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A scoping review of cardiovascular risk factor screening rates in general or family practice attendees living with severe mental ill-health

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ABSTRACT

Background: Primary care is essential to address the unmet physical health needs of people with severe mental ill-health. Continued poor cardiovascular health demands improved screening and preventive care. No previous reviews have examined primary care cardiovascular screening rates for people living with severe mental ill-health; termed in the literature "severe mental illness".

Methods: A scoping review following Joanna Briggs Institute methodology was conducted. Cardiovascular risk factor screening rates in adults with severe mental ill-health were examined in general or family practices (as the main delivery sites of primary care). Literature published between 2001 and 2023 was searched using electronic databases including Medline, Embase, Web of Science, PsychINFO and CINAHL. Two reviewers independently screened titles and abstracts and conducted a full-text review. The term "severe mental illness" was applied as the term applied in the literature over the past decades. Study information, participant details and cardiovascular risk factor screening rates for people with 'severe mental illness' were extracted and synthesised.

Results: Thirteen studies were included. Nine studies were from the United Kingdom and one each from Canada, Spain, New Zealand and the Netherlands. The general and/or family practice cardiovascular disease screening rates varied considerably across studies, ranging from 0 % to 75 % for people grouped within the term "severe mental illness". Lipids and blood pressure were the most screened risk factors.

Conclusions: Cardiovascular disease screening rates in primary care settings for adults living with severe mental ill-health varied considerably. Tailored and targeted cardiovascular risk screening will enable more comprehensive preventive care to improve heart health outcomes and address this urgent health inequity.

1. Introduction

Severe mental ill-health is characterised in the literature as severe mental illness (SMI). The term SMI is applied to a group of conditions called schizophrenia, bipolar disorder, major depression and other psychotic disorders. The term is often employed to refer to a population group rather than as a disease entity for people described as living with severe mental ill-health (Zumstein and Riese, 2020). People living with severe mental ill-health in the SMI grouping are at increased risk of cardiovascular disease (CVD) related to unmet and preventable physical health needs (Rossom et al., 2022; De Hert et al., 2009; De Hert et al., 2011b). Physical health comorbidities in people with severe mental ill-health such as cancer, cardiometabolic and respiratory illnesses can lead to a 10–30-year shorter years of life lived (Chew-Graham et al., 2021; De Hert et al., 2011b; Holt, 2015). This is driven in part by sub-optimal rates of physical health screening and delayed delivery of preventive care and treatment (Lamontagne-Godwin et al., 2018; Kohn et al., 2022). CVD contributes 17.4 % and 22 % to the total life-years lost in men and women living with a SMI, respectively (Nielsen et al., 2021). CVD-related excess mortality in people with SMI is seen globally (Correll et al., 2017). People with severe mental ill-health in low- and middle-income countries experience poorer physical health outcomes than in

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high-income countries due to financial barriers and inadequate healthcare resources (Firth et al., 2019; De Hert et al., 2011a). In high-income countries higher rates have been established of comorbid CVD and SMI compared to low- and middle-income countries (Lambert et al., 2022). Cardiovascular health outcomes have improved for the general community, but these gains have not been seen in people who live with severe mental ill-health and the mortality gap is widening (Nielsen et al., 2021; Chew-Graham et al., 2021; Holt, 2015). CVD risk screening should result in timely diagnosis and earlier intervention for heart health, and ideally lead to effective preventive care across the life course (Brunero and Lamont, 2009; Baller et al., 2015). However, despite the existence of clinical guidelines to support CVD risk screening and preventive care specifically for people with severe mental ill-health in countries such as the United Kingdom (UK), the United States (US) and Australia (Clark, 2004; Mitchell and Hardy, 2013; Baller et al., 2015; Galletly et al., 2016), CVD screening rates for people who live with a severe mental ill-health remain lower than the rates in the general population (Holt and Peveler, 2010; Holt, 2015; Solmi et al., 2021).

Primary care practitioners, as the first point of contact, deal with undifferentiated health problems and provide longitudinal person-centred care (Gunn and Palmer, 2014), and people with severe mental ill-health should be considered an important target population for preventive primary care (Planner et al., 2014; Zumstein and Riese, 2020; Spooner et al., 2022). Here, primary care refers to services delivered in, residential environments or community settings by general practitioners (GPs) and practice nurses, also termed "family or general practice" (Donaldson et al., 1996). People with severe mental ill-health attend primary care more frequently than the general population (Kontopantelis et al., 2015; Waterreus and Morgan, 2017), which provides a major opportunity to screen, monitor and deliver cardiovascular health care (Palmer et al., 2018). Common modifiable cardiovascular risk factors appear more frequently in people with SMI compared to people who do not live with SMI (Spooner et al., 2022; De Hert et al., 2011b). However, little is known about cardiovascular risk screening in primary care attendees living with a SMI. It is surprising, given the importance of this issue, that previous reviews have not examined the screening rates for CVD risk factors among people with SMI specifically in primary care. To address this knowledge gap, we have conducted an up-to-date, comprehensive scoping review using the Joanna Briggs Institute methodology (Peters et al., 2015; Peters et al., 2020) to identify cardiovascular risk factor screening rates in general or family practice attendees living with SMI.

2. Methods

This scoping review followed a methodology developed by the Joanna Briggs Institute and Joanna Briggs Collaborating Centres. The core steps outlined in the methodology included: (1) defining the review objective; (2) developing the inclusion criteria; (3) searching studies; (4) study selection; (5) extracting and charting the results; (6) analysis of the extracted data; (7) presentation of results; (8) conclusions and implications for research and practice (Peters et al., 2015; Peters et al., 2020). This methodology was chosen as it aligns with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) checklist for transparent reporting of a scoping review (Tricco et al., 2018; Peters et al., 2020).

2.1. Eligibility criteria

Studies meeting the eligibility criteria shown in Table 1 were included in the scoping review. Primary care settings were limited to "family or general practices" to allow the clearest picture of primary care screening as these settings are central to the primary healthcare systems across the UK, Europe, Canada, New Zealand and Australia in which primary and secondary responses can be clearly delineated (Hashim, 2016; The King's Fund, 2011).

Table 1
Inclusion and exclusion criteria.

Criteria	Inclusion	Exclusion
Design	Randomised controlled trials, cluster randomised controlled trials, cohort studies, case-control studies, cross-sectional studies non-randomised controlled trials, controlled before-and-after studies, clinical audits, medical record audits and mixed-methods studies	Qualitative studies, historically controlled studies, interrupted time series studies or research studies where CVD screening was undertaken for recruitment or as an intervention
Outcome	Percentage of screening for or assessment of cardiovascular risk factors including but not limited to blood pressure, lipids, glucose, smoking status and body mass index	No percentage of screening shown for one or more or all cardiovascular risk factors, or percentage of screening for risk factors of diseases other than CVD
Population	Adult general or family attendees aged over 18 years old with any type of SMI referred to as schizophrenia, bipolar disorder and other psychoses including major depression	Not primary care attendees, or people younger than 18 or without SMI
Publication type	Peer-reviewed primary research journal articles	Conference/meeting abstracts, review articles, news, duplicate publications, books/book chapters, research protocols, case reports, editorials studies with unavailable full texts or government and non-government agency reports
Place	All geographical locations	None
Publication period	January 2001 – January 2023	Earlier than 2001
Language	English	Not English
Settings	Primary care (general practices or family practices only)	Secondary or tertiary care, or community care delivered through outpatients or other services such as health centres

Abbreviations: CVD, cardiovascular disease; SMI, severe mental illness.

2.2. Identifying literature

A comprehensive, systematic search of peer-reviewed academic journal articles published between January 2001 and January 2023 from five electronic databases was conducted, including Medline, Embase (Excerpta Medica database), Web of Science, PsychINFO and CINAHL (Cumulative Index to Nursing and Allied Health Literature). A full list of search terms is included in Table 2. Search terms were chosen to capture as many relevant articles as possible that relate to the four key topics: SMI, screening, CVD risk and primary care settings (specifically general or family practices). The type of SMI was not restricted in this review since we wanted to include all people with SMI as a population

Table 2
Search strategy.

Search terms	Topic
schizophrenia or severe mental illness* or psychotic disorder* or psychos* or bipolar disorder* or bipolar affective disorder* or bipolar personality disorder* or SMI or schizoaffective disorder* or antipsych* AND	SMI
screen* or assess* AND	Screening
cardiovascular disease* or heart disease* or cardiac disease* or CVD or ischemic heart disease* or ischaemic heart disease* or absolute cardiovascular disease risk or ACVDR AND	CVD risk
primary adj2 (care or health care or healthcare or medical care or patient care) OR (family or general) adj2 (practi*)	Primary care settings

Abbreviations: SMI, severe mental illness; CVD, cardiovascular disease.

group irrespective of specific mental illness diagnoses. Our preferred terminology would be severe mental ill-health but to identify papers in the past with this would be limited so the term SMI had to be applied. Primary prevention or primary preventive care was not included in the search strategy as it extends beyond screening to include other preventive care steps such as risk identification, early intervention and ongoing monitoring of CVD risk which could be a focus of a future review. Next, additional filters including publication type, publication dates and language were applied for each database. One reviewer (YX) independently completed the search for eligible articles from the listed databases. The most recent search was executed on 4 January 2023.

2.3. Data extraction and synthesis

Identified references were imported into Covidence, a web-based primary screening and data extraction tool (Babineau, 2014). Two reviewers (YX and ML) independently screened article titles and abstracts, followed by a full-text review with conflicts resolved via consensus between the two reviewers (YX and ML) or arbitration by a third reviewer (VP). One reviewer further extracted and compiled data from the included studies in Excel (Microsoft Corporation, 2021). Extracted data included: study (author, year), country, study design, study group(s), sample size, age range, mean age, sex (% female), ethnicity, proportion of people with SMI by the specific type of mental illness, proportion of the sample using antipsychotics, any comorbidities in people with SMI, guidelines that were reported to have been followed for screening, CVD risk factors screened, screening period, frequency of screening, percentage of screening in people with SMI, and main findings. After data extraction, results were discussed with co-authors to establish consistency. The results were then synthesised by identifying study and participant characteristics and findings related to CVD screening as common themes across studies.

Internal validity of the reviewed studies was not assessed as this is outside the parameters of scoping reviews which are designed to provide an exploratory and descriptive overview of the research evidence regardless of quality of individual studies (Peters et al., 2015). Risk of bias assessment within and across included studies is more applicable to systematic reviews of interventions that can be analytical in nature and aim to answer a specific research question (Tricco et al., 2018; Peters et al., 2015). Ethical approval was not required as no human subjects were involved in this review on published research.

3. Results

A total of 974 studies were identified by the search and imported into Covidence. After 380 duplicates were removed, 594 studies underwent title and abstract screening and 548 studies did not meet inclusion criteria. Full text review was conducted on 47 studies with one study identified from the reference list of an article. The most common reason for exclusion was that studies did not report the screening rate(s) for one or more or all CVD risk factors. After excluding 34 studies due to ineligibility, 13 primary research articles were included in this scoping review (Fig. 1).

3.1. Characteristics of studies and participants

Table 3 presents study information and participant characteristics. Nine of the 13 included studies were conducted in the UK (Osborn et al., 2011; Hardy et al., 2013; Hardy et al., 2014; Mitchell and Hardy, 2013; Yeomans et al., 2014; Osborn et al., 2003; McLean et al., 2014; Ratcliffe et al., 2011; Roberts et al., 2007); one in Canada (O'Neill et al., 2020); one in Spain (Castillo-Sánchez et al., 2017); one in New Zealand (Keenan et al., 2020); and one in the Netherlands (Jakobs et al., 2020). These countries all share similar primary care systems where family physicians, GPs and/or practice nurses deliver usual care. Six studies were clinical audits (Hardy et al., 2014; Hardy et al., 2013; Keenan et al., 2020; Mitchell and Hardy, 2013; Yeomans et al., 2014; Ratcliffe et al., 2011), four studies were retrospective cohort studies (Osborn et al., 2011; O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Jakobs et al., 2020), two studies were cross-sectional studies (McLean et al., 2014; Osborn et al., 2003) and one study was a case-matched retrospective chart review (Roberts et al., 2007).

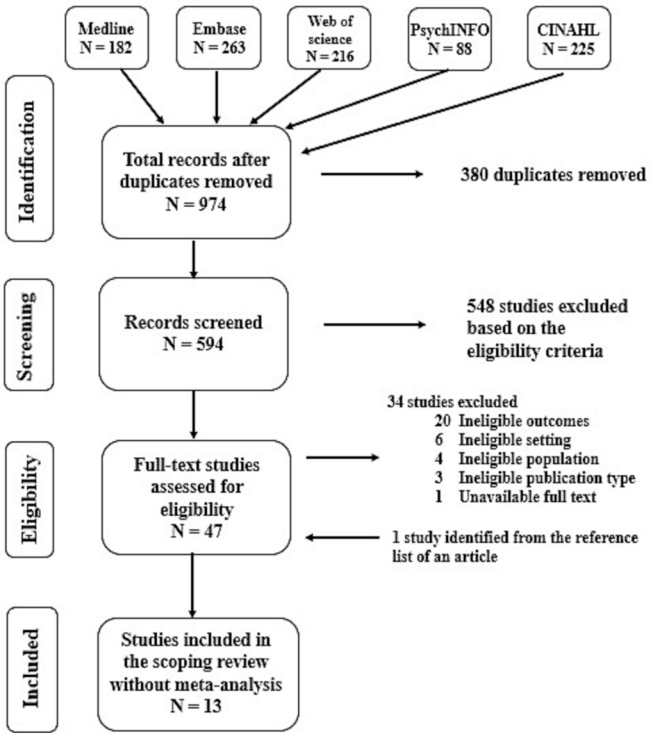

Fig. 1. PRISMA flow diagram.

Sample sizes varied greatly, ranging from 117 (Keenan et al., 2020) to 2,911,914 people (Mitchell and Hardy, 2013). In most studies, people with SMI were compared to another group such as people without SMI (Osborn et al., 2011; O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Osborn et al., 2003; McLean et al., 2014; Roberts et al., 2007), people diagnosed with diabetes (Mitchell and Hardy, 2013; Hardy et al., 2013) or those who had SMI with an additional comorbidity (i.e. CVD or diabetes) (Jakobs et al., 2020). From studies that reported participant mean age (Osborn et al., 2011; Castillo-Sánchez et al., 2017; Keenan et al., 2020; Jakobs et al., 2020; Roberts et al., 2007) or gender (Osborn et al., 2011; O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Keenan et al., 2020; Hardy et al., 2013; Roberts et al., 2007; McLean et al., 2014; Jakobs et al., 2020), the study samples of people living with SMI were generally in their 40s or 50s and broadly gender balanced (four studies reported approximately 50 % female inclusion and four studies reported lower than 50 % female inclusion, with the lowest proportion being 36 %). The proportion of people by the specific name of SMI differed across the eight studies that reported it (Osborn et al., 2011; O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Keenan et al., 2020; Jakobs et al., 2020; McLean et al., 2014; Roberts et al., 2007; Ratcliffe et al., 2011). Participants were referred to as people with a specific mental illness in six studies which included people only with bipolar disorder or schizophrenia (Ratcliffe et al., 2011), or comprised 100 % of individuals with schizophrenia or schizoaffective disorder (O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Keenan et al., 2020; Roberts et al., 2007; McLean et al., 2014). To compare, participants were referred to as people with SMI as a population group in the remaining seven studies (Osborn et al., 2011; Jakobs et al., 2020; Hardy et al., 2013; Hardy et al., 2014; Mitchell and Hardy, 2013; Osborn et al., 2003; Yeomans et al., 2014). Among these studies, two studies reported the proportion of people by their SMI

Table 3
Study information and participant characteristics.

Study information			Patient characteristics								
Study (first author, year)	Country	Study design	Study group(s)	Sample size	Age range	Mean age	Sex (% female)	Race/ Ethnicity	Proportion of people with SMI reported by the specific name of mental illness	Proportion of people with SMI using antipsychotics	Any comorbidities in people with SMI
Castillo-Sánchez, 2017 (Castillo-Sánchez et al., 2017)	Spain	Retrospective cohort study	Schizophrenia group vs no schizophrenia but taking antipsychotics (NS-TAD) group vs control group	107712 (schizophrenia: 4911; NS-TAD: 4157; control: 98644)	18+	Schizophrenia: 43.6; NS-TAD: 51.1 control: 44.7	Schizophrenia: 36 %; NS-TAD: 52 %; control: 52 %	Not reported	100 % schizophrenia	Not reported	Prevalence at the start or end of the study period: 36.4 % obesity (end), 11.3 % hypertension (start), 8.7 % diabetes (start), and 19.3 % dyslipidaemia (start)
Hardy, 2013 (Hardy et al., 2013)	UK	Retrospective audit	SMI group vs diabetes group	2261 (SMI: 386; diabetes: 1875)	16+	Not reported	With SMI: 47 %; with diabetes: not reported	Not reported	Not reported	Not reported	Not reported
Hardy, 2014 (Hardy et al., 2014)	UK	Before-and-after audit	Pre-training year vs post-training year	400 people with SMI in the pre-training or post-training audit (groups are similar)	16+	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
Jakobs, 2020 (Jakobs et al., 2020)	Netherlands	Retrospective cohort study	Participants with SMI and/or taking antipsychotics without diabetes or CVD (SMI/AP-only) vs participants with SMI/AP and diabetes mellitus (SMI/AP + DM) vs participants with SMI/AP and a history of CVD (SMI/AP + CVD)	1705 (SMI/AP-only: 1383; SMI/AP + DM: 206; SMI/AP + CVD: 116)	18+	47.7 (SMI/AP-only: 44.9; SMI/AP + DM: 58.5; SMI/AP + CVD: 61.8)	51.7 % (SMI/AP-only: 52.1 %; SMI/AP + DM: 53.4 %; SMI/AP + CVD: 44.0 %)	Not reported	Overall for people with SMI: 30.0 % schizophrenia, 33.0 % affective psychosis/bipolar disorder and 41.5 % other psychoses	43.8 (SMI/AP-only: 42.1 %; SMI/AP + DM: 56.7 %; SMI/AP + CVD: 41.7 %)	For the study sample with SMI/AP: 6.6 % chronic obstructive pulmonary disease, 5.8 % alcohol abuse, 21.0 % tobacco abuse and 6.2 % drug abuse
Keenan, 2020 (Keenan et al., 2020)	New Zealand	Clinical audit	People with SMI receiving antipsychotic medications	117	15+	48	43 %	53 Māori (45.3 %) and 64 non-Māori (54.7 %)	100 % schizophrenia/ schizoaffective disorder	100 %	Not reported
Mclean, 2014 (McLean et al., 2014)	UK	Cross-sectional study	SMI group vs no SMI group by gender	845228 (with SMI: 6581; without SMI: 838647)	35–74	Not reported	With SMI: 49 %; without SMI: 51 %	Not reported	100 % schizophrenia	Not reported	Not reported
Mitchell, 2013 (Mitchell and	UK	Retrospective audit	A national sample: SMI group vs diabetes group	2911914 (diabetes group: 2488948; SMI group: 422966)	Diabetes group: not clear; SMI group: 40+	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported

(*continued on next page*)

Table 3 (*continued*)

Study information			Patient characteristics								
Study (first author, year)	Country	Study design	Study group(s)	Sample size	Age range	Mean age	Sex (% female)	Race/ Ethnicity	Proportion of people with SMI reported by the specific name of mental illness	Proportion of people with SMI using antipsychotics	Any comorbidities in people with SMI
Hardy, 2013)											
O'Neill, 2020 (O'Neill et al., 2020)	Canada	Retrospective cohort study	SMI group vs no SMI group	197309 (with SMI: 4882; without SMI: 192427)	40–75	Not reported	With SMI: 52 %; without SMI: 56 %	Not reported	100 % schizophrenia	Not reported	19 % type II diabetes
Osborn, 2003 (Osborn et al., 2003)	UK	Cross-sectional study	SMI group vs no SMI group	495 (with SMI: 182; without SMI: 313)	30–75	Not reported	Not reported	Not reported	Not reported	24.7 % (among people with SMI who have available data on drugs)	Not reported
Osborn, 2011 (Osborn et al., 2011)	UK	Retrospective cohort study	SMI group vs no SMI group	114208 (with SMI: 18696; without SMI: 95512)	18+	With SMI: 52.1; without SMI: 53.2	With SMI: 50 %; without SMI: 53 %	Not reported	37.4 % schizophrenia/ schizoaffective disorder, 24.5 % bipolar disorder and 38.1 % other psychoses	Not reported	Not reported
Ratcliffe, 2011 (Ratcliffe et al., 2011)	UK	Clinical audit	Participants with SMI	128	Not reported	Not reported	Not reported	Not reported	30.4 % bipolar disorder and 69.5 % schizophrenia	Not reported	Not reported
Roberts, 2007 (Roberts et al., 2007)	UK	Case-matched retrospective review	SMI group vs general control group vs asthma control group	975 (with SMI: 195; general control: 390; asthma control: 390)	21–64	With SMI: 42.8; general control: 42.6; asthma control: 42.8	With SMI: 42 %; general control: 42 %; asthma control: 42 %	Not reported	100 % schizophrenia	Not reported	Not reported
Yeomans, 2014 (Yeomans et al., 2014)	UK	Retrospective audit	Whole SMI register vs SMI register with template review	5056 (Whole SMI register: 5056; SMI register with template review: 335)	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported

Abbreviations: SMI, severe mental illness.

diagnosis including schizophrenia/schizoaffective disorder, bipolar disorder and other psychoses such as major depression, or psychoses not otherwise specified (Osborn et al., 2011; Jakobs et al., 2020).

3.2. CVD screening rates

Table 4 presents screening information extracted from the included studies. The frequency of CVD risk factor screening differed across the reviewed studies as did the cardiovascular risk factors being screened. Over the study period when screening took place (with a 12-month period being most common), the frequency of screening ranged from once (Osborn et al., 2003) to every 15 months (Hardy et al., 2013; Mitchell and Hardy, 2013) to annually (Osborn et al., 2011; Hardy et al., 2014; Yeomans et al., 2014) to at least once (O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Keenan et al., 2020; Ratcliffe et al., 2011; McLean et al., 2014; Roberts et al., 2007; Jakobs et al., 2020).

The number of screened cardiovascular risk factors ranged from four in six studies (Osborn et al., 2011; O'Neill et al., 2020; Hardy et al., 2013; Hardy et al., 2014; Mitchell and Hardy, 2013; Yeomans et al., 2014) to six in five studies (Keenan et al., 2020; Ratcliffe et al., 2011; Osborn et al., 2003; McLean et al., 2014; Roberts et al., 2007). Eight studies reported that risk factors were screened as specified independent heath checks (Roberts et al., 2007), elements of a comprehensive physical health check (Hardy et al., 2014; Yeomans et al., 2014; Hardy et al., 2013; Mitchell and Hardy, 2013), or elements included in the Framingham Risk Eq. (D'Agostino et al., 2008) to calculate a person's absolute cardiovascular disease risk (ACVDR) (O'Neill et al., 2020; McLean et al., 2014; Osborn et al., 2003). The other studies reported screening rates for individual risk factors (Osborn et al., 2011; Keenan et al., 2020; Castillo-Sánchez et al., 2017; Jakobs et al., 2020; Ratcliffe et al., 2011). Five CVD risk factors were commonly reported in the reviewed studies. These were blood pressure, lipid profile for cholesterol, smoking status, body mass index (BMI) and blood glucose. The CVD screening rate for all reported risk factors (i.e. a full CVD screen) was reported by seven studies (O'Neill et al., 2020; Hardy et al., 2013; Hardy et al., 2014; Mitchell and Hardy, 2013; Yeomans et al., 2014; Keenan et al., 2020; McLean et al., 2014) with the rate varying considerably across studies, being as low as 0 % (Keenan et al., 2020) and as high as 75 % for people with SMI (Mitchell and Hardy, 2013).

Screening rates for each risk factor varied across studies. Lipid profile and blood pressure were the most commonly screened risk factors, ranging from 12 % (Roberts et al., 2007) to 78 % (Castillo-Sánchez et al., 2017) for lipids, and 56 % (Roberts et al., 2007) to 94 % (McLean et al., 2014) for blood pressure. Among the five single and common risk factors listed above, the average percentage of screening in people with SMI was highest for blood pressure (74 %) (O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Hardy et al., 2013; Hardy et al., 2014; Keenan et al., 2020; Mitchell and Hardy, 2013; Yeomans et al., 2014; Ratcliffe et al., 2011; McLean et al., 2014; Roberts et al., 2007) and lowest for blood glucose (50 %) (Hardy et al., 2014; Hardy et al., 2013; Keenan et al., 2020; Mitchell and Hardy, 2013).

One UK study showed that before 2004 when funding incentives for UK GPs were introduced, people living with SMI were significantly less likely to have CVD screening compared to those without SMI (Osborn et al., 2011). However, three years after the funding incentives were introduced, screening rates for most risk factors were similar (approximate average rates for BMI: 32 %; cholesterol: 18 %; glucose: 24 %) between the two groups under 60 years old (Osborn et al., 2011). One UK study demonstrated no association between being diagnosed with SMI and participation in CVD risk screening, with an average participation rate of 45 % for the study sample (i.e. a low overall CVD screening rate) (Osborn et al., 2003). One study demonstrated that people living with SMI were equally likely to receive a full CVD screen (risk factors indicated in Table 4) compared to those without SMI, but screening rates were lower than 50 % (O'Neill et al., 2020). One study showed similar CVD screening rates between people with and without SMI for most individual risk factors (with rates varying across the risk factors) (Roberts et al., 2007) while another indicated that people living with SMI had more complete documentation of most cardiovascular risk factors compared to those without SMI (O'Neill et al., 2020). A Spanish study found that people living with schizophrenia were more frequently screened for dyslipidaemia and diabetes, less for smoking and equally for obesity and hypertension compared to those without schizophrenia (Castillo-Sánchez et al., 2017). Two studies that compared a SMI group to people with diabetes indicated that the percentages of people with SMI who received screening for each CVD risk factor and across all CVD risk factors were significantly lower than those of the diabetic group (Hardy et al., 2013; Mitchell and Hardy, 2013). One study from the Netherlands demonstrated that the group with SMI and/or receiving antipsychotics only was less likely to be screened for most or all CVD risk factors compared to the group who had SMI and/or receiving antipsychotics, and an additional comorbid diagnosis of CVD or diabetes (Jakobs et al., 2020).

In addition to outcomes comparing CVD screening rates between groups, one study suggested that practices where more GPs were interested in physical and mental health and a higher quality GP care was provided might enhance the chance of CVD screening in primary care attendees (Ratcliffe et al., 2011). Three studies demonstrated that new public health interventions carried out by the government and health professionals about CVD screening in people living with SMI resulted in increased screening rates of cardiovascular risk factors (Hardy et al., 2014; Yeomans et al., 2014; Osborn et al., 2011). These included training practice nurses in CVD prevention (Hardy et al., 2014), the use of a computer-based physical health screening template in primary care (Yeomans et al., 2014) and the introduction of Quality and Outcomes Framework policy in the UK in 2004 (Osborn et al., 2011), a contract through which GPs receive financial incentives for the care of people with long-term conditions, including screening for CVD risk factors for people living with SMI (Osborn et al., 2011; Mitchell and Hardy, 2013; Yeomans et al., 2014; McLean et al., 2014; Hardy et al., 2014; Hardy et al., 2013; Ratcliffe et al., 2011).

4. Discussion

4.1. Summary and interpretation of the findings

This scoping review has identified that cardiovascular screening rates for people living with severe mental ill-health in primary care have historically been, and continue to be, lower than would be considered best practice. The findings indicate that CVD screening rates must be improved in primary care for people with SMI. Although some studies demonstrated that people with SMI had similar or even higher screening rates than the general population (Castillo-Sánchez et al., 2017; O'Neill et al., 2020; Osborn et al., 2011; Roberts et al., 2007), these screening rates are lower than would be indicated by the outsized impact of CVD on early mortality for people with SMI. This issue persists across years and is especially evident for the administration of a full screen of CVD risk factors with screening rates below 30 % in this population (Hardy et al., 2013; Hardy et al., 2014; Keenan et al., 2020; McLean et al., 2014). The primary-care-focused results reported in this study are consistent with findings from a previous scoping review examining CVD screening rates in people with SMI across all health settings in the US (Baller et al., 2015).

Our results showed that lipid profile and blood pressure were the most screened cardiovascular risk factors for people living with SMI. Among the five common risk factors screened in the included studies, blood pressure (measured by ten studies) had the highest average screening rate (O'Neill et al., 2020; Castillo-Sánchez et al., 2017; Hardy et al., 2013; Hardy et al., 2014; Keenan et al., 2020; Mitchell and Hardy, 2013; Yeomans et al., 2014; Ratcliffe et al., 2011; McLean et al., 2014; Roberts et al., 2007). Overall, screening rates for individual CVD risk factors were lower than recommended in Australian, American and the

Table 4
Screening rates for CVD risk factors.

Study (first author, year)	Guidelines followed for screening	CVD risk factors screened	Screening period	Frequency of screening	Percentage of screening in people with SMI	Main findings
Castillo-Sánchez, 2017 (Castillo-Sánchez et al., 2017)	Not specified	(i) tobacco use (ii) obesity (iii) hypertension (iv) diabetes (v) dyslipidaemia	2006–2011	At least once	44 % for smoking, 39 % for obesity, 81 % for hypertension, 80 % for diabetes and 78 % dyslipidaemia	People with schizophrenia were screened more frequently for diabetes and dyslipidaemia and less frequently for tobacco use than the control group. For obesity and hypertension, the odds of screening for both groups were equal.
Hardy, 2013 (Hardy et al., 2013)	CVD and diabetes in people with SMI position statement from the EPA; NICE	(i) BMI (ii) blood pressure (iii) serum cholesterol (iv) blood glucose	September 2009–August 2010	Every 15 months	21 % for all four risk factors, 48 % for BMI, 63 % for blood pressure, 37 % for serum cholesterol and 35 % for blood glucose	Only 81 out of 386 people (21 %) with SMI had a full CVD screen. People with SMI were far less likely to be screened for each cardiovascular risk factor and to receive a full CVD screen than those with diabetes. On average, each individual with SMI received screening for fewer than two cardiovascular risk factors (from a possible four).
Hardy, 2014 (Hardy et al., 2014)	Guidelines suggested in the article named 'metabolic syndrome in people with schizophrenia: a review'; NICE	(i) BMI (ii) blood pressure (iii) serum cholesterol (iv) blood glucose	Pre-training: September 2009–August 2010; post-training: September 2010–August 2011	Annually	Pre-training: 20 % for all four risk factors, 47 % for BMI, 61 % for blood pressure, 36 % for serum cholesterol and 31 % for blood glucose; post-training: 23 % for all four risk factors, 55 % for BMI, 75 % for blood pressure, 44 % for serum cholesterol and 45 % for blood glucose	After the practice nurse training, the screening rates of each CVD risk factor in a health check significantly increased for people with SMI. People with SMI had 1.43, 1.22, 1.23 and 1.18 times higher chance of receiving screening for glucose, blood pressure, serum cholesterol and BMI respectively, after the practice nurse training. Although training increased the percentage of screening for all four risk factors, the result was not significant.
Jakobs, 2020 (Jakobs et al., 2020)	Dutch guidelines for family practitioners	Screening was divided in three levels: (i) adequate: BMI, smoking status, blood pressure, glucose and cholesterol/HDL ratio were all recorded; (ii) moderate: BMI, smoking status and blood pressure were all recorded; (iii) insufficient: if the previous two requirements were not met	January 2013–December 2014	At least once for yearly assessment of cardiovascular risk	SMI/AP-only group: 90.2 % "insufficient", 1.4 % "moderate" and 8.5 % "adequate"; SMI/AP + DM group: 29.6 % "insufficient", 1.9 % "moderate" and 68.4 % "adequate"; SMI/AP + CVD group: 68.1 % "insufficient", 5.2 % "moderate" and 26.7 % "adequate"	The SMI/AP + DM or SMI/AP + CVD group was significantly more likely to receive moderate or adequate CVD screening compared to the SMI/AP-only group, with odds ratios being 21.8 (95 % CI: 15.4–30.8) and 4.3 (95 % CI: 2.8–6.6) respectively.
Keenan, 2020 (Keenan et al., 2020)	Royal Australian and New Zealand College of Psychiatrists (RANZCP) and Best Practice Advisory Centre (BPAC) guidelines	(i) patient weight (ii) waist circumference (iii) blood pressure (iv) fasting plasma glucose (v) fasting lipid profiles (vi) complete blood count	1 April 2016–31 March 2017	At least once	None were fully screened. 82 % for patient weight, 3 % for waist circumference, 85 % for blood pressure, 70 % for fasting plasma glucose, 66 % for fasting lipid profiles, 68 % for complete blood count	None of the 117 people with SMI were fully screened for all cardiovascular risk factors. Approximately two-thirds of the patients were screened for blood glucose, lipids, blood pressure, complete blood count and patient weight. However, less than 5 % of the patients had waist circumference recorded.
Mclean, 2014 (McLean et al., 2014)	Joint British Societies' guidelines on prevention of cardiovascular disease in clinical practice	(i) age (ii) sex (iii) SBP (iv) smoking status (v) diabetes (vi) total cholesterol	NA	At least once	29.5 % for all eight risk factors, 100 % for age, sex and diagnosis of diabetes, 96.7 % for smoking, 94.1 % for SBP and 29.8 % for total cholesterol	According to the summary statistics, overall both men and women with SMI were more likely to have all risk factors and individual risk factors including smoking

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Table 4 (*continued*)

Study (first author, year)	Guidelines followed for screening	CVD risk factors screened	Screening period	Frequency of screening	Percentage of screening in people with SMI	Main findings
						status, SBP and total cholesterol recorded compared to the gender-specific controls. However, statistical analyses were not used to compare the two groups.
Mitchell, 2013 (Mitchell and Hardy, 2013)	the Quality and Outcomes Framework standards	(i) BMI (ii) blood pressure (iii) cholesterol (iv) blood glucose	For diabetes group: 2010–2011; for SMI group: 2011–2012	Every 15 months	75 % for all four risk factors, 84 % for blood pressure, 80 % for BMI, 72 % for cholesterol and 65 % for blood glucose	The percentages of patients who received screening for each CVD risk factor and across all four CVD risk factors were significantly higher among patients with diabetes than among those with SMI.
O'Neill, 2020 (O'Neill et al., 2020)	Several Canadian guidelines for management and prevention of CVD	(i) smoking status (ii) SBP (iii) total cholesterol (iv) HDL cholesterol	1 April 2016–31 March 2018	At least once	45 % for all four risk factors, 62 % for HDL cholesterol, 61 % for total cholesterol, 75 % for SBP and 80 % for smoking status	The screening rate for each cardiovascular risk factor except smoking status was significantly higher for people with schizophrenia compared to those without schizophrenia. Overall, people with schizophrenia did not have decreased adjusted odds for a full CVD screen compared to those without SMI (95 % CI for the population OR including 1).
Osborn, 2003 (Osborn et al., 2003)	NICE	(i) age (ii) sex (iii) smoking status (iv) diabetes (v) blood pressure (vi) cholesterol concentrations	NA	Once	41.2 % for participation in assessment of cardiovascular risk (with the number or type of risk factors screened for each person not reported, however)	Being diagnosed with SMI was not significantly associated with participation in CVD risk screening after adjusting for age, sex, practice, and SBP. People with SMI consulted their general practitioner more often than those without SMI in the previous year.
Osborn, 2011 (Osborn et al., 2011)	Not specified	(i) systolic and/or diastolic blood pressure (ii) BMI (iii) serum glucose (random or fasting) (iv) serum cholesterol	2000–2007	Annually	Percentages were plotted on the graph for each year between 2000 and 2007 based on sex and age, with annual screening rates increasing for all four risk factors for both sexes and age groups	Before introducing financial incentives for general practitioners in 2004, compared to those without SMI, people with SMI are less likely to be screened for cardiovascular risk factors. In 2007 people with SMI under 60 were equally likely to be screened for all cardiovascular risk factors except blood pressure (all 95 % CIs for the population incidence rate ratios for being screened including 1). However, those with SMI over 60 remain significantly less likely to be screened.
Ratcliffe, 2011 (Ratcliffe et al., 2011)	NICE	(i) blood pressure (ii) BMI (iii) smoking history (iv) alcohol consumption history (v) non-fasting total cholesterol (vi) diabetes	In the previous 15 months when the study takes place	At least once	90 % for smoking history, 52 % for alcohol consumption history, 68 % for blood pressure, 54 % for BMI, 45 % for cholesterol and 41 % for diabetes	From two general practices, people with schizophrenia were more likely to have a diabetes screen but were equally likely to be screened for other risk factors than people with bipolar disorder. People with mental illness from general practice A were more likely to have their smoking history, alcohol consumption history, blood pressure and BMI

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Table 4 (*continued*)

Study (first author, year)	Guidelines followed for screening	CVD risk factors screened	Screening period	Frequency of screening	Percentage of screening in people with SMI	Main findings
						recorded compared to people with mental illness from general practice B. This may be due to a presence of more general practitioners interested in physical and mental health and a higher quality healthcare provided in practice A, and more frequent visits to general practices in patients registered with practice A.
Roberts, 2007 (Roberts et al., 2007)	Not specified	(i) blood pressure (ii) weight (iii) cholesterol (iv) smoking status (v) alcohol consumption (vi) family history of heart disease	1 April 1996–31 March 1999	At least once	55.9 % for blood pressure, 39.5 % for weight, 12.3 % for cholesterol, 47.7 % for smoking status, 37.4 % for alcohol intake and 29.7 % for family history	After adjusting for potential confounders, people with SMI were significantly less likely to be assessed for blood pressure and cholesterol compared to general controls, and for blood pressure and smoking status compared to asthma controls. However, screening rates for most risk factors were equal between people with SMI and general controls or asthma controls (95 % CIs for the population ORs including 1).
Yeomans, 2014 (Yeomans et al., 2014)	NICE	(i) SBP (ii) BMI (iii) HDL: cholesterol ratio (iv) smoking status	1 July 2012–1 July 2013	Annually	32 % for all four risk factors, 75 % for SBP, 71 % for BMI, 45 % for HDL: cholesterol ratio and 72 % for smoking status	Only 32 % of patients on the whole SMI register received an annual health check that includes metabolic screening. Use of the annual physical health screening template was significantly associated with an increased in the proportion of patients having individual measures recorded, which were 97 %, 91 %, 76 % and 92 % for SBP, BMI, HDL: cholesterol ratio and smoking status, respectively.

Abbreviations: BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease; EPA, European Psychiatric Association; HDL, high-density lipoprotein; MDD, major depressive disorder; NICE, National Institute for Health and Clinical Excellence; OR, odds ratio; SBP, systolic blood pressure; SMI, severe mental illness.

UK guidelines for clinical care for antipsychotic users or people with SMI. These guidelines suggest regular (e.g. four, eight and twelve weeks after antipsychotic medications are commenced) and annual systematic monitoring of cardiovascular risk factors for antipsychotic users or people living with SMI (Clark, 2004; Galletly et al., 2016; NICE (National Institute for Health and Clinical Excellence), 2014b). While the scoping review did not determine if follow up care and monitoring were completed as well as screening, existing evidence suggests that ongoing cardiac care will be sub-optimal (Mitchell and Lord, 2010).

Current screening and treatment algorithms for cardiovascular disease make it likely that increased age and the presence of any comorbidities should lead to increased CVD screening rates for people with SMI (Hardy et al., 2013; Keenan et al., 2020; Ritchie and Muldoon, 2017; Jakobs et al., 2020). A previous cross-sectional study supported this possibility by showing that both increased age and a history of metabolic conditions were significantly associated with receiving a full CVD screen in participants with SMI (Black and Held, 2017). These risk factors are key components required for population-level CVD screening outcomes (NICE, 2014a; United States Preventive Services Task Force, 2018; National Vascular Disease Prevention Alliance, 2012) and risk estimation models such as the Framingham Risk Equation and its Australian equivalent to determine ACVDR (Lalor et al., 2012). However, the weighting for age in CVD screening guidelines (NICE, 2014a) and models of ACVDR for the general population (Berry et al., 2007) may not accurately represent the true CVD risk in people with SMI. People experience increased risk at younger ages, have additional cardiometabolic risk arising from taking antipsychotic medication or have severe multimorbidity (Foley et al., 2013).

It is important to consider that the age when CVD risk becomes clinically relevant using risk calculations such as the Framingham Risk Equation is the time when people with SMI are currently losing their lives (Chew-Graham et al., 2021; National Vascular Disease Prevention Alliance, 2012). Population-based ACVDR calculations can underestimate true CVD risk in people with SMI by about one-third in men and two-thirds in women (Cunningham et al., 2019). There is an urgent need to develop screening guidelines and validated CVD risk prediction tools to identify more accurate CVD risk specifically for people with SMI. These guidelines and tools need to recognise the increased CVD risk that

occurs at a younger age for people with SMI compared to the general population (Osborn et al., 2015) which is an issue that needs to become more widely known in the general community and across healthcare settings to effect change.

CVD screening rates may be higher in people with SMI who are using antipsychotics compared to those who are not (Morrato et al., 2011; Jakobs et al., 2020), which may be due to more intensive screening programmes created for people with SMI using antipsychotics (Castillo-Sánchez et al., 2017). An alternative explanation is that people prescribed antipsychotics may be more readily identifiable in primary health care records, and thus more likely to be screened than those not using antipsychotics among people with SMI as diagnostic information is often poorly recorded in electronic medical records or only included within text notes (Hardy et al., 2013; Hardy et al., 2014; Spooner et al., 2022).

The introduction and implementation of national CVD screening guidelines likely influences the variations in screening rates reported in the included studies. National guidelines or financial incentives for CVD screening, such as the UK Quality and Outcomes Framework, appeared to increase the CVD screening rates for a full CVD screen and for specific risk factors including blood pressure, glucose, BMI and lipid profile in people with SMI (Osborn et al., 2011; Mitchell and Hardy, 2013; McLean et al., 2014; Hardy et al., 2014). The results presented here suggest however that guidelines may not be routinely followed (O'Neill et al., 2020; Yeomans et al., 2014; Keenan et al., 2020). Implementation of CVD screening guidelines could be optimised through a co-design approach that incorporates the needs and perspectives of primary care clinicians and people with SMI (Tindall et al., 2021).

Other possible explanations exist for the high degree of variability in CVD screening rates across studies. Studies reporting CVD screening rates over a long study period could capture more frequent screening events although the annual screening rate could remain low. Furthermore, people who attend primary care more frequently could have a higher chance of being screened for CVD, and may represent a distinct sub-population of people with SMI who are better supported than those who are more socially isolated or are disengaged from primary care (Black and Held, 2017; O'Neill et al., 2020; Jakobs et al., 2020; Ratcliffe et al., 2011).

Based on our search, there remains a paucity of literature about assessments of ACVDR in people who live with severe mental ill-health and attend primary care and evidence suggests that screening rates are lower than is warranted. The reasons for this under-screening are complex. There may be diagnostic overshadowing, where physical health care needs are overshadowed by the mental illnesspeople have complex multimorbidity and primary care is a time and resource pressured environment. Another explanation could reflect implicit or explicit stigma from clinicians who may view people with severe mental ill-health as too difficult to treat (Nielsen et al., 2021; Mitchell et al., 2009; Palmer et al., 2018; Launders et al., 2022). Offering focused training programs on conducting CVD screening to primary care teams has been shown to raise the confidence of performing the screening in people living with SMI (Hardy et al., 2014). Additionally, enhancing the understanding and expanding the knowledge of health workers in primary care about experiences of mental ill-health may improve the attitudes towards people with SMI, reduce stigma and further increase access to health care (Nielsen et al., 2021). Further, educating the general population about the early mortality due to CVD experienced by people with SMI (Correll et al., 2017; Lambert et al., 2022) may inspire a positive change in CVD screening for people with SMI.

It is important to develop literacy and shared understandings around how poor physical health is experienced by people with SMI for both health professionals and people living with SMI. Working in partnership with people living with SMI in the design, development and implementation of person-centred guidelines, co-designed assessment tools and models of care with clear pathways that are tailored to this group is likely to improve CVD screening rates and health outcomes including experiences of care (Palmer et al., 2021; Palmer et al., 2018). This may help address structural inequities in provision of high-quality care between people with SMI and the general population, and also increase the comfort and confidence of people living with SMI to request physical health checks (including CVD screening) (Hardy et al., 2014; Nielsen et al., 2021; Hardy et al., 2013). We are currently undertaking a study of an assertive cardiac intervention co-designed by people with SMI, a multidisciplinary team of clinicians and mental health researchers to reduce the 5-year ACVDR in people with SMI in the primary care setting (Lewis et al., 2020).

4.2. Strengths and limitations

As far as we are aware, this is the first comprehensive scoping review to determine CVD risk screening rates in adults living with SMI attending primary care. We adopted a broad approach to CVD screening in our search terms and investigated CVD screening in a range of SMI across multiple databases. We included three studies that had younger participants alongside their adult participants (Hardy et al., 2013; Hardy et al., 2014; Keenan et al., 2020) and two studies that did not report the age of the sample (Yeomans et al., 2014; Ratcliffe et al., 2011) because these studies were otherwise eligible. Several limitations to the work exist. First, the review inclusion criteria only allowed studies reporting screening rates for risk factors in a broad context of CVD risk, and not as stand-alone factors. This is because we aimed to understand how screening practices were undertaken to determine ACVDR based on multiple risk factors (D'Agostino et al., 2008; National Vascular Disease Prevention Alliance, 2012). It is possible that targeted work examining individual cardiovascular risk factors would yield different screening rates to those reported here, but that was beyond our current research focus. Second, our findings were drawn from the healthcare systems that are similar, in which the earliest point of CVD assessment in primary care can more easily be determined. Therefore, these results may not be generalisable to the US where primary and secondary care are often integrated or overlapping to meet the needs of people with SMI (Ramanuj et al., 2018; Pomerantz and Sayers, 2010; Leung et al., 2019), and developing countries where the first contact for accessing mental health care occurs in non-primary care settings including traditional and religious healers, mental health practitioners including psychiatrists, or general or psychiatric hospitals(Rathod et al., 2017; Lilford et al., 2020). Existing evidence suggests that our findings are similar to those in the US (Baller et al., 2015) and global settings (Solmi et al., 2021). Third, most of the included studies were published over five years ago and the outcomes may have limited application in the development of person-centred preventive care approaches for people with SMI in primary care settings today. Finally, we only included published, English language studies, so publication or language bias may exist in our results. However, the impact of these limitations would likely be small as the study outcomes reflect the limited existing work examining CVD screening in people with SMI (Baller et al., 2015).

5. Conclusion

CVD screening rates varied considerably in primary care attendees with SMI, with the type and number of cardiovascular risk factors screened for differing between studies. Of the seven studies that included screening rates for all cardiovascular risk factors, most reported that less than 50 % of the sample with SMI received a full CVD screen. Screening is an important first step to best practice preventive care, and it appears that current government and health care policies and guidelines are not improving CVD screening rates in people with SMI. Therefore, efforts to improve screening and preventive care must be an urgent priority. There is a need to co-design SMI-specific guidelines and care pathways for CVD screening with people who have lived-experience of ongoing distress and SMI that are accompanied by a targeted implementation strategy to enhance their uptake and adherence in

primary care. It is similarly important to develop risk estimation calculators and supportive preventive care tools that reflect the elevated CVD risk experienced by people living with SMI. These tools will need to encompass a broader range of SMI-specific CVD risk factors such as antipsychotic medications, socioeconomic status, access barriers due to financial stress, social isolation, and the impact of stigma from clinicians.

It is overwhelmingly clear that health-related risk factors are compounded by social determinants and other issues experienced by people living with SMI. Future randomised controlled trials of people living with SMI in primary care settings could be conducted to determine the effectiveness of co-designed guidelines and co-created assessment tools in CVD screening. Training programs about CVD screening in people with SMI are also needed to increase the screening rates. These can be matched with preventive care which can lead to better responses to cardiovascular risk and improve their overall health and wellbeing outcomes.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, or reporting of this manuscript. Lived experience co-designers and researchers are involved in the broader NHMRC research program and will inform dissemination plans and future outcomes arising from this work.

Patient consent for publication

Not required.

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CRediT authorship contribution statement

Yichen Xue was responsible for concept formation, search strategy design, data extraction and synthesis, and manuscript composition. Yichen Xue and Matthew Lewis were involved in the article screening process. Matthew Lewis and Victoria Palmer are co-supervisors for Yichen Xue who conducted this work as part of a research higher degree PhD program. Elise Dettmann provided a lived experience perspective to the paper and study outcomes. All authors contributed to critically revising the manuscript.

Declaration of competing interest

None declared.

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References

Babineau, J., 2014. Product review: covidence (systematic review software). J. Can. Health Libr. Assoc. 35, 68–71.

Baller, J.B., Mcginty, E.E., Azrin, S.T., Juliano-Bult, D., Daumit, G.L., 2015. Screening for cardiovascular risk factors in adults with serious mental illness: a review of the evidence. BMC Psychiatry 15, 55. https://doi.org/10.1186/s12888-015-0416-y.

Berry, J.D., Lloyd-Jones, D.M., Garside, D.B., Greenland, P., 2007. Framingham risk score and prediction of coronary heart disease death in young men. Am. Heart J. 154, 80–86. https://doi.org/10.1016/j.ahj.2007.03.042.

Black, D.R., Held, M.L., 2017. Cardiovascular risk screening for individuals with serious mental illness. Soc. Work Health Care 56, 809–821. https://doi.org/10.1080/00981389.2017.1354955.

Brunero, S., Lamont, S., 2009. Systematic screening for metabolic syndrome in consumers with severe mental illness. Int. J. Ment. Health Nurs. 18, 144–150. https://doi.org/10.1111/j.1447-0349.2009.00595.x.

Castillo-Sánchez, M., Fàbregas-Escurriola, M., Bergè-Baquero, D., Fernández-Sanmartín, M., Goday-Arno, A., 2017. Screening of cardiovascular risk factors in patients with schizophrenia and patients treated with antipsychotic drugs: are we equally exhaustive as with the general population? Clin. Exp. Hypertens. 39, 441–447. https://doi.org/10.1080/10641963.2016.1267200.

Chew-Graham, C.A., Gilbody, S., Curtis, J., Holt, R.I., Taylor, A.K., Shiers, D., 2021. Still 'being bothered about Billy': managing the physical health of people with severe mental illness. Br. J. Gen. Pract. 71, 373–376. https://doi.org/10.3399/bjgp21X716741.

Clark, N.G., 2004. Consensus development conference on antipsychotic drugs and obesity and diabetes. J. Clin. Psychiatry 65 (2), 267–272.

Correll, C.U., Solmi, M., Veronese, N., Bortolato, B., Rosson, S., Santonastaso, P., Thapa-Chhetri, N., Fornaro, M., Gallicchio, D., Collantoni, E., Pigato, G., Favaro, A., Monaco, F., Kohler, C., Vancampfort, D., Ward, P.B., Gaughran, F., Carvalho, A.F., Stubbs, B., 2017. Prevalence, incidence and mortality from cardiovascular disease in patients with pooled and specific severe mental illness: a large-scale meta-analysis of 3,211,768 patients and 113,383,368 controls. World Psychiatry 16, 163–180. https://doi.org/10.1002/wps.20420.

Cunningham, R., Poppe, K., Peterson, D., Every-Palmer, S., Soosay, I., Jackson, R., 2019. Prediction of cardiovascular disease risk among people with severe mental illness: a cohort study. PLoS ONE 14, e0221521. https://doi.org/10.1371/journal.pone.0221521.

D'Agostino, R.B., Vasan, R.S., Pencina, M.J., Wolf, P.A., Cobain, M., Massaro, J.M., Kannel, W.B., 2008. General cardiovascular risk profile for use in primary care. Circulation 117, 743–753. https://doi.org/10.1161/CIRCULATIONAHA.107.699579.

De Hert, M., Dekker, J.M., Wood, D., Kahl, K.G., Holt, R.I.G., Möller, H.J., 2009. Cardiovascular disease and diabetes in people with severe mental illness position statement from the European Psychiatric Association (EPA), supported by the European Association for the Study of Diabetes (EASD) and the European Society of Cardiology (ESC). Eur. Psychiatry 24, 412–424. https://doi.org/10.1016/j.eurpsy.2009.01.005.

De Hert, M., Cohen, D., Bobes, J., Cetkovich-Bakmas, M., Leucht, S., Ndetei, D.M., Newcomer, J.W., Uwakwe, R., Asai, I., Möller, H.J., Gautam, S., Detraux, J., Correll, C.U., 2011a. Physical illness in patients with severe mental disorders. II. Barriers to care, monitoring and treatment guidelines, plus recommendations at the system and individual level. World Psychiatry 10, 138–151. https://doi.org/10.1002/j.2051-5545.2011.tb00036.x.

De Hert, M., Correll, C.U., Bobes, J., Cetkovich-Bakmas, M., Cohen, D., Asai, I., Detraux, J., Gautam, S., Möller, H.J., Ndetei, D.M., Newcomer, J.W., Uwakwe, R., Leucht, S., 2011b. Physical illness in patients with severe mental disorders. I. Prevalence, impact of medications and disparities in health care. World Psychiatry 10, 52–77. https://doi.org/10.1002/j.2051-5545.2011.tb00014.x.

Donaldson, M.S., Yordy, K.D., Lohr, K.N., Vanselow, N.A., 1996. Primary Care: America's Health in a New Era. National Academies Press.

Firth, J., Siddiqi, N., Koyanagi, A., Siskind, D., Rosenbaum, S., Galletly, C., Allan, S., Caneo, C., Carney, R., Carvalho, A.F., Chatterton, M.L., Correll, C.U., Curtis, J., Gaughran, F., Heald, A., Hoare, E., Jackson, S.E., Kisely, S., Lovell, K., Maj, M., Mcgorry, P.D., Mihalopoulos, C., Myles, H., O'donoghue, B., Pillinger, T., Sarris, J., Schuch, F.B., Shiers, D., Smith, L., Solmi, M., Suetani, S., Taylor, J., Teasdale, S.B., Thornicroft, G., Torous, J., Usherwood, T., Vancampfort, D., Veronese, N., Ward, P. B., Yung, A.R., Killackey, E., Stubbs, B., 2019. The Lancet Psychiatry Commission: a blueprint for protecting physical health in people with mental illness. Lancet Psychiatry 6, 675–712. https://doi.org/10.1016/s2215-0366(19)30132-4.

Foley, D.L., Mackinnon, A., Watts, G.F., Shaw, J.E., Magliano, D.J., Castle, D.J., Mcgrath, J.J., Waterreus, A., Morgan, V.A., Galletly, C.A., 2013. Cardiometabolic risk indicators that distinguish adults with psychosis from the general population, by age and gender. PLoS ONE 8, e82606. https://doi.org/10.1371/journal.pone.0082606.

Galletly, C., Castle, D., Dark, F., Humberstone, V., Jablensky, A., Killackey, E., Kulkarni, J., Mcgorry, P., Nielssen, O., Tran, N., 2016. Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for the management of schizophrenia and related disorders. Aust. N. Z. J. Psychiatry 50, 410–472. https://doi.org/10.1177/0004867416641195.

Gunn, J., Palmer, V., 2014. Visions of generalism - what does the future hold? Aust. Fam. Physician 43, 649–651.

Hardy, S., Hinks, P., Gray, R., 2013. Screening for cardiovascular risk in patients with severe mental illness in primary care: a comparison with patients with diabetes. J. Ment. Health 22, 42–50. https://doi.org/10.3109/09638237.2012.759194.

Hardy, S., Hinks, P., Gray, R., 2014. Does training practice nurses to carry out physical health checks for people with severe mental illness increase the level of screening for cardiovascular risk? Int. J. Soc. Psychiatry 60, 236–242. https://doi.org/10.1177/0020764013483721.

Hashim, M.J., 2016. Principles of family medicine and general practice–defining the five core values of the specialty. J. Prim. Health Care 8, 283–287.
Holt, R.I., 2015. Cardiovascular disease and severe mental illness. In: Comorbidity of Mental and Physical Disorders. Karger Publishers.
Holt, R., Peveler, R., 2010. Diabetes and cardiovascular risk in severe mental illness: a missed opportunity and challenge for the future. Pract. Diabetes Int. 27, 79-84ii. https://doi.org/10.1002/pdi.1451.
Jakobs, K.M., Posthuma, A., De Grauw, W.J.C., Schalk, B.W.M., Akkermans, R.P., Lucassen, P., Schermer, T., Assendelft, W.J.J., Biermans, M.J.C., 2020. Cardiovascular risk screening of patients with serious mental illness or use of antipsychotics in family practice. BMC Fam. Pract. 21, 153. https://doi.org/10.1186/s12875-020-01225-7.
Keenan, R., Chepulis, L., Ly, J., Carter, S., Lao, C., Asim, M., Bhat, A., Deo, S., Lim, K.P., Mohammed, R., Scarlet, S., Lawrenson, R., 2020. Metabolic screening in primary care for patients with schizophrenia or schizoaffective disorder and taking antipsychotic medication. J. Prim. Health Care 12, 29–34. https://doi.org/10.1071/hc19023.
Kohn, L., Christiaens, W., Detraux, J., De Lepeleire, J., De Hert, M., Gillain, B., Delaunoit, B., Savoye, I., Mistiaen, P., Jespers, V., 2022. Barriers to somatic health care for persons with severe mental illness in Belgium: a qualitative study of patients' and healthcare professionals' perspectives. Front. Psychol. 12, 798530.
Kontopantelis, E., Olier, I., Planner, C., Reeves, D., Ashcroft, D.M., Gask, L., Doran, T., Reilly, S., 2015. Primary care consultation rates among people with and without severe mental illness: a UK cohort study using the Clinical Practice Research Datalink. BMJ Open 5, e008650. https://doi.org/10.1136/bmjopen-2015-008650.
Lalor, E., Boyden, A., Cadilhac, D., Colagiur, S., Doust, J., Fraser, D., Harris, M., Huang, N., Johnson, D., Johnson, G., 2012. Guidelines for the Management of Absolute Cardiovascular Disease Risk.
Lambert, A.M., Parretti, H.M., Pearce, E., Price, M.J., Riley, M., Ryan, R., Tyldesley-Marshall, N., Avşar, T.S., Matthewman, G., Lee, A., Ahmed, K., Odland, M.L., Correll, C.U., Solmi, M., Marshall, T., 2022. Temporal trends in associations between severe mental illness and risk of cardiovascular disease: a systematic review and meta-analysis. PLoS Med. 19.
Lamontagne-Godwin, F., Burgess, C., Clement, S., Gasston-Hales, M., Greene, C., Manyande, A., Taylor, D., Walters, P., Barley, E., 2018. Interventions to increase access to or uptake of physical health screening in people with severe mental illness: a realist review. BMJ Open 8, e019412.
Launders, N., Kirsh, L., Osborn, D.P., Hayes, J.F., 2022. The temporal relationship between severe mental illness diagnosis and chronic physical comorbidity: a UK primary care cohort study of disease burden over 10 years. Lancet Psychiatry 9, 725–735.
Leung, L.B., Post, E.P., Jaske, E., Wells, K.B., Rubenstein, L.V., 2019. Quality of mental health care in integrated veterans affairs patient-centered medical homes: a National Observational Study. J. Gen. Intern. Med. 34, 2700–2701. https://doi.org/10.1007/s11606-019-05310-1.
Lewis, M., Chondros, P., Mihalopoulos, C., Lee, Y.Y., Gunn, J.M., Harvey, C., Furler, J., Osborn, D., Castle, D., Davidson, S., Jayaram, M., Kenny, A., Nelson, M.R., Morgan, V.A., Harrap, S., Mckenzie, K., Potiriadis, M., Densley, K., Palmer, V.J., 2020. The assertive cardiac care trial: a randomised controlled trial of a coproduced assertive cardiac care intervention to reduce absolute cardiovascular disease risk in people with severe mental illness in the primary care setting. Contemp. Clin. Trials 97, 106143. https://doi.org/10.1016/j.cct.2020.106143.
Lilford, P., Wickramaseckara Rajapakshe, O.B., Singh, S.P., 2020. A systematic review of care pathways for psychosis in low-and middle-income countries. Asian J. Psychiatr. 54, 102237 https://doi.org/10.1016/j.ajp.2020.102237.
McLean, G., Martin, J.L., Martin, D.J., Guthrie, B., Mercer, S.W., Smith, D.J., 2014. Standard cardiovascular disease risk algorithms underestimate the risk of cardiovascular disease in schizophrenia: evidence from a national primary care database. Schizophr. Res. 159, 176–181. https://doi.org/10.1016/j.schres.2014.07.022.
Microsoft Corporation, 2021. Microsoft Excel [Online]. Available: https://office.microsoft.com/excel [Accessed].
Mitchell, A.J., Hardy, S.A., 2013. Screening for metabolic risk among patients with severe mental illness and diabetes: a national comparison. Psychiatr. Serv. 64, 1060–1063. https://doi.org/10.1176/appi.ps.201200514.
Mitchell, A.J., Lord, O., 2010. Review: do deficits in cardiac care influence high mortality rates in schizophrenia? A systematic review and pooled analysis. J. Psychopharmacol. 24, 69–80. https://doi.org/10.1177/1359786810382056.
Mitchell, A.J., Malone, D., Doebbeling, C.C., 2009. Quality of medical care for people with and without comorbid mental illness and substance misuse: systematic review of comparative studies. Br. J. Psychiatry 194, 491–499. https://doi.org/10.1192/bjp.bp.107.045732.
Morrato, E.H., Druss, B.G., Hartung, D.M., Valuck, R.J., Thomas, D., Allen, R., Campagna, E., Newcomer, J.W., 2011. Small area variation and geographic and patient-specific determinants of metabolic testing in antipsychotic users. Pharmacoepidemiol. Drug Saf. 20, 66–75. https://doi.org/10.1002/pds.2062.
National Vascular Disease Prevention Alliance, 2012. Australian Absolute Cardiovascular Disease Risk Calculator.
NICE (National Institute for Health & Clinical Excellence), 2014a. Cardiovascular Disease: Risk Assessment and Reduction, Including Lipid Modification.
NICE (National Institute for Health & Clinical Excellence), 2014b. Psychosis and Schizophrenia in Adults: Prevention and Management.
Nielsen, R.E., Banner, J., Jensen, S.E., 2021. Cardiovascular disease in patients with severe mental illness. Nat. Rev. Cardiol. 18, 136–145. https://doi.org/10.1038/s41569-020-00463-7.
O'Neill, B., Kalia, S., Aliarzadeh, B., Sullivan, F., Moineddin, R., Kelly, M., Greiver, M., 2020. Cardiovascular risk factor documentation and management in primary care electronic medical records among people with schizophrenia in Ontario, Canada: retrospective cohort study. BMJ Open 10, e038013. https://doi.org/10.1136/bmjopen-2020-038013.
Osborn, D.P., King, M.B., Nazareth, I., 2003. Participation in screening for cardiovascular risk by people with schizophrenia or similar mental illnesses: cross sectional study in general practice. Bmj. 326, 1122–1123. https://doi.org/10.1136/bmj.326.7399.1122.
Osborn, D.P., Baio, G., Walters, K., Petersen, I., Limburg, H., Raine, R., Nazareth, I., 2011. Inequalities in the provision of cardiovascular screening to people with severe mental illnesses in primary care: cohort study in the United Kingdom THIN Primary Care Database 2000–2007. Schizophr. Res. 129, 104–110. https://doi.org/10.1016/j.schres.2011.04.003.
Osborn, D.P.J., Hardoon, S., Omar, R.Z., Holt, R.I.G., King, M., Larsen, J., Marston, L., Morris, R.W., Nazareth, I., Walters, K., Petersen, I., 2015. Cardiovascular risk prediction models for people with severe mental illness: results from the prediction and management of cardiovascular risk in people with severe mental illnesses (PRIMROSE) research program. JAMA Psychiatry 72, 143–151. https://doi.org/10.1001/jamapsychiatry.2014.2133.
Palmer, V., Lewis, M., Stylianopolous, V., Furler, J., 2018. Primary care prevention of the cardiovascular health crisis for people with severe mental illnesses. Aust. J. Gen. Pract. 47, 846–850.
Palmer, V.J., Chondros, P., Furler, J., Herrman, H., Pierce, D., Godbee, K., Densley, K., Gunn, J.M., 2021. The CORE study—an adapted mental health experience codesign intervention to improve psychosocial recovery for people with severe mental illness: a stepped wedge cluster randomized-controlled trial. Health Expect. 24, 1948–1961. https://doi.org/10.1111/hex.13334.
Peters, M.D.J., Godfrey, C.M., Khalil, H., Mcinerney, P., Parker, D., Soares, C.B., 2015. Guidance for conducting systematic scoping reviews. JBI Evid. Implement. 13, 141–146. https://doi.org/10.1097/xeb.0000000000000050.
Peters, M.D.J., Marnie, C., Tricco, A.C., Pollock, D., Munn, Z., Alexander, L., Mcinerney, P., Godfrey, C.M., Khalil, H., 2020. Updated methodological guidance for the conduct of scoping reviews. JBI Evid. Synth. 18, 2119–2126. https://doi.org/10.11124/jbies-20-00167.
Planner, C., Gask, L., Reilly, S., 2014. Serious mental illness and the role of primary care. Curr. Psychiatry Rep. 16, 458. https://doi.org/10.1007/s11920-014-0458-8.
Pomerantz, A.S., Sayers, S.L., 2010. Primary care-mental health integration in healthcare in the Department of Veterans Affairs. Fam. Syst. Health 28, 78.
Ramanuj, P.P., Talley, R., Breslau, J., Wang, S.S., Pincus, H.A., 2018. Integrating behavioral health and primary care services for people with serious mental illness: a qualitative systems analysis of integration in New York. Community Ment. Health J. 54, 1116–1126. https://doi.org/10.1007/s10597-018-0251-y.
Ratcliffe, T., Dabin, S., Barker, P., 2011. Physical healthcare for people with serious mental illness. Clin. Govern. Int. J. 16, 20–28. https://doi.org/10.1108/14777271111104556.
Rathod, S., Pinninti, N., Irfan, M., Gorczynski, P., Rathod, P., Gega, L., Naeem, F., 2017. Mental health service provision in low- and middle-income countries. Health Serv. Insights 10. https://doi.org/10.1177/1178632917694350.
Ritchie, S., Muldoon, L., 2017. Cardiovascular preventive care for patients with serious mental illness. Can. Fam. Physician 63, e483–e487.
Roberts, L., Roalfe, A., Wilson, S., Lester, H., 2007. Physical health care of patients with schizophrenia in primary care: a comparative study. Fam. Pract. 24, 34–40. https://doi.org/10.1093/fampra/cml054.
Rossom, R.C., Hooker, S.A., O'connor, P.J., Crain, A.L., Sperl-Hillen, J.M., 2022. Cardiovascular risk for patients with and without schizophrenia, schizoaffective disorder, or bipolar disorder. J. Am. Heart Assoc. 11, e021444 https://doi.org/10.1161/JAHA.121.021444.
Solmi, M., Fiedorowicz, J., Poddighe, L., Delogu, M., Miola, A., Høye, A., Heiberg, I.H., Stubbs, B., Smith, L., Larsson, H., 2021. Disparities in screening and treatment of cardiovascular diseases in patients with mental disorders across the world: systematic review and meta-analysis of 47 observational studies. Am. J. Psychiatry 178, 793–803.
Spooner, C., Afrazi, S., De Oliveira Costa, J., Harris, M.F., 2022. Demographic and health profiles of people with severe mental illness in general practice in Australia: a cross-sectional study. Aust. J. Prim. Health 28, 408–416. https://doi.org/10.1071/py21240.
The King's Fund, 2011. The Evolving Role and Nature of General Practice in England. King's Fund London.
Tindall, R.M., Ferris, M., Townsend, M., Boschert, G., Moylan, S., 2021. A first-hand experience of co-design in mental health service design: opportunities, challenges, and lessons. Int. J. Ment. Health Nurs. 30, 1693–1702. https://doi.org/10.1111/inm.12925.
Tricco, A.C., Lillie, E., Zarin, W., O'brien, K.K., Colquhoun, H., Levac, D., Moher, D., Peters, M.D., Horsley, T., Weeks, L., 2018. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann. Intern. Med. 169, 467–473.
United States Preventive Services Task Force, 2018. Screening for cardiovascular disease risk with electrocardiography: recommendation statement. Am. Fam. Physician 98 (374A-374D).
Waterreus, A., Morgan, V.A., 2017. Treating body, treating mind: the experiences of people with psychotic disorders and their general practitioners – findings from the

Australian National Survey of high impact psychosis. Aust. N. Z. J. Psychiatry 52, 561–572. https://doi.org/10.1177/0004867417728806.
Yeomans, D., Dale, K., Beedle, K., 2014. Systematic computerised cardiovascular health screening for people with severe mental illness. Psychiatr. Bull. 38, 280–284. https://doi.org/10.1192/pb.bp.113.045955.
Zumstein, N., Riese, F., 2020. Defining severe and persistent mental illness-a pragmatic utility concept analysis. Front. Psychol. 11, 648. https://doi.org/10.3389/fpsyt.2020.00648.