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Psychiatric-Medical Comorbidity

The Psychiatric–Medical Comorbidity section will focus on the prevalence and impact of psychiatric disorders in patients with chronic medical illness as well as the prevalence and impact of medical disorders in patients with chronic psychiatric illness.

Cancer survival in the context of mental illness: a national cohort study

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ABSTRACT

Objective: To explore the reasons for worse cancer survival in people with experience of mental illness, including differences by cancer type and psychiatric diagnosis.
Method: New Zealand breast and colorectal cancer registrations (2006–2010) were linked to psychiatric hospitalization records for adults (18–64 years). Cancer-specific survival was compared for recent psychiatric service users and nonusers using Cox regression. The contributions of deprivation, comorbidity and stage at diagnosis were assessed for those with schizophrenia or bipolar affective disorder (Group A) and others using mental health services (Group B).
Results: Of 8762 and 4022 people with breast and colorectal cancer respectively, 440 (breast) and 190 (colorectal) had recent contact with psychiatric services. After adjusting for confounding, risk of death from breast cancer was increased for Group A [Hazard Ratio (HR) 2.55 (95% confidence interval 1.49–4.35)] and B [HR 1.62 (1.09–2.39)] and from colorectal cancer for Group A [HR 2.92 (1.75–4.87)]. Later stage at diagnosis contributed to survival differences for Group A, and comorbidity contributed for both groups. Fully adjusted HR estimates were breast: Group A 1.65 (0.96–2.84), B 1.41 (0.95–2.09); colorectal: Group A 1.89 (1.12–3.17), B 1.25 (0.89–1.75)].
Conclusions: The high burden of physical disease and delayed cancer diagnosis in those with psychotic disorders contributes to worse cancer survival in New Zealand psychiatric service users.

1. Background

Experience of mental illness is associated with adverse physical health outcomes. People with mental illness have higher rates of many physical illnesses than others in the population and also fare worse once diagnosed with physical conditions [1–3]. Understanding the pathways that lead from experience of mental illness to worse outcomes from physical health conditions is crucial in enabling health services to improve outcomes for this group.

Cancer is a leading cause of death in those with mental illness in developed countries [4,5], and while cancer incidence rates have generally been found to be comparable between people with and without a history of mental illness, cancer mortality is higher [6]. Cancer mortality depends on cancer incidence and cancer survival. The small number of studies which have examined the impact of mental illness on cancer survival has found disparities across cancer types, mental health diagnoses and settings [7–11]. There is some evidence to suggest that these survival disparities may be due to later diagnosis [10] and being less likely to receive treatment for cancer [11]. However few studies have had the power to investigate the contribution of specific factors to cancer survival disparities.

There are a number of possible pathways to apparently worse cancer survival. The difference in survival may be due to confounding — the age, sex and ethnicity of those with experience of mental illness may explain the differences seen in cancer survival. The higher burden of physical illnesses such as diabetes, heart disease and liver disease among those with mental illness compared to those without may impact on survival both directly and through ability to tolerate cancer treatments. People with mental illness may be less likely to access primary care services, or their mental illness may overshadow their cancer symptoms when they do, resulting in cancers being diagnosed later with worse prognosis. Finally, health care quality, or the likelihood of receiving appropriate and timely treatment once diagnosed, may impact on subsequent survival.

This study uses information from a national mental health service dataset linked to a national cancer registry to answer two questions: first, what is the relative importance of the different drivers of cancer survival (particularly stage and comorbid illness) in explaining differences in survival after diagnosis with common cancers for those with

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mental illness, and second, how does the role of these drivers differ by psychiatric diagnosis and cancer type?

2. Methods

We examined 5-year survival in a cohort of adults diagnosed with breast or colorectal cancers between 1/1/2006 and 31/12/2010 and compared those in contact with public psychiatric services in the 5 years prior to cancer diagnosis to those without such a history. Breast and colorectal cancers were chosen as the two most commonly registered cancers in New Zealand (aside from prostate cancer) [12].

2.1. Participants

Adults, usually resident in New Zealand, who were diagnosed with incident breast cancer (ICD10 codes: C50x) or colorectal cancer (ICD10 codes: C18x C19x C20x) between 1/01/2006 and 31/12/2010, and were aged 18–64 at cancer diagnosis.

2.2. Data sources

All data were extracted from collections held by the New Zealand Ministry of Health, which were linked using the National Health Index (a unique identifying number that is assigned to all individuals who use health services in New Zealand) and subsequently anonymised. Data on cancer diagnosis came from the New Zealand Cancer Registry, a population-based register of all malignant cancers diagnosed in New Zealand (except nonmelanoma skin cancers), with mandatory reporting by laboratories and clinicians. Data on psychiatric service use came from the Mental Health Information National Collection (1/1/2001–30/6/2008) and Project for Integration of Mental Health Data (1/7/2008–31/12/2010) data collections, which record data on all public inpatient and outpatient mental health service use in those aged under 65. Data on mortality and cause of death were drawn from the New Zealand Mortality Data Collection, which records all deaths occurring in New Zealand. Data on comorbid diagnoses were drawn from the National Minimum Data Set, which records all inpatient public secondary care contacts.

2.2.1. Exposure

Recent mental illness was defined as mental illness that has been disruptive enough to lead to contact with adult secondary mental health services (for assessment and/or treatment) in the 5 years prior to cancer diagnosis. In order to separately investigate the pathways for different types of mental illness, participants with mental health service use were divided into those with any diagnosis of schizophrenia, schizoaffective disorder, bipolar affective disorder, or other nonorganic psychosis (ICD10 codes: F20, F25, F28, F29, F30, F31) (Group A) and those with any other recorded psychiatric diagnoses or no psychiatric diagnosis recorded (Group B). The remainder of the cohort (with no recorded contact) was treated as the reference group for calculation of hazards ratios. Contact with inpatient psychiatric services over the 5 years prior to cancer diagnosis was also used as an alternative measure of severity as a sensitivity analysis.

2.2.2. Outcomes

Cancer-specific survival (where cancer was identified as the underlying cause of death on the death certificate) was used as the primary outcome (those dying of noncancer causes were censored at time of death). All-cause survival was also estimated with mortality for any cause being treated as the event of interest. Participants who were still alive at the end of the follow-up period were treated as censored in both analyses.

2.3. Variables

Age at cancer diagnosis was calculated from date of diagnosis and date of birth. Age was modeled in the survival analyses using a restricted cubic spline function with three knots (knots at 10th, 50th and 90th percentiles). Sex was used as recorded on the Cancer Registry (male or female), and this information was complete for all of those identified in the cohort.

Ethnic group, as recorded on the Cancer Registry, was used. There are four main ethnic groups in New Zealand: the indigenous Maori population (14%) and European (70%), Pacific (7%) and Asian (11%) groups [13]. Multiple ethnic identities can be recorded on the Cancer Registry, but for reporting, a single prioritized group is used, with the prioritization order of Maori, then Pacific, then Asian and then a residual group. For the analyses reported here, the indigenous Maori population was compared with all other (non-Maori) groups. Those with missing ethnicity information were included in the non-Maori group. Further analysis by ethnic group was limited by small numbers.

Level of deprivation was measured using the NZDep (2006) index, which is a small area measure of deprivation based on data from the 2006 Census [14]. Deprivation level was missing where information on area of residence at the time of cancer diagnosis was not available (about 2%), and these data were imputed using values from multiple other variables [age, sex (for colorectal cancer), ethnicity, cancer stage, comorbidity score and whether the person died] to predict likely deprivation score. The Proc MI (multiple imputation) procedure was used in the analytic programme SAS, and five output datasets were created. Deprivation quintiles were used in survival analysis.

The C3 comorbidity index [15] was used to estimate level of comorbid illness present at the time of cancer diagnosis. This index, specifically developed to measure comorbidity in the context of cancer using administrative hospitalization data, includes up to 42 conditions. For the C3 index, conditions are identified from ICD-10 coded diagnoses recorded for any hospitalization event for a given patient in the 5 years prior to cancer diagnosis. Each condition is weighted according to its impact on a 1-year noncancer mortality (as a mark of severity). The weights are summed to give an overall index score for each patient, with a higher score indicating a higher level of comorbidity. The index was adapted for the current study to exclude psychiatric diagnoses. Comorbidity was modeled using a restricted cubic spline function using three knots for the survival analysis (for breast cancer knots at 0, 0.5 and 1.3; for colorectal cancer knots at 0, 0.5 and 2.0) [16]. For the descriptive analysis C3 scores were divided into three categories: 0, 1–2 and 3+.

Stage at diagnosis is recorded on the Cancer Registry based on all available information on staging within 3 months of diagnosis. The SEER (Surveillance Epidemiology and End Results Programme) summary staging system is used, and this was converted into local, regional and distant disease for analyses. Those with missing stage data were treated as having unstaged disease, and this was used as a stage category.

2.4. Analysis

Breast and colorectal cancer cohorts with a history of recent mental health service use (in the 5 years prior to cancer diagnosis) were compared to those without such a history in terms of demographics, cancer characteristics and comorbidity. Kaplan Meir survival curves for cancer-specific mortality were estimated for those with and without a history of mental health service use and visually compared to assess proportionality of hazards. Cox proportional hazards modeling was used to compare cancer-specific and all-cause survival between those with recent mental health service use and those without and to investigate the contribution of demographic confounders (age, sex, ethnicity) and factors likely to be on the causal pathway (deprivation, comorbidity and stage at diagnosis). Survival estimates were also produced using the Fine Gray method which takes into account deaths from competing causes [17] to check for any bias due to analysis method selection. A directed acyclic graph (DAG) was used to plot the assumed causal

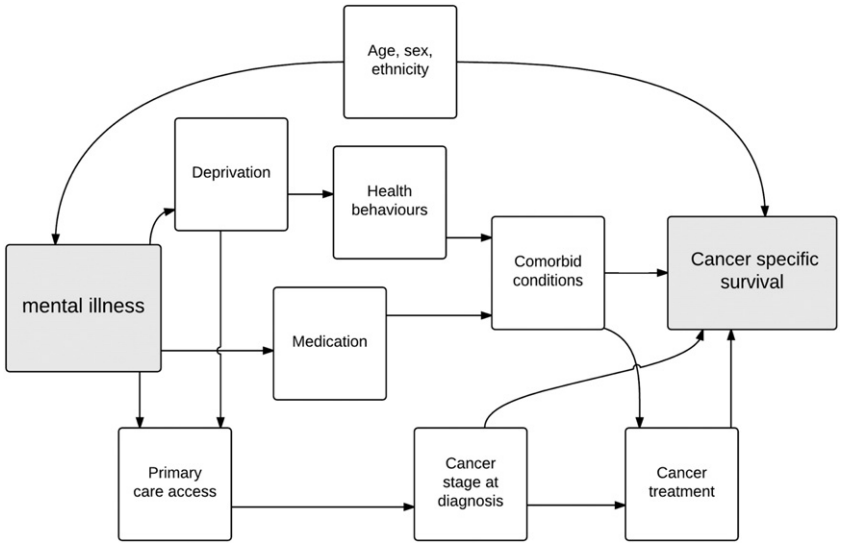

Fig. 1. DAG, demonstrating assumed causal and confounding relationships.

relationships investigated (see Fig. 1). The maximum postdiagnosis follow-up time for the survival analysis was 5 years.

All analysis was performed using SAS version 9.3.

Ethical approval for this study was granted by the New Zealand Multi-region Ethics Committee (reference number MEC/12/05/046).

3. Results

We identified 8762 women with a diagnosis of breast cancer, of whom 440 had had contact with mental health services in the 5 years prior to cancer diagnosis [112 had a diagnosis of schizophrenia, schizoaffective disorder or bipolar disorder (Group A)]. There were 4022 people identified with colorectal cancer diagnosed before age 65, of whom 190 had contact with psychiatric services in the 5 years prior (33 in Group A). For both cancers, compared to people without any recent mental health service use, those with a history of recent mental illness (both Group A and Group B) were more likely to be of indigenous (Maori) ethnicity, live in deprived areas and have a higher level of physical comorbidity. These patterns were most marked for mental health service users in Group A. People in Group A also had a less favorable distribution of stage at diagnosis (Tables 1 and 2) for both cancer cohorts.

Women with breast cancer and a history of mental health service use (both Groups A and B) were more likely to die from their breast cancer compared to other women (Fig. 2). Women in Group A had two and half times the risk of death after adjusting for confounding by age and ethnicity [adj. HR 2.55 (95% CI 1.49–4.35)], while women in Group B had a 60% increased risk of death [adj. HR 1.62 (1.09–2.39)] (Table 3). The factors contributing to poor survival were different for these two groups, as shown in Table 3. After adjusting for age and ethnicity, stage accounted for 45% of the remaining survival difference for Group A but did not account for any of the survival difference for Group B. Comorbidity accounted for 25–30% of the remaining difference after adjusting for stage and deprivation for both Group A and Group B. After adjustment for all available factors, a substantial survival difference remained and was similar in magnitude for Group A (fully adj. HR 1.65 (0.96–2.84) and Group B (fully adj. HR 1.41 (0.95–2.09). The results were not substantially different when all-cause survival was used as an outcome measure.

A similar picture was seen for colorectal cancer survival, although the differences between the diagnostic groups were more marked (Table 4) (Fig. 3). Those in Group A were nearly three times as likely to die from their cancer after adjusting for demographic confounders [HR 2.92 (95% CI 1.75–4.87)], while those in group B did not have a significantly elevated risk of death [HR 1.15 (0.84–1.59)]. As for breast cancer, stage was an important contributor to survival differences for Group A. After adjusting for age and ethnicity, stage accounted for 39% of the remaining survival difference for Group A but did not account for the survival difference for Group B. After adjusting for stage and deprivation, comorbidity accounted for 10% of the remaining difference for Group A and around 50% of the remaining difference for Group B. Full adjustment for stage, deprivation and comorbidity reduced the estimate for Group A [HR 1.89 (1.12–3.17)], while adjustment for these factors increased the estimate for Group B [HR 1.25 (0.89–1.75)]. As with breast cancer, similar results were found for all-cause survival.

Using competing cause methods instead of Cox regression methods did not alter the estimates (changes to hazard ratios at the second

Table 1
Breast cancer cohort ($n=8772$) description of sociodemographic and clinical characteristics by mental health service use groups.

Factor/Characteristic	Group A People with a diagnosis of functional psychosis		Group B People in contact with mental health services for other reasons		No MHS use	
	n	%	*n*	%	*n*	%
Total number	112		328		8322	
Age at diagnosis						
18–44	21	18.75	99	30.18	1746	20.98
45–54	48	42.86	139	42.38	3367	40.46
55–64	43	38.39	90	27.44	3209	38.56
Gender						
Female	112	100.0	328	100.0	8322	100.0
Ethnicity						
NZ Maori	31	27.7	67	20.4	1194	14.3
Non-Maori	81	72.3	261	79.6	7128	85.7
NZDep quintile						
1	10	8.9	48	14.6	1677	20.2
2	11	9.8	47	14.3	1511	18.2
3	17	15.2	67	20.4	1592	19.1
4	34	30.4	78	23.8	1699	20.4
5	37	33.0	83	25.3	1624	19.5
Missing	3	2.7	5	1.5	219	2.6
Comorbidity score						
0	64	57.1	231	70.4	7382	88.7
1–2	38	33.9	67	20.4	775	9.3
3+	10	8.9	30	9.1	165	2.0
Stage						
Local	53	47.3	162	49.4	4467	53.7
Regional	38	33.9	123	37.5	3021	36.3
Distant	11	9.8	16	4.9	277	3.3
Unstaged	10	8.9	27	8.2	557	6.7

Table 2
Colorectal cancer cohort ($n=4022$) description of sociodemographic and clinical characteristics by mental health service use groups.

Factor/Characteristic	Group A People with a diagnosis of functional psychosis		Group B People in contact with mental health services for other reasons		No MHS use	
	n	%	*n*	%	*n*	%
Total number	33		157		3832	
Age at diagnosis						
18–44	4	12.1	38	24.2	454	11.8
45–54	13	39.4	38	24.2	999	26.1
55–64	16	48.5	81	51.6	2379	62.1
Gender						
Female	17	51.5	77	49.0	1761	46.0
Male	16	48.5	80	51.0	2071	54.0
Ethnicity						
NZ Maori	3	9.1	28	17.8	326	8.5
Non-Maori	30	90.9	129	82.2	3506	91.5
NZDep quintile						
1	3	9.1	17	10.8	754	19.7
2	5	15.2	28	17.8	658	17.2
3	1	3.0	29	18.5	789	20.6
4	9	27.3	50	31.8	824	21.5
5	15	45.5	32	20.4	697	18.2
Missing	0	0.0	1	0.6	110	2.9
Comorbidity score						
0	15	45.5	85	54.1	2922	76.3
1–2	13	39.4	45	28.7	743	19.4
3+	5	15.2	27	17.2	167	4.4
Stage						
Local	4	12.1	45	28.7	883	23.0
Regional	13	39.4	48	30.6	1501	39.2
Distant	13	39.4	39	24.8	835	21.8
Unstaged	3	9.1	25	15.9	613	16.0

decimal place only — results not shown). Using inpatient versus outpatient service use as an alternative measure of severity of psychiatric illness (instead of the grouping by psychiatric diagnosis reported above) gave similar results, with those with a history of inpatient service use having significantly worse survival than those who had used outpatient services only (results not shown).

4. Discussion

Men and women with a history of recent psychiatric service use in New Zealand had poorer survival after diagnosis with breast or colorectal cancer than those who did not have such a history. Those who had been diagnosed with schizophrenia, schizoaffective disorder or bipolar disorder prior to cancer diagnosis had two and half times (breast) to three times

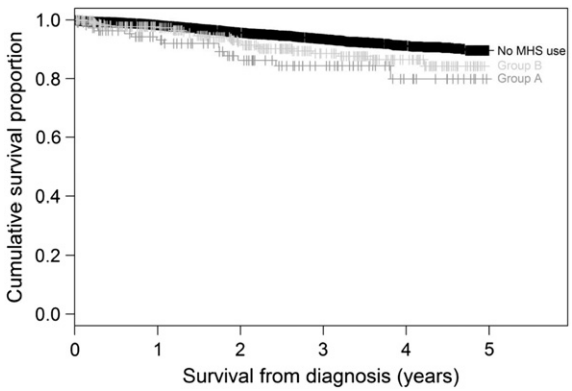

Fig. 2. Breast cancer survival (unadjusted Kaplan–Meier estimates of cancer-specific survival) by mental health service (MHS) use history [Group A (psychosis diagnosis) $n=112$, Group B (other MHS use) $n=328$ and no history of service use $n=8322$].

Table 3
Hazard ratio estimates (from Cox regression models) for breast cancer mortality according to mental health service use history, unadjusted and adjusted for confounders/mediators.

	Group A		Group B	
Model*	HR	95% CI	HR	95% CI
0	2.62	1.54–4.46	1.72	1.17–2.54
1	2.55	1.49–4.35	1.62	1.09–2.39
2	1.85	1.08–3.17	1.63	1.10–2.41
3	1.81	1.05–3.11	1.60	1.08–2.36
4	1.65	0.96–2.84	1.41	0.95–2.09

* 0=crude survival; 1=adj for age+ethnicity; 2=1+SEER stage at diagnosis; 3=2+NZ Deprivation Index score; 4=3+C3 comorbidity index score.

(colorectal cancer) the risk of dying from their cancer within 5 years, after adjusting for confounding. Late stage at diagnosis explained more than a third of the survival difference for this group, but was not a factor for service users with other diagnoses. Comorbid illness also played an important role in explaining survival disparities for both groups. After adjustment for available factors, a 30 to 80% survival disadvantage remained unexplained, although this was no longer significant except in the case of colorectal cancer in people with schizophrenia or bipolar disorder. A similar pattern was seen for both breast and colorectal cancers.

The finding of worse cancer survival associated with a history of mental illness is consistent with the small number of other studies that have examined this question, both for specific cancers or mental illnesses [11,18], and for cancers or mental disorders combined [7,8]. It is also consistent with the wider literature suggesting that cancer mortality is disproportionately increased compared to incidence in people with a history of mental illness [6,19]. The factors potentially contributing to cancer survival inequalities include clinical factors such as comorbidity and health service factors including access to screening and early diagnosis and access to timely treatment. In this study we were able to investigate the impact of stage at diagnosis and comorbidity.

Other studies which have examined the role of cancer stage at diagnosis in survival disparities for people with history of mental illness have produced conflicting findings, with some studies finding that mental illnesses are associated with late diagnosis [10], while others finding an association with early diagnosis [20], or no association [7]. Preexisting illness (including mental illness) can influence the stage at which cancers are diagnosed in a variety of ways, sometimes overshadowing cancer symptoms resulting in late diagnosis, but in other cases leading to increased surveillance resulting in earlier cancer diagnosis, depending on factors such as the severity of the illness, the type of cancer and the health system context [21]. For example, more severe illness may distract attention from cancer symptoms resulting in late diagnosis (as may have occurred with schizophrenia and bipolar disorder in this study), while less severe illness may result in earlier diagnosis through increased contact with the health system and hence increased opportunities for detection. Where all cancers and/or all mental illnesses are examined together, the different stage distribution for different cancers and mental illnesses may be obscured, resulting in no apparent relationship (for example [7]). Differences in findings for the same mental illness diagnosis (e.g., schizophrenia) are likely to relate

Table 4
Hazard ratio estimates (from Cox regression models) for colorectal cancer mortality according to mental health service use history, unadjusted and adjusted for confounders/mediators.

	Group A		Group B	
Model*	HR	95% CI	HR	95% CI
0	2.84	1.70–4.73	1.21	0.88–1.67
1	2.92	1.75–4.87	1.15	0.84–1.59
2	2.17	1.30–3.63	1.47	1.07–2.04
3	2.01	1.20–3.36	1.47	1.06–2.03
4	1.89	1.12–3.17	1.25	0.89–1.75

* 0=crude survival; 1=adj for age+sex+ethnicity; 2=1+SEER stage at diagnosis; 3=2+NZ Deprivation Index score; 4=3+C3 Comorbidity Index score.

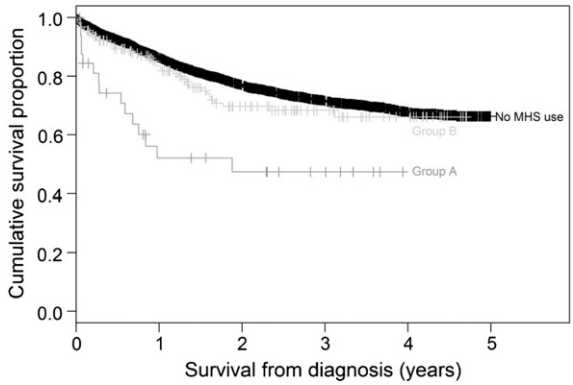

Fig. 3. Colorectal cancer survival (unadjusted Kaplan–Meier estimates of cancer-specific survival) by mental health service use history (Group A (psychosis diagnosis) $n=33$, Group B (other MHS use) $n=157$ and no history of service use $n=3832$).

to the cancer and the health system setting — for example, the finding of earlier lung cancer diagnosis in Medicare patients with schizophrenia than others [20] suggests that these patients undergo a high degree of surveillance of the type likely to pick up lung cancer (likely chest x-rays) in the Medicare system.

Late diagnosis of breast cancers in people with schizophrenia and bipolar disorder in New Zealand may relate to poorer access to screening for breast cancer. In New Zealand, free population-based screening is offered for breast cancer, and coverage rates across the population are high but vary by ethnicity [22]. Screening coverage for people with experience of mental illness in New Zealand is not known, but most studies in other countries have found lower screening coverage rates in people with severe mental illness [23]. Population-based screening for colorectal cancer was not offered at the time of this study. Access to primary care is also important for early cancer diagnosis. The New Zealand health system provides public secondary and tertiary care, including cancer and mental health care, free of charge. However primary care is provided by private practitioners (although largely publicly funded), and copayments are charged for primary care visits and prescriptions. These copayments have been significantly reduced in recent years but continue to present a barrier to access for some groups [24]. In addition to cost barriers, other factors such as overshadowing of physical by psychiatric symptoms and confusion among providers about responsibility for the physical health care of people with severe mental illness may contribute to delays in diagnosis. However as the large linkage studies of cancer survival disparities in Denmark have shown, ready access to primary care and screening for early detection, as is provided by the Danish health system, is not a solution by itself to survival disparities associated with deprivation or diagnoses such as schizophrenia [25].

Coexisting illness (referred to as comorbidity) is also known to be an important factor in cancer survival disparities [26]. Comorbidity can impact on cancer stage at diagnosis as explained above, but independently can also impact on survival through influencing treatment options, and the survivability of treatments and the cancer itself. Most studies of cancer survival in the context of mental illness have either had no information on comorbidity (e.g., [7]), treated comorbidity as a confounder (e.g., [8]) or included it in models together with stage so that its individual contribution could not be assessed (e.g., [27]). Examining the impact of comorbid illness on survival as a mediator draws attention to the fact that the impact of mental illness cannot be considered in isolation — those with mental illness are often also living with physical illness, and cancer treatment needs to be considered in this complex context. In this study we found that comorbidity, after accounting for stage at diagnosis, is an important factor in understanding survival disparities, particularly for those using mental health services for reasons other than psychotic illnesses. Moreover, the impact of comorbidity on treatment decisions is not inevitable, and in fact there is evidence that treatment may at times be inappropriately withheld on the basis of comorbid illness [28,29]. Therefore comorbidity should be considered a cause of mental health-related survival differences that is potentially amenable to intervention.

Beyond the effect of individual factors and timely diagnosis, receipt of timely cancer treatment has also been shown to play an important role in cancer survival disparities, and this is likely to also be the case for people with mental illness [30]. Several studies have found that those with a history of mental illness are less likely to receive treatments such as surgery and chemotherapy [8,27,11]. Moreover, the stigma and discrimination associated with mental illness is likely to be playing a role in these treatment disparities [31,32]. It was not possible to ascertain complete information on treatment receipt in this study. However after adjustment for all available factors, those using mental health services had worse survival than those without a history of mental health service use (although the differences were for the most part no longer statistically significant), and some of this remaining unexplained survival disadvantage may relate to differences in treatment. While secondary care, including mental health and cancer care, is universally available free of charge in New Zealand's public system, evidence of differences in treatment receipt by ethnicity [33], as well as reports of experience of discrimination by health services from people with experience of mental illness [31], suggests that treatment receipt may be a factor in the survival differences found.

4.1. Strengths and weaknesses

This is a population-based study, using complete national data, which allowed longitudinal observation of all New Zealanders using mental health services who subsequently developed common cancers, and comparison to all other New Zealanders with these cancers. This study focused on those under 65, as data on mental health service use for those over 65 are not uniformly or universally collected in New Zealand. Many of the other studies on this topic have been limited to the US Medicare population (over 65). The younger group reported on in the current study is more amenable to interventions to improve cancer survival, and furthermore prevention of premature cancer mortality is an important policy goal, so investigation of this group provides important information for health services and policy makers. It is likely that there was little loss to follow up, as all deaths occurring in New Zealand were captured. It was possible to separately examine breast and colorectal cancer outcomes and the pathways leading to them for people with a diagnosis of schizophrenia, bipolar disorder or schizoaffective disorder, and all others in contact with mental health services, with sufficient power to investigate differences. There was reasonable completeness of data, including cancer stage. Multiple imputation was performed to augment deprivation status completeness.

There was limited information available on psychiatric diagnosis (around 50% had no diagnosis recorded or had “no diagnosis” recorded on their record), so it was not possible to investigate differences in cancer survival and pathways between types of mental illness in more detail. However, it was possible to identify those with schizophrenia and bipolar disorder, conditions generally regarded as the most severe mental illnesses, and it is likely that people with these diagnoses would have this information correctly recorded. It was not possible to obtain reliable information on cancer treatment for this study, and it is likely that treatment differences would explain some of the remaining survival differences. Data on lifestyle factors such as smoking status were not available, but their potential impacts on cancer survival are likely to be at least partially accounted for by including a measure of comorbidity. There is some imprecision in the measurement of each pathway examined. Stage at diagnosis is based on Cancer Registry records, and it is possible that the quality of staging data might vary by mental health status. For example if those with mental illness were less thoroughly investigated, then the Cancer Registry records might incorrectly report disease at a lower stage, resulting in an underestimation of the difference between those with and without mental illness. Comorbidity

may also be mismeasured. Comorbid physical illness was ascertained from previous diagnoses recorded on hospital records, using an index that predicts the relationship between these diagnoses and mortality risk [15]. Not all preexisting illness will be diagnosed, and not all diagnosed illnesses will necessarily be recorded on hospital medical records, and there could be a bias in either direction for those using mental health services (i.e., diagnoses may be more or less likely to be made and more or less likely to be recorded, and this would be likely to vary by the severity and type of mental illness). The comorbidity index used here which is designed specifically for use in cancer populations explains a larger proportion of the difference in survival than the commonly used Charlson comorbidity index, and it is possible that a better measure of comorbidity (if that were possible) would explain even more of the survival difference.

4.2. Implications

These findings add to the limited body of research examining cancer survival in adults with experience of mental illness. Consistent with other work, we have found worse breast and colorectal cancer survival in this group, and in particular much worse survival among those diagnosed with schizophrenia or bipolar disorder. Comorbidity is a contributor to the survival differences found for all those using mental health services, while late stage at diagnosis is an important contributor for those with the most severe psychiatric illnesses. Ensuring timely cancer diagnosis for those with schizophrenia and bipolar disorder is therefore important in improving survival, but on its own will not be enough. Preventive and treatment interventions to reduce the physical disease burden in those with mental illness and treatment guidelines to ensure that comorbid illness does not unnecessarily impede cancer treatment also have the potential to improve cancer survival. The gap in outcomes that remains unexplained may be partly due to imprecision in measuring other factors. However it is also likely that timely access to appropriate treatment and less tangible factors on the treatment pathway such as communication and the relationships between clinicians and patients play an important role in cancer outcomes for those with mental illness. Further investigation of the cancer treatment journey for those with experience of mental illness is needed to understand the reasons for the remaining unexplained gap in outcomes.

Conflicts of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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