



## Research paper

# Referral to chronic pain management and physiotherapy services in adults with severe mental illness: A matched cohort study

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## ABSTRACT

**Introduction:** Chronic pain (CP) is common among people with severe mental illness (SMI). It remains unclear whether patients with comorbid CP and SMI receive equivalent pain management referrals compared to those with CP alone. This retrospective cohort study used linked primary and mental healthcare data to address this knowledge gap.

**Methods:** We identified patients aged  $\geq 18$  years with comorbid SMI and CP from secondary mental healthcare records, with the later of either diagnosis serving as the index date. Cases were matched 1:4 by age bands and gender to controls with CP but no SMI diagnosis. Co-primary outcomes were referrals to specialized pain treatment services and musculoskeletal physiotherapy. Cox regression models analyzed associations between SMI status and referral patterns, with sensitivity analyses stratifying follow-up into early (0–3.99 years), medium (4–7.99 years), and late ( $\geq 8$  years) periods.

**Results:** The final sample included 1120 patients with CP and SMI and 2681 matched non-SMI controls. SMI diagnosis strongly predicted increased healthcare utilization in adjusted analyses, with significantly higher referral rates to pain treatments (HR = 13.2, 95 % CI 7.8–22.4,  $p < 0.001$ ) and physiotherapy (HR = 11.5, 95 % CI 9.3–14.4,  $p < 0.001$ ). The association between SMI and pain treatment referrals was strongest during the early post-diagnosis period (HR = 13.2, 95 % CI 6.6–26.4,  $p < 0.001$ ).

**Conclusion:** Contrary to expectations, people with SMI and CP received more pain management referrals compared to matched controls, particularly in the early post-diagnosis period. These findings were restricted to those with a CP diagnosis already, and further research should investigate whether increased referrals translate to improved clinical outcomes.

## 1. Introduction

Chronic pain (CP), defined as pain persisting or recurring for more than three months, represents a significant global health burden affecting approximately 20 % of adults worldwide [1]. This persistent pain profoundly impacts daily functioning, quality of life, and mental

health, while placing considerable strain on healthcare systems [2]. The relationship between CP and mental health is complex and bidirectional, with particularly severe implications for individuals with severe mental illness (SMI; [3,4]).

SMI (e.g., schizophrenia, bipolar and severe major depression) refers to a group of mental, behavior, or emotional disorders that result in

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significant functional impairment, substantially limiting one or more major life activities [5]. People with SMI also experience substantially poorer physical health compared to the general population, facing a myriad of comorbidities that exacerbate mental health challenges, impair social functioning, and contribute to a striking premature mortality gap of 15–20 years [6,7,8,9]. Many of these physical comorbidities, such as diabetes, fractures, and osteoarthritis, are closely linked with CP [10,4,8,9,11–13]. Meta-analyses indicate that 25–40 % of people with SMI experience CP [14,11]. However, pain management interventions specifically tailored to this vulnerable population remain scarce. In particular, healthcare provision for people with SMI is often complicated by diagnostic overshadowing, where physical symptoms are misattributed to mental health conditions [7,15]. This phenomenon contributes to well-documented disparities in healthcare access, including lower rates of cardiovascular disease treatment despite higher mortality rates [16,17] and reduced access to cancer screening programs [18].

Whether these healthcare disparities extend to pain management services remains poorly understood [4]. Notably, no prior research has examined differences in referral patterns to pain management services and physiotherapy between people with comorbid SMI and CP versus those with CP alone. This study seeks to address this critical knowledge gap, contributing to a deeper understanding of healthcare equity for individuals with SMI. We hypothesized that individuals with comorbid SMI and CP would have reduced access to these services than the general population, therefore further highlighting healthcare inequalities already faced by this population.

## 2. Methods

### 2.1. Data sources

Data for this study were assembled from a comprehensive population-based electronic health records (EHR) linkage system, integrating two primary sources: primary care (Lambeth Datanet; LDN), secondary mental healthcare (Clinical Record Interactive Search; CRIS).

The sample included in this study was identified in CRIS. The CRIS infrastructure was developed by the NIHR Maudsley Biomedical Research Centre in collaboration with the South London and Maudsley NHS Foundation Trust (SLaM) [19,20]. SLaM provides all mental health care to an estimated 1.3 million residents in a defined geographic catchment area of four local authorities (Croydon, Lambeth, Lewisham, and Southwark; including all of Lambeth borough). SLaM has used fully electronic records for all its services since 2006 and CRIS provides researcher access to de-identified data from the full record, enhanced by text-derived meta-data via a suite of natural language processing applications developed over the last 10–15 years. CRIS has received full ethical approval (Oxford Research Ethics Committee C, reference 23/SC/0257).

CRIS data are linked to primary care records, LDN. LDN encompasses 96.8 % of GP services in Lambeth, South London, serving over 827,000 registered adults and providing pseudonymised clinical data including sociodemographic information, consultations, service referrals, and medication records [21]. Lambeth represents one of London's most diverse boroughs, with 43 % of residents from ethnic minority backgrounds and 24 % identifying as Black, Black British African, or British Caribbean [22], while ranking as the 11th most deprived borough (out of 32 boroughs in total) in London.

### 2.2. Study population

We identified patients with comorbid SMI and CP using ICD-10 codes (F2\*, F30\*, F31\*, F32.3, and F33.3) for SMI diagnoses in CRIS [23] and Read codes [24] for CP in LDN. CP diagnoses were identified through either diagnostic Read codes or prescriptions for pain medication lasting more than 90 days. The CP diagnostic criteria, developed by a

multidisciplinary team (physiotherapist, GP, psychiatrist, and EHR researchers) and validated by a Patient and Public Involvement panel, encompassed various pain conditions, including abdominal, back, chest, facial, generalized, limb, and pelvic pain (Code list available upon request).

Eligible patients were aged  $\geq 18$  years at first SMI diagnosis and active in both CRIS and LDN for at least 2 years from their index date (defined as the later of first SMI or CP diagnosis) between March 2011 and March 2021. Cases were matched 1:4 with non-SMI controls based on gender and 5-year age bands (18–22 to 88+ years). Controls could be repeated (i.e., one control could be matched with more than one cases). Controls had no recorded mental health disorders and no past SLaM referral.

### 2.3. Outcome measures

Co-primary outcomes included referrals to CP treatments (pain/back pain management services) and musculoskeletal physiotherapy clinics post-index date. Secondary outcomes comprised the number of physiotherapy sessions offered and missed, and social prescribing referrals. Social prescribing for CP is a healthcare approach that connects patients to non-medical community resources and activities, such as exercise classes, support groups, but also creative programs, to address the social, emotional, and practical factors contributing to their pain. All outcomes were identified using Read codes in LDN (Code list available upon request).

Covariates included sociodemographic information (age, gender, ethnicity, deprivation score derived from Lower Super Output Areas [25]), and clinical factors (long-term conditions, mental health diagnoses, medications). The Index of Multiple Deprivation (IMD15) was calculated based on residential areas at the index date.

### 2.4. Statistical analysis

Baseline characteristics were compared using *t*-tests for continuous variables and Pearson's Chi-Square tests for categorical variables. The association between SMI diagnosis and outcomes was evaluated using Cox regression models, both unadjusted and adjusted for age at index, ethnicity, deprivation score, CP diagnoses, and pre-index comorbidities. Sensitivity analyses stratified follow-up periods into early (0–3.99 years), medium (4–7.99 years), and late (>8 years) intervals. We also conducted a subgroup analysis among those with a schizophrenia spectrum disorder alone. Results are presented as hazard ratios (HR) with 95 % confidence intervals, analyzed using STATA 18.

## 3. Results

### 3.1. Sample characteristics

Our final analytic sample comprised 3801 participants: 1120 patients with severe mental illness (SMI) and 2681 matched controls. The SMI cohort had a mean age of 60.2 years (SD = 14.8) with 55.4 % female representation, while controls were older (mean age 67.7 years, SD = 14.2) with a similar gender distribution (50.1 % female). Within the SMI group, diagnostic distribution included schizophrenia ( $n = 719$ , 64.2 %), bipolar disorder ( $n = 250$ , 22.3 %), depressive disorder ( $n = 89$ , 8.0 %), and other SMI diagnoses such as schizoaffective disorder ( $n = 62$ , 5.5 %).

Generalized or unspecified CP was the predominant pain category in both groups (37.3 % in SMI, 30.2 % in controls), followed by lower limb pain (18.8 % in SMI, 18.3 % in controls) and abdominal pain (12.3 % in SMI, 17.2 % in controls). Over the study period, 159 CP treatment referrals were documented (127 in SMI cases [11.3 %] and 32 in controls [1.2 %]), along with 853 physiotherapy referrals (502 in SMI cases [44.8 %] and 351 in controls [13.1 %]). SMI patients received significantly more physiotherapy sessions (mean 1.46, SD = 2.45) compared to controls (mean 0.36, SD = 1.50). Detailed demographic and clinical

characteristics are presented in Table 1.

### 3.2. Primary outcomes

SMI diagnosis was associated with increased healthcare utilization for CP management. In unadjusted analyses, SMI patients showed significantly higher rates of both CP treatments (HR = 12.7, 95 % CI 9.2–19.8,  $p < 0.001$ ) and physiotherapy referrals (HR = 9.9, 95 % CI 8.3–11.8,  $p < 0.001$ ) compared to controls. These associations persisted after adjusting for potential confounders (age at index date, ethnicity, deprivation score, CP diagnosis, and pre-existing comorbidities), with adjusted hazard ratios of 13.2 (95 % CI 7.8–22.4,  $p < 0.001$ ) for CP treatments and 11.5 (95 % CI 9.3–14.4,  $p < 0.001$ ) for physiotherapy referrals (Table 2).

### 3.3. Temporal patterns

When stratified by follow-up periods, the association between SMI and CP treatments was most pronounced during the early post-index date period ( $\leq 4$  years after index date), with an adjusted HR of 13.2 (95 % CI 6.6–26.4,  $p < 0.001$ ), which attenuated to HR = 3.6 (95 % CI 1.5–8.9,  $p = 0.01$ ) during the medium follow-up period, with insufficient events for analysis in the late period (Table 3).

For physiotherapy referrals (Table 4), the association was comparatively lower in the early period (HR = 4.9, 95 % CI 3.8–6.3,  $p < 0.001$ ), increased during the medium follow-up period (HR = 10.7, 95 % CI 6.4–17.8,  $p < 0.001$ ), and became non-significant in the late period (HR = 4.9, 95 % CI 0.7–36.6,  $p = 0.12$ ).

### 3.4. Specific SMI diagnoses

Among patients with schizophrenia spectrum disorders specifically, there was an increased likelihood of receiving pain management referrals compared to controls (adjusted HR = 10.1, 95 % CI 5.7–18.1,  $p < 0.001$ ) (Supplementary Table 1). This association was slightly stronger during the early post-index date period (HR = 10.3, 95 % CI 4.7–22.5,  $p < 0.001$ ) (Supplementary Table 2).

For physiotherapy referrals among patients with schizophrenia spectrum, high rates were observed in both unadjusted (HR = 9.1, 95 % CI 7.5–11.1,  $p < 0.001$ ) and adjusted models (HR = 10.8, 95 % CI 8.5–13.8,  $p < 0.001$ ) (Supplementary Table 1). When examining temporal patterns, the association was present during the early period, peaked during the medium follow-up period (HR = 9.5, 95 % CI 5.2–17.1,  $p < 0.001$ ), and then diminished in the late period (Supplementary Table 3).

### 3.5. Secondary outcomes

SMI diagnosis was also associated with increased social prescribing utilization (Table 2). Unadjusted models showed significant elevation (HR = 22.4, 95 % CI 13.7–36.8,  $p < 0.001$ ), with similar magnitude after adjustment (HR = 9.5, 95 % CI 7.4–12.3,  $p < 0.001$ ). This association was most pronounced in the early post-index date period (HR = 70.4, 95 % CI 8.3–598.2,  $p < 0.001$ ), remained significant in the medium period (HR = 22.1, 95 % CI 9.7–50.2,  $p < 0.001$ ), and continued in the late period (HR = 12.3, 95 % CI 3.4–45.2,  $p < 0.001$ ) (Table 5).

Among people with schizophrenia specifically, there was similarly increased social prescribing referral in both unadjusted (HR = 21.5, 95 % CI 12.8–35.9,  $p < 0.001$ ) and adjusted models (HR = 20.5, 95 % CI 10.6–39.9,  $p < 0.001$ ) (Supplementary Table 1). This association was particularly strong during the early post-index date period (HR = 55.7, 95 % CI 6.3–495.4,  $p < 0.001$ ) (Supplementary Table 4).

The number of pre-existing comorbidities was significantly associated with social prescribing across all time periods (early period: HR = 1.6, 95 % CI 1.0–2.5,  $p = 0.03$ ; medium period: HR = 1.7, 95 % CI 1.2–2.3,  $p = 0.001$ ; late period: HR = 1.8, 95 % CI 1.0–3.1,  $p = 0.04$ ) (Table 5).

## 4. Discussion

Our study presents novel evidence that people with SMI and CP receive significantly more referrals to pain management services and physiotherapy compared to matched CP controls without SMI diagnoses. While these findings appear to challenge traditional narratives of

**Table 1**  
Comparison of variables between SMI cases and non-SMI controls.

Variables	Total		SMI and chronic pain cases (n = 1120)		Chronic pain Non-SMI controls (n = 2681)		Chi-square (df)	P value
	Mean (SD) or %	N	Mean (SD) or %	N	Mean (SD) or %	N		
<b>Age</b>	65.48 (14.79)	3801	60.19 (14.84)	1120	67.69 (14.20)	2681		
<b>Gender</b>								
Male	48.33 %	1837	44.64 %	500	49.87 %	1337		
Female	51.67 %	1964	55.36 %	620	50.13 %	1344		
<b>Ethnicity</b>							174.47 (4)	<0.001
White	54.32 %	1755	49.24 %	551	57.01 %	1204		
Black	29.50 %	953	35.48 %	397	26.33 %	556		
Asian	8.05 %	260	5.99 %	67	9.14 %	193		
Mixed	1.95 %	63	5.63 %	63	0	0		
Arab/others	6.19 %	200	3.66 %	41	7.53 %	159		
<b>Deprivation score</b>	29.52 (9.92)	3643	31.25 (9.24)	1120	28.75 (10.11)	2523		<0.001
<b>Chronic pain diagnosis</b>							28.57 (8)	<0.001
Abdominal pain	15.87 %	522	12.32 %	110	17.19 %	412		
Back pain	9.73 %	320	10.30 %	92	9.51 %	228		
Chest pain	8.54 %	281	8.29 %	74	8.64 %	207		
Facial pain	6.53 %	215	5.15 %	46	7.05 %	169		
Generalized pain not localised/pain unspecified	32.10 %	1056	37.29 %	333	30.16 %	723		
Lower limb pain	18.42 %	606	18.81 %	168	18.27 %	438		
Chronic regional pain syndrome/vertebral pain	0.09 %	3	0.22 %	2	0.04 %	1		
Pelvic pain	4.98 %	164	4.14 %	37	5.30 %	127		
Upper limb pain	3.74 %	123	3.47 %	31	3.84 %	92		
<b>Chronic pain treatment (Yes)</b>	4.18 %	159	11.34 %	127	1.19 %	32	202.88 (1)	<0.001
<b>Physiotherapy (Yes)</b>	22.44 %	853	44.82 %	502	13.09 %	351	456.94 (1)	<0.001
<b>Number of physiotherapy sessions offered</b>	0.68 (1.90)	3801	1.46 (2.45)	1120	0.36 (1.50)	2681	-16.84 (3799)	<0.001
<b>Number of non-attended physiotherapy</b>	0.003 (0.06)	3801	0.01 (0.04)	1120	0.001 (0.04)	2681	-2.83 (3799)	0.005
<b>Social prescribing (Yes)</b>	4.34 %	165	11.25 %	126	1.45 %	39	182.53 (1)	<0.001

**Table 2**  
Cox regression models for primary and secondary outcomes, controlling for covariates.

Predictors	Chronic pain treatments		Physiotherapy		Social prescribing	
	HR (95 %CI)	P value	HR (95 % CI)	P value	HR (95 % CI)	P value
<b>Group</b>						
CP controls	Reference		Reference		Reference	
SMI-CP cases	13.23 (7.82, 22.37)	<0.001	11.53 (9.25, 14.36)	<0.001	9.52 (7.40, 12.25)	<0.001
<b>Age at index date</b>	0.99 (0.98, 1.01)	0.37	1.00 (0.99, 1.00)	0.24	0.97 (0.96, 0.98)	<0.001
<b>Ethnicity</b>						
White	Reference		Reference		Reference	
Black	0.53 (0.33, 0.84)	0.01	0.85 (0.70, 1.05)	0.13	1.05 (0.83, 1.33)	0.69
Asian	0.73 (0.33, 1.60)	0.44	1.03 (0.73, 1.43)	0.88	1.26 (0.86, 1.84)	0.23
Mixed	0.84 (0.36, 1.96)	0.68	0.82 (0.53, 1.28)	0.38	1.05 (0.63, 1.74)	0.86
Arab/Other	1.51 (0.74, 3.08)	0.26	1.26 (0.85, 1.87)	0.24	0.82 (0.47, 1.42)	0.48
<b>Deprivation score</b>	1.01 (0.99, 1.03)	0.34	1.00 (0.99, 1.01)	0.70	0.00 (0.99, 1.02)	0.48
<b>CP diagnoses</b>						
Abdominal pain	Reference		Reference		Reference	
Back pain	1.27 (0.60, 2.67)	0.53	1.41 (0.96, 2.05)	0.08	1.17 (0.78, 1.76)	0.46
Chest pain	1.04 (0.46, 2.35)	0.92	1.15 (0.77, 1.72)	0.50	0.91 (0.59, 1.41)	0.68
Facial pain	0.84 (0.30, 2.33)	0.74	1.21 (0.77, 1.89)	0.41	1.37 (0.86, 2.17)	0.19
Pain unspecified	1.12 (0.61, 2.08)	0.71	1.19 (0.88, 1.61)	0.26	0.98 (0.71, 1.36)	0.89
Lower limb pain	0.84 (0.41, 1.71)	0.63	2.12 (1.55, 2.90)	<0.001	0.88 (0.60, 1.27)	0.48
Vertebral pain	3.36 (0.43, 26.08)	0.25	4.98(1.21, 20.60)	0.03	Omitted	Omitted
Pelvic pain	1.14 (0.41, 3.18)	0.80	1.19 (0.72, 1.97)	0.49	0.99 (0.58, 1.68)	0.96
Upper limb pain	1.16 (0.41, 3.24)	0.78	1.73 (1.07, 2.79)	0.03	1.03 (0.59, 1.81)	0.91
<b>Number of comorbidities before index</b>	1.09 (0.85, 1.40)	0.49	1.00 (0.89, 1.13)	0.94	0.93 (0.80, 1.09)	0.39

**Table 3**  
Cox regression models for chronic pain treatments, controlling for covariates, stratified by follow-up periods.

Predictors	Chronic pain treatments					
	Early post-index date period		Medium post-index date period		Late post-index date period	
	HR (95 %CI)	P value	HR (95 % CI)	P value	HR (95 % CI)	P value
<b>Group</b>						Omitted
CP controls	Reference		Reference			
SMI-CP cases	13.16 (6.57, 26.37)	<0.001	3.63 (1.47, 8.93)	0.01		
<b>Age at index date</b>	0.98 (0.97, 0.99)	0.03	1.02 (0.99, 1.06)	0.22		
<b>Ethnicity</b>						Omitted
White	Reference		Reference			
Black	0.67 (0.40, 1.12)	0.13	0.73 (0.26, 2.07)	0.55		
Asian	0.83 (0.33, 2.12)	0.70	1.15 (0.25, 5.32)	0.86		
Mixed	1.23 (0.47, 3.24)	0.67	1.41 (0.17, 12.00)	0.75		
Arab/Other	1.46 (0.61, 3.52)	0.40	2.06 (0.55, 7.69)	0.28		
<b>Deprivation score</b>	1.01 (0.98, 1.03)	0.50	1.02 (0.97, 1.06)	0.47		
<b>CP diagnoses</b>			Omitted			Omitted
Abdominal pain	Reference					
Back pain	1.07 (0.46, 2.47)	0.88				
Chest pain	0.71 (0.27, 1.88)	0.49				
Facial pain	0.61 (0.17, 2.15)	0.44				
Pain unspecified	0.94 (0.50, 1.79)	0.86				
Lower limb pain	0.89 (0.42, 1.89)	0.76				
Vertebral pain	omitted	omitted				
Pelvic pain	0.50 (0.11, 2.22)	0.36				
Upper limb pain	1.19 (0.33, 4.27)	0.79				
<b>Number of comorbidities before index</b>	1.25 (0.96, 1.63)	0.09				

healthcare inequities in populations with SMI, they require careful interpretation and nuanced understanding. The increased referral rates observed may reflect either improved care pathways or potentially a greater burden of pain severity necessitating more intensive management approaches for this vulnerable population.

The substantially higher rates of pain management referrals among patients with SMI, particularly in the early post-diagnosis period, likely reflect multiple underlying factors. Individuals with SMI may experience more severe or complex pain presentations requiring intensive management, aligning with research demonstrating heightened pain sensitivity in certain populations with SMI, especially those with bipolar disorder and depression [14,11]. However, our sample predominantly comprised people with schizophrenia spectrum disorders, a group previously shown to have elevated pain thresholds and tolerance [11,12]. Since our cohort with SMI already had CP codes recorded, these findings

may simply indicate that these patients experienced more severe pain, necessitating specialized referrals.

An important consideration is that our results may reflect inherent selection bias intrinsic to studies utilizing routine electronic health records. By design, our analysis included only those individuals with SMI who had already received CP codes in their medical records, potentially representing cases where pain was sufficiently severe to warrant clinical documentation. This methodological limitation raises critical questions about the broader population of individuals with SMI experiencing pain who remain unidentified within healthcare systems. The prevalence and clinical significance of undetected and consequently untreated pain among people with SMI remains largely unknown. Several factors may contribute to this potential gap in identification, including communication difficulties, diagnostic overshadowing where physical symptoms are attributed to mental health conditions, altered pain expression in

**Table 4**  
Cox regression models for physiotherapy, controlling for covariates, stratified by follow-up periods.

Predictors	Physiotherapy					
	Early post-index date period		Medium post-index date period		Late post-index date period	
	HR (95 %CI)	P value	HR (95 % CI)	P value	HR (95 % CI)	P value
<b>Group</b>						
CP controls	Reference		Reference		Reference	
SMI-CP cases	4.89 (3.81, 6.27)	<0.001	10.66 (6.38, 17.83)	<0.001	4.94 (0.67, 36.63)	0.12
<b>Age at index date</b>	1.00 (0.99, 1.00)	0.35	0.99 (0.97, 1.01)	0.17	0.99 (0.91, 1.07)	0.72
<b>Ethnicity</b>						
White	Reference		Reference		Reference	
Black	0.97 (0.78, 1.21)	0.77	0.62 (0.36, 1.05)	0.07	0.44 (0.05, 4.23)	0.48
Asian	1.12 (0.77, 1.65)	0.55	1.89 (0.91, 3.95)	0.09	Omitted	
Mixed	0.99 (0.59, 1.63)	0.95	1.03 (0.39, 2.73)	0.95	Omitted	
Arab/Other	1.14 (0.75, 1.76)	0.54	1.45 (0.56, 3.76)	0.45	Omitted	
<b>Deprivation score</b>	1.00 (0.99, 1.02)	0.36	1.00 (0.98, 1.02)	0.97	0.98 (0.90, 1.08)	0.71
<b>CP diagnoses</b>						
Abdominal pain	Reference		Reference		Reference	
Back pain	1.55 (1.03, 2.34)	0.04	0.49 (0.14, 1.80)	0.28	2.61 (0.22, 30.81)	0.45
Chest pain	1.21 (0.78, 1.88)	0.40	0.68 (0.23, 2.00)	0.49	Omitted	
Facial pain	1.00 (0.59, 1.68)	1.00	1.43 (0.52, 3.94)	0.49	2.50 (0.15, 42.95)	0.53
Pain unspecified	1.21 (0.86, 1.70)	0.27	1.21 (0.60, 2.44)	0.60	Omitted	
Lower limb pain	2.24 (1.57, 3.18)	<0.001	2.27 (1.09, 4.73)	0.03	1.06 (0.06, 18.14)	0.97
Vertebral pain	2.97 (0.71, 12.41)	0.14	Omitted		Omitted	
Pelvic pain	1.06 (0.61, 1.85)	0.84	1.48 (0.46, 4.69)	0.51	Omitted	
Upper limb pain	2.74 (1.62, 4.61)	<0.001	1.32 (0.36, 4.85)	0.67	Omitted	
<b>Number of comorbidities before index</b>	0.93 (0.82, 1.05)	0.25	1.15 (0.87, 1.51)	0.33	0.88 (0.24, 3.20)	0.85

**Table 5**  
Cox regression models for social prescribing, controlling for covariates, stratified by follow-up periods.

Predictors	Social prescribing					
	Early post-index date period		Medium post-index date period		Late post-index date period	
	HR (95 %CI)	P value	HR (95 % CI)	P value	HR (95 % CI)	P value
<b>Group</b>						
CP controls	Reference		Reference		Reference	
SMI-CP cases	70.41 (8.29, 598.24)	<0.001	22.06 (9.69, 50.23)	<0.001	12.32 (3.36, 45.20)	<0.001
<b>Age at index date</b>	1.00 (0.98, 1.03)	0.72	1.01 (0.99, 1.03)	1.19	0.96 (0.92, 1.01)	0.11
<b>Ethnicity</b>						
White	Reference		Reference		Reference	
Black	0.61 (0.26, 1.42)	0.25	1.27 (0.69, 2.33)	0.45	0.37 (0.10, 1.43)	0.15
Asian	0.51 (0.07, 3.90)	0.51	1.40 (0.55, 3.56)	0.47	0.64 (0.08, 5.21)	0.68
Mixed	1.33 (0.36, 4.89)	0.67	0.32 (0.04, 2.39)	0.27	1.89 (0.34, 10.62)	0.47
Arab/Other	0.67 (0.09, 5.26)	0.71	4.57 (1.89, 11.02)	0.001	Omitted	
<b>Deprivation score</b>	1.04 (0.99, 1.08)	0.09	0.97 (0.95, 1.00)	0.07	1.02 (0.97, 1.08)	0.42
<b>CP diagnoses</b>						
Abdominal pain	Reference		Reference		Omitted	
Back pain	0.77 (0.17, 3.55)	0.74	0.11 (0.01, 0.93)	0.04		
Chest pain	0.45 (0.07, 2.80)	0.39	0.82 (0.29, 2.31)	0.71		
Facial pain	0.75 (0.08, 6.94)	0.80	0.79 (0.16, 3.79)	0.77		
Pain unspecified	0.72 (0.21, 2.43)	0.60	1.05 (0.47, 2.37)	0.91		
Lower limb pain	0.78 (0.21, 2.86)	0.71	0.80 (0.31, 2.02)	0.63		
Vertebral pain	Omitted		Omitted			
Pelvic pain	0.66 (0.07, 6.10)	0.71	0.43 (0.05, 3.46)	0.43		
Upper limb pain	Omitted		0.44 (0.05, 3.61)	0.45		
<b>Number of comorbidities before index</b>	1.60 (1.04, 2.47)	0.03	1.67 (1.23, 2.25)	0.001	1.78 (1.02, 3.09)	0.04

some populations with SMI, reduced healthcare-seeking behavior due to stigma or access barriers, as well as potential biases in clinical decision-making or systematic disparities in the treatment of individuals with SMI [26–29].

The absence of pain assessment and coding may have substantial consequences for this vulnerable population, potentially contributing to functional impairment, reduced quality of life, exacerbation of psychiatric symptoms, and increased disability ([16,14]; Davis et al., 2020). Furthermore, unmanaged pain may lead to self-medication through substance use, medication non-adherence, and heightened suicide risk [30]. Systematic challenges in pain assessment for people with SMI have been documented, including difficulties in using traditional self-report measures and limited validation of pain assessment tools for this

population [31]. Further research employing mixed methodologies—including standardized pain assessments across populations with SMI regardless of prior pain documentation—is urgently needed to determine the true prevalence of clinically significant pain, identify barriers to pain recognition, and develop targeted interventions to address this potential care gap [32,33].

Several factors may explain the higher referral rates for pain management observed in our SMI cohort. First, individuals with SMI may present with physical conditions, including CP, at later stages due to diagnostic overshadowing or missed opportunities for early intervention. For example, prior research indicates that people with schizophrenia are often diagnosed with cancer at more advanced stages, contributing to higher mortality despite similar incidence rates [18,34].

Second, individuals with SMI may develop CP and other comorbidities at younger ages due to lifestyle factors (e.g., smoking), lower rates of preventive screening, and limited access to primary care. Our SMI cohort, with a mean age of 60.2 years, may reflect a subgroup with more severe or complex CP necessitating specialized referrals. Third, increased healthcare contact associated with SMI management may enhance opportunities for pain assessment and subsequent referrals. These mechanisms are not mutually exclusive and may interact or confound one another. For instance, younger age at CP onset could amplify healthcare engagement, while late-stage presentations may reflect systemic barriers. Recent policy initiatives promoting integrated care for SMI likely contribute to these findings, though further research is needed to disentangle these factors and their impact on referral patterns.

The temporal pattern of referrals, strongest in the early post-diagnosis period, suggests particularly vigilant healthcare provision during this critical phase. This aligns with the emphasis on early intervention in SMI and may reflect enhanced monitoring during initial mental health care engagement. However, the declining referral rates in later follow-up periods deserve further investigation to ensure sustained access to pain management services. This decline could reflect the resolution of pain conditions, the development of effective self-management strategies, or concerning disengagement from healthcare services over time. Understanding these mechanisms would help tailor interventions to maintain appropriate care throughout the illness trajectory.

Our findings regarding social prescribing deserve special attention, as patients with SMI showed markedly higher referral rates for these interventions. This may reflect growing recognition of non-pharmacological approaches in managing both mental health and CP, particularly given concerns about medication interactions and side effects in this population. Social prescribing may also address the multi-dimensional nature of CP, including psychosocial factors that are particularly pertinent for individuals with SMI [7,35].

These results should be interpreted within several important contexts. While increased referral rates appear encouraging, they don't necessarily translate to better pain management outcomes. A recent systematic review found that there were a distinct paucity of randomised trials testing pain interventions in people with SMI [3]. Future research should examine service quality, treatment adherence, and pain-related outcomes in this population. Furthermore, our findings from a diverse urban UK setting may not generalize to other healthcare systems or geographical regions. Importantly, this study only included people who had a clinical diagnostic recording of clinical pain. The proportion of people with SMI who have clinically relevant pain and have not been assessed for their pain may be high and needs to be explored.

#### 4.1. Clinical implications

Our findings suggest healthcare providers actively identify and address CP in SMI populations, particularly during early care stages. This challenges notions of diagnostic overshadowing and may reflect successful implementation of integrated care approaches. However, high referral rates could also indicate greater pain management needs in this population, highlighting the importance of comprehensive assessment strategies tailored to individuals with SMI. Clinicians should remain vigilant about both over-referral without meaningful follow-through and under-recognition of pain in patients unable to effectively communicate their experiences [26].

#### 4.2. Strengths and limitations

This study's strengths include its large sample size, comprehensive linked dataset, and robust matching methodology. However, several limitations warrant acknowledgment. Reliance on administrative data prevents assessment of referral appropriateness or quality. We cannot

determine whether increased referrals translated into improved pain outcomes. Our findings may not apply to other healthcare systems or geographical contexts. Most importantly, although we accounted for various confounding factors including CP diagnoses, pain severity could not be captured or controlled for. Additionally, our study design cannot account for individuals with SMI experiencing pain who never received formal pain documentation, potentially introducing selection bias toward more severe or articulated pain experiences. Lastly, while our study provides insight into referral patterns within a highly integrated health system, we were unable to capture detailed information on referral pathways (e.g., whether referrals were initiated by GPs or mental healthcare providers), appointment wait times and co-location of pain specialists and GP services. These system-level factors may have influenced patients' access to specialist pain care, therefore may limit the generalisability of our findings to other healthcare settings with different infrastructures. Future research would benefit from incorporating service-level data to better understand how such structural elements may affect referral patterns for individuals with SMI and CP.

#### 4.3. Future research

Further research should examine the quality and outcomes of pain management interventions in populations with SMI, including treatment adherence, pain reduction, and functional improvements. Investigation of mechanisms underlying higher referral rates, including integrated care models and healthcare provider decision-making, would provide valuable insights. Research exploring declining referral rates in later follow-up periods could inform strategies for maintaining appropriate pain management over time. Prospective studies incorporating standardized pain assessments across SMI populations, regardless of pre-existing pain diagnoses, would help establish the true prevalence of undertreated pain and identify barriers to effective management [31, 32].

#### 4.4. Conclusion

This study provides compelling evidence that people with SMI and CP receive significantly more referrals to pain management services and physiotherapy than matched controls with CP alone. These findings offer a nuanced perspective on healthcare delivery for populations with SMI, suggesting both potential improvements in care integration and possible responses to greater clinical need. While increased referral rates may reflect enhanced recognition of pain management needs in this population, they also highlight the importance of ensuring these referrals translate to meaningful improvements in pain outcomes and overall wellbeing. The declining referrals over time necessitate further research to explore underlying mechanisms and ensure sustained access to pain management services. Ultimately, these findings underscore the need for a comprehensive approach that includes pharmacological treatments and non-medical interventions such as social prescribing, while emphasizing quality assessments and outcome evaluations to ensure that increased service utilization translates to improved quality of life for this vulnerable population.

#### CRediT authorship contribution statement

**Ruimin Ma:** Writing – review & editing, Writing – original draft, Project administration, Formal analysis, Data curation. **Eugenia Romano:** Writing – review & editing, Validation. **Gayan Perera:** Writing – review & editing, Validation, Formal analysis. **Trevor Thompson:** Writing – review & editing, Validation, Formal analysis. **Davy Vancampfort:** Writing – review & editing, Validation. **Robert Stewart:** Writing – review & editing, Validation, Supervision. **Kerem Böge:** Writing – review & editing, Validation. **Nilufar Mossaheb:** Writing – review & editing, Validation. **Mark Ashworth:** Writing – review & editing, Validation, Investigation, Conceptualization. **Brendon**

**Stubbs:** Writing – review & editing, Writing – original draft, Validation, Supervision, Funding acquisition, Conceptualization.

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## Declaration of competing interest

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BS acquired funding for the study. RM conducted data linkage and analysis. BS and RM drafted the manuscript. All authors (BS, RM, ER, GP, TT, MA, RS, DV, KB, NM) provided critical revisions and approved the final version.

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