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ORIGINAL ARTICLE



# Quality of clinical management of cardiometabolic risk factors in patients with severe mental illness in a specialist mental health care setting

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**ABSTRACT**

**Purpose:** Cardiometabolic disease in patients with severe mental illness is a major cause of shortened life expectancy. There is sparse evidence of real-world clinical risk prevention practice. We investigated levels of assessments of cardiometabolic risk factors and risk management interventions in patients with severe mental illness in the Norwegian mental health service according to an acknowledged international standard.

**Methods:** We collected data from 264 patients residing in six country-wide health trusts for: (a) assessments of cardiometabolic risk and (b) assessments of levels of risk reducing interventions. Logistic regressions were employed to investigate associations between risk and interventions.

**Results:** Complete assessments of all cardiometabolic risk variables were performed in 50% of the participants and 88% thereof had risk levels requiring intervention according to the standard. Smoking cessation advice was provided to 45% of daily smokers and 4% were referred to an intervention program. Obesity was identified in 62% and was associated with lifestyle interventions. Reassessment of psychotropic medication was done in 28% of the obese patients. Women with obesity were less likely to receive dietary advice, and use of clozapine or olanzapine reduced the chances for patients with obesity of getting weight reducing interventions.

**Conclusions:** Nearly nine out of the ten participants were identified as being at cardiometabolic high risk and only half of the participants were adequately screened. Women with obesity and patients using antipsychotics with higher levels of cardiometabolic side effects had fewer adequate interventions. The findings underscore the need for standardized recommendations for identification and provision of cardiometabolic risk reducing interventions in all patients with severe mental illness.

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Severe mental illness; schizophrenia; cardiovascular risk; cardiometabolic health; cardiometabolic risk; mortality risk reduction; health resource

## Introduction

Severe mental illness (SMI) is a major public health problem, causing extensive suffering and disabilities and a need for costly treatment and care. Schizophrenia alone is among the top ten causes of disability-adjusted life years worldwide [1]. SMI is associated with an increased risk of the metabolic syndrome, defining a combination of co-occurring risk factors for coronary artery disease, stroke, type 2 diabetes and cancer [2–5]. Further, unhealthy lifestyle habits such as smoking, sedentary behavior and unhealthy diet are common in this population [6–10]. Life expectancy for people with schizophrenia is up to 20% shorter than for the general population, and comorbid somatic disease is a major contributor to the increased mortality [11–13], with little improvement during the last decades [14]. Side effects of antipsychotics are considered to play a role in the increased risk of metabolic syndrome [15–17], but the overall effect of antipsychotics on mortality is disputed [18,19]. Clozapine and olanzapine are considered as the antipsychotics with the highest potential for weight gain and other cardiometabolic risk increasing side effects [20,21].

The need to improve early detection, pre–ntion and treatment in the clinical management of comorbid somatic

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disease in patients with SMI has thus become increasingly pertinent throughout the last decade. There are several efforts to develop standardized tools and guidelines to secure more effective and evidence-based measures [22–24]. However, adherence to evidence-based guidelines in mental health care shows large variation [25,26] and the strength of evidence regarding effectiveness of interventions for improved physical health is mixed [26]. Before implementing new guidelines, it is therefore of special interest to describe status of practice in the field, including the level of adherence to international evidence-based guidelines.

The 'Healthy Heart Tool' incorporates guidelines in a framework for individual primary prevention of cardiovascular diseases (CVD) [27]. The tool is a Norwegian adaptation of the Australian Positive Cardiometabolic Health resource [28] and a British adaptation thereof (the 'Lester Tool'), which has already been implemented in several countries [29,30]. Importantly, the Healthy Heart Tool defines a 'Risk Zone' as an intervention threshold, with recommended interventions and risk reducing aims for each of the defined risks. This provides a standard for both assessment of CVD risk in SMI, as well as for investigating compliance to current international guidelines. At the time of the current study, this tool was not part of the national guidelines.

## Methods

### Aim, design and setting

The aims of the current study were to evaluate the standards of cardiovascular risk monitoring and risk reducing interventions in the Norwegian mental health services by investigating to what extent the (non-official) standards of the Healthy Heart Tool were followed for (a) risk assessment, and (b) risk specific interventions, and to investigate potential factors affecting whether the Tools' recommendations were followed. Norwegian mental health care is catchment area based and is divided in specialist health care and community health care. The specialist health care is organised in hospitals, which provide both in- and outpatient services. The community health care includes general practitioners and community mental health workers, e.g. providing low threshold services, home visits etc.

The current investigation is part of a larger Healthy Heart study, which is a multicenter study under the umbrella of the Norwegian Research Network in Severe Mental Illness (NORSMI). We investigated the cardiometabolic risk level and level of adherence to the Healthy Heart Tool guidelines in the patient group at six Norwegian hospitals at a time before the Healthy Heart Tool formed part of national guidelines (this occurred in September 2018). From December 2016 to April 2018, 264 patients were included in the study from the following Norwegian health trusts: Oslo University Hospital ($n = 108$), Diakonhjemmet Hospital ($n = 75$), University Hospital of North Norway ($n = 27$), Helse Bergen Hospital Trust ($n = 23$), Vestfold Hospital Trust ($n = 18$) and St Olav's Hospital Trust ($n = 13$). The study was approved by the Ethical Review Board of Northern Norway (Regional Ethical Committee of Northern Norway – 2016/29665).

### Participants

Patients in the adult mental health care of the participating hospitals aged between 18 and 90 years with schizophrenia spectrum disorder (ICD F20-F29), bipolar spectrum disorder (affective disorders with hypomania, mania or psychotic symptoms: ICD F30, F31, F32.3 or F33.3) or current use of antipsychotic medication, were eligible for inclusion. Emphasis was put on inclusion regardless of perceived cardiometabolic risk status. Exclusion criterion was inability to give informed consent.

General information about the project was given to the clinical personnel at inpatient and outpatient services at information meetings and by email. The clinical personnel then referred eligible patients to the research staff with a focus on consecutive recruitment. Research staff (research nurses or other staff personnel) informed patients in more detail about the project and collected informed consent from those who wanted to participate. It was emphasised that there were noegateve consequences of not participating. Recruitment was solely based on inclusion criteria. Everyone received the same questions, and data were validated with patient journal information. At every site, there was a local project partner overseeing the recruitment procedures in close collaboration with the rest of the project partners. This method allowed for broad inclusion of patients at different sites, but data on patients who were not asked or refused participation were not possible to obtain.

Clinicians collected data from patient interviews and patient records. All participants have given written informed consent to participation and publication of data.

### Assessments

The following sociodemographic data were collected: age, gender, civil status, ethnicity and level of education. ICD-10 diagnosis as diagnosed by their treating clinician was recorded. Time of start of treatment of the current psychiatric disorder was recorded and duration in moths was calculated. Inpatient or outpatient treatment status was recorded. Data on current use of psychotropic medication and use of illegal substances past 6 months were collected from participants and medical records. The Global Assessment of Functioning scale (GAF), in an adapted version with separate scoring of symptoms (GAF-S) [31,], was used to measure level of general psychiatric symptoms.

Standards of cardiovascular risk monitoring and risk reducing interventions were evaluated by comparing practice with the recommendations of the Healthy Heart Tool (Figure 1). Information on cardiometabolic risk assessments according to the Healthy Heart Tool obtained during the 12 months prior to inclusion (either at the hospital or with the general practitioner) was collected from patients and medical records. Daily smoking was recorded. Physical activity was defined as any activity to increase physical fitness, based on self report. Patents were asked how often they participated in such activities. One session of physical activity per week or less was defined as sedentary behavior [32].

| *"Risk Zone" risk factors* | **Daily smoking** | **Sedentary lifestyle** | **BMI≥30 kg/m$^2$ or waist circumference ≥102 cm males /≥88 cm females** | **BMI≥35 kg/m$^2$ and diabetes or diagnosis of hypertension or BMI≥40 kg/m$^2$** | **High blood pressure (≥140/90 mmHg)** | **Blood glucose dysregulation (Hemoglobin A1c ≥6,5 %)** | **Total cholesterol ≥7.0 mmol/l** | **CVD[1]** | **≥ 1 Risk factor (in «Risk Zone»)** |
|---|---|---|---|---|---|---|---|---|---|
| ***Interventions*** | Smoking cessation advice<br><br>Smoking cessation program | Physical activity: Counselling and motivational interventions and organized activities<br><br>Diet: advice and guidance | Physical activity: Counselling and motivational interventions and organized activities<br><br>Diet: advice and guidance<br><br>Reassessment of psychotropic medication | Referral to specialist | Physical activity: Counselling and motivational interventions and organized activities<br><br>Salt intake reduction: Advice and guidance<br><br>Reassessment of psychotropic medication | Physical activity: Counselling and motivational interventions and organized activities<br><br>Diet: advice and guidance<br><br>Prescription of Metformin<br><br>Reassessment of psychotropic medication<br><br>Referral to specialist | Physical activity: Counselling and motivational interventions and organized activities<br><br>Diet: advice and guidance<br><br>Prescription of Statins<br><br>Reassessment of psychotropic medication<br><br>Referral to specialist | Prescription of Statins<br><br>Reassessment of psychotropic medication | Patient contact with GP[2]<br><br>Documented cooperation with GP[2] |

[1]Cardiovascular disease. [2]General Practioning Medical Doctor

**Figure 1.** Risk factors ('Risk Zone') and corresponding recommended interventions of the Healthy Heart Tool. [a]Cardiovascular disease; [b]General Practioning Medical Doctor.

Measurements included weight and height (calculation of body mass index (BMI), waist circumference, systolic and diastolic blood pressure, glycosylated hemoglobin A1c and non-fasting plasma lipids (total cholesterol, high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), triglycerides). Comorbidities including cardiovascular disease (CVD), hypertension or diabetes were recorded. Elevated cardiometabolic risk ('Risk Zone') was defined as meeting any of the risk thresholds defined in the Healthy Heart Tool as follows: daily smoking, sedentary behavior, obesity (BMI $\geq$ 30 kg/m2), blood pressure $\geq$140/90 mmHg, Hemoglobin A1c (HbA1c) $\geq$6.5%, total cholesterol $\geq$7 mmol/L or a reported diagnosis of CVD or diabetes (Figure 1). Information on cardiometabolic risk reducing interventions according to the Healthy Heart Tool performed during the last 12 months were collected from patients and medical records. Counselling and motivational interventions was defined as any direct verbal communication with patients intended to affect their behaviour in a positive way (e.g. increased physical activity).

## *Statistics*

Proportions of patients with risk factor assessments were examined. Based on these values, prevalence of risks as described in the Healthy Heart Tool, and the level of the corresponding recommended interventions were assessed. Data on risk interventions were not collected for all patients with risk factors, but we have no reason to believe that lack of complete datasets for each participant conferred a specific bias to the dataset. Chi-square tests were applied to assess the difference in the proportion of interventions for patients with the current risk, relative to patients without the current risk. Due to multiple testing (31 separate tests), the significance level for the chi- square tests was set to 0.002 (Bonferroni). Otherwise, the significance level was set to 0.05. Use of olanzapine or clozapine was grouped as one dichotomous variable, because of the well-known cardiometabolic risk profiles of these antipsychotics [20]. Putative predictors for the resulting significant associations were then investigated adjusting for clinically relevant confounding factors using logistic regression models to calculate odds ratios (OR), with the specific intervention as dependent variable and the following 12 independent variables: age, sex, ethnicity (European vs non-European origin), civil status (married or cohabitating), education (>/< 12 years of education), type of disorder (schizophrenia spectrum vs bipolar spectrum disorder or other), duration of treatment (months), inpatient vs outpatient treatment, use of olanzapine or clozapine, use of illicit drugs past six months, level of general symptoms as measured with the GAF-S, as well as the corresponding risk factor for the specific intervention according to the guideline. Low n of patients with risk factors receiving recommended interventions hindered investigations with logistic regressions for some of the resulting significant associations (the following associations were investigated: daily smoking and smoking cessation advice, obesity and counselling and motivational interventions for physical activity, obesity and

**Table 1.** Demographic and clinical characteristics.

| | Men ($n = 147$) | Women ($n = 117$) |
|---|---|---|
| Age, mean (SD[a]) | 42.6 (14.3) | 47.5 (16.1) |
| European ethnicity, *n* (%) | 114 (77.6) | 101 (86.3) |
| Married or cohabiting, *n* (%) | 20 (13.8) | 31 (26.7) |
| More than 12 yrs education, *n* (%) | 57 (40.7) | 63 (54.8) |
| Schizophrenia spectrum[b], *n* (%) | 122 (83.6) | 85 (73.3) |
| Bipolar spectrum[c], *n* (%) | 17 (11.6) | 21 (18.1) |
| Other diagnosis[d], *n* (%) | 7 (4.8) | 10 (8.6) |
| Duration of treatment in months, mean (SD) | 17.9 (13.2) | 19.3 (13.6) |
| Use of olanzapine or clozapine, *n* (%) | 71 (50.4) | 41 (36.0) |
| Use of illicit drugs past 6 months, *n* (%) | 26 (18.4) | 8 (7.3) |
| GAF Symptoms, mean (SD) | 47.7 (13.9) | 51.9 (14.1) |
| Inpatient treatment, *n* (%) | 48 (33.1) | 29 (25.0) |

[a]Standard deviation,
[b]ICD F20-F29,
[c]ICD F30, F31, F32.3, F33.3,
[d]Not (a) or (b) and current use of antipsychotic.

**Table 2.** Proportions of participants with physical examinations and blood samples in the past 12 months, either at the hospital or with the general practitioner (family doctor).

| | Men, *n* (%) | Women, *n* (%) |
|---|---|---|
| Body weight | 122 (86.5) | 84 (75.0) |
| Waist circumference | 79 (58.1) | 57 (52.8) |
| Blood pressure | 113 (80.7) | 87 (79.1) |
| Hemoglobin A1c | 115 (81.6) | 88 (77.2) |
| Lipids[a] | 126 (89.4) | 89 (79.5) |
| Underwent all above assessments, *n* (%) | 73 (51.0) | 55 (48.2) |

[a]Total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol, triglycerides.

diet advice). Final models were checked for 'goodness of fit' with Hosmer-Lemeshow tests.

## Results

A total of 264 patients participated in the study. Their demographic and clinical characteristics are presented in Table 1. There were 147 men (55.7%) and 117 women (44.3%) and a total of 207 participants (79.0%) had schizophrenia spectrum disorder. The average length of treatment was 18.5 months (range: 0–57 months). Seventy-seven participants (30%) received inpatient treatment at the time of the study while the rest were outpatients. We have no records of patients who declined participation.

The proportion of patients who had received cardiometabolic risk assessments according to the Healthy Heart Tool is shown in Table 2 (only counting patients with registration of whether the assessments were performed or not). Investigations of all recommended risk factors, i.e. of body weight, waist circumference, blood pressure, HbA1c and lipids had been performed in 131 participants (49.8%), either at the hospital or with the general practitioner and communicated to the hospital.

Two hundred thirty-one (87.5%) were in the Risk Zone of the total group of included patients. Table 3 shows the

**Table 3.** Patients in the specialist health care with cardiometabolic risk factors receiving the appropriate recommended interventions according to the Healthy Heart Tool.

| | Patients with risk factors | | Patients with risk factors receiving recommended interventions | | | |
|---|---|---|---|---|---|---|
| Risk factor | n | % | | n | %[a] | *p*-value |
| In 'Risk Zone'[b] | 231 | 87.5 | Contact with GP[c] | 133 | 71.5 | 0.647 |
| | | | Documented cooperation with GP | 56 | 29.3 | 0.062 |
| Daily smoking | 99 | 38.5 | Smoking cessation advice | 34 | 44.7 | **<0.001** |
| | | | Smoking cessation program | 3 | 4.1 | 0.312 |
| Sedentary lifestyle[d] | 132 | 50.2 | Physical activity: Counselling and motivational interventions | 86 | 72.3 | 0.126 |
| | | | Physical activity: organized activities | 45 | 39.1 | 1.000 |
| | | | Diet: advice and guidance | 62 | 55.4 | 0.023 |
| BM/ $\geq$ 30 kg/m$^2$ or waist circumference $\geq$ 102 cm men /$\geq$88 cm women | 150 | 62.0 | Physical activity: Counselling and motivational interventions | 106 | 77.9 | **<0.001** |
| | | | Physical activity: Organized activities | 54 | 40.9 | 0.473 |
| | | | Diet: Advice and guidance | 76 | 58.0 | **<0.001** |
| | | | Reassessment of psychotropic medication | 34 | 27.9 | 0.399 |
| BM/ $\geq$ 35 kg/m$^2$ and diabetes or hypertension or BM/ $\geq$ 40 kg/m$^2$ | 21 | 8.0 | Referral to specialist | 4 | 21.1 | 0.020 |
| High blood pressure ($\geq$140/90 mmHg) | 84 | 32.4 | Physical activity: Counselling and motivational interventions | 57 | 75.0 | 0.134 |
| | | | Physical activity: Organized activities | 29 | 39.2 | 1.000 |
| | | | Salt intake reduction: Advice and guidance | 10 | 14.7 | 0.033 |
| | | | Reassessment of psychotropic medication | 17 | 25.0 | 1.000 |
| Blood glucose dysregulation /Diabetes (Hemoglobin A1*c* $\geq$ 6.5 %) | 27 | 10.5 | Physical activity: Counselling and motivational interventions | 19 | 86.4 | 0.055 |
| | | | Physical activity: Organized activities | 10 | 47.6 | 0.485 |
| | | | Diet: Advice and guidance | 16 | 72.7 | 0.023 |
| | | | Metformin (current prescription) | 7 | 33.3 | **<.001** |
| | | | Reassessment of psychotropic medication | 6 | 30.0 | 0.592 |
| | | | Referral to specialist | 4 | 20.0 | 0.026 |
| Total Cholestero/ $\geq$ 7 mmol/L | 12 | 4.7 | Physical activity: Counselling and motivational interventions | 5 | 50.0 | 0.302 |
| | | | Physical activity: Organized activities | 3 | 30.0 | 0.744 |
| | | | Diet: Advice and guidance | 4 | 40.0 | 0.750 |
| | | | Statins (current prescription) | 0 | 0.0 | 1.000 |
| | | | Reassessment of psychotropic medication | 0 | 0.0 | 0.069 |
| | | | Referral to specialist | 0 | 0.0 | 1.000 |
| Cardiovascular disease | 25 | 9.5 | Statins (current prescription) | 6 | 27.3 | **0.002** |
| | | | Reassessment of psychotropic medication | 7 | 36.8 | 0.269 |

Chi square tests.
[a]Incomplete datasets for each participant.
[b]'Risk Zone' of the Healthy Heart Tool: daily smoking, sedentary lifestyle, unhealthy diet, Body Mass Index > 30 kg/m$^2$, blood pressure over140/90 mmHg, HbA1C $\geq$6.5%, total cholesterol $\geq$7 or diagnosis of cardiovascular disease, hypertension or diabetes.
[c]General practioning medical doctor.
[d]One session of physical activity per week or less.
Bold: significant after Bonferroni correction, $p = 0.002$.

**Table 4.** Associations between interventions and sex, age and corresponding risk factors from the logistical regressions.

| Interventions (dependent variables) | Significant independent variables and corresponding risk factor | Odds Ratios (95%CI[a]) | *p*-value |
|---|---|---|---|
| Smoking cessation advice | Age | 1.01 (0.96–1.06) | 0.756 |
| | Female sex | 0.34 (0.11–1.097) | 0.066 |
| | Married or cohabitating | 4.23 (1.13–15.76) | **0.032** |
| | Illicit substance use | 0.09 (0.01–0.54) | **0.009** |
| | Daily smoking | 11.46 (3.60–36.49) | **<0.001** |
| Physical activity: Counselling and motivational interventions | Age | 1.00 (0.96–1.04) | 0.985 |
| | Female sex | 0.50 (0.20–1.21) | 0.125 |
| | Use of olanzapine or clozapine | 0.34 (0.15–0.78) | **0.011** |
| | Obesity or high waist circumference[b] | 4.70 (2.03–10.88) | **<0.001** |
| Diet: Advice and guidance | Age | 0.97 (0.93–1.01) | 0.088 |
| | Female sex | 0.30 (0.13–0.71) | **0.006** |
| | Duration of treatment | 1.05 (1.01–1.09) | **0.015** |
| | Use of olanzapine or clozapine | 0.37 (0.17–0.80) | **0.012** |
| | Obesity or high waist circumference[b] | 4.97 (2.15–11.50) | **<0.001** |

Showing age, sex and significant effects from the full models.
[a]Confidence interval.
[b]BMI $\geq$ 30 kg/m$^2$ or waist circumference $\geq$102 cm men/$\geq$88 cm women.
Bold: Significant effect; significance level: 0.05.

proportion of patients with risk factors who received risk-specific interventions recommended in the Healthy Heart Tool. The following associations were statistically significant: daily smoking and smoking cessation advice, obesity and counselling and motivational interventions for physical activity, obesity and diet advice, (blood) glucose dysregulation and metformin prescription, CVD and statin prescription.

The logistical regressions controlling for potential confounders (Table 4) showed that smoking cessation advice was significantly associated with daily smoking, but illicit drug use significantly reduced the likelihood of receiving such advice. Counselling and motivational interventions for physical activity was significantly associated with obesity or high waist circumference, but prescription of clozapine or olanzapine significantly reduced the likelihood of receiving the intervention.

Dietary advice and guidance were also significantly associated with obesity or high waist circumference. The likelihood of the dietary intervention was increased with longer duration of treatment, but reduced in women and for participants prescribed clozapine or olanzapine.

## Discussion

We found that nearly nine out of ten participants were in the risk zone according to the Healthy Heart Tool and only half of the participants were adequately screened for cardiometabolic risk. Furthermore, a high proportion of patients at risk did not receive adequate preventive interventions. The level of interventions varied substantially between areas of risk. Women with obesity were less prone to receiving dietary advice, and the prescription of antipsychotics with disruptive metabolic load reduced the chances for patients with obesity of getting weight reducing interventions. Further, use of illicit drugs reduced the chances for receiving smoking cessation advice. Together, these findings highlight the large proportion of SMI patients with high CVD risk in a mental health care specialist setting, and the low percentage of participants receiving adequate clinical management.

The current findings show a similar level of key risk factors for cardiometabolic disease reported before the introduction of the 'Lester Tool' at four NHS trusts in England in 2014, where the level of recommended screening was 46% [30]. Waist circumference in our study was measured in just above half of the patients. This confirms earlier findings of low levels of screening with a relevant and sensitive physical measure in SMI patients [33]. Only 30% of patients at risk had had their psychotropic drug use reassessed. This low proportion is consistent with previous findings [34].

For performance of recommended risk interventions, we found that advice on physical activity was provided for more than 70% of the patients. For physical activity counselling and motivational interventions in patients with high glycosylated hemoglobin, the implementation rate can also be considered satisfactory (86%), but the level of referral of patients to organized physical exercise for any risk area was not (30–50%). The observation that few were referred to a physical exercise service may be due to services being little known or difficult to access. Possibly, clinicians have a lower threshold for giving advice than to *refer* to a specific service. Lack of attention to or knowledge of the problem or work overload in the staff could be additional explanations.

Sedentary lifestyle, obesity and hypercholesterolemia was associated with a 40–60% likelihood of receiving dietary advice. For high long-term blood glucose, the level of dietary advice was 73% but the relationship did not reach statistical significance. The specific risks smoking and obesity were significantly related to targeted, adequate measures such as smoking cessation advice, counselling and motivational interventions for physical activity and dietary advice, even after controlling for possible confounding factors. This could be related to the Norwegian targeted reimbursement for these specific interventions in the health services, possibly indicating high effectiveness of this administrative measure. In the 'Lester Tool' evaluation in England (2015), level of recommended interventions for people at risk was generally higher than in our study, at 79% [30]. That is; while the screening level in Norway was similar to the UK level, the intervention

level was lower. Another possible explanation for such a difference could be that longer distances to the nearest adequate interventions service hinder referral in the more scarcely populated Norway. Differences in study populations and regions could affect results, as e.g. patients with more psychiatric symptoms may have higher barriers for receiving referrals implying longer travelling distances. Also, differences in the regional administration of health care could represent varying levels of obstacles. The differences found between health trusts in the Lester Tool evaluation for level of interventions support this. Our findings may thus suggest that some risk areas appear to the clinician as risk factors that more obviously require intervention (e.g. obesity).

The study results point to some potentially important roadblocks for adequate interventions. Women were less likely than men to receive dietary advice for obesity. This finding could be due to factors related to differences in clinicians' evaluation of obesity in men vs women. Obesity is more common in women than in men, independent of age and socioeconomic status [35]. A meta-analysis by Spahlholtz *et al.* [36] reported that women experience more weight related stigma and discrimination than men. One might speculate that clinicians more often observe obesity in women and hence consider this as more «normal», but it could also be that clinicians are more hesitant to address weight related questions in women. This may be due to the assumption that female patients experience weight related questions negatively. Further, the use of illicit drugs was associated with a lower likelihood of receiving smoking cessation advice. This could indicate lower ambitions in clinicians for smoking cessation in drug abusers, e.g. because of the more negative social consequences of drug abuse, and possibly reflecting the well-known stigma for this group [37,38].

Another notable finding was that prescription of the cardiometabolic risk associated antipsychotics clozapine and olanzapine reduced the chances for patients with obesity of getting motivational interventions for increased physical activity or receiving dietary advice. One potential explanation could be that patients on clozapine or olanzapine have more psychiatric symptoms, limiting the possibilities for active interventions, but symptom load did not act as a significant confounder in the analyses of the associations. It could still be that the type of medication may affect the clinicians' interpretation. A focus on medication compliance could perhaps overshadow the follow-up of possible side effects. Another possibility is that prescription of these antipsychotics biases the clinicians' attitudes towards thinking that weight reducing interventions may have lower efficacy. We also found that longer duration of treatment increased the chances of dietary advice for obesity. This may just be due to a high correlation between weight increase and duration of treatment, but if the findings indicate that dietary advice is not given in an early treatment phase it is problematic, as early interventions are crucial for prevention of risk factors.

On a more general level we have seen that basic equipment necessary for medical examinations such as scales, measuring tapes and blood pressure cuffs (and stethoscopes) is missing in many places, especially in outpatient clinics. The general lack of available targeted intervention possibilities or programs will probably affect referral rates for risk conditions.

There are several limitations in the current study. The number of participants is low in some of the risk factor subgroups, making the estimates of interventions in adherence to guidelines uncertain. Further, the inclusion criteria were relatively wide, and a bias due to possible inclusion of specific patient groups, e.g. better functioning patients, cannot be ruled out. As we do not have data for non-participants this is difficult to judge, but we have no indications that the participants were uncharacteristic of other SMI-groups in specialized health care e.g. in demographics. Emphasis was put on inclusion regardless of risk factors and there were no significant differences between the sites in risk factor incidence. If better functioning patients should have been selected in our study, one could possibly expect a bias towards a normalization of findings, i.e. toward a higher level of follow-up of somatic health. As this is a cross-sectional study no inferences can be made concerning causality between risk factors and interventions. Blood samples were not fasting, increasing the risk for artificially elevated values for lipids.

The main strength of the study is the unique survey of risk factors and risk interventions and associated factors in a fairly large patient sample from different psychiatric hospital services across Norway. The findings suggest that we do not detect the existing elevated risk in a high proportion of patients, but providing adequate interventions within specialized health care may be an even greater challenge.

After the present study was conducted, in September 2018, the Norwegian Directorate of Health issued national guidelines with standardized 'Treatment Packages' for mental health and substance abuse [39]. One section of these guidelines is an 'Action Package' called 'Somatic Health and Living Habits of Mental Health Care for Adults', in which the Healthy Heart Tool is part. Data were collected in the days leading up to the launch of the national standardized guidelines.

## Conclusions

The study results point to relevant factors in the association between cardiometabolic risk areas and interventions. Even if patients with severe mental disorders are known to have high rates of cardiovascular risk factors, they receive inadequate levels of investigations and interventions. In particular, women with obesity and patients using antipsychotics with higher levels of cardiometabolic side effects seem to have fewer adequate interventions.

The findings highlight the need for continued focus on education of health care personnel, stigma fighting and efforts to ease the access to interventions to reduce comorbid CVD in people with SMI. There is a large need for implementation of standardized guidelines, in order to improve risk detection and secure adequate interventions.

## Ethics approval

Regional Ethics Committee South East: #2009/2485.


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