyberg V, Ioannides K, Jennings C, Rydén L, Stagmo M *et al.* Accuracy of a simplified glucose measurement device—the HemoCue Glucose 201RT. *Diabetes Technol Ther* 2015;**17**:755–758.
7. Oldridge N, Höfer S, McGee H, Conroy R, Doyle F, Saner H *et al.*; for the HeartQoL Project Investigators. HeartQoL: I. Development of a new core health-related quality of life questionnaire for patients with ischemic heart disease. *Eur J Prev Cardiol* 2014;**21**:90–97.
8. Sverre E, Peersen K, Perk J, Husebye E, Gullestad L, Dammen T *et al.* Challenges in coronary heart disease prevention—experiences from a long-term follow-up study in Norway. *Scand Cardiovasc J* 2020;**4**:1–9.
9. Lopez-Jimenez F, Wu CO, Tian X, O'Connor C, Rich MW, Burg MM *et al.* Weight change after myocardial infarction—the Enhancing Recovery in Coronary Heart Disease patients (ENRICHD) experience. *Am Heart J* 2008;**155**:478–484.
10. Fadl YY, Krumholz HM, Kosiborod M, Masoudi FA, Peterson PN, Reid KJ *et al.* Predictors of weight change in overweight patients with myocardial infarction. *Am Heart J* 2007;**154**:711–717.
11. Wood DA, Kotseva K, Connolly S, Jennings C, Mead A, Jones J *et al.* EUROACTION Study Group. Nurse-coordinated multidisciplinary, family-based cardiovascular disease prevention programme (EUROACTION) for patients with coronary heart disease and asymptomatic individuals at high risk of cardiovascular disease: a paired, cluster-randomised controlled trial. *Lancet* 2008;**371**:1999–2012.
12. Romero-Corral A, Montori VM, Somers VK, Korinek J, Thomas RJ, Allison TG *et al.* Association of bodyweight with total mortality and with cardiovascular events in coronary artery disease: a systematic review of cohort studies. *Lancet* 2006;**368**:666–678.
13. Angerås O, Albertsson P, Karason K, Råmunddal T, Matejka G, James S *et al.* Evidence for obesity paradox in patients with acute coronary syndromes: a report from the Swedish Coronary Angiography and Angioplasty Registry. *Eur Heart J* 2013;**34**:345–353.
14. Ades PA, Savage PD. Obesity in coronary heart disease: an unaddressed behavioral risk factor. *Prev Med* 2017;**104**:117–119.
15. Lavie CJ, Milani RV, Artham SM, Patel DA, Ventura HO. The obesity paradox, weight loss, and coronary disease. *Am J Med* 2009;**122**:1106–1114.
16. Pedersen LR, Olsen RH, Anholm C, Astrup A, Eugen-Olsen J, Fenger M *et al.* Effects of 1 year of exercise training versus combined exercise training and weight loss on body composition, low-grade inflammation and lipids in overweight patients with coronary artery disease: a randomized trial. *Cardiovasc Diabetol* 2019;**18**:127.
17. Wang ZJ, Zhou YJ, Galper BZ, Gao F, Yeh RW, Mauri L. Association of body mass index with mortality and cardiovascular events for patients with coronary artery disease: a systematic review and meta-analysis. *Heart* 2015;**101**:1631–1638.
18. Pack QR, Rodriguez-Escudero JP, Thomas RJ, Ades PA, West CP, Somers VK *et al.* The prognostic importance of weight loss in coronary artery disease: a systematic review and meta-analysis. *Mayo Clin Proc* 2014;**89**:1368–1377.
19. Ades PA, Savage PD. Potential benefits of weight loss in coronary heart disease. *Prog Cardiovasc Dis* 2014;**56**:448–456.
20. Lavie CJ, Milani RV. Effects of cardiac rehabilitation, exercise training, and weight reduction on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in obese coronary patients. *Am J Cardiol* 1997;**79**:397–401.
21. Manzoni GM, Villa V, Compare A, Castelnuovo G, Nibbio F, Titon AM *et al.* Short-term effects of a multi-disciplinary cardiac rehabilitation programme on psychological well-being, exercise capacity and weight in a sample of obese inpatients with coronary heart disease: a practice-level study. *Psychol Health Med* 2011;**16**:178–189.
22. Sjöström L, Peltonen M, Jacobson P, Sjöström CD, Karason K, Wedel H *et al.* Bariatric surgery and long-term cardiovascular events. *JAMA* 2012;**307**:56–65.
23. Pirlet C, Biertho L, Poirier P, Marceau S, Marceau P, Biron S *et al.* Comparison of short and long term cardiovascular outcomes after bariatric surgery in patients with vs without coronary artery disease. *Am J Cardiol* 2020;**125**:40–47.
24. Ades PA, Savage PD, Toth MJ, Harvey-Berino J, Schneider DJ, Bunn JY *et al.* High-calorie-expenditure exercise: a new approach to cardiac rehabilitation for overweight coronary patients. *Circulation* 2009;**119**:2671–2678.
25. Ades PA, Savage PD, Harvey-Berino J. The treatment of obesity in cardiac rehabilitation. *J Cardiopulm Rehabil Prev* 2010;**30**:289–298.
26. Riegel B. Self-care for the prevention and management of cardiovascular disease and stroke. A scientific statement for Healthcare Professionals from the American Heart Association. *J Am Heart Assoc* 2017;**6**:e006997.
27. Barnason S, Zimmerman L, Schulz P, Pullen C, Schuelke S. Weight management telehealth intervention for overweight and obese rural cardiac rehabilitation participants: a randomised trial. *J Clin Nurs* 2019;**28**:1808–1818.
28. Davies M, Færch L, Jeppesen OK, Pakseresht A, Pedersen SD, Perreault L *et al.* Semaglutide 2·4 mg once a week in adults with overweight or obesity, and type 2 diabetes (STEP 2): a randomised, double-blind, double-dummy, placebo-controlled, phase 3 trial. *Lancet* 2021;**397**:971–984.
29. Wilding JPH, Batterham RL, Calanna S, Davies M, Van Gaal LF, Lingvay I *et al.* Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med* 2021;**384**:989–1002.
30. Barrett KV, Savage PD, Ades PA. Effects of behavioral weight loss and weight loss goal setting in cardiac rehabilitation. *J Cardiopulm Rehabil Prev* 2020;**40**:383–387.