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Age-specific cancer incidence rates that continue to rise through the oldest age groups

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Abstract

Introduction—In the U.S., from 2005 to 2009, nearly 8% of all cancers diagnosed and 15% of cancer deaths occurred in individuals aged 85 years and older (85+ age group). With the aging of the U.S. population, an analysis of incidence of cancer in the elderly population may provide information for clinical care and resource allocation.

Materials and Methods—Previously reported data were retrieved from the Surveillance Epidemiology and End Results (SEER) 18 Registry for years 2000–2010 and Central Brain Tumor Registry of the United States (CBTRUS) for years 2004–2008. Cancers included invasive cases only, except for non-malignant meningiomas, and rates were per 100,000.

Results—The age-specific cancer incidence rate (IR) increases with age until a decrease in the 85+ age group. IR for all cancers combined for this age group was 2,317 per 100,000. Statistically, males had significantly higher IR as compared to females [3,194 versus 1,911 ($p = 0.0001$)]. Blacks had an IR similar to whites [2,255 versus 2,340 ($p = 0.12$)]. Despite a drop in the overall IR in this oldest age group, IR for certain cancers continued to increase. Among these cancers gastrointestinal (GI) cancers like colorectal, pancreatic, and stomach had the highest incidence and mortality rates.

Conclusions—Our study contributes to measuring cancer burden in the oldest old population. Certain cancers including meningiomas the IR continue to rise with advancing age. Management of cancer in elderly is challenging and screening persons in the 85+ age group for frailty very thoroughly may help guide decisions of palliative versus aggressive therapies.

Keywords

Cancer; age 85+; incidence; mortality; epidemiology

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Introduction

In 2010, the population aged 85–94 years represented 1.6% of the total United States (U. S.) population and had increased by 30% from 2000–2010 [1]. The increased life expectancy of the U. S. population along with advances in cancer screening has led to a growing number of cancer diagnoses in elderly (85+ age group) Americans. In the U.S., from 2005 to 2009, 7.7% of all cancers diagnosed and 15.5% of cancer deaths occurred in patients age 85 and older [2]. Cancer in the elderly population poses major concerns as the diagnosis is likely to be made in the context of pre-existing adverse health conditions and age-related complexities. In light of the 2012 Centers for Disease Control and Prevention's (CDC) finding that the life expectancy of people aged 85+ without cancer is more than five years in all races, origins and both sexes [3], up-to-date evidence-based guidelines for cancer screening and treatment are needed.

Incidence patterns are known to change with age. A limited number of studies have investigated which particular types of cancer are most associated with advanced age. We looked at site-specific cancer incidence and mortality rates among the elderly, focusing on cancers with age-specific incidence rates that continue to climb in the elderly age group with the goal of providing benchmark data on cancer sites/histologies that most warrant screening and treatment. This information can ultimately be used to guide screening, diagnosis, and treatment of cancer in this age group.

Materials and Methods

Overall age-specific and site-specific cancer incidence and mortality rates were obtained to determine age-related patterns. Incidence and mortality rates were obtained online from the National Cancer Institute's Surveillance Epidemiology and End Results (SEER) website [4]. Specifically, data were extracted from the SEER 18 Registry and included invasive cancer cases newly diagnosed in the years 2000–2010. Age-specific rates for malignant and non-malignant meningiomas were obtained from the Central Brain Tumor Registry of the United States (CBTRUS) Statistical Report 2012: NPCR (National Program of Cancer Registries) and SEER (2004–2008) [6]. Additional information on mortality was obtained from the National Center for Health Statistics [5].

We focused on cancers with age-specific incidence rates that continued to rise in the 85+ age group with the goal of providing benchmark data on cancer sites/histologies that most warrant screening and treatment. Incidence rates were determined using SEER Faststats online tool [4], and tabulated along with comparisons of rates in males versus females and whites versus blacks to further define incidence patterns. Two tailed p-values were calculated using Fisher's test or Chi-square test with Yates correction, by means of graphpad scientific software using quickcalcs categorical data tool (<http://graphpad.com/quickcalcs>). P-values < 0.05 were considered significant. Likewise, mortality rates of cancers that continued to climb after age 85 were tabulated in order to determine cancers that need critical attention for screening and treatment in this age group. Comparisons were made for males versus females and blacks versus whites to further define mortality patterns.

Results

Cancer incidence rates increase with advancing age and peak at 80–84 years (2,500 per 100,000) before beginning to decline in the 85+ age group (2,340 per 100,000) (Figure 1) [4]. Despite this, certain cancers continue to increase in incidence even after age 85 (Table 1) which brings to attention the need to continue screening for these cancers in the elderly population and also emphasizes the role of age in the etiology of these cancers.

Incidence

For people aged 85+, the age-specific incidence rates (IR) for all cancer sites combined for the years 2000–2010, all races, both sexes is 2,340 per 100,000. The rate for males (3,194) is statistically significantly higher compared to females [1,911 (p = 0.0001)] [4]. Blacks have an IR similar to whites [2,255 versus 2,340 (p=0.12)]. Cancer sites and/or histologies in which the age-specific IR continues to rise in the 85+ age group include: colorectal, pancreas, stomach, myelodysplastic syndromes, meningioma, lymphocytic leukemia, vulva, soft tissue including heart, gall bladder, anal canal, vagina, as well as Kaposi's sarcoma (Table 1).

Among these thirteen sites, colorectal cancer has the highest IR (376/100,000) (Figure 2) followed by cancers of the pancreas and stomach. Statistically, males compared with females had significantly higher IR for colorectal, stomach, myelodysplastic syndromes, lymphocytic leukemia and soft tissue tumors including heart (Table 2). Blacks have a statistically significantly higher IR than whites for pancreatic and stomach cancers (Table 2).

Mortality

Age-specific cancer mortality rates, like age-specific incidence rates, continue to rise with advancing age group (Figure 3). Mortality, however, does not peak before reaching the oldest age group (85+ age group); rather, it continues on an upward trajectory. The age-specific mortality rate for all cancer sites combined for this age group, all races, and both sexes is 1,759 per 100,000 [5]. Males have a higher mortality rate as compared to females [2,542 versus 1,409 (p = 0.0001)]. Blacks have higher mortality than whites [1,924 versus 1,761 (p=0.003)].

Among these twelve cancer sites/histologies identified above, colorectal cancer has the highest mortality rate (232/100,000) followed by cancers of the pancreas and stomach (Table 3). Colorectal cancer mortality reaches its peak in the oldest age group (Figure 3); the mortality rate is statistically significantly higher in males as compared to females. This is also the case for stomach cancer as well as for lymphocytic leukemia (Table 3). Blacks have statistically significant higher mortality rates than whites for colorectal and stomach cancers.

Discussion

We obtained data from the SEER research cancer registry, which encompasses about 28% of the US population, and included all those cancer sites available in the SEER registry with the exception of meningioma. Mortality rates may have been affected by other variables not included in the SEER registry, such as co-morbid conditions, treatment efficacy and tolerance as well as biologic differences [7] in the oldest age group.

Overall age specific incidence rate in the oldest age group declines. This could be explained by limitation on carcinogenesis being age dependent, with possibility of strongly varying exposures to carcinogens with age [8]. In addition, suppression of tumorigenesis could be due to decreased proliferative potential of cells at the oldest ages [9] and age-dependent remodeling of the immune system [10].

Despite a drop in the overall age-specific incidence rate in the oldest age group, age-specific cancer incidence rates for 12 specific sites/histologies continued to increase in the 85+ age group. Generally, most of these sites/histologies have less serious outcomes than other cancer sites, but this may not be true for the elderly population. Elderly patients with same stage disease generally fare worse than younger patients as they tend to have a more aggressive disease and are less likely to receive effective therapy for various reasons [11, 12].

Age, at a minimum, is a reflection of cumulative and/or prolonged carcinogen exposure [13]. Dose-duration effects of carcinogenic exposures have been suggested to increase cancer risk with age, regardless of any effects of aging. This explanation is supported by the data from rodent experiments with carcinogens and observations on occupational exposure in humans [14]. Thus, for cancers that have higher incidence with advancing age, prolonged and/or cumulative carcinogen exposure may have played a role in etiology. This emphasizes the importance of targeting carcinogen exposure in health policies aimed at primary prevention for these cancer sites. With respect to secondary prevention, the impact of early diagnosis and screening for cancer needs to be carefully evaluated in the elderly [13].

We need to identify cancer burden in the oldest old population to help guide prevention and screening decisions. Core measures of disease burden include disease-specific incidence, prevalence, mortality, and years of potential life lost (YLL) [15, 16]. YLL provides a measure of the total burden of cancer on society, in terms of life-years lost [15, 16]. It especially gives more weight to cancers that occur in younger age groups than those occurring in the older population [15, 16]. In the oldest old YLL is expected to be low due to lower life expectancy at this age. Additionally, this measure does not necessarily provide an accurate guide for assessing the number of life-years that would be gained through effective cancer prevention, screening, or treatment [15]. For the older age groups effective measures of cancer burden would be incidence, prevalence, mortality. The fact that age-specific cancer incidence of cancers that continue to increase in the 85+ age group places greater importance of prevention and screening for these cancer sites/histologies. Few studies present data for or against cancer screening in older adults and evidence-based guidelines are needed. Cancers destined to result in death before five years may be too aggressive for patients to benefit from early detection and treatment, suggesting that older patients who have life expectancies of less than five years will not derive survival benefit from cancer screening [17]. However, life expectancy as per the 2012 CDC report of people aged 85+ without cancer, was more than five years in all races, origins, and both sexes [3], allowing for discussion on the role for cancer screening in this age group. Issues related to the risks and benefits of screening in older patients are complicated and estimated survival is key in recommending screening [18]. It should be noted that screening provides no clinical benefit

for individuals destined to die from another cause, thus policy analysts seriously consider the issue of discontinuing cancer screening after a certain age [19].

Management of cancer in the elderly poses multiple challenges due to age-related co-morbidities, poly-pharmacy, and physiologic changes in organ function which affect the ability to predict tolerance to anticancer therapy [20]. Elderly individuals constitute a heterogeneous population with regard to their overall health condition, hence screening and management decisions in this population are often individualized [21] with clinicians quantifying various factors (life expectancy, physical and mental status, co-morbidities, risk of developing cancer, benefits/risks of screening procedures, and individual preferences) rather than focusing on age alone [17]. After age 85 years there is increased functional dependence, geriatric syndromes and prevalence of clinical frailty [22]. This is further complicated by limited evidence-based guidelines for appropriate management of this population, ultimately leading to under-treatment due to fear of toxicity. Encouraging elderly patients to participate in investigational studies that produce evidence-based data will help us establish such guidelines and overcome fears. Advanced age alone should not preclude patients from receiving standard anticancer therapy [20]. Patients need to be categorized as fit or frail depending on their performance status (good versus poor), co-morbidities (limited versus multiple) and geriatric syndromes [20]. Fitness scales like comprehensive geriatric assessment (CGA) best account for the diversities in the geriatric population [22] and are recommended to evaluate chemotherapy appropriateness [25]. Treatment approach for patients in these two categories differs, with more aggressive treatment for fit patients and more conservative therapies for frail patients [20]. It appears reasonable to screen persons aged 85 and older for frailty very thoroughly and manage these patients with symptom palliation and quality-of-life preservation.

The oldest-old population (85+ age group) grew from just over 100,000 in 1900 to 5.5 million in 2010. The U.S. Census Bureau projects that the population aged 85 and over could grow from 5.5 million in 2010 to 19 million by 2050 [24]. Improvements in health and welfare result in longer life expectancy and diagnoses of various health issues including cancer. Even with a drop in the age-specific cancer incidence rates for the oldest age group, the absolute number of individuals diagnosed with cancer will continue to increase because of these population changes [25]. Thus, the demand for screening, prevention, diagnosis and management of cancer in the elderly population will increase. Continued utilization of quality population-based data systems and translation of evidence-based clinical and basic research findings to public health practices are essential to the development of public policies for cancer [25].

Conclusion

Our study contributes to measuring cancer burden in the oldest old population with use of SEER and CBTRUS data. We demonstrate that incidence of certain cancers continues to climb through the oldest old population, despite an overall drop in cancer IR in this age group. GI cancers like colorectal, pancreas and stomach had the highest incidence and mortality rates among these cancers.

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Figure 1.

Age-specific (Crude) SEER US incidence rates of all cancer sites combined, all ages, all races, both sexes 2000–2010. X-axis: Age group; Y-axis: IR per 100,000. Cancer sites include invasive cases only. Incidence source: SEER 18 areas [4].

Figure 2.

SEER incidence rates (2000–2010) of top 10 cancer sites with age specific incidence rates that continue to rise in the 85+ age group, including all races and both sexes. X-axis: Cancer sites; Y-axis: Age specific IR per 100,000. Data from eighteen SEER registries for the years 2000–2010 were included [4]. Cancer sites/histologies included invasive cases only, except for meningioma, and rates were per 100,000. *Age-specific incidence rates for malignant and non-malignant meningioma were obtained from Central Brain Tumor Registry of the United States (CBTRUS) Statistical Report 2012: NPCR (National Program of Cancer Registries) and SEER (2004–2008) [6].

Figure 3.

Age-specific (Crude) SEER US mortality rates of all cancer sites combined and colorectal cancer, all ages, all races, both sexes 2000–2010. X-axis: Age Groups; Y axis: Mortality Rates per 100,000. Cancer sites include invasive cases only. Mortality source: US Mortality Files, National Center for Health Statistics, CDC [5].

Table 1

Incidence rates (IR) for all age groups, of certain cancer sites that continue to increase in IR in the 85+ age group.

Cancer Sites	Age Groups										
	<1	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	
Colorectal	*	*	*	0.05	0.3	0.9	2	4.3	8.2	15.8	
Pancreas	*	*	*	*	0.06	0.09	0.2	0.4	1	2.5	
Stomach	*	*	*	*	0.06	0.2	0.5	1.02	1.8	2.9	
Myelodysplastic syndromes	0.2	0.1	0.08	0.07	0.1	0.1	0.1	0.2	0.3	0.6	
Lymphocytic leukemia	2.1	7.8	3.4	2.1	1.7	1	0.7	0.9	1.1	1.7	
Vulva	*	*	*	*	*	0.2	0.2	0.5	1	1.6	
Soft tissue including heart	3.5	1.2	0.6	0.9	1.1	1.3	1.4	1.8	2.1	2.5	
Gall bladder	*	*	*	*	*	*	*	0.05	0.1	0.3	
Anus and anorectum	*	*	*	*	*	*	0.06	0.2	0.6	1.4	
Vagina	*	0.10	*	*	*	*	*	0.1	0.2	0.3	
Kaposi's sarcoma	*	*	*	*	*	0.2	0.5	0.9	1.3	1.3	
Meningioma	0.09				0.2	1.4			4.4		

Cancer Sites	Age Groups										
	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+		
Colorectal	29.1	55.8	77	112	168	223.4	283.2	337.1	376.4		
Pancreas	5.4	10.5	18.1	29.2	43.1	59.1	74.6	89.3	99.3		
Stomach	5	7.7	11.6	17.5	26.7	36.5	45.6	55	60.3		
Myelodysplastic syndromes	1	1.7	3.4	6.6	12.4	20.9	33.6	47	51.2		
Lymphocytic leukemia	3.1	5.1	8.6	13.2	19.3	24.7	31.8	36.1	41.5		
Vulva	2.4	3.1	3.8	4.8	6	8	10.9	14.5	17.4		
Soft tissue including heart	3	3.7	4.6	5.9	7.6	9.2	11.7	13.8	14.2		
Gall bladder	0.5	0.9	1.6	2.5	4.1	5.6	7.7	9.5	10.6		
Anus and anorectum	2.3	3.2	3.8	4.2	4.9	5.4	5.9	6.5	6.9		
Vagina	0.7	0.9	1.4	1.9	2.5	2.7	3.4	4	4.9		
Kaposi's sarcoma	1	0.6	0.5	0.4	0.6	0.8	1	1.6	2.4		

Cancer Sites	Age Groups								
	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Meningioma	8.4		13.8		23.4		33.4		41.8

Data from eighteen SEER registries for the years 2000–2010 were included. Cancer sites/histologies included invasive cases only, except for meningioma, and rates were per 100,000 [4]. Age-specific incidence rates for malignant and non-malignant meningioma were obtained from Central Brain Tumor Registry of the United States (CBTRUS) Statistical Report 2012; NPCR (National Program of Cancer Registries) and SEER (2004–2008) [6].

* Statistic not available due to less than 16 cases

Table 2
Age-specific incidence rates (IR) of cancer sites that continue to increase in the 85+ age group.

Cancer Sites/histologies	IR	IR in males	IR in females	P value	IR in blacks	IR in whites	P value
Colorectal	376.4	429.9	351.6	0.0004	394.2	413.4	0.4
Pancreas	99.3	105.7	96.3	0.5	122	95.2	0.06
Stomach	60.3	87.7	47.6	0.0001	111.7	50.8	0.0001
Myelodysplastic syndromes	51.2	82.4	37	0.0001	43.9	52.1	0.3
Meningioma	41.8						
Lymphocytic leukemia	41.5	61.6	32.2	0.0001	30.9	42.6	0.1
Vulva	--	--	17.36	--	10.2	18.4	0.1
Soft tissue including heart	14.2	22.1	10.5	0.03	9.7	14.6	0.4
Gall bladder	10.6	8.3	11.7	0.5	12.2	10.2	0.8
Anus and anorectum	6.9	5.8	7.4	1.0	5.7	7.1	1.0
Vagina	--	--	4.95	--	5.8	5.04	1.0
Kaposi's sarcoma	2.4	4.4	1.4	0.4	*	2.4	--

Data from eighteen SEER registries for the years 2000–2010 were included. Cancer sites/histologies included invasive cases only, except for meningioma, and rates were per 100,000 [4]. Age-specific incidence rates for malignant and non-malignant meningioma were obtained from Central Brain Tumor Registry of the United States (CBTRUS) Statistical Report 2012: NPCR (National Program of Cancer Registries) and SEER (2004–2008) [6].

* Statistic not available due to less than 16 cases.

-- Not Applicable

Table 3

Age specific mortality rates (MR) of cancer sites that continue to increase in incidence in the 85+ age group.

Cancer Sites/histologies	MR in 85+	MR in males	MR in females	P value	MR in blacks	MR in whites	P value
Colorectal	232	267.6	216	0.007	274.6	230.7	0.02
Pancreas	103.6	112.1	99.8	0.4	123.4	102.5	0.1
Stomach	42.4	60.3	34.42	0.0004	83.2	37.9	0.0001
Myelodysplastic syndromes	*	*	*	--	*	*	--
Meningioma	**	--	--	--	--	--	--
Lymphocytic leukemia	30.7	44	24.8	0.007	20.9	32.2	0.1
Vulva	7.6	--	7.6	--	4.0	8.0	0.4
Soft tissue including heart	8.5	11.9	7	0.3	7	8.7	1.0
Gall bladder	7	5.5	7.7	0.6	8.3	6.8	1.0
Anus and anorectum	1.4	1.2	1.6	1.0	1.5	1.5	1.0
Vagina	3.1	--	3.1	--	4.4	3.0	1.0
Kaposi's sarcoma	*	*	*	--	*	*	--

Data from eighteen SEER registries for the years 2000–2010 were included. Cancer sites include invasive cases only unless otherwise noted. Mortality source: US Mortality Files, National Center for Health Statistics, CDC [5]. Rates are per 100,000.

* Statistic not available due to less than 16 cases.

--Not Applicable;

** 56% 5year survival rate for patients aged 65years and older [26].