Health Service Research

Overweight can be used as a tool to guide case-finding for cardiovascular risk assessment

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Abstract

Background. In general practice, it is too time-consuming to invite all patients for cardiovascular risk assessment.

Objective. To examine how many patients with an indication for treatment with cardiovascular medication can be identified by ad hoc case-finding when all patients with overweight/obesity are invited for risk assessment.

Methods. A cross-sectional analysis of the baseline measurements of the Netherlands Epidemiology of Obesity study, a population-based prospective cohort study in 6673 persons aged 45–65 years. We calculated the proportion of participants with a treatment indication using the risk prediction Systematic COronary Risk Evaluation (SCORE-NL 2011), for lean, overweight and obese participants. Participants with a history of cardiovascular disease, diabetes mellitus or rheumatoid arthritis or using cardiovascular medication were not eligible for ad hoc case-finding because they were already identified as being at risk and/or had been treated.

Results. Of the study population, 30% had already been identified and/or treated with cardiovascular medication and were therefore not eligible for ad hoc case-finding. Of the eligible participants, 47% were lean, 41% overweight and 12% obese. Of the participants with overweight, 12% had a treatment indication and of the participants with obesity, 19% had a treatment indication. Of all participants with a treatment indication 24% were not yet treated. Of all participants with a new treatment indication, 70% had overweight or obesity.

Conclusions. Of the participants with a treatment indication, 24% were not yet treated. Inviting patients with overweight/obesity for cardiovascular risk assessment may help to detect 70% of these residual patients with a treatment indication.

Key words: Cardiovascular diseases, general practice, overweight, primary prevention, risk assessment, risk factors.

Introduction

To calculate the risk of cardiovascular disease (CVD) and corresponding treatment indication, several risk estimation systems have been developed for primary prevention based on cardiovascular risk factors (e.g. Framingham, SCORE, QRISK, PROCAM) (1). Cardiovascular risk assessment in general practice is time-consuming, with on average a first consultation of 20 minutes for history
taking and examination of the patient and a second consultation of 20 minutes to discuss the results (2,3). Therefore, at present in the Netherlands, not all patients are invited for risk assessment; however, high-risk patients are usually identified first, either based on a more programmatic approach or by *ad hoc* case-finding. In a programmatic approach, for example, all patients of 45 or older are invited to complete a risk questionnaire (4). Patients at increased risk are advised to consult their GP for cardiovascular risk assessment. However, this method is time-consuming and it is reported that only 36% of patients at risk responds to the invitation (4). *Ad hoc* case-finding among general practice attendants is the most commonly used approach, which is less expensive and has better coverage since potential high-risk patients are invited for cardiovascular risk assessment during a regular consultation for other reasons. However, a disadvantage of *ad hoc* case-finding is that it is unclear what strategy can best be followed to identify high-risk patients efficiently, in addition only a short consultation is planned for the actual reason for the encounter. As a consequence, *ad hoc* case-finding is often neglected and high-risk patients with a treatment indication may remain untreated.

Further optimization of the yield of case-finding may reduce time and costs related to cardiovascular risk management; however, the identifying factor needs to be obtained within a few seconds during a regular consultation. Overweight may be a promising candidate because this is a visible and (combined with simple measurements) easily obtained risk factor. Therefore, we aimed to examine how many patients with a treatment indication can be identified when all patients with overweight or obesity are invited for cardiovascular risk assessment by *ad hoc* case-finding. Hereto we used the data of the Netherlands Epidemiology of Obesity (NEO) study, a population-based prospective cohort study including lean, overweight and obese participants (5). This study population allowed us to calculate the gain in identification of patients with a treatment indication when using weight as guidance for *ad hoc* case-finding.

**Methods**

**Study design and study population**

The NEO study is a population-based prospective cohort study in persons aged 45–65 with an oversampling of participants with a body mass index (BMI) ≥ 27 kg/m². The study design has been described elsewhere (5). Participants with a self-reported BMI ≥ 27 kg/m² were recruited from the greater area of Leiden, the Netherlands, via GPs, municipal registers and advertisements. In one municipality (Leiderdorp), all inhabitants aged 45–65 years were invited, irrespective of their BMI, to allow for a reference distribution of BMI.

Prior to the NEO study visit, participants were asked to complete a questionnaire including questions about demographics, lifestyle and clinical information. During the baseline visit at the NEO study centre of the Leiden University Medical Center (LUMC), several measurements were performed, including a physical examination and blood sampling.

This study is a cross-sectional analysis of the baseline measurements of the NEO study.

The study was approved by the Medical Ethics Committee of the LUMC and all participants gave informed consent.

**Data collection in the NEO study**

We used SCORE-NL 2011 to calculate the 10-year CVD risk for participants eligible for *ad hoc* case-finding; this includes sex, age, systolic blood pressure (SBP), total cholesterol/high-density lipoprotein (TC/HDL) ratio, smoking status, diabetes mellitus (DM), first-degree family history of CVD, physical activity, BMI, estimated glomerular filtration rate (eGFR), poor metabolic control and albuminuria (6). The method of SCORE-NL 2011 is described in more detail in online Supplementary Data.

Participants without a history of CVD, DM or rheumatoid arthritis (RA) and without using antihypertensive or lipid-lowering drugs were eligible for *ad hoc* case-finding. The rationale for this selection is that all other participants are regularly assessed due to being at increased risk or have already been identified with a treatment indication.

We defined prevalent CVD as a history of angina pectoris, myocardial infarction (MI), stroke, aortic aneurysm and peripheral arterial disease as reported in the questionnaire. First-degree family history of MI or stroke was reported in the questionnaire in five age groups: before age 50 years, 50–60 years, 60–70 years, after age 70 years and age unknown. In SCORE-NL 2011, an event before age 60 years (one member) and before age 65 years (two members) is used as additional risk factor. For the latter, we used a CVD event before age 70 years.

We defined newly discovered DM as a fasting plasma glucose ≥ 7.0 mmol/l or a non-fasting glucose ≥ 11.1 mmol/l (7) and a history of DM as having a self-reported history of DM or using glucose-lowering therapy. Poor metabolic control was defined as haemoglobin A1c (HbA1c) ≥ 7% (8,9).

We defined participants with RA who regularly visit a physician, as participants using disease-modifying antirheumatic drugs, such as methotrexate, sulfasalazine, immunosuppressive drugs and biopharmaceuticals.

Physical activity was assessed with the Short Questionnaire to ASsess Health-enhancing physical activity (10), with a sedentary lifestyle as being zero days per week physically active for at least 30 minutes with at least a moderate intensity.

Smoking status was dichotomized into current smokers and non-smokers (including former smokers).

Body weight and height were measured during the study visit with a calibrated scale and a vertically fixed, calibrated tape measure during the study visit. The trained staff reported the height in centimetre; body weight was rounded to 100 g, 1 kg was subtracted to correct for the weight of clothing. BMI was calculated by dividing weight (in kilogram) by the square of height (in metre). Overweight was defined according to the World Health Organization as a BMI 25–30 kg/m² and obesity as a BMI ≥ 30 kg/m² (11).

Waist circumference (WC) was measured between the border of the lower costal margin and the iliac crest rounded to 0.1 cm. An increased WC was defined as a WC ≥ 102 cm for men and WC ≥ 88 cm for women (12).

SBP was measured three times on the right arm by an automatic monitor after 10 minutes rest in sitting position. The mean of these measurements was used in the analyses.

Blood samples were taken after an overnight fast. Serum cholesterol concentrations, glucose, HbA1c and creatinine were determined in the central clinical chemical laboratory of the LUMC. Albuminuria was defined as an albumin/creatinine ratio ≥ 2.5 mg/mmol for men and ≥ 3.5 mg/mmol for women. eGFR was calculated using the Modification of Diet in Renal Disease (13). A reduced eGFR was defined as eGFR < 60 ml/min/1.73 m² in participants aged < 65 years, and eGFR < 45 ml/min/1.73 m² in participants aged ≥ 65 years.

**Statistical analysis**

In the NEO study, there is an oversampling of participants with a BMI ≥ 27 kg/m². To correctly represent the general population,
participants were weighted towards the BMI distribution of the participants from the Leiderdorp municipality (14,15) whose BMI distribution was similar to the BMI distribution of the Dutch general population (16). Hereto, participants with a BMI < 27 kg/m², who were under-represented in the study population, received a greater weight in the analyses. All results were based on weighted analyses. Consequently, the results apply to a population-based study without oversampling of participants with a BMI ≥ 27 kg/m².

For participants eligible for ad hoc case-finding, we calculated the predicted 10-year CVD risk and treatment indication according to SCORE-NL 2011. Differences in proportions were tested using the Pearson’s chi-square test. We also calculated the proportion of participants with a new treatment indication of all patients with a treatment indication for primary prevention, and the proportion of participants with a treatment indication of all participants with an increased WC.

The first 863 participants included in the study completed a questionnaire that did not contain questions about family history of CVD; these participants were considered as having no first-degree relative with a CVD event. However, we also performed a sensitivity analysis considering these participants as having two first-degree relatives with a CVD event before 65 years of age.

All analyses are stratified by BMI category into BMI < 25 kg/m², BMI 25–30 kg/m² and BMI ≥ 30 kg/m². Only proportions, not counts, could be reported due to the weighted analysis.

For all analyses, STATA statistical software (Statacorp, College Station, TX), version 12 was used.

Results

Of the 6673 persons included in the NEO study, 5215 had a BMI ≥ 27 kg/m². The individual participants were weighted towards the BMI distribution of the general Dutch population. After weighting, 42% of the participants had a BMI < 25 kg/m², 42% a BMI 25–30 kg/m², and 16% a BMI ≥ 30 kg/m². Six percentage of the participants were excluded due to missing data for SCORE risk prediction.

The weighted baseline characteristics of the participants included in the present analysis stratified by BMI category are shown in Table 1. Participants with overweight or obesity had a higher SBP, a higher TC/HDL ratio and more newly diagnosed DM compared with lean participants.

The eligibility for ad hoc case-finding and the 10-year CVD risk and treatment indication was calculated. Of the total study population, 30% of the participants were already identified and/or treated. With increasing levels of BMI, more participants were already identified and/or treated and not eligible for ad hoc case-finding, i.e. 20% of the participants with a BMI < 25 kg/m² were already identified and/or treated, 32% with a BMI 25–30 kg/m² and 49% with a BMI ≥ 30 kg/m². This was mainly due to a higher proportion of participants with a history of DM, RA or CVD and a higher proportion of participants using antihypertensive or lipid-lowering drugs in the groups with a higher BMI (Table 2, Fig. 1).

Overall, 80% of the participants eligible for ad hoc case-finding had a low CVD risk, 13% an intermediate risk and 4% a high risk based on the SCORE function, and 3% had a definite treatment indication based on a single high-risk factor. Of all eligible participants, treatment was indicated in 10% (19% of the men, 4% of the women).

Of the eligible participants with a BMI 25–30 kg/m², 12% (18% of the men, 6% of the women) had a treatment indication and of the eligible participants with a BMI ≥ 30 kg/m², 19% (35% of the men, 3% of the women) had a treatment indication (Table 2).

| Table 1. Baseline characteristics of the participants of the NEO study, aged 45–65 years, recruited in 2008–12 and stratified by BMI group |
|-----------------|-----------------|-----------------|
| BMI (kg/m²)     | <25             | 25–30           | ≥30             |
| Age (years)     | 56 (3)          | 56 (6)          | 56 (10)         |
| Sex (% men)     | 35              | 54              | 44              |
| BMI (kg/m²)     | 22.6 (0.8)      | 27.1 (1.4)      | 33.9 (6.6)      |
| Smoking (% current) | 15              | 17              | 16              |
| SBP (mmHg)      | 127 (9)         | 132 (17)        | 134 (29)        |
| TC/HDL ratio    | 3.4 (0.6)       | 4.2 (1.3)       | 4.4 (2.2)       |
| Newly discovered DM (%) | 1              | 3               | 5               |
| HbA1c (%)       | 6.1 (0.8)       | 6.1 (0.8)       | 6.3 (1.2)       |
| ACR             | 0.6 (0.1)       | 1.1 (2.5)       | 3.6 (28.6)      |
| eGFR (ml/min/1.73 m²) | 85 (7)         | 85 (14)         | 86 (26)         |
| Reduced eGFR (%) | 2              | 2               | 3               |
| First-degree family history of CVD ≥1 member aged <60 years (%) | 21 | 22 | 23 |
| ≥1 member aged <65 years (%) | 36 | 34 | 36 |
| ≥2 members aged <65 years (%) | 8  | 8  | 10  |
| Sedentary lifestyle (%)  | 3              | 5               | 8               |

Data are expressed as mean (SD) or %. ACR, albumin/creatinine ratio; SD, standard deviation.

Results are based on weighted analyses and therefore represent the general population.

*Reduced eGFR: eGFR < 60 ml/min/1.73 m² in patients aged <65 years, eGFR < 45 ml/min/1.73 m² in patients aged ≥65 years.

Sedentary lifestyle: being zero days per week physically active for at least 30 minutes with at least a moderate intensity.

| Table 2. Eligibility for ad hoc case-finding for cardiovascular risk assessment in participants aged 45–65 years of the NEO study, stratified by BMI group |
|-----------------|-----------------|-----------------|
| BMI (kg/m²)     | <25             | 25–30           | ≥30             |
| % (95% CI)      | (42%)           | (42%)           | (16%)           |

Eligible for ad hoc case-finding

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<tr>
<td>&lt;45 years old</td>
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<td>History of DM or RA</td>
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<td>History of CVD</td>
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<td>Use of antihypertensive or lipid-lowering drugs</td>
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CI, confidence interval.

*Results are based on weighted analyses.

†More than one reason can be present in the participants not eligible for ad hoc case-finding.

6% of the women) had a treatment indication (Table 3). When combining all eligible participants with overweight or obesity (BMI ≥ 25 kg/m²), 14% (men 21%, women 6%) had a treatment indication.

When considering all participants with a treatment indication (including those already using primary preventive medication and those with a new treatment indication), 24% were not yet treated,
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i.e. 26% of the participants with a BMI < 25 kg/m², 26% with a BMI 25–30 kg/m² and 20% with a BMI ≥30 kg/m² (P = 0.19). Of all participants with a new treatment indication, 70% had overweight or obesity.

Of all participants eligible for \textit{ad hoc} case-finding, 32% had an increased WC; of those with an increased WC, 14% had a treatment indication.

Of the 863 participants who did not report their family history, only 60 participants were both eligible for \textit{ad hoc} case-finding and fell in the category \textquoteleft intermediate risk\textquoteleft, in which family history may influence the treatment indication. In a sensitivity analysis, when we considered these participants as having two first-degree relatives with a CVD event before 65 years of age, this had no marked effect on our results, i.e. 14% of the eligible participants with a BMI 25–30 kg/m² had a treatment indication and 19% of the eligible participants with a BMI ≥ 30 kg/m² had a treatment indication.

\textbf{Discussion}

This study used data from a large population-based prospective cohort study with all the information present to calculate the 10-year CVD risk and corresponding treatment indication. We aimed to identify high-risk patients for cardiovascular risk assessment by \textit{ad hoc} case-finding among patients visiting their GP for other reasons. We observed that with higher levels of BMI more participants were already identified with a high risk or disease by the GP, leading to treatment. However, 24% of the participants with a treatment indication were not yet identified and treated. In the participants eligible for \textit{ad hoc} case-finding, 12% of the participants with overweight and 19% of the participants with obesity had a treatment indication. Importantly, most of them were men. Hence, the risk of eight patients with overweight or five patients with obesity needs to be assessed to detect one patient with a treatment indication.
When the results are applied to a standard general practice in the Netherlands (2400 patients registered, 590 patients aged 45–64 years old), 413 patients are eligible for ad hoc case-finding. Of the 50 patients that would have obesity (BMI ≥ 30 kg/m²), 9 patients would have a treatment indication. When patients with overweight (BMI 25–30 kg/m²) could also be identified, then 219 patients (BMI ≥ 25 kg/m²) would be selected for further risk assessment, of which 31 with a treatment indication.

To our knowledge, few studies have examined the yield of identification of high-risk patients by ad hoc case-finding in general practice. Previous studies mainly focused on improving the risk estimation systems or on the development of a programmatic approach for identification of high-risk patients.

For example, in the Prevention Consultation, a programmatic approach in the Netherlands for the prevention and early detection of CVD, DM and chronic kidney disease (CKD), a risk questionnaire is sent to all patients aged 45–70 years, and patients with a high-risk score are referred to their GP for extensive measurements including cardiovascular risk assessment. As a result, 20% of the patients who visited their GP with a high-risk score had a cardiovascular treatment indication, DM or CKD (4). An advantage of our approach, identifying high-risk patients by ad hoc case-finding, is that it costs less in terms of time and money to invite patients for risk assessment.

A prospective modelling study compared different screening strategies to identify high-risk patients with the invitation of all patients aged 40–79 years. When patients aged 40–79 years with overweight (BMI ≥ 27, 5 kg/m² or a WC > 94 cm in men or WC > 80 cm in women) are identified for cardiovascular risk assessment, 70% of the CVD events can be prevented that would have been prevented when all patients had been invited for risk assessment (with a number needed to intervene to prevent one new CVD event of 100) (17). This may imply that, compared with inviting all patients, a major proportion of the preventable CVD events are prevented when only patients with overweight are identified.

Strengths of this study are the large sample size, and the extensive and uniform measurements of all information needed for calculating the 10-year CVD risk. A limitation is that the identification of patients for further risk assessment by ad hoc case-finding depends on whether patients regularly consult their GP. On average, 74% of the registered patients visit a GP at least once a year (18), with a higher attendance rate with higher BMI (19). Though, for GPs it will be a challenging task to fit identification for cardiovascular risk assessment into a consultation that has another reason for the encounter. Another limitation is oversampling of participants with a BMI ≥ 27 kg/m², which is corrected by weighted analyses to represent the general population. Without these adjustments, the proportion of participants with a BMI ≥ 27 kg/m² would be higher and therefore the proportion participants with a treatment indication would be higher. In contrast, the weighted results can be translated to the general population.

Remarkably, 30% of all participants had already been identified and/or received treatment. This may even be an underestimation because there may have been eligible participants without a treatment indication whose risk had already been assessed in general practice, resulting in no treatment indication. Overall, 24% of all participants with a treatment indication had not yet been treated, with no differences between BMI groups.

Case-finding by inviting patients with overweight or obesity does not imply measuring weight and height and calculating BMI at each consultation. In practice, GPs can visually identify patients based on their perception of the patient’s weight status. It is reported that GPs correctly classify 75% of overweight patients (BMI ≥ 25 kg/m²) as having overweight, with higher rates with increasing BMI levels (20). In our study WC, a measure reflecting abdominal obesity, also showed a similar proportion of participants with a treatment indication compared with BMI.

Due to the lower costs and because it is initially less time-consuming, the most frequently used approach to identify high-risk patients for cardiovascular risk assessment is ad hoc case-finding. We hypothesized that patients with overweight/obesity are an important subgroup to identify for further risk assessment because overweight is associated with the cardiovascular risk factors used in risk estimation systems and is easy to obtain. We observed that with higher levels of BMI more participants had a treatment indication, some already identified and treated. When all eligible patients with overweight/obesity are invited for further risk assessment, 70% of the residual patients with a treatment indication could be identified, who would otherwise remain untreated.

In conclusion, our findings show that although a large part of the participants had already been identified and treated, inviting patients with overweight or obesity (especially men) for cardiovascular risk assessment may help to detect a substantial additional group of patients with a treatment indication.

Supplementary material
Supplementary material is available at Family Practice online.

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Ethical approval: Protocol P08.109 approved on 4 August 2008 by the Medical Ethics Committee of the LUMC.

Conflicts of interest: none.

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