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ORIGINAL RESEARCH

Patterns and Factors Associated with Podiatry Service Use Among Colorectal Cancer Patients Following Chemotherapy in South Australia: Focus on Chemotherapy-Induced Peripheral Neuropathy (CIPN)

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Objective: To investigate patterns and factors associated with podiatry service use following chemotherapy for colorectal cancer (CRC) in South Australia (SA), with a focus on addressing needs related to Chemotherapy Induced Peripheral Neuropathy (CIPN), a common and detrimental complication of neurotoxic chemotherapy.

Methods: This retrospective cohort study included adult CRC cases in SA (2011 to 2013). Patient characteristics, chemotherapy and podiatry service use were determined using linked health and administrative datasets. Crude and adjusted Poisson regression analyses compared annual rates of podiatry service use between chemotherapy recipients and non-recipients, and whether chemotherapy was neurotoxic from four years before to five years after diagnosis. Multivariable Poisson regression identified factors associated with podiatry service use post-diagnosis.

Results: This is the first population-level study to examine the use of Medicare funded podiatry services by people with CRC within South Australia. Of 3,292 patients, 1,535 (47%) received chemotherapy. Despite a high prevalence of CIPN reported in the literature (up to 24% at 3 years post-chemotherapy), the crude rate of podiatry service use among chemotherapy recipients in this study did not exceed 20% across the five years post-diagnosis. Adjusted analyses showed similar podiatry service use among chemotherapy recipients and non-recipients, except for higher rates during the second-year post-diagnosis in chemotherapy recipients (Incidence Rate Ratios (IRR) 1.22, 95% CI: 1.01–1.48). No differences were observed at any timepoint between neurotoxic or non-neurotoxic chemotherapy recipients. Podiatry service use post-diagnosis was positively associated with prior podiatry service use (IRR 4.08, 95% CI: 3.48–4.79), having diabetes (IRR 1.26, 95% CI: 1.01–1.57), receiving chemotherapy (IRR 1.18, 95% CI: 1.01–1.37) and older age (IRR 1.28, 95% CI: 1.07–1.53, 80+ vs <80years).

Conclusion: Despite a known higher prevalence of CIPN of up to 24% at 3 years post-chemotherapy, the podiatry service use by chemotherapy recipients in this study appears low, and independent of neurotoxic risk. This may indicate suboptimal follow up care for CIPN in CRC patients receiving chemotherapy who are at an inferred higher risk of CIPN. Given the known risks of CIPN to lower limb health (eg, proprioception loss, falls, ulcers), improved integration of podiatry services into cancer survivorship care is critical to address unmet needs in CIPN management.

Keywords: colorectal neoplasms, chemotherapy adjuvant, chemotherapy induced peripheral neuropathy, CIPN, podiatry, Poisson regression analysis, cancer survivors

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Introduction

Colorectal cancer (CRC) is the fourth most diagnosed cancer in Australia (57.2 cases/100,000 persons in 2024)[1] and worldwide (18.4/100,000 cases in 2022).[2] It is the second leading cause of cancer related mortality in Australia (19.3/100,000 persons in 2024) and globally (8.1/100,000 persons in 2022).[1,2] CRC treatment is heavily dependent on systemic chemotherapy, delivered pre- or post-operatively, often with radiotherapy preoperatively for rectal cancer and generally first line treatment for metastatic disease.[3,4] Chemotherapies used for CRC can have long-lasting effects due to their toxicities.[5] Chemotherapy Induced Peripheral Neuropathy (CIPN) is the most prevalent of these adverse effects, impacting 68% of people within the first month and up to 30% six months or more after treatment has ended.[6] Specifically, Platinum-based chemotherapy agents such as Oxaliplatin, which are the standard treatment for CRC,[3,4] are neurotoxic and associated with increased risk of developing CIPN.[5,7,8] A recent systematic review on long term CIPN in CRC patients reported 24% prevalence at 3 years after oxaliplatin chemotherapy.[8] CIPN symptoms can be so severe, they frequently lead to chemotherapy dose-reduction (in 15–17% patients) or a cessation (up to 13% people).[9,10]

With 27% of CIPN cases affecting only the lower extremities,[11] the implications of CIPN for lower limb health are well known with most studies reporting impacts on patients with CRC.[11–14] These include increased risk of balance deficits,[12] falls[15] and fall-related injuries such as fractures, dislocations, and head injuries.[16] The inability to feel the peripheries due to sensation loss caused by CIPN, similarly to diabetes-related neuropathy, can lead to ulcerations and subsequent amputations in the absence of adequate care.[17] Other common effects of CIPN include difficulty walking[13] and nerve stimulated neuropathic pain, which can severely affect participation in activities of daily living.[14,18] Bonhof et al 2020 investigated impact of CIPN related neuropathic pain on QoL exclusively in CRC cohort reporting functional deterioration (social, role, cognitive, emotional and physical)[14] for those with painful CIPN. Painful and unpleasant toenail and foot and leg skin conditions have also been reported with CIPN.[19–21]

According to the National Cancer Institute (NCI)[22] and American Society of Clinical Oncology (ASCO)[23] updated practice guideline on CIPN, there are no evidence-based prevention strategies, nor are there any management approaches that can reverse CIPN effects. Consequently, monitoring and management of signs and symptoms of CIPN along with education on preventing complications should be a key component of survivorship care. Further, no Australian guidelines exist for CIPN management and one published consensus-based clinical pathway on its management does not include podiatry services.[24] As registered allied healthcare professionals, podiatrists have expertise in diagnosis, assessment and management of foot, ankle and lower limb disorders.[25] Indeed, there is a paucity of investigations on the use of podiatry services for those with CIPN. The benefits of podiatry management are well documented for falls prevention, ulceration and amputation management, and skin and nail care, all of which present as symptoms of CIPN.[26–29] A recently published Delphi survey of Australian podiatrists reported consensus-based clinical recommendations for assessment and management of patients with CIPN.[30] Given survivors of common cancers such as CRC living with the impact of CIPN could benefit from podiatry input, it stands to reason that podiatrists should be included in cancer survivorship care.

Podiatry service access in Australia is largely reliant on Medicare-subsided services in private sector via Chronic Disease Management Plan (CDMP) initiated by general practitioner.[31] More than 3.5 million podiatry services were provided to over 1.1 million people via Medicare-subsided CDMP compared to 2.8 million services funded by private health insurances in 2020.[32] In South Australia, the private sector is largely responsible for providing podiatry services due to strict triage systems of public hospitals and high-risk podiatry clinics.[34] Recent studies that have reported use of Medicare-subsided podiatry services are in broader cohorts with either no focus on cancer survivors[26] or in cancer cohorts with no focus on CIPN or chemotherapy types.[35] Therefore, the aim of this study is to explore the use of Medicare-subsided podiatry services among an Australian cohort with CRC and identify factors associated with the use of podiatry services by this cohort, with a view of identifying:

I. If a significant difference exists in the use of podiatry services for CRC patients who received chemotherapy compared to those who did not?
II. If the type of chemotherapy (neurotoxic vs. non-neurotoxic) influences the use of podiatry services in CRC patients? and
III. What factors are associated with higher rates of podiatry service use after CRC diagnosis?

Methods

Ethics approvals were provided by Australian Institute of Health and Welfare (AIHW – Ref# EO2016/4/317), South Australian Department of Health and Ageing (SA-DHA, Ref# HREC/16/SAH/6) and University of South Australia (Ref# 0000036128), with waiver of consent to use deidentified data.

Data Sources and Cohort

This population-based retrospective cohort study used data on CRC cases from the South Australian Cancer Registry (SACR) linked to data from other administrative and health datasets. The Linked dataset included hospital admission records from the Integrated South Australian Activity Collection (ISAAC), data from the SA Clinical cancer registry (for patients treated in public teaching hospitals), health services data from the Medicare Benefit Schedule (MBS) and prescribed medications data for the Pharmaceutical Benefit Scheme (PBS). All data were linked through integrated data linkage authorities: SA-NT Link for state-based datasets and the Australian Institute of Health and Welfare (AIHW) Data Integration Services Unit for Commonwealth datasets. De-identified datasets with unique anonymous identification keys were provided to researchers within a secure data platform (Secure Unified Research Environment).[36]

The study cohort included all adult cases (>18 years) of CRC (ICD C18-20) diagnosis in South Australia between 2011 and 2013. Patients under 18 years of age at diagnosis and those with anal cancers (C21) were excluded. Only the initial diagnosis was included for those with multiple CRC diagnoses. The main exposure of interest was any chemotherapy for CRC, with further subgrouping into neurotoxic or non-neurotoxic agent(s). Types of chemotherapy were identified using Anatomical Therapeutic Chemical (ATC) classification codes for antineoplastic agents (LO1) from the PBS records plus any inpatient chemotherapy data recorded in the clinical registry. Neurotoxicity was established through published literature (Appendix, Table 1).

The key outcome of interest was podiatry service identified from MBS records using the service code (10962) which was introduced in 2004.[37] This code covers Medicare funded podiatry services in private podiatry settings following a referral from General Practitioners (GPs) as Chronic Disease Management Plan (CDMP). Data on services provided in public settings (hospital in-patient, out-patient, or community health services) were not available.

Extracted demographic and clinical covariates included age at diagnosis, sex, remoteness (based on the Accessibility/ Remoteness Index of Australia Plus-ARIA+),[38] socioeconomic status (based on the Australian Socio-Economic Indexes for Areas (SEIFA) for residential postcode[39]), diagnosis year, and date of death (collected by SACR through routine cross checking with state and national death registries). Charlson Comorbidity Index (CCI) scores were calculated based on hospital diagnosis codes reported at initial admission. The CCI scores indicate the number and severity of co-morbidities present with higher CCI indicating greater mortality risk.[40] Other medical conditions that can cause neuropathy were also extracted (eg Diabetes, alcoholism, idiopathic neuropathy, and other neuropathies such as inflammatory neuropathy etc). However, with exception of Diabetes (ICD-10 codes from hospital admissions and ATC codes from PBS) no other neuropathy causing conditions were identified in the cohort.

Statistical Analysis

Data were analysed using Stata™ software.[41] Annual rates of podiatry service use (any use as recorded in MBS) were calculated for the four years before and five years after CRC diagnosis. The cancer diagnosis date was nominated as the reference date for lookback and follow-up to facilitate comparisons between groups who did and did not receive chemotherapy. Follow-up time was adjusted accounting for death within 5 years of diagnosis. Crude and adjusted analyses were conducted using Poisson regression modelling for each yearly interval pre and post diagnosis, and outputs were reported as Incidence Rate Ratios (IRR) and 95% confidence intervals for differences between groups. Adjusted models included the following covariates: age at diagnosis (10 years age groups), sex, diagnosis year, comorbidity (using CCI scores grouped as 0, 1 and 2+), pre-existing diabetes, remoteness (grouped as major cities, regional and remote), and socioeconomic status, grouped as quintiles from most to least disadvantaged).

To identify factors associated with podiatry service use, multivariable Poisson regression analysis was undertaken, considering only the five-year period post-diagnosis. Factors included in these analyses were age at diagnosis, sex, CCI groups, pre-existing diabetes, chemotherapy treatment/neurotoxic chemotherapy and any podiatry service use within four

years pre-diagnosis. All variables had complete data, other than missing data for sex, which were categorised as unknown sex and accounted for in the analysis. Statistical significance was set at a p-value of <0.05. Julius AI (www.julius.ai) was used to develop figures for better visual representation of the data.

Results

Population Characteristics

The study cohort comprised of 3,292 people diagnosed with CRC between 2011 and 2013, with follow-up for 5 years (mean = 3.7 ± 1.8 years) from diagnosis. Overall, 1,535 (46.6%) people received chemotherapy, and 84.2% of these received one or more neurotoxic agents. Among chemotherapy recipients, 83.7% commenced chemotherapy within the 1st year of diagnosis. The mean age at diagnosis was 69.4 years (±13.1 years). However, those who received chemotherapy were significantly younger (65 years versus 73 years, p-value< 0.001) and had a lower comorbidity index (CCI 2+, 7.4% versus 10.8%, p-value< 0.001) than those who did not. Likewise, neurotoxic chemotherapy recipients were younger and less likely to have pre-existing diabetes (11.3% compared to 16.1% in non-neurotoxic group, p-value = 0.034). Table 1 shows detailed demographic characteristics of the cohort and differences amongst the groups (chemotherapy versus non-chemotherapy, and neurotoxic versus non-neurotoxic chemotherapy).

Table 1 Population Characteristics

Category	Chemotherapy Group		Non-Chemotherapy Group			Neurotoxic Chemotherapy		Non-Neurotoxic Chemotherapy		
	n	%	n	%	p-value	n	%	n	%	p-value
Total	**1,535**	**46.6**	**1,757**	**53.4**		**1,293**	**84.2**	**242**	**15.8**	
Mean Age ± SD (years)	65 ± 12.4 years		73 ±12.4 years		<0.001+	63 ±12 years		74 ±9.5 years		<0.001+
< 60 years	495	32	224	13	<0.001+	477	37	18	7	<0.001+
60-69 years	432	28	377	21	<0.001+	391	30	41	17	<0.001+
70-79 years	415	27	498	28	<0.001+	316	24	99	41	<0.001+
80+ years	193	13	658	37	<0.001+	109	8	84	35	<0.001+
Sex										
Male	785	51	836	47.5	<0.001+	686	53	99	41	<0.001+
Female	608	40	799	45.5		485	37.5	123	51	
Unknown	142	9	122	7		122	9.5	20	8	
Area Remoteness					0.046+					0.027+
Major cities	1,051	68	1,270	72		892	69	159	66	
Regional Australia	428	28	424	24		361	28	67	28	
Remote Australia	56	4	63	4		40	3	16	6	
Socioeconomic status (SES) using IRSD*					0.441					0.808
Q1 (greater disadvantage)	391	25	409	23		333	26	58	24	
Q2	368	24	418	24		315	24	53	22	
Q3	266	17	339	19		222	17	44	18	
Q4	285	19	342	19		235	18	50	21	
Q5 (lesser disadvantage)	222	15	249	14		186	14	36	15	

(*Continued*)

Table 1 (Continued).

Category	Chemotherapy Group		Non-Chemotherapy Group			Neurotoxic Chemotherapy		Non-Neurotoxic Chemotherapy		
	n	%	n	%	p-value	n	%	n	%	p-value
Charleson comorbidity index (CCI)					<0.001[+]					0.513
CCI = 0	1,311	86	1,365	77.5		1,110	86	201	83	
CCI = 1	111	7	202	11.5		90	7	21	8.5	
CCI = 2+	113	7	190	11		93	7	20	8	
Diabetes prior to diagnosis	185	12	253	14	0.048[+]	146	11	39	16	0.034[+]
Vital status (at 5 years post diagnosis)										
Alive	901	59	1,191	68	<0.001[+]	751	58	150	62	0.258
Dead	634	41	566	32		542	42	92	38	

Notes: *IRSD – Index of Relative Social Disadvantage by World Health Organisation (WHO), [+]p-value<0.05 = statistically significant.

Patterns of Podiatry Service Use

Crude rates show a gradual increase in podiatry service use by both groups (chemotherapy and non-chemotherapy) over the entire study period, i.e, rates increased over time from 38/1000 person-years (3-<4 years pre-Dx) to 189/1000 person-years (4-<5 years post-Dx) for chemotherapy group and from 60/1000 person-years to 249/1000 person-years in non-chemotherapy group, respectively. However, in the follow-up period of five years post-diagnosis the proportion of chemotherapy recipients receiving podiatry services stayed below 20% (Appendix, Table 2).

Unadjusted regression analysis comparing rates of podiatry service use indicated consistently lower use among chemotherapy recipients compared to non-recipients for all yearly intervals both pre- and post-diagnosis. The only exception was during year 1-<2 post-diagnosis, where the difference between groups with respect to podiatry service use was not statistically significant (p-value = 0.063) (Appendix, Table 2).

When adjusted for confounding factors, chemotherapy recipients were just as likely to receive podiatry service as non-recipients in the years preceding their diagnosis and in the year of diagnosis (Figure 1). However, during the 1-year post-diagnosis podiatry service use was greater among those who received chemotherapy (IRR 1.22, 95% CI: 1.01–1.48, p-value: 0.039). In subsequent follow-up years, use of podiatry services once again did not differ significantly between groups.

When comparing those who received neurotoxic versus non-neurotoxic chemotherapy, in crude analysis podiatry service use was consistently lower in neurotoxic chemotherapy recipients at all time points pre- and post-diagnosis (Appendix, Table 3). When adjusted for confounding factors, rates of podiatry services did not differ statistically at any time point between neurotoxic and non-neurotoxic chemotherapy recipients (Figure 2).

Factors Associated with Increased Podiatry Service Use Following Chemotherapy

Poisson regression analysis which simultaneously adjusted for covariates was used to examine use of any podiatry service in the 5-year period post diagnosis (Appendix, Table 4). Analysis among the entire CRC cohort showed that receiving chemotherapy, having pre-existing diabetes, increasing age (80+ years) and prior podiatry service use were associated with greater podiatry service use after diagnosis of CRC (Figure 3). The strongest association was observed with prior use of podiatry services, with this group being four times more likely to use podiatry services after CRC diagnosis (IRR 4.08, 95% CI: 3.48–4.79). People with a pre-existing diagnosis of diabetes were also 26% more likely to receive podiatry services (IRR 1.26, 95% CI: 1.01–1.57), and those who received chemotherapy were 17% more likely to use podiatry services than those who did not (IRR 1.17, 95% CI: 1.01–1.37).

Likewise, analysis restricted to those who underwent chemotherapy indicated that having used podiatry services prior to diagnosis was strongly associated with podiatry service use after diagnosis (IRR 4.34, 95% CI: 3.34–5.64). Younger

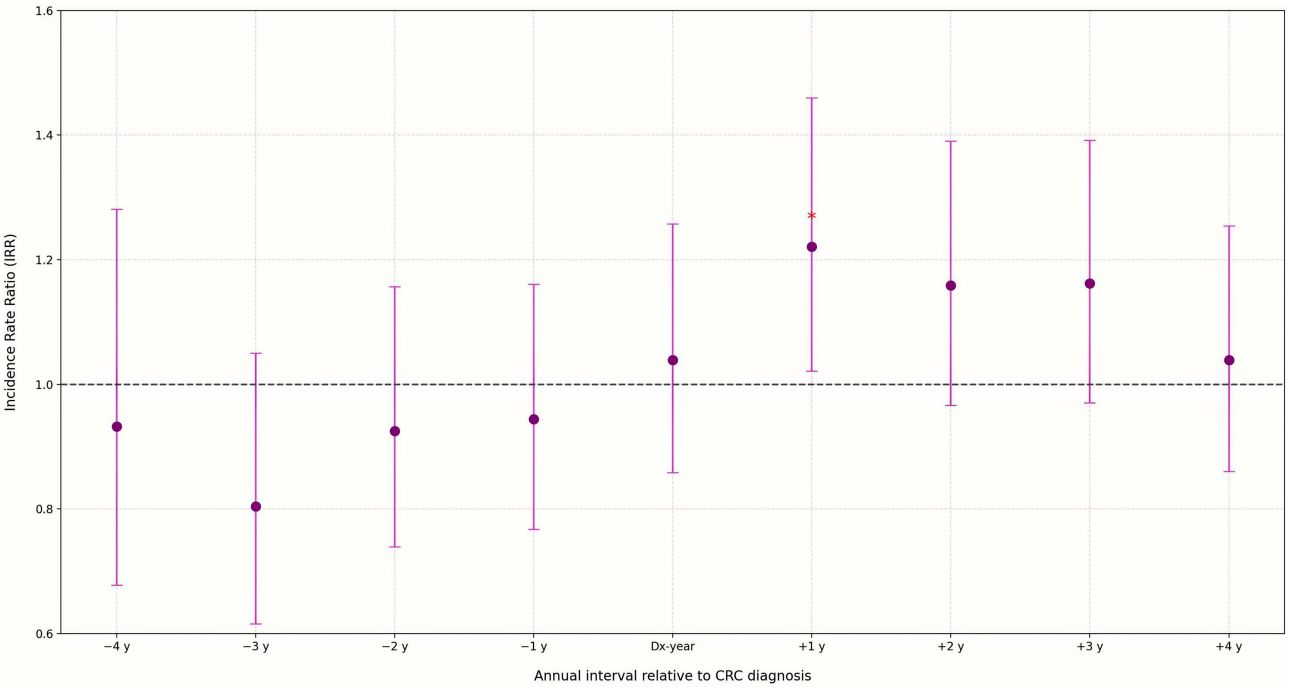

Figure 1 Podiatry service use among people with CRC, comparison between chemotherapy and non-chemotherapy groups across annual increments before and after diagnosis.

Notes: The negative time frames on the x-axis represent years prior to the diagnosis of cancer and positive numbers represent years post-cancer diagnosis. Each purple dot indicates the Incidence Rate Ratio (IRR) point estimate for podiatry service use during the respective 12-month interval, while the orchid whiskers indicate the lower-to-upper bound of 95% confidence intervals values. The red asterisk (*) represents statistical significance with p-value <0.05.

age was associated with a lower rate of podiatry service use among chemotherapy recipients (IRR 0.62, 95% CI: 0.47–0.83, <70 versus 70–79 years). Having received neurotoxic chemotherapy was not associated with increased podiatry service use.

Amongst those who received chemotherapy, the majority who used podiatry services after diagnosis were existing podiatry service users, i.e, had used podiatry services prior to the cancer diagnosis and only 14% were new to podiatry, accessing podiatry services for the first time after cancer diagnosis. Among those who have received neurotoxic chemotherapy, around 13% of people were new to podiatry services after cancer diagnosis.

Discussion

This is the first population-level study to examine the use of Medicare funded podiatry services by people with CRC within South Australia. Our adjusted analysis showed that, for the most part, the use of podiatry services following the diagnosis of CRC did not differ between chemotherapy recipients and non-recipients. Only in the second year after diagnosis did podiatry service use among chemotherapy recipients exceeded that of non-chemotherapy recipients. However, at no point during follow up period were podiatry service used by more than 20% of chemotherapy recipients in any single year. We also found that at no time point did the rate of podiatry service use differ according to whether chemotherapy included neurotoxic agents or not. Our findings raise concerns about whether there is an unmet need for access to podiatry services to manage CIPN, a common side effect of neurotoxic platinum-based chemotherapy agents used in treatment for CRC.[3–5,7,8,42]

The results of this study do not show an increase in podiatry service use among chemotherapy recipients, including neurotoxic chemotherapy recipients. The low rates of podiatry service use are surprising given reports that 24% of CRC patients receiving platinum-based chemotherapy are likely to have persistent CIPN at 3 years post-chemotherapy[8] and 27% of those with CIPN have neuropathy exclusively in lower extremities.[11] This is also a concerning finding given the impacts of CIPN on lower limb health include balance deficits,[12] dermatological side-effects[19–21] and increased injury and amputation risk due to affected sensation,[43] all of which can be mitigated or managed by podiatry care. As the first

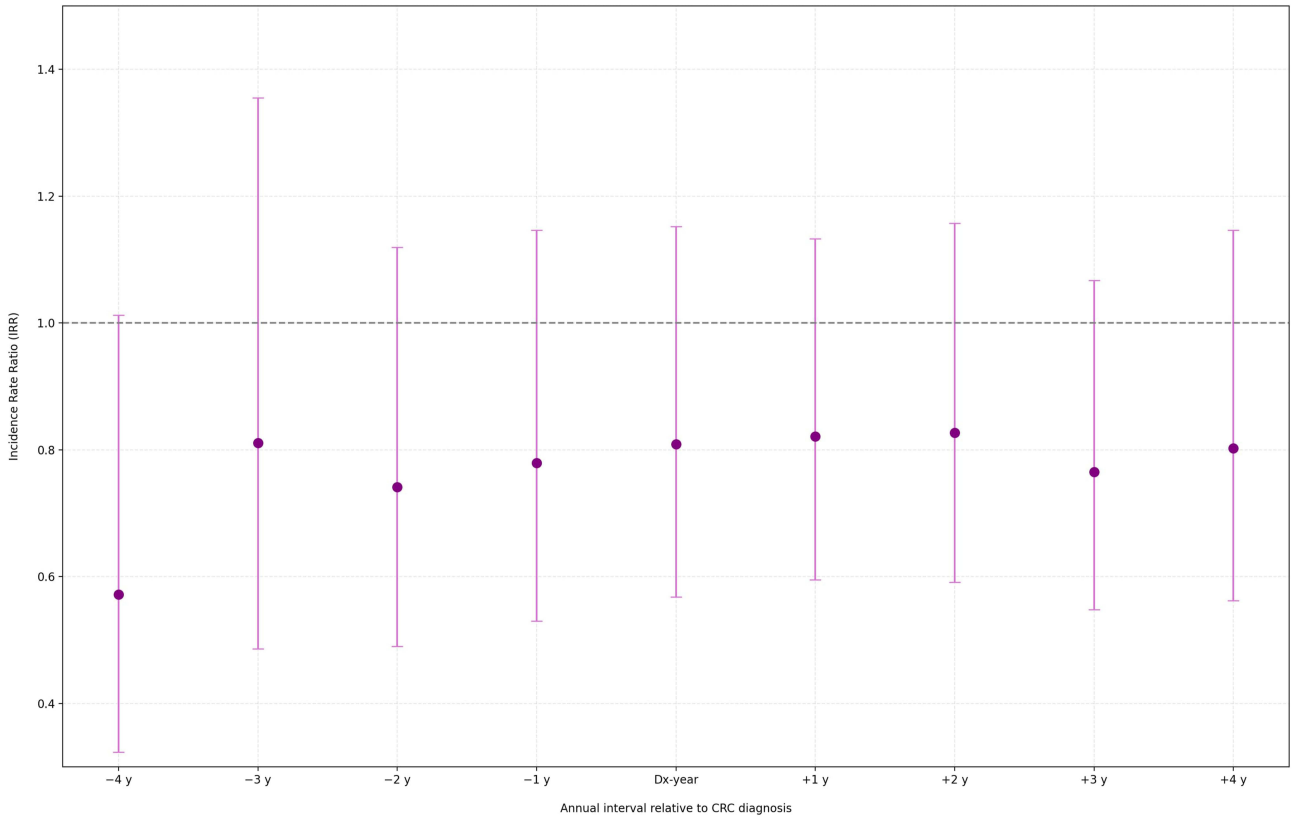

Figure 2 Podiatry service use among chemotherapy recipients, comparison between neurotoxic chemotherapy and non-neurotoxic chemotherapy groups across annual increments before and after diagnosis.

Notes: The negative time frames on the x-axis represent years prior to the diagnosis of cancer and positive numbers represent years post-cancer diagnosis. Each purple dot indicates the Incidence Rate Ratio (IRR) point estimate for podiatry service use during the respective 12-month interval, while the orchid whiskers indicate the lower-to-upper bound of 95% confidence intervals values for that timeframe.

study specific to CRC cohort receiving chemotherapy, it is important to consider these findings in context of data constraints and known evidence.

Importantly, our findings include only Medicare funded services in private podiatry settings, referred by GPs under a CDMP. The data for people with CRC seeking private, tertiary, community or university-based podiatry care are not included in this analysis. However, in South-Australia the high-risk podiatry services are dominated by those with active foot ulcerations or infections mainly caused by Diabetes.[34] The data for those seeking these services is not available publicly nor contained within accessible databanks. Our approach and data inclusion, however, are consistent with other investigations, albeit limited investigations of podiatry use, including a recent study investigating CDMP utilisation following cancer.[35] This study observed 27% of people using Medicare funded podiatry services after cancer diagnosis. Their investigation, however, did not specify chemotherapy use or type and only covered post-diagnosis period with no focus on CIPN.

Podiatry use in the broader population has also been identified as relatively low, evidence being limited but suggests overall under-utilisation with only 17.7% of people with foot pain reported to seek podiatry services.[26] Analysis of podiatry use identify strong associations with most being female, older and with existing comorbidities.[26] This raises the question about awareness of the role of podiatry and suggests improved advocacy is required to inform, educate, and support those receiving chemotherapy for CRC and other forms of cancer that may result in CIPN. Indeed, a recent review of people undergoing chemotherapy concluded that even though foot problems are prevalent in this population, their care is neglected.[44] Ideally, support for the use of podiatrists in CIPN would mirror that of diabetes, where evidence and advocacy has resulted in high uptake of podiatry services among people with diabetes with improved outcomes noted.[27–29]

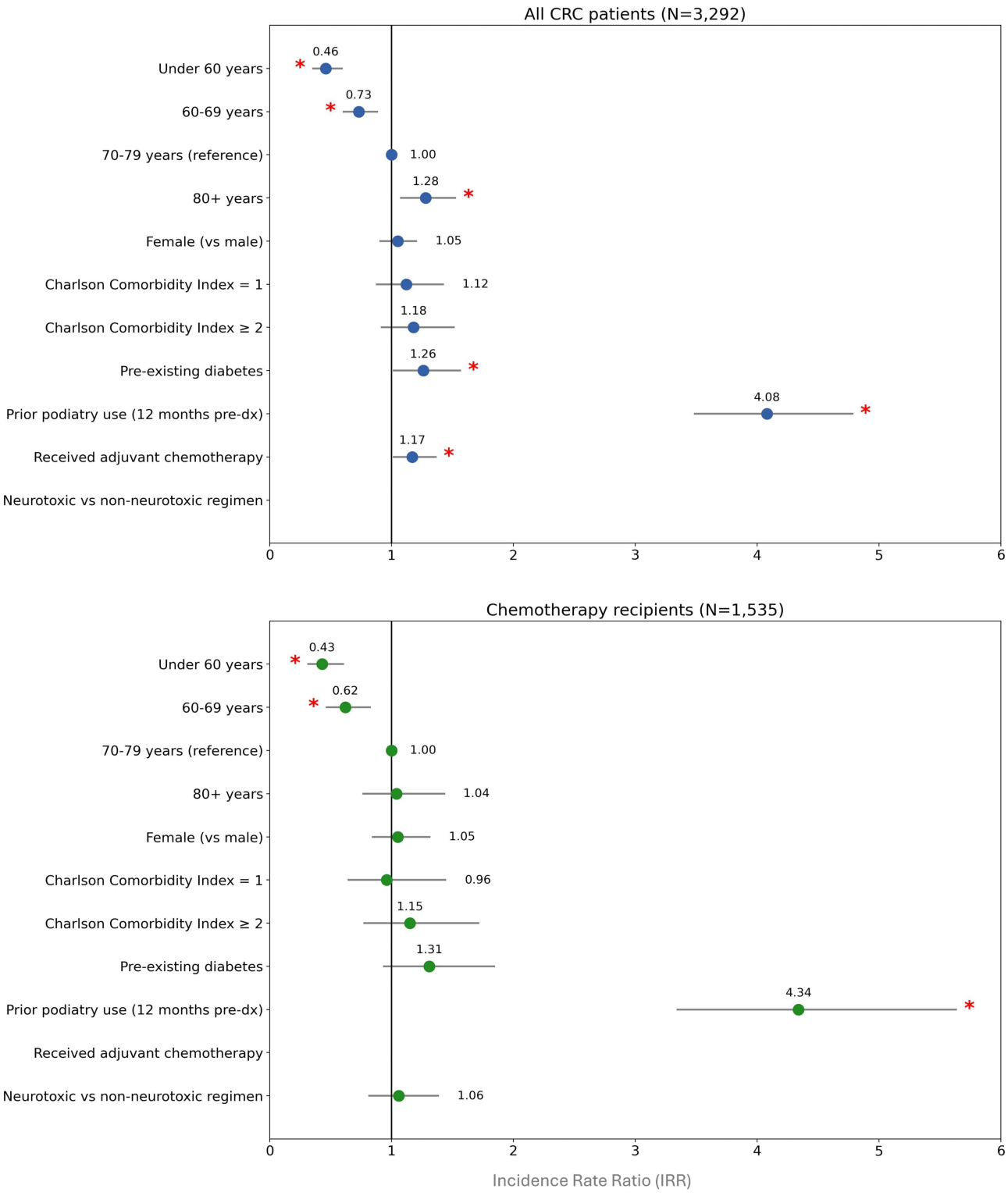

Figure 3 Factors associated with podiatry service use in the five years after CRC diagnosis.
Notes: Incidence Rate Ratios (IRR) for any use of podiatry services during the five years after CRC diagnosis is shown on the x-axis. Each blue dot indicates the Incidence Rate Ratio (IRR) for the predictive factors (labelled on the y-axis) relative to their respective reference group, while the blue lines indicate the lower-to-upper bound of 95% confidence interval. The red asterisk (*) represents statistical significance from the reference group with p value <0.05.

The impact of CIPN does not appear to be lessening as dose-limitation or chemotherapy cessation is a known management to reduce symptoms of CIPN.[9,10] A pooled-analysis of several randomised controlled trials (RCTs) has examined the effectiveness of shortening neurotoxic chemotherapy regimens from 6 months (standard regime since 2004) to 3 months, while a substantial reduction in peripheral neuropathy was observed in the 3 month duration cohort (16.6% FOLFOX and 14.2% CAPOX group) compared to 6 months duration cohort (47.7% FOLFOX and 44.9% CAPOX)[45] there could not be confirmation of impact on survival outcomes. Therefore, the regimen of longer neurotoxic chemotherapy duration and the resultant cumulative neurotoxicity including CIPN is to be a continuing problem for cancer survivors. Incorporating access and referral to podiatry services as a key element in the survivorship care of cancer patients receiving chemotherapy and mainly neurotoxic chemotherapy can reduce the negative implications on lower limb health[13,19,21] and overall quality of life[46] for those impacted. Further, having access to data indicating podiatry use in publicly funded services would allow cost and impact evaluation.

In the absence of consistent diagnostic tools for CIPN and known significant discrepancies between patient reported severity of CIPN versus clinicians' objective assessments,[47,48] the objective diagnostic methods such as the 10gm monofilament test and tuning fork are used which are gold standard for diagnosing diabetes-related neuropathy.[49] Incorporating podiatry care for chemotherapy recipients could be a first step towards robustly identifying the presence of previously undiagnosed neuropathy caused by chemotherapy, leading to initiation of necessary preventative care by Podiatrists.

Unfortunately, to our knowledge, none of the current guidelines or clinical pathways for the management of CIPN[23,24] incorporate podiatry as an integral part of cancer survivorship care. CRC patients need to be well informed about CIPN and its impact on the lower limbs and have easy access to professional care by podiatrists to prevent and manage any problems that may arise due to CIPN. A recent Australian consensus study to develop recommendations for assessment and management of CIPN strongly recommended (98.5% of participants) incorporating footcare for CIPN management.[24] Links were made to physiotherapy, occupational therapy, or exercise physiologist interventions for improving functional capacity. However, podiatrists were not identified as a part of allied health professional team to manage footcare[24] despite them being well placed to provide this care.

Research, awareness and advocacy are needed in relation to podiatry management of lower limb complications with CIPN. Raising awareness among oncologists and nurse practitioners with the aim of improving referral pathways specifically for patients receiving neurotoxic chemotherapy is important given those receiving chemotherapy tend to be younger and less likely to have prior conditions needing podiatry services (e.g, diabetes), and hence may not be aware of podiatrists' role in lower-limb health.

Strengths and Limitations

The major strengths of this study are exploration of podiatry service use at the population level, having a large sample size with a control group and following the patterns of service use both pre- and post-diagnosis.

One of the major limitations of this study is that follow-up of CRC patients was only available to 2017, and hence more recent trends cannot be reported. Based on the increasing trends seen among our cohort, and the general evidence of increased use of CDMP via Medicare,[31] it is likely that podiatry service use among cancer patients has increased irrespective of whether they received chemotherapy. However, while our recent Delphi survey of Australian podiatrists (2023) indicated that 71% had seen someone with CIPN in the last year, 67% of podiatrists had only seen 0–5 people with CIPN in the previous 3 months.[30] Secondly, as discussed above, it was not possible to directly measure diagnosed CIPN within our cohort because there are no specific ICD-10 diagnostic codes available. A generic code exists for drug-induced neuropathy (G62.0) and polyneuropathy due to toxic agents (G62.2), though no patients in our dataset were recorded as having neuropathy. This could be a potential misclassification risk, however given the availability of CRC survivorship literature reporting high incidence of CIPN with neurotoxic chemotherapy,[5,7,32,42] this indirect assessment of CIPN is a plausible indication. This identifies the need for a specific ICD code for CIPN to be able to better monitor the chemotherapy impacts in future research.

We also acknowledge that the use of secondary data collected for administrative purposes could have introduced some imprecision and variability in measures of exposures and outcomes. We did not have data available for podiatry service provision as inpatients and outpatients in hospitals since these encounters are not recorded in the MBS. Being MBS based, it also excludes podiatry services utilised under private health insurance schemes or non-subsidised funding models, i.e, self-

paid. It would be ideal to have prospectively recorded data on the use of allied health services like podiatry (in different settings) for people undergoing chemotherapy. Lastly, while every effort was made to account for covariates that may impact use of podiatry service such as age, sex, comorbidity burden, other unknown/residual confounding factors such as frailty, cognition, mobility, end-stage disease, may have biased our findings. Some other potential confounding factors that are beyond the scope of this study include functional status, patient/caregiver awareness of podiatry services and GP referral practices which could not be adjusted for with the data available.

Conclusion

This population-based study of MBS funded podiatry services among people with CRC in SA found a slight difference in service use only in the second year after diagnosis among chemotherapy recipients compared with non-recipients. No significant differences between neurotoxic chemotherapy recipients and non-recipients were observed. The risk of CIPN in chemotherapy recipients of this cohort is plausibly inferred given the relatively high reported incidence of CIPN with neurotoxic chemotherapy and its negative effects on lower limbs and overall quality of life in CRC survivorship literature. To reduce the risk of complications and to manage any arising lower limb problems among those receiving neurotoxic chemotherapy, better incorporation of podiatry services into the cancer care team is recommended. This appears to be particularly relevant for younger patients who have not accessed podiatry services before given our findings that older age and prior podiatry service use are strong predictors for seeking podiatry post-diagnosis. In the absence of evidence-based guidelines and clinical pathways that incorporate podiatry services for the care of CIPN, there is a need to advocate for the role of podiatry in this setting to help improve the quality of life of cancer survivors living with CIPN.

Abbreviations

AIHW, Australian Institute of Health and Welfare; ARIA, Accessibility/Remoteness Index of Australia; ASCO, American Society of Clinical Oncology; ATC, Anatomical Therapeutic Chemicals; CAPOX, Chemotherapy containing Capecitabine plus oxaliplatin; CCI, Charlson Comorbidity Index; CDMP, Chronic Disease Management Plans; CI, Confidence Intervals; CIPN, Chemotherapy Induced Peripheral Neuropathy; CRC, Colorectal Cancer; Dx, Diagnosis; FOLFOX, Chemotherapy containing Fluorouracil, leucovorin and oxaliplatin, oxaliplatin; GPs, General Practitioner(s); ICD, International Classifications of Diseases; IQR, Interquartile range; IRR, Incidence Rate Ratios; ISAACIntegrated South Australian Activity Collection; MBS, Medicare Benefit Schedule; NCI, National Cancer Institute; PBS, Pharmaceutical Benefit Scheme; SA, South Australia; SACR, South Australian Cancer Registry; SA-DHA, South Australian Department of Health and Ageing; SEIFA, Socio-Economic Indexes for Areas; SURE, Secure Unified Research Environment; UniSA, University of South Australia.

Data Sharing Statement

The linked datasets that support the findings of this study are stored in the Secure Unified Research Environment (SURE) system, where restrictions apply regarding data access, and so are not publicly available to anyone without prior ethics approvals.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare there are no competing or conflicts of interest in this work.

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