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Pain-Related Disparities in Healthcare Expenditures Among Adults with Cancer in the United States: Evidence from the Medical Expenditure Panel Survey (2019–2022)

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Background: Cancer-related pain is a common and debilitating symptom that reduces quality of life and increases healthcare utilization. While prior studies have examined pain in specific cancer populations, its national economic impact remains understudied.
Objective: To estimate pain prevalence among US adults with cancer, evaluate differences in healthcare expenditures by pain status, and identify drivers of these disparities, with the aim of informing value-based cancer care and pain management policies.
Methods: We analyzed 4368 adults with cancer from the 2019–2022 Medical Expenditure Panel Survey (MEPS). Pain defined as self-reported interference with normal activities in the past four weeks. Total healthcare expenditures including: inpatient, outpatient, prescription, emergency, and other costs were examined using generalized linear models, adjusting for demographic, socioeconomic, and clinical factors. Blinder–Oaxaca decomposition quantified contributions of observed and unobserved factors to expenditure differences.
Results: Pain was reported by 55% of adults with cancer. Unadjusted mean expenditures were higher for patients with pain ($22,072) versus those without ($13,366; $p < 0.0001$). Adjusted analyses indicated pain was associated with an incremental total cost of $4473 ($p = 0.001$), mainly driven by inpatient ($2002; $p = 0.001$), prescription ($1711; $p = 0.045$), and outpatient costs ($1347; $p = 0.003$). Decomposition analysis showed 64% of the expenditure difference was explained by observed factors particularly self-reported health and comorbidities, while 36% remained unexplained, suggesting gaps in pain assessment, care quality, or access to effective management strategies. Pain prevalence and associated costs were higher among older adults, socioeconomically disadvantaged individuals, and those with multiple chronic conditions.
Conclusion: Pain places a substantial economic burden on adults with cancer, with disparities influenced by both clinical and socioeconomic factors. Implementing systematic pain assessment and management, including patient-reported outcomes and multimodal interventions, may support cost containment, improve outcomes, and advance value-based oncology care. Policy efforts should prioritize equitable access to comprehensive pain management and integration of pain metrics into cancer care quality frameworks and reimbursement models.
Keywords: cancer, pain, healthcare expenditures, medical expenditure panel survey, financial toxicity, health disparities, United States

Introduction

Cancer remains a leading public health concern in the United States, contributing significantly to morbidity, mortality, and escalating healthcare costs. Cancer-related pain is a common and debilitating symptom that reduces quality of life and increases healthcare utilization. While prior studies have examined pain in specific cancer populations, its national economic impact remains understudied, particularly with respect to how pain-related expenditure differences arise within a nationally representative population and across multiple categories of healthcare spending.

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In 2025, an estimated 2.04 million new cancer cases and 618,120 cancer-related deaths are projected, emphasizing the immense burden of this disease on both individuals and healthcare systems.[1] Beyond the direct costs of diagnosis and treatment, cancer survivors often face long-term challenges related to persistent symptoms. One of the most common and distressing of these symptoms is pain, which affects a substantial proportion of cancer patients.

Studies have consistently shown that cancer-related pain affects up to 55% of patients during anticancer treatment and 66% of those with advanced, metastatic, or terminal disease.[2] Notably, many patients continue to experience moderate to severe pain even after curative treatment, with symptoms often persisting throughout survivorship.[3] A comprehensive review reported pooled pain prevalence rates of 53% across all cancer stages, 59% during treatment, and 64% among patients with advanced or terminal disease, with over one-third of these patients reporting moderate to severe pain.[4] More recent studies estimate that 44.5% of cancer patients experience pain, with approximately 31% reporting moderate to severe pain. These findings suggest some improvement in pain management, yet also highlighting a continued burden that persists across the cancer continuum.[5]

This persistent pain, both physical and psychological, contributes significantly to the economic burden of cancer care. Beyond the direct costs of treatment, cancer-related pain drives increased healthcare utilization, including prescriptions, outpatient visits, hospitalizations, and emergency department encounters. A recent analysis using nationally representative data reported that 10.5% to 24.2% of cancer survivors experience chronic post-treatment pain, leading to an incremental national healthcare expenditure of $27.3 to $40.2 billion annually.[6] Additionally, cancer survivors aged 18–64 years report average annual out-of-pocket costs of $1000, compared to $622 for adults without a cancer history. These survivors are also more likely to experience material (25%) and psychological (34%) financial hardship, underscoring that cancer-related pain is not just a clinical issue but also a key driver of financial toxicity in cancer care.[7]

Despite these well-documented findings, few studies have comprehensively examined how cancer-related pain influences healthcare expenditures using large, nationally representative data. Much of the existing literature has been limited to specific cancer types or single-institution samples, which reduces the generalizability of findings. Even among studies using nationally representative datasets such as MEPS, prior analyses have primarily focused on overall cancer-related expenditures or survivorship costs without explicitly isolating pain-related interference as a distinct cost driver or disentangling observed versus unobserved contributors to expenditure disparities. This gap in knowledge is critical, as quantifying the incremental costs associated with pain can inform the design of effective interventions, shape insurance coverage and benefit structures, and promote more equitable allocation of resources in cancer care. Importantly, improved pain management not only addresses the immediate symptom burden for patients but could also serve as a policy-relevant strategy to reduce unnecessary spending and financial hardship among cancer survivors.

The present study aim to estimate the prevalence of self-reported pain interference among US adults with cancer, compare total and category-specific healthcare expenditures between cancer patients with and without pain, and decompose the expenditure differences to identify both observable and unobservable drivers. By linking pain to excess healthcare costs in a nationally representative cohort, this study provides actionable insights for clinicians, policymakers, and payers on how effective pain management can enhance patient outcomes while alleviating the financial burden of cancer care.

Methods

Study Design and Data

A cross-sectional analysis was conducted using retrospective data from the Medical Expenditure Panel Survey (MEPS), a nationally representative survey of the United States population administered by the Agency for Healthcare Research and Quality (AHRQ).[8,9] Data from the 2019–2022 MEPS were utilized, incorporating information from household, medical conditions, prescribed medications, outpatient visits, and other relevant files. Given the cross-sectional design, all findings reflect associations rather than causal relationships.

Study Population

The study sample included adults aged 18 years and older with a diagnosis of Cancer, who were alive during the study period and had complete data on pain status. Individuals with cancer were identified using the clinical diagnostic codes from the International Classification of Diseases, tenth Revision, Clinical Modification (ICD-10-CM), which are included in the MEPS medical conditions (icd10cdx for Type 2 Diabetes Mellitus is "C18, C34, C43, C44, C50, C55, C61, C64, C67, C73, C85, C95, D04, D22, D48, D49"). Cancer included all type of cancer (colon, bronchus and lung, melanoma of the skin, breast, uterus, prostate, kidney, bladder, thyroid, non-Hodgkin lymphoma, leukemia, skin, other types of cancer).

Measures

Outcome: Healthcare Expenditures

The analysis included various categories of healthcare expenditures, such as inpatient care, outpatient services, prescription medications, emergency department visits, and other healthcare-related costs (eg, dental care, vision services, and durable medical equipment). Total healthcare expenditures were calculated by summing costs across all categories. To adjust for inflation, all expenditure values were standardized to 2022 US dollars using the Consumer Price Index, as provided by the US Bureau of Labor Statistics.[1,10]

Key Independent Variable (Pain)

Data on Pain are obtained from the MEPS. Pain was identified in MEPS using the variable ADPAIN42,[2] which captures whether respondents reported that pain interfered with their normal work outside the home and housework during the past 4 weeks? Which included the options *not at all, a little bit, moderately, quite a bit*, and *extremely*, were recoded into two categories: (1) Pain (Combining *a little bit, moderately, quite a bit* and *extremely*), and (2) **N**o pain (*not at all*). Based on the presence of documented pain conditions, adults with cancer were categorized into two groups: (1) Cancer with pain and (2) Cancer only (ie, without comorbid pain conditions). This approach of identifying pain has been used by previous studies using MEPS data.[11–15]

Pain data were extracted from the Medical Expenditure Panel Survey (MEPS) using the variable ADPAIN42,[2] which assesses whether pain interfered with respondents' normal activities, including work outside the home and household tasks, over the past four weeks. Response options included *not at all, a little bit, moderately, quite a bit*, and *extremely*, were dichotomized into two categories: (1) *Pain* (combining responses of *a little bit, moderately, quite a bit*, and *extremely*), and (2) *No pain* (*not at all*). Based on the presence of self-reported pain interference, individuals with cancer were classified into two groups: (1) *Cancer with pain* and (2) *Cancer only* (ie, without reported pain interference). This classification method has been previously validated and employed in prior studies utilizing MEPS data.[11–15]

Other Independent Variables

The study measured a comprehensive set of covariates spanning demographic, socioeconomic, and health-related domains, such as sex, race/ethnicity, age, marital status, geographic region, employment status, educational attainment, income level, self-reported physical health, health insurance status, prescription drug coverage, and physical activity. Additionally, a broad spectrum of chronic conditions was assessed, including cardiovascular disease, hypertension, diabetes, hyperlipidemia, asthma, chronic obstructive pulmonary disease (COPD), gastroesophageal reflux disease (GERD), arthritis, thyroid disorders, cancer, anxiety, and depression. These conditions were selected based on their high prevalence in the US adult population and their well-documented impact on morbidity and healthcare costs.

Statistical Analyses

Descriptive statistics were utilized to summarize the characteristics of the study population. Chi square testes were used to evaluate unadjusted difference in the study population stratified by cancer status (cancer with pain vs cancer without pain). Differences in unadjusted mean total and category-specific healthcare expenditures between the groups were assessed using one-way analysis of variance (ANOVA). To examine the association between pain and healthcare expenditures among individuals with cancer, generalized linear models (GLMs) with a log link function and gamma

distribution were employed. These models adjusted for a comprehensive set of covariates, including sociodemographic characteristics, insurance coverage, health behaviors, self-rated physical health, and comorbid chronic conditions. To further assess the extent to which pain contributes to differences in healthcare expenditures, a linear decomposition analysis based on the Blinder–Oaxaca method was conducted. This approach decomposes the observed mean expenditure difference between the cancer groups into an "explained" component attributable to differences in observed covariates and an "unexplained" component reflecting differences in the effects (coefficients) of those covariates. A two-sided p-value of <0.05 was considered statistically significant. All analyses accounted for the complex survey design of MEPS by incorporating design variables including strata, primary sampling units, and person-level survey weights. Analyses were performed using the survey procedures in SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) and STATA version 15.1 (StataCorp LLC, College Station, TX, USA).

Results

Characteristics of the Cancer Patients Sample

Table 1 represents demographic, socioeconomic, and health-related characteristics of 4368 adults with cancer, comparing those with pain (55%) to those without pain (45%). Pain prevalence was significantly associated with multiple socio-demographic and health-related factors. Age was associated with pain ($p < 0.0001$), with those over 65 experiencing higher pain (60.3%) than younger adults (22–39 years) (35.3%). Education level showed a strong relationship

Table 1 Characteristics of the Total Study Sample and Characteristics by Pain Among Adults with Cancer

	Total Sample		Pain		No Pain		Chi-Square Value	P-value	Sig.
	N	Wt.%	N	Wt.%	N	Wt.%			
All	4368	100.0	2495	55.0	1873	45.0			
Age in years									
22–39	173	5.8	59	35.3	114	64.7	54.599	<0.0001	***
40–49	225	6.6	90	39.2	135	60.8			
50–64	925	24.0	506	50.0	419	50.0			
>65	3045	63.6	1840	60.3	1205	39.7			
Gender									
Women	2331	53.4	1371	55.3	960	44.7	0.108	0.743	
Men	2037	46.6	1124	54.6	913	45.4			
Race/ethnicity									
White	3700	87.9	2110	55.7	1590	44.3	7.778	0.051	
African American	302	5.0	180	53.1	122	46.9			
Latino	237	4.5	127	43.7	110	56.3			
Others	129	2.6	78	54.3	51	45.7			
Marital status									
Married	2485	62.3	1390	54.7	1095	45.3	10.704	0.005	**
Widow	1509	29.8	913	58.1	596	41.9			
Sep/Div	374	7.8	192	45.6	182	54.4			
Education level									
< High School	119	2.1	88	69.9	31	30.1	48.824	<0.0001	***
High School	193	3.7	146	79.8	47	20.2			
> High School	4039	94.0	2246	53.6	1793	46.4			
Region									
Northeast	766	17.2	418	53.4	348	46.6	3.315	0.346	
Mid-west	976	22.4	590	57.2	386	42.8			
South	1468	37.5	856	56.1	612	43.9			
West	1158	22.9	631	52.3	527	47.7			

(*Continued*)

Table 1 (Continued).

	Total Sample		Pain		No Pain		Chi-Square Value	P-value	Sig.
	N	Wt.%	N	Wt.%	N	Wt.%			
Employment									
Employed	1508	39.8	652	42.7	856	57.3	96.887	<0.0001	***
Not employed	2859	60.2	1842	63.1	1017	36.9			
Poverty status									
Poor	417	6.7	310	76.8	107	23.2	87.496	<0.0001	***
Near Poor	675	12.8	449	63.3	226	36.7			
Middle Income	1134	25.6	683	59.5	451	40.5			
High Income	2142	54.9	1053	48.3	1089	51.7			
Health Insurance									
Private	2592	65.0	1365	51.3	1227	48.7	32.669	<0.0001	***
Public	1764	34.8	1124	62.0	640	38.0			
Uninsured	12	0.2	6	38.2	6	61.8			
Rx Insurance									
Rx ins	1853	47.9	951	50.0	902	50.0	19.409	<0.0001	***
No Rx ins	2515	52.1	1544	59.6	971	40.4			
General health									
Ex/very good	2159	51.6	903	40.1	1256	59.9	362.647	<0.0001	***
Good	1403	31.6	914	63.8	489	36.2			
Fair/poor	806	16.8	678	83.9	128	16.1			
Physical activity									
3/week	2194	51.2	1076	47.4	1118	52.6	108.476	<0.0001	***
No exercise	2165	48.6	1412	62.8	753	37.2			
Heart									
Yes	966	20.2	646	68.8	320	31.2	64.943	<0.0001	***
No	3402	79.8	1849	51.5	1553	48.5			
Hypertension									
Yes	2262	49.9	1470	64.2	792	35.8	110.725	<0.0001	***
No	2106	50.1	1025	45.7	1081	54.3			
Diabetes									
Yes	759	16.1	503	65.9	256	34.1	25.146	<0.0001	***
No	3609	83.9	1992	52.9	1617	47.1			
Hyperlipidemia									
Yes	1887	41.4	1187	61.4	700	38.6	33.799	<0.0001	***
No	2481	58.6	1308	50.4	1173	49.6			
Asthma									
Yes	418	8.7	308	67.3	110	32.7	16.309	<0.0001	***
No	3950	91.3	2187	53.8	1763	46.2			
COPD									
Yes	292	5.6	212	70.8	80	29.2	18.810	<0.0001	***
No	4076	94.4	2283	54.0	1793	46.0			
Arthritis									
Yes	813	16.9	645	79.2	168	20.8	144.331	<0.0001	***
No	3555	83.1	1850	50.1	1705	49.9			
GERD									
Yes	652	14.5	462	68.2	190	31.8	31.861	<0.0001	***
No	3716	85.5	2033	52.7	1683	47.3			

Notes: Based on 4,368 adults and elderly with Cancer and were alive during the calendar years 2019–2022. ***P <0.001; **001 ≤ P <0.01.
Abbreviations: Wt, weighted percentage; Rx, Medication; Wid./Div./Sep., widowed, divorced, and separated.

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($p < 0.0001$); individuals with high school education had the highest pain prevalence (79.8%) compared to those with higher than higher education (53.6%). Employment status was highly significant ($p < 0.0001$), with unemployed individuals more likely to experience pain (63.1%) than those employed (42.7%). Poverty status was also significant ($p < 0.0001$); poor individuals reported the most pain (76.8%), while high-income individuals reported the least (48.3%).

Health coverage played a role: those with public insurance reported more pain (62%) than private (51.3%) ($p < 0.0001$), and lack of prescription insurance was associated with more pain (59.6%) vs those with coverage (50%). Self-rated general health was strongly associated to pain ($p < 0.0001$); 83.9% of those with fair/poor health reported pain, compared to 40.1% with excellent/very good health. Physical activity was associated with pain ($p < 0.0001$); 62.8% of inactive individuals reported pain vs 47.4% of active ones.

Several chronic conditions were significantly associated with higher pain prevelance (all $p < 0.0001$): heart disease (68.8%), hypertension (64.2%), diabetes (65.9%), hyperlipidemia (61.4%), asthma (67.3%), COPD (70.8%), arthritis (79.2%), and GERD (68.2%). In contrast, gender ($p = 0.743$) and region ($p = 0.346$) showed no statistically significant association with pain. These results describe patterns of co-occurrence rather than causal relationships, emphasizing that pain among adults with cancer is correlated with socioeconomic disadvantage, comorbidity burden, and poorer self-reported health status.

Mean Total and Type of Healthcare Expenditures by Cancer Group

Unadjusted analysis of healthcare expenditures among adults with cancer revealed significantly higher costs for those experiencing pain compared to those without pain (Table 2). The mean total healthcare expenditure for cancer patients with pain was $22,072.20, compared to $13,365.80 for those without pain ($p < 0.0001$). This significant difference was observed across all categories of spending. Inpatient costs were notably higher among those with pain ($4,006.90 vs $1,716.90; $p = 0.0018$), as were outpatient expenses ($9,789.10 vs $6,568.60; $p < 0.0001$). Prescription drug costs were also substantially greater for those with pain ($5,740.50 vs $3,241.40; $p = 0.0009$), along with emergency room expenditures ($373.50 vs $192.20; $p = 0.0006$). Other healthcare expenses (including dental, vision, and durable medical equipment) were also significantly elevated in the pain group ($2,162.10 vs $1,646.50; $p < 0.0001$.

Adjusted Total and Type of Healthcare Expenditures by Cancer Group

The adjusted generalized linear model showed that adults with cancer who also reported pain had significantly higher healthcare expenditures across most categories compared to those without pain (Table 3). After adjusting for covariates (demographic, socioeconomic, and health-related characteristics), total healthcare costs were $4,473.20 higher for those with pain ($\beta = 0.241$, $p = 0.001$). The largest incremental cost was seen in inpatient care, with an increase of $2,001.90 ($\beta = 0.580$, $p = 0.001$), followed by prescription costs ($1,710.90, $\beta = 0.277$, $p = 0.045$) and outpatient services ($1,347.10, $\beta = 0.239$, $p = 0.003$). Emergency room expenditures were also significantly higher ($108.80, $\beta = 0.382$, $p = 0.013$). However, "other" healthcare expenses (eg, dental, vision, durable medical equipment) did not show

Table 2 Mean Healthcare Expenditures by Cancer Group, MEPS Data of 2019–2022

	Total Sample Mean ($)	SD	Cancer & Pain Mean ($) (N=2495)	SE	Cancer Only Mean ($) (N=1873)	SE	p-value
Total Expenditures	18,581.2	43,243.8	22,072.2	1,126.2	13,365.8	793.9	<0.0001
Inpatient	2,949.5	16,101.1	4,006.9	432.9	1,716.9	274.7	0.0018
Outpatient	8,393.2	24,756.4	9,789.1	730.8	6,568.6	497.2	<0.0001
Prescription	4,867.7	28,528.4	5,740.5	677.8	3,241.4	446.3	0.0009
Emergency Room	285.0	1,279.3	373.5	37.1	192.2	26.6	0.0006
Other	2,085.6	8,953.4	2,162.1	154.3	1,646.5	270.5	<0.0001

Notes: P value represent mean differences by Cancer groups using One Way Anova. Other expenditures included dental, vision, durable medical equipment use, and others.
Abbreviations: SD, Standard Deviation; SE, Standard Error.

Table 3 Adjusted Generalized Linear Model with Log Link and Gamma Distribution on Health Care Expenditures, Medical Expenditure Panel Survey 2019–2022 (N= 4368)

	Cancer & Pain							p-value
	Intercept	SE	β	SE	Incremental Cost	Lower CI	Upper CI	
Total	9.743	0.510	0.241	0.071	$4,473.2	0.101	0.380	0.001
Inpatient	7.736	0.784	0.580	0.167	$2,001.9	0.251	0.909	0.001
Outpatient	8.530	0.589	0.239	0.080	$1,347.1	0.082	0.395	0.003
Prescription	7.259	0.780	0.277	0.137	$1,710.9	0.006	0.547	0.045
Emergency	5.681	0.669	0.382	0.152	$108.8	0.082	0.681	0.013
Other	7.603	0.343	−0.040	0.111	$-39.5	−0.259	0.180	0.723

Notes: Other expenditures included dental, vision, durable medical equipment use, and others. Incremental Cost (Dollars)=Incremental Cost (Coefficient)×Mean Expenditure.
Abbreviations: β, Coefficient; SE, Standard Error, Reference group for cancer groups= Cancer only.

a significant difference (β = -0.040, p = 0.723). These results confirm that pain among cancer patients is associated with significantly increased costs, especially for inpatient, outpatient services, and prescribed medications.

Factors Explaining Excess Pain Related Healthcare Expenditure Among Adults with Cancer from Linear Decomposition Analysis

The linear decomposition analysis of log-transformed total healthcare expenditures revealed that adults with cancer and pain had significantly higher total healthcare costs than those without pain (Table 4). The mean expenditure was $22,134.01 for the pain group and $13,859.54 for the no-pain group, resulting in a total difference of $8,274.47 (p < 0.0001). Of this difference, $5,292.73 (64%) was explained by observed characteristics (eg, demographics,

Table 4 Linear Decomposition of Log-Transformed Total Healthcare Differences by Cancer Group, MEPS 2019–2022 (N=4,368)

	β	SE	p-value	Lower CI	Upper CI
Cancer & Pain	22134.01	1001.58	<0.0001	20170.95	24097.06
Cancer Only	13859.54	740.71	<0.0001	12407.78	15311.30
Difference	8274.47	1245.72	<0.0001	5832.91	10716.02
Explained	5292.73	867.04	<0.0001	3593.37	6992.09
Unexplained	3561.33	1499.46	0.018	622.44	6500.23
Interaction	−579.60	1207.57	0.631	−2946.39	1787.19
Estimate due to difference in characteristics (Explained)					
Age group	2.68	218.07	0.99	−424.73	430.08
Gender	13.05	57.23	0.82	−99.12	125.22
Race	7.25	43.31	0.867	−77.64	92.15
Marital Status	4.93	15.69	0.753	−25.83	35.69
Education	239.40	170.59	0.16	−94.94	573.75
Employment	98.08	338.65	0.772	−565.66	761.82
Income	−524.28	321.84	0.103	−1155.08	106.51
Health Insurance	−158.21	224.47	0.481	−598.17	281.76
RX Insurance	−163.49	207.01	0.43	−569.23	242.25
Perceived Health	3490.23	671.17	<0.0001	2174.75	4805.70
Physical activity	346.20	256.49	0.177	−156.52	848.92
Region of residence	−4.59	16.55	0.781	−37.02	27.84
Heart disease	818.72	212.14	<0.0001	402.92	1234.51

(*Continued*)

Table 4 (Continued).

	β	SE	p-value	Lower CI	Upper CI
Hypertension	200.96	273.68	0.463	−335.44	737.37
Diabetes	250.79	150.47	0.096	−44.13	545.70
Hyperlipidemia	−85.95	172.91	0.619	−424.84	252.94
Asthma	−226.79	203.84	0.266	−626.31	172.72
COPD	469.30	173.39	0.007	129.46	809.15
Arthritis	270.73	435.44	0.534	−582.72	1124.18
GERD	243.72	205.69	0.236	−159.42	646.85

Abbreviations: β, Coefficient; SE, Standard Error.

socioeconomic), while $3,561.33 (36%) was unexplained ($p = 0.018$), potentially reflecting unmeasured factors like pain severity or quality of care.

Among the characteristics, perceived health ($3,490.23, $p < 0.0001$) and heart disease ($818.72, $p < 0.0001$) contributed most to the explained cost difference. COPD ($469.30, $p = 0.007$) was also a significant contributor. Other factors such as age, gender, race, education, income, insurance, and comorbidities were not statistically significant. These findings suggest that differences in self-reported health and key chronic conditions account for much of the excess healthcare costs among cancer patients with pain.

Discussion

Cancer-related pain remains a substantial clinical and economic burden, posing persistent challenges for patients, caregivers, and healthcare systems. Our analysis demonstrates that adults with cancer experiencing pain incurred, on average, $8274 more in unadjusted annual healthcare expenditures and $4473 more after adjustment for demographic, socioeconomic, and clinical characteristics, underscoring pain as a key driver of healthcare costs across multiple service domains. These findings are consistent with prior literature indicating that pain is one of the most prevalent and debilitating symptoms in oncology, significantly impairing quality of life and increasing healthcare utilization.[1,3]

Importantly, this study extends prior evidence by quantifying the incremental financial impact of cancer-related pain and highlighting its broader societal implications. When extrapolated nationally, the adjusted incremental cost translates into billions of dollars in additional annual healthcare spending among cancer survivors.[1] Decomposition analyses indicated that both explained and unexplained factors contribute to expenditure disparities. Self-perceived health accounted for approximately $3490 (42%) of the explained difference, while chronic comorbidities, including heart disease and COPD, were additional major drivers. These results emphasize that self-rated health is not merely a subjective measure but a robust predictor of economic burden, consistent with prior studies linking poor self-reported health to higher healthcare utilization.[3] The unexplained component likely reflects unmeasured variation in pain severity, treatment intensity, or access to high-quality care.

Disaggregating expenditures revealed that pain was significantly associated with higher inpatient, outpatient, prescription drug, and emergency department costs, but not "other" expenditures. Clinically, this pattern is intuitive: pain increases hospital admissions, outpatient visits for symptom management, emergency utilization for breakthrough pain, and prescription use of analgesics and adjuvant medications.[2,6] These findings align with prior studies demonstrating the multifaceted economic consequences of inadequately controlled cancer pain.[5,6]

Beyond direct medical costs, cancer-related pain contributes to financial toxicity, medication nonadherence, productivity loss, caregiver strain, and long-term disability.[16–19] Chronic post-cancer treatment pain (PCTP) further amplifies this burden. Recent longitudinal analyses by Mbous et al[17] reported that PCTP is associated with incremental annual healthcare expenditures exceeding $27–40 billion in the United States, with survivors experiencing substantial out-of-pocket (OOP) burdens. Similarly, Iragorri et al[18] found that OOP costs of cancer care frequently exceed 40% of annual household income in low- and middle-income countries, with pain management and medications among the most

significant contributors. Collectively, these data highlight the urgent need for targeted insurance coverage policies and financial assistance programs to mitigate inequities in pain care.

Clinically, cancer-related chronic pain remains one of the most prevalent and disabling symptoms, persisting long after primary treatment. Green et al[20] reported that nearly 20% of diverse cancer survivors experienced chronic pain, with women and Black patients disproportionately affected by greater pain severity and interference with daily functioning. These disparities illustrate that pain in survivorship is not only a medical issue but also a quality-of-life and equity concern. The persistence of cancer-related chronic pain contributes to ongoing healthcare utilization and underscores the need for long-term surveillance and intervention strategies.

Disparities in pain management are well documented. Socioeconomic status, race, gender, and age intersect to shape pain experiences, with younger, female, and lower-income patients consistently reporting worse outcomes.[21,22] Minority patients often receive less guideline-concordant pain management, including lower opioid prescribing, even after adjusting for insurance coverage.[23–26] Structural inequities, implicit provider bias, and geographic limitations exacerbate these disparities, with patients in rural or resource-limited settings facing reduced access to specialized pain services.[26] These findings align with prospective cohort studies showing higher supportive care needs among minority patients with advanced cancers, particularly in psychological, physical symptom, and daily functioning domains.[25]

A critical challenge is that pain is inherently subjective and cannot be adequately assessed without patient input. Unlike laboratory values or imaging, pain originates from the patient's lived experience, making patient-reported outcomes (PROs) central to both assessment and management. Integrating PROs into routine oncology practice represents not only a clinical imperative but also a cornerstone of value-based, patient-centered care. Randomized trials demonstrate that electronic PRO symptom monitoring enhances early pain detection, improves quality of life, reduces emergency visits, and may even confer survival benefits.[27] Digital health solutions, including telemedicine-based pain consultations, have also shown promise in expanding access to supportive care and reducing inequities.[28] Embedding PRO-driven monitoring into standard care pathways ensures timely identification and management of cancer-related pain, particularly for underserved populations. In this way, patient-centered pain assessment becomes aligned with value-based care principles, directing resources toward interventions that improve outcomes most meaningful to patients.

Policy implications are multifaceted. Insurance and reimbursement frameworks should increasingly consider pain management as an integral component of comprehensive cancer care, given its consistent association with higher healthcare utilization and expenditures, while ensuring equitable access to opioids, adjuvants, and non-pharmacologic interventions. Incentive structures that support the integration of PRO based monitoring may enhance patient-centered care and system efficiency, particularly by facilitating earlier identification of unmet supportive care needs. Multimodal pain management strategies combining pharmacologic therapy, rehabilitation, and psychosocial support have demonstrated cost-effectiveness in prior studies and may merit greater emphasis in clinical guidelines and payment models.[29] Finally, persistent structural inequities affecting racial and ethnic minority populations underscore the importance of evaluating targeted policy approaches, including culturally competent pain management protocols, provider education initiatives, and financial protection mechanisms that may help mitigate out-of-pocket burden and access gaps.

Integrating evidence from international contexts further supports these recommendations. For example, Scandinavian studies demonstrate that early palliative interventions and multimodal pain approaches reduce hospitalizations and healthcare costs,[5,16] while low- and middle-income countries face disproportionate OOP burdens and inequitable access to analgesics.[18] These comparisons highlight the need for context-specific strategies while emphasizing universal principles: equitable access, early intervention, and integration of PROs into care delivery.

Our findings also have implications for survivorship care. Chronic pain is a persistent and often under-recognized challenge for long-term survivors, and it is associated with consequences for adherence to ongoing therapies, quality of life, and functional independence.[6,7] Incorporating systematic pain assessment and management into survivorship care plans may help mitigate long-term economic and clinical burdens, particularly for vulnerable populations.

Several limitations should be acknowledged. First, the use of MEPS data relies on self-reported measures, which may be subject to recall bias. Second, pain was captured as a patient-reported experience rather than a clinically validated measure, potentially introducing variability. Third, while MEPS provides nationally representative data, it does not capture institutionalized populations, such as nursing home residents, who may experience higher pain prevalence and

associated costs. Finally, causality cannot be inferred given the cross-sectional design, and all policy or clinical implications should be interpreted as informative rather than prescriptive.

Conclusion

Cancer-related pain continues to impose profound clinical, financial, and equity challenges. Evidence consistently demonstrates that disparities in pain outcomes are driven by structural, socioeconomic, and racial inequities. Policy and practice initiatives that strengthen pain coverage, integrate PRO-based monitoring, expand multimodal care, and address systemic barriers may help improve equity and outcomes in oncology care. The findings provide informative guidance for resource allocation and pain management strategies, while acknowledging the observational nature of the data. High-quality, longitudinal, and pragmatic studies are essential to guide effective interventions and optimize survivorship care while mitigating the broader economic and societal burden of cancer-related pain.

Institutional Review Board Statement

This study did not require ethical review or approval because it utilized a publicly accessible secondary database, the Medical Expenditure Panel Survey (MEPS) database.

Data Sharing Statement

Researchers can access the publicly accessible dataset used in this study from the MEPS database at this URL: https://meps.ahrq.gov/data_stats/download_data_files.jsp (accessed on 25 December 2024).

Informed Consent Statement

Due to the fact that this study employed a secondary database, the Medical Expenditure Panel Survey (MEPS) database, which is publicly accessible, patient consent was waived for this research.

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Disclosure

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