

Incidence of Cancer in Adolescents and Young Adults in Jordan, 2000-2017

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PURPOSE The epidemiology of cancer in adolescents and young adults (AYAs) is distinct and underinvestigated. Therefore, we investigated the incidence of cancer in AYAs in Jordan.

PATIENTS AND METHODS We accessed all records submitted to the Jordan Cancer Registry between 2000 and 2017. We included all patients, age 15-39 years, who were ordinarily resident in Jordan. We then calculated frequencies, age-adjusted incidence rates (AAIRs), and annual percentage changes (APCs) and performed subgroup analyses by biologic sex, age subgroups, and site (SEER AYA site recode/WHO 2008). We also performed site-specific trend analyses using joinpoint models.

RESULTS We identified 14,115 eligible patients, of whom 1,531 (10.8%), 4,278 (30.3%), and 8,306 (58.8%) were 15-19, 20-29, and 30-39 years old at diagnosis, respectively. The numbers of male and female AYAs were 5,792 (41.0%) and 8,323 (59.0%), respectively. The crude number of cases increased from 654 in 2000 to 954 in 2017 (APC, 2.6%). The overall AAIR ranged from 32.3 in 2000 to 24.3 in 2017 (APC, -1.7%). The AAIR was 27.6 over the full study period and was higher in females (34.1) than in males (21.6). Carcinomas, lymphomas, and leukemias were the most common cancers. The incidence rates of the majority of cancers trended downward over the study period.

CONCLUSION The incidence of cancer in AYAs in Jordan is relatively low and declining. However, the absolute number of cases is increasing because this downtrend does not offset the effect of a high population growth rate; almost a 1,000 cases of cancer are now diagnosed every year, which represents a significant increase in the burden of cancer in a developing country with limited healthcare resources.

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INTRODUCTION

The National Cancer Institute's Adolescent and Young Adult Oncology Progress Review Group defines adolescents and young adults (AYAs) with cancer as those diagnosed at age 15-39 years.¹ AYAs are distinct from children and older adults because of important differences among the three population groups in the distribution of cancer sites, risk factor profiles, host and disease biology, survivorship, and long-term health consequences.² These differences are clinically significant because, historically, advances in cancer therapy have benefitted children and older adults more so than AYAs.³ In addition, the burden of cancer in AYAs is generally increasing; Gupta et al⁴ studied AYAs with cancer in 41 countries over a 15-year period (1998-2012) and found that the incidence increased in 23 countries, decreased in two, and remained the same in 16. According to the GLOBOCAN 2018 estimates, cancer was diagnosed in 1.2 million AYAs worldwide.⁵

Cancer statistics for AYAs are often presented in aggregate with those of children or older adults, which obfuscates the distinct epidemiology of cancer in this population group. In addition, classification schemes that are not tailored to AYAs poorly capture the major cancer sites that affect these individuals.⁶ Many studies have documented the incidence of cancer in Jordan using data from the Jordan Cancer Registry (JCR), a high-quality population-based cancer registry.⁷⁻¹⁰ However, none has presented aggregate data for AYAs, and none has used a classification scheme tailored to AYAs. Jordan is a developing country with a rapidly growing population characterized by an expansive population pyramid (Fig 1). Therefore, this research gap is particularly pressing given that AYAs in Jordan comprise a larger proportion of the total population compared with AYAs in developed countries. For example, the mean proportion of AYAs between 2000 and 2017 was 42.7% in Jordan and 34.4% in the United States.¹¹ To address the research gap, we

ASSOCIATED CONTENT

Appendix

Author affiliations and support information (if applicable) appear at the end of this article.

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CONTEXT

Key Objective

The epidemiology of cancer in adolescents and young adults (AYAs) in Jordan has not been investigated. AYA oncology is particularly relevant in developing countries because AYAs comprise a larger proportion of the population. Our aim was to describe the incidence of cancer in AYAs in Jordan.

Knowledge Generated

We accessed data from a population-based registry and described the incidence of cancer in 14,115 AYAs in Jordan (2000–2017). Although the crude number of cases generally increased annually, the age-adjusted incidence rate generally decreased. Carcinomas, lymphomas, and leukemias were the most common cancers. The overall incidence of cancer was higher in female AYAs, largely because of the higher incidence of thyroid and breast carcinomas.

Relevance

Because of the high population growth rate, the absolute number of cases is increasing despite the downtrend in cancer incidence. Therefore, the burden of cancer in AYAs is increasing in a developing country with limited healthcare resources.

accessed data from the JCR and described the incidence of cancer in AYAs in Jordan (2000–2017) using the SEER AYA site recode/WHO 2008.

PATIENTS AND METHODS

We accessed all records submitted to the JCR between January 2000 and December 2017. The JCR, a population-based registry established in 1996, is included in the Cancer Incidence in Five Continents Volume XI database. The registry collects data from all hospitals and laboratories in Jordan using passive and active methods (eg, notification forms and case finding, respectively), and reporting is mandatory. The JCR is a member of a network of population-based registries sponsored by the Middle East Cancer Consortium (MECC). The MECC was established in 1996 with the support of the United States National Cancer Institute; University of California, Irvine; Emory University; and the International Agency for Research on Cancer.^{12,13} The immediate aim of the MECC was to establish the

network and ensure the comparability of data.¹² The network operates according to the standards outlined in the Manual of Standards for Cancer Registration (first disseminated in December 1998).¹⁴ The steering committee of the MECC routinely performs external audits to assure data consistency and quality. According to these audits, the coverage rate of the JCR falls between 92% and 97%.¹³

We filtered the records to include all patients, age 15–39 years, who were ordinarily resident in Jordan. We interrogated the World Development Indicators database to retrieve population estimates. The estimates include all residents regardless of legal status or citizenship.¹¹ We then reformatted the collated data using SEER*Prep (version 2.5.8) and calculated frequencies, age-adjusted incidence rates (AAIRs), and annual percentage changes (APCs) using SEER*Stat (version 8.3.8). The reference population was the World Standard Population. We also performed subgroup analyses by biologic sex, age subgroups (15–19, 20–29, and 30–39 years), and site (SEER AYA site recode/WHO 2008). Finally, we used Joinpoint Regression Program (version 4.8.0.1) to perform site-specific trend analyses using joinpoint models. We calculated 95% CIs using the method described by Tiwari et al¹⁵ as implemented in SEER*Stat, and we interpreted values of $P \leq .05$ to indicate statistical significance.

RESULTS

We examined 20,318 patients for eligibility and included 14,115 (69.5%) who were ordinarily resident in Jordan. Of the patients we included, 1,531 (10.8%) were 15–19 years old at diagnosis, 4,278 (30.3%) were 20–29 years old at diagnosis, and 8,306 (58.8%) were 30–39 years old at diagnosis. The median age at diagnosis was 31 years (IQR, 25–36 years). The number of female AYAs was 8,323 (59.0%) compared with 5,792 male AYAs (41.0%), for a male-to-female ratio of 1:1.4. A small majority of patients were residents of the Amman Governorate ($n = 7,917$ [56.1%]), and the majority were Jordanian nationals

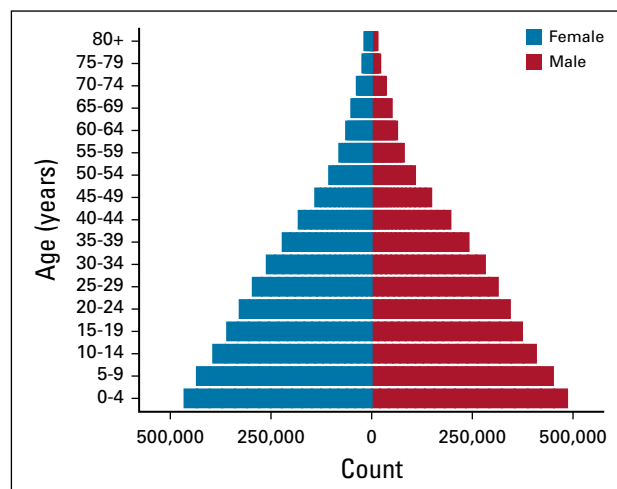


FIG 1. Pyramid plot of the mean population estimates in Jordan by age group and sex (2000–2017). Reproduced with permission.¹¹

($n = 13,874$ [98.3%]). In 2017, the proportion of Jordanian nationals was 99.1%.

The crude number of cases increased from 654 in 2000 to 954 in 2017. The AAIRs were 27.6 (27.1 to 28.0 years) overall, 11.6 (11.0 to 12.2 years) for those age 15-19 years, 18.7 (18.1 to 19.2 years) for those age 20-29 years, and 46.5 (45.5 to 47.5 years) for those age 30-39 years. The overall AAIR ranged from 32.3 (29.9 to 34.9) in 2000 to 24.3 (22.8 to 25.9) in 2017 for a total APC of -1.7% (-2.3 to -1.2 ; $P < .001$). The trends of the 15-19, 20-29, and 30-39 age subgroups were similar to the overall trend (Fig 2). The total APC in the AAIRs was -2.5% (-4.0 to -1.1 ; $P = .002$), -1.4% (-2.0 to -0.7 ; $P < .001$), and -1.8% (-2.4 to -1.1 ; $P < .001$) for those age 15-19 years, 20-29 years, and 30-39 years, respectively.

The overall AAIR was higher in female AYAs (34.1 [33.4 to 34.8]) than in male AYAs (21.6 [21.0 to 22.1]). The rates did not differ between females and males in the 15-19 age subgroup (11.0 [10.2 to 11.9] and 12.2 [11.4 to 13.0], respectively). However, in the 20-29 age subgroup, the rates differed between females and males (20.8 [20.0 to 21.7] and 16.7 [16.0 to 17.4], respectively). In addition, the rates of females and males in the 30-39 age subgroup (61.8 [60.2 to 63.5] and 32.3 [31.2 to 33.5], respectively) differed, and this rate difference was the main contributor to the overall rate difference.

We classified cases according to the SEER AYA site recode/WHO 2008 and calculated the crude number of cases, proportion of cases, and AAIRs accordingly (Table 1 and Table A1). We also calculated the female-to-male AAIR ratios (Table A2). The most common cancers in the 15-19 age subgroup were lymphomas ($n = 491$ [32.1%]; AAIR = 3.7), leukemias ($n = 271$ [17.7%]; AAIR = 2.1), and carcinomas ($n = 246$ [16.1%]; AAIR = 1.9). The most

common lymphoma and leukemia were Hodgkin lymphoma (71.9%) and acute lymphoid leukemia (54.6%), respectively. Hodgkin lymphoma disproportionately affected female AYAs (AAIR ratio = 0.58 [0.42 to 0.79]; $P < .001$), whereas acute lymphoid leukemia disproportionately affected male AYAs (AAIR ratio = 1.53 [1.23 to 1.90]; $P < .001$). Carcinomas of the head and neck, including thyroid carcinoma, accounted for 67.5% of all carcinomas. Thyroid carcinoma was disproportionately incident in female AYAs (AAIR ratio = 5.84 [3.21 to 11.49]; $P < .001$). During the 18-year study period, one case of breast carcinoma was diagnosed in this age subgroup (0.1%).

In the 20-29 age subgroup, the most common cancers were carcinomas ($n = 1,553$ [36.3%]; AAIR = 6.8), lymphomas ($n = 1,002$ [23.4%]; AAIR = 4.4), and leukemias ($n = 411$ [9.6%]; AAIR = 1.8). The most common lymphoma was, again, Hodgkin lymphoma (66.2%), but the most common leukemia was acute myeloid leukemia (37.7%). Hodgkin lymphoma was more common in female AYAs (AAIR ratio = 1.24 [1.06 to 1.45]; $P = .006$), whereas acute myeloid leukemia was equally incident (AAIR ratio = 1.09 [0.78 to 1.51]; $P = .65$). Carcinomas of the head and neck, including thyroid carcinoma, were still the most common carcinomas at 44.4%, but breast carcinomas were the second most common at 21.0%. Both thyroid and breast carcinomas were more common in female AYAs (AAIR ratios = 4.46 [3.61 to 5.56] and 69.01 [29.29 to 214.09], respectively; $P < .001$).

In the 30-39 age subgroup, the most common cancers were, again, carcinomas ($n = 5,319$ [64.0%]; AAIR = 29.9), lymphomas ($n = 885$ [10.7%]; AAIR = 4.9), and leukemias ($n = 464$ [5.6%]; AAIR = 2.6). Non-Hodgkin lymphoma was the predominant lymphoma (53.1%), and acute myeloid leukemia remained the most common leukemia (37.7%), followed by chronic myeloid leukemia (29.7%). Although the incidence of non-Hodgkin lymphoma was higher in male AYAs, the incidence of the myeloid leukemias did not differ between the sexes. Breast carcinoma was the most common carcinoma in this age subgroup (42.6%), and its AAIR was more than 100-fold higher in female AYAs (AAIR ratio = 103.99 [69.20 to 164.44]; $P < .001$).

The shifting predominance of lymphomas and leukemias in the 15-19 age subgroup to carcinomas in the 30-39 age subgroup is depicted in Figure 3. Notably, osseous and chondromatous neoplasms were the fourth most common cancer in the 15-19 age subgroup but steadily accounted for a lesser proportion of cases in each successive age subgroup. On the other hand, melanoma and skin carcinomas were the least common cancer in the 15-19 age subgroup but steadily accounted for a higher proportion of cases in each successive age subgroup. Germ cell and trophoblastic neoplasms were relatively common across all three subgroups and were most incident in the 20-29 age subgroup. CNS and other intracranial and intraspinal

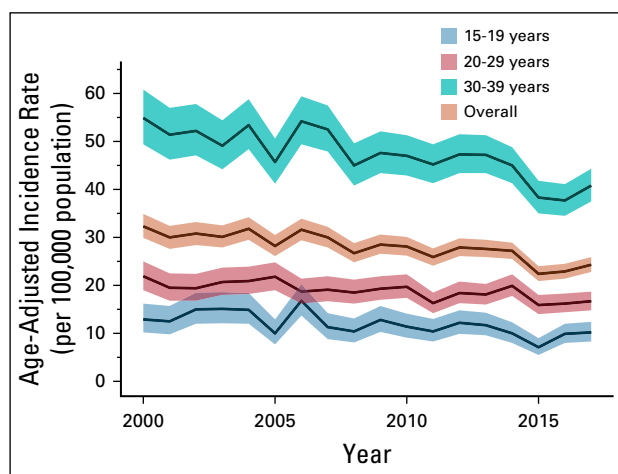


FIG 2. Line plots of the annual age-adjusted incidence rates of all cancers diagnosed in adolescents and young adults (15-39 years) in Jordan, 2000-2017 ($N = 14,115$). Data are stratified by the 15-19, 20-29, and 30-39 age subgroups. Error bands are 95% CIs.

TABLE 1. The Crude No. of Cases and the Age-Adjusted Incidence Rates (per 100,000 population) of Cancers Diagnosed in Adolescents and Young Adults in Jordan, 2000-2017 (N = 14,115)

Classification	15-39 Years		15-19 Years		20-29 Years		30-39 Years	
	Crude No. (%)	Rate	Crude No. (%)	Rate	Crude No. (%)	Rate	Crude No. (%)	Rate
Leukemias	1,146 (8.1)	2.1	271 (17.7)	2.1	411 (9.6)	1.8	464 (5.6)	2.6
Acute lymphoid leukemia	356 (2.5)	0.6	148 (9.7)	1.1	125 (2.9)	0.5	83 (1.0)	0.5
Acute myeloid leukemia	412 (2.9)	0.8	82 (5.4)	0.6	155 (3.6)	0.7	175 (2.1)	1
Chronic myeloid leukemia	246 (1.7)	0.5	17 (1.1)	0.1	91 (2.1)	0.4	138 (1.7)	0.8
Other and unspecified leukemias	132 (0.9)	0.3	24 (1.6)	0.2	40 (0.9)	0.2	68 (0.8)	0.4
Lymphomas	2,378 (16.8)	4.4	491 (32.1)	3.7	1,002 (23.4)	4.4	885 (10.7)	4.9
Non-Hodgkin lymphoma	947 (6.7)	1.8	138 (9.0)	1.0	339 (7.9)	1.5	470 (5.7)	2.6
Hodgkin lymphoma	1,431 (10.1)	2.6	353 (23.1)	2.7	663 (15.5)	2.9	415 (5.0)	2.3
CNS and other intracranial and intraspinal neoplasms	778 (5.5)	1.5	109 (7.1)	0.8	296 (6.9)	1.3	373 (4.5)	2.1
Astrocytoma	411 (2.9)	0.8	49 (3.2)	0.4	143 (3.3)	0.6	219 (2.6)	1.2
Other gliomas	136 (1.0)	0.3	12 (0.8)	0.1	53 (1.2)	0.2	71 (0.9)	0.4
Ependymoma	51 (0.4)	0.1	12 (0.8)	0.1	20 (0.5)	0.1	19 (0.2)	0.1
Medulloblastoma and other PNETs	97 (0.7)	0.2	19 (1.2)	0.1	53 (1.2)	0.2	25 (0.3)	0.1
Unspecified malignant intracranial and intraspinal neoplasms	51 (0.4)	0.1	13 (0.8)	0.1	15 (0.4)	0.1	23 (0.3)	0.1
Osseous and chondromatous neoplasms	465 (3.3)	0.8	182 (11.9)	1.4	193 (4.5)	0.8	90 (1.1)	0.5
Osteosarcoma	173 (1.2)	0.3	84 (5.5)	0.6	67 (1.6)	0.3	22 (0.3)	0.1
Chondrosarcoma	57 (0.4)	0.1	6 (0.4)	0.0	24 (0.6)	0.1	27 (0.3)	0.1
Ewing tumor	162 (1.1)	0.3	76 (5.0)	0.6	66 (1.5)	0.3	20 (0.2)	0.1
Other specified and unspecified bone tumors	73 (0.5)	0.1	16 (1.0)	0.1	36 (0.8)	0.2	21 (0.3)	0.1
Soft tissue sarcomas	560 (4.0)	1.1	74 (4.8)	0.6	204 (4.8)	0.9	282 (3.4)	1.6
Fibromatous neoplasms	133 (0.9)	0.3	10 (0.7)	0.1	46 (1.1)	0.2	77 (0.9)	0.4
Rhabdomyosarcoma	63 (0.4)	0.1	24 (1.6)	0.2	21 (0.5)	0.1	18 (0.2)	0.1
Other soft tissue sarcomas	364 (2.6)	0.7	40 (2.6)	0.3	137 (3.2)	0.6	187 (2.3)	1.1
Germ cell and trophoblastic neoplasms	800 (5.7)	1.5	89 (5.8)	0.7	365 (8.5)	1.6	346 (4.2)	1.9
Germ cell and trophoblastic neoplasms of gonads	719 (5.1)	1.4	70 (4.6)	0.5	331 (7.7)	1.4	318 (3.8)	1.8
Germ cell and trophoblastic neoplasms of nongonadal sites	81 (0.6)	0.2	19 (1.2)	0.1	34 (0.8)	0.1	28 (0.3)	0.2
Melanoma and skin carcinomas	351 (2.5)	0.7	18 (1.2)	0.1	89 (2.1)	0.4	244 (2.9)	1.4
Melanoma	97 (0.7)	0.2	4 (0.3)	0	37 (0.9)	0.2	56 (0.7)	0.3
Skin carcinomas	254 (1.8)	0.5	14 (0.9)	0.1	52 (1.2)	0.2	188 (2.3)	1
Carcinomas	7,118 (50.4)	14.4	246 (16.1)	1.9	1,553 (36.3)	6.8	5,319 (64.0)	29.9
Thyroid carcinoma	1,510 (10.7)	2.9	86 (5.6)	0.7	560 (13.1)	2.5	864 (10.4)	4.8
Other carcinomas of head and neck	496 (3.5)	1.0	80 (5.2)	0.6	130 (3.0)	0.6	286 (3.4)	1.6
Carcinoma of trachea, bronchus, and lungs	197 (1.4)	0.4	3 (0.2)	0.0	39 (0.9)	0.2	155 (1.9)	0.9
Carcinoma of breast	2,591 (18.4)	5.4	1 (0.1)	0.0	326 (7.6)	1.4	2,264 (27.3)	12.8
Carcinoma of genitourinary tract	763 (5.4)	1.5	25 (1.6)	0.2	167 (3.9)	0.7	571 (6.9)	3.2
Carcinoma of GI tract	1,346 (9.5)	2.7	37 (2.4)	0.3	276 (6.5)	1.2	1,033 (12.4)	5.8
Carcinoma of other and ill-defined sites, NOS	215 (1.5)	0.4	14 (0.9)	0.1	55 (1.3)	0.2	146 (1.8)	0.8
Miscellaneous specified neoplasms, NOS	284 (2.0)	0.6	25 (1.6)	0.2	92 (2.2)	0.4	167 (2.0)	0.9
Other pediatric and embryonal tumors, NOS	29 (0.2)	0.1	5 (0.3)	0.0	16 (0.4)	0.1	8 (0.1)	0.0
Other specified and embryonal tumors, NOS	255 (1.8)	0.5	20 (1.3)	0.2	76 (1.8)	0.3	159 (1.9)	0.9
Unspecified malignant neoplasms	230 (1.6)	0.4	25 (1.6)	0.2	72 (1.7)	0.3	133 (1.6)	0.7
Unclassified	5 (0.0)	0.0	1 (0.1)	0.0	1 (0.0)	0.0	3 (0.0)	0.0

NOTE. Cancers are classified according to the SEER AYA site recode/WHO 2008.

Abbreviations: AYA, adolescents and young adults; NOS, not otherwise specified; PNETs, primitive neuroectodermal tumors.

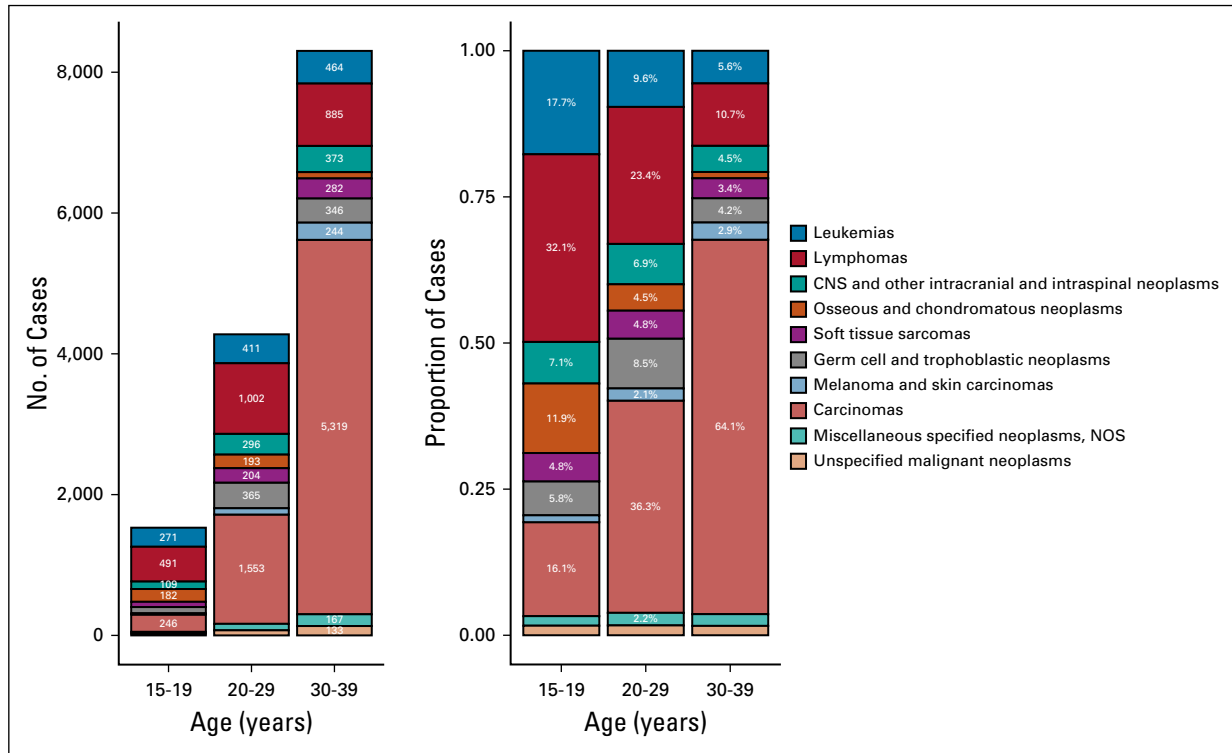


FIG 3. Bar plots of the number and proportion of cases of cancers diagnosed in adolescents and young adults (15-39 years) in Jordan, 2000-2017 (N = 14,115). Cases are stratified by the 15-19, 20-29, and 30-39 age subgroups. Cancers are classified according to the 10 main cancer groups of the SEER AYA site recode/WHO 2008. AYA, adolescents and young adults; NOS, not otherwise specified.

neoplasms ranked fifth in the 15-19 and 20-29 age subgroups and fourth in the 30-39 age subgroup. Finally, soft tissue sarcomas ranked seventh in the 15-19 age subgroup and sixth in the 20-29 and 30-39 age subgroups.

We used joinpoint regression to identify changes in the AAIRs of cancer over the 18-year study period (Table 2). Of the 10 main cancer groups of the SEER AYA site recode/WHO 2008, the incidence rates of six—namely, leukemias, lymphomas, CNS and other intracranial and intraspinal neoplasms, osseous and chondromatous neoplasms, soft tissue sarcomas, and melanoma and skin carcinomas—statistically significantly decreased in a single linear trend over the full study period. On the other hand, the incidence rates of unspecified malignant neoplasms (a heterogeneous group of malignant neoplasms) statistically significantly increased in a single linear trend over the full study period. The incidence rates of germ cell and trophoblastic neoplasms and miscellaneous specified neoplasms remained constant over the full study period. Interestingly, the analysis revealed a single joinpoint for carcinomas in year 2014. Between 2000 and 2014, the yearly incidence rates of carcinomas were constant; however, between 2014 and 2017, there was a statistically significant linear downtrend.

DISCUSSION

We accessed data from the JCR and described the incidence of cancer in AYAs in Jordan (2000-2017) using the

SEER AYA site recode/WHO 2008. We found that the crude number of cases increased over time, but the AAIRs steadily decreased. We also found that the overall incidence rate of cancer was higher in female AYAs, largely because of the rate difference between the sexes in the 30-39 age subgroup. The higher incidence rates of thyroid and breast carcinomas in female AYAs largely explained this difference. In addition, we found that carcinomas, lymphomas, and leukemias were the most common cancers in AYAs. Lymphomas and leukemias accounted for almost the majority of cases in the 15-19 age subgroup, whereas carcinomas accounted for the majority of cases in the 30-39 age subgroup. Finally, we found that the incidence rates of the majority of cancers trended downward over the study period and unspecified malignant neoplasms were the only one major cancer group to trend upward.

In our study, the overall AAIR of cancer in AYAs in Jordan was 27.6 (per 100,000 population), which is comparable with the incidence rates for AYAs in other Middle Eastern countries.^{4,16} Estimates in Middle Eastern countries fall among the lower range of estimates in Asian countries, which in turn are generally lower than estimates in countries in Americas, Europe, and Oceania.^{4,17,18} In addition, many studies have reported the incidence of cancer in Jordan using data from the JCR.⁷⁻⁹ Khader et al⁹ studied the incidence of cancer in Jordan over a 14-year period (2000-2013) and reported that the overall AAIR was 126 per

TABLE 2. Joinpoint Trend Analyses of Age-Adjusted Incidence Rates of Tumors Diagnosed in Adolescents and Young Adults (15-39 years) in Jordan, 2000-2017 (N = 14,115)

Classification	APC, % (95% CI)	Trend	P
Leukemias	-3.9 (-5.8 to -2.0)	↘	< .001
Acute lymphoid leukemia	-5.1 (-7.7 to -2.3)	↘	.001
Acute myeloid leukemia	-2.6 (-5.3 to 0.1)	→	.062
Chronic myeloid leukemia	-3.8 (-6.3 to -1.3)	↘	.006
Other and unspecified leukemias	-4.6 (-8.7 to -0.4)	↘	.035
Lymphomas	-2.1 (-3.4 to -0.8)	↘	.003
Non-Hodgkin lymphoma	-3.9 (-5.3 to -2.4)	↘	< .001
Hodgkin lymphoma	-1.0 (-2.5 to 0.6)	→	.20
CNS and other intracranial and intraspinal neoplasms	-3.9 (-5.0 to -2.8)	↘	< .001
Astrocytoma	-6.0 (-8.1 to -3.9)	↘	< .001
Other gliomas	-1.7 (-4.6 to 1.3)	→	.23
Ependymoma	NA	NA	NA
Medulloblastoma and other PNETs	0.9 (-3.1 to 5.0); -63.8 (-94.4 to 133.5)	→	.64; .26
Unspecified malignant intracranial and intraspinal neoplasms	NA	NA	NA
Osseous and chondromatous neoplasms	-4.2 (-6.2 to -2.1)	↘	< .001
Osteosarcoma	-3.9 (-6.4 to -1.3)	↘	.006
Chondrosarcoma	-1.3 (-8.2 to 6.2)	→	.72
Ewing tumor	-6.4 (-10.4 to -2.2)	↘	.006
Other specified and unspecified bone tumors	-3.1 (-7.3 to 1.3)	→	.16
Soft tissue sarcomas	-3.2 (-5.2 to -1.0)	↘	.006
Fibromatous neoplasms	-3.6 (-7.3 to 0.2)	→	.061
Rhabdomyosarcoma	NA	NA	NA
Other soft tissue sarcomas	-2.4 (-4.5 to -0.3)	↘	.027
Germ cell and trophoblastic neoplasms	1.0 (-0.7 to 2.7)	→	.24
Germ cell and trophoblastic neoplasms of gonads	1.0 (-0.6 to 2.7)	→	.20
Germ cell and trophoblastic neoplasms of nongonadal sites	NA	NA	NA
Melanoma and skin carcinomas	-3.5 (-5.4 to -1.6)	↘	.001
Melanoma	NA	NA	NA
Skin carcinomas	-3.4 (-5.0 to -1.8)	↘	< .001
Carcinomas	-0.5 (-1.2 to 0.2); -7.2 (-13.6 to -0.5)	→↘	.15; .038
Thyroid carcinoma	1.0 (-0.2 to 2.3)	→	.11
Other carcinomas of head and neck	-3.2 (-5.3 to -1.1)	↘	.005
Carcinoma of trachea, bronchus, and lungs	-1.0 (-4.0 to 2.2)	→	.52
Carcinoma of breast	-0.9 (-1.6 to -0.1)	↘	.023
Carcinoma of genitourinary tract	-3.3 (-5.5 to -1.1)	↘	.006
Carcinoma of GI tract	-0.1 (-1.7 to 1.6); -11.3 (-18.8 to -3.1)	→↘	.94; .012
Carcinoma of other and ill-defined sites, NOS	-5.7 (-8.7 to -2.5)	↘	.002
Miscellaneous specified neoplasms, NOS	-53.4 (-79.8 to 7.5); 45.0 (-56.9 to 387.4); -3.2 (-7.4 to 1.1)	→	.069; .51; .13
Other pediatric and embryonal tumors, NOS	NA		NA
Other specified and embryonal tumors, NOS	-53.9 (-80.5 to 8.9); 38.3 (-60.1 to 379.7); -2.2 (-6.6 to 2.5)	→	.072; .57; .32
Unspecified malignant neoplasms	7.0 (2.3 to 11.8)	↗	.005
Unclassified	NA	NA	NA

NOTE. Cancers are classified according to the SEER AYA site recode/WHO 2008.

Abbreviations: APC, annual percentage change; AYA, adolescents and young adults; NA, not applicable; NOS, not otherwise specified; PNETs, primitive neuroectodermal tumors.

↘ Linear downtrend; → Constant; ↗ Linear uptrend. Bold P values are statistically significant (≤ 0.05).

100,000 population. Over the study period, the annual age-adjusted rate trended upward from 113.6 in 2000 to 142.1 in 2013. In comparison, we showed that the incidence of cancer in AYAs in Jordan trended downward from 32.3 in 2000 to 24.3 in 2017. The variation between these cancer statistics exemplifies the unique epidemiology of cancer in AYAs compared with the general population.

The distribution of cancers in our study (according to the SEER AYA site recode/WHO 2008) is generally similar to the distribution of cancers reported by other population-based registries.^{2,4} The shift in the distribution of cancers between the 15-19 and 30-39 age subgroups is also similar. However, there are some notable differences that are attributable to known population characteristics. For example, compared with our results, cutaneous melanoma is much more common in AYAs in the United States.² This difference is expected because the incidence rates of cutaneous melanoma vary according to ethnicity more so than most other cancers. Indeed, cutaneous melanoma is disproportionately incident in fair-skinned White populations.¹⁹ Furthermore, some differences in cancer incidence are related to sexual behavior. For example, in our cohort, Kaposi sarcoma was diagnosed in seven individuals over the 18-year study period, but the disease is much more common in other countries.^{2,4} The main explanation for this difference is that Kaposi sarcoma is 20,000 times more common in people with AIDS, and the prevalence rate of AIDS in Jordan is 0.02% in the general population.^{20,21} In addition, the incidence rate of cervical carcinomas was much lower in our cohort compared with other international estimates—likely because the prevalence rate of human papillomavirus 16/18 in Jordan is relatively low.²²

We also performed a trend analysis over the 18-year study period (2000-2017). Gupta et al⁴ studied trends in the incidence of cancer in AYAs using data from 41 countries over a 15-year period (1998-2012) and found that the annual incidence rate trended upward or remained constant in all but two countries. By contrast, we showed that the annual incidence rate in Jordan trended downward. This downtrend was also consistent across most of the major cancer site groups. We speculate that the widespread downtrend represents a decrease in the registry's access to the population at risk rather than a decrease in the burden of cancer. The number of non-Jordanian residents increased from 392,273 (7.0% of 5,580,224) in

2004 to 2,918,125 (31.5% of 9,266,575) in 2015.^{11,23,24} By contrast, the majority of our cohort were Jordanian nationals (98.3%), and 99.1% of cases in 2017 were Jordanian nationals. Therefore, non-Jordanian residents are grossly under-represented in our cohort, and the increase in the proportion of non-Jordanian residents may explain the downtrend we found. Indeed, a previous study of the burden of cancer in Syrian refugees—on the basis of data from the registry—also noted discrepancies that indicate under-reporting.²⁵ Jordanian law requires that all cancer diagnoses are reported to the JCR, so non-Jordanian residents may be less likely to receive cancer care. For example, refugees constitute a large portion of the non-Jordanian population, and they may be more prone to diagnostic delay or late presentation because of poor healthcare access and utilization.²⁶ Interestingly, financial limitations are the main barrier to cancer care for Syrian refugees in Jordan.²⁷ On the other hand, the government bears the cost of cancer care for Jordanian nationals.²⁸

Our study has several limitations. First, our cohort consists primarily of Jordanian nationals and the relative frequencies of other nationalities are disproportionately lower than population estimates. Further studies are required to investigate the incidence of cancer in AYAs from other population groups in Jordan, and the reasons for their under-representation in the national registry should be explored. Second, survival data are not well-curated so we were not able to perform survival analysis. This important research gap in survivorship must be investigated in future studies. Third, we were not able to describe other important variables, such as SEER Summary Stage 2018, because of substantial data missingness. Finally, none of the cases we studied were diagnosed postmortem because autopsies are not routinely performed in Jordan. Therefore, undiagnosed cases may partly explain the relatively low incidence of cancer in AYAs in Jordan. Further studies are required to assess the potential impact of this limitation.

In conclusion, the incidence of cancer in AYAs in Jordan is relatively low and declining. However, the absolute number of cases is increasing because this downtrend does not offset the effect of a high population growth rate; almost a 1,000 cases of cancer are now diagnosed every year, which represents a significant increase in the burden of cancer in a developing country with limited healthcare resources. Further studies are required to investigate the incidence of cancer in non-national residents.

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Open Payments is a public database containing information reported by companies about payments made to US-licensed physicians ([Open Payments](http://OpenPayments)).

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

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APPENDIX

TABLE A1. The Crude No. of Cases and the Age-Adjusted Incidence Rates (per 100,000 population) of Cancers Diagnosed in Adolescents and Young Adults in Jordan, 2000-2017 (N = 14,115)

Classification	15-39 Years		15-19 Years		20-29 Years		30-39 Years	
	Crude No. (%)	Rate	Crude No. (%)	Rate	Crude No. (%)	Rate	Crude No. (%)	Rate
Leukemias	1,146 (8.1)	2.1	271 (17.7)	2.1	411 (9.6)	1.8	464 (5.6)	2.6
Acute lymphoid leukemia	356 (2.5)	0.6	148 (9.7)	1.1	125 (2.9)	0.5	83 (1.0)	0.5
Acute myeloid leukemia	412 (2.9)	0.8	82 (5.4)	0.6	155 (3.6)	0.7	175 (2.1)	1.0
Chronic myeloid leukemia	246 (1.7)	0.5	17 (1.1)	0.1	91 (2.1)	0.4	138 (1.7)	0.8
Other and unspecified leukemias	132 (0.9)	0.3	24 (1.6)	0.2	40 (0.9)	0.2	68 (0.8)	0.4
Lymphomas	2,378 (16.8)	4.4	491 (32.1)	3.7	1,002 (23.4)	4.4	885 (10.7)	4.9
Non-Hodgkin lymphoma	947 (6.7)	1.8	138 (9.0)	1.0	339 (7.9)	1.5	470 (5.7)	2.6
Hodgkin lymphoma	1,431 (10.1)	2.6	353 (23.1)	2.7	663 (15.5)	2.9	415 (5.0)	2.3
CNS and other intracranial and intraspinal neoplasms	778 (5.5)	1.5	109 (7.1)	0.8	296 (6.9)	1.3	373 (4.5)	2.1
Astrocytoma	411 (2.9)	0.8	49 (3.2)	0.4	143 (3.3)	0.6	219 (2.6)	1.2
Specified low-grade astrocytic tumors	61 (0.4)	0.1	6 (0.4)	0.0	28 (0.7)	0.1	27 (0.3)	0.1
Glioblastoma and anaplastic astrocytoma	218 (1.5)	0.4	26 (1.7)	0.2	71 (1.7)	0.3	121 (1.5)	0.7
Astrocytoma, NOS	132 (0.9)	0.3	17 (1.1)	0.1	44 (1.0)	0.2	71 (0.9)	0.4
Other gliomas	136 (1.0)	0.3	12 (0.8)	0.1	53 (1.2)	0.2	71 (0.9)	0.4
Ependymoma	51 (0.4)	0.1	12 (0.8)	0.1	20 (0.5)	0.1	19 (0.2)	0.1
Medulloblastoma and other PNETs	97 (0.7)	0.2	19 (1.2)	0.1	53 (1.2)	0.2	25 (0.3)	0.1
Medulloblastoma	65 (0.5)	0.1	16 (1.0)	0.1	32 (0.7)	0.1	17 (0.2)	0.1
Supratentorial PNET	32 (0.2)	0.1	3 (0.2)	0.0	21 (0.5)	0.1	8 (0.1)	0.0
Other specified intracranial and intraspinal neoplasms	32 (0.2)	0.1	4 (0.3)	0.0	12 (0.3)	0.1	16 (0.2)	0.1
Unspecified malignant intracranial and intraspinal neoplasms	51 (0.4)	0.1	13 (0.8)	0.1	15 (0.4)	0.1	23 (0.3)	0.1
Osseous and chondromatous neoplasms	465 (3.3)	0.8	182 (11.9)	1.4	193 (4.5)	0.8	90 (1.1)	0.5
Osteosarcoma	173 (1.2)	0.3	84 (5.5)	0.6	67 (1.6)	0.3	22 (0.3)	0.1
Chondrosarcoma	57 (0.4)	0.1	6 (0.4)	0.0	24 (0.6)	0.1	27 (0.3)	0.1
Ewing tumor	162 (1.1)	0.3	76 (5.0)	0.6	66 (1.5)	0.3	20 (0.2)	0.1
Other specified and unspecified bone tumors	73 (0.5)	0.1	16 (1.0)	0.1	36 (0.8)	0.2	21 (0.3)	0.1
Soft tissue sarcomas	560 (4.0)	1.1	74 (4.8)	0.6	204 (4.8)	0.9	282 (3.4)	1.6
Fibromatous neoplasms	133 (0.9)	0.3	10 (0.7)	0.1	46 (1.1)	0.2	77 (0.9)	0.4
Rhabdomyosarcoma	63 (0.4)	0.1	24 (1.6)	0.2	21 (0.5)	0.1	18 (0.2)	0.1
Other soft tissue sarcomas	364 (2.6)	0.7	40 (2.6)	0.3	137 (3.2)	0.6	187 (2.3)	1.1
Specified soft tissue sarcoma	290 (2.1)	0.6	28 (1.8)	0.2	105 (2.5)	0.5	157 (1.9)	0.9
Specified (excluding Kaposi sarcoma)	283 (2.0)	0.6	28 (1.8)	0.2	104 (2.4)	0.5	151 (1.8)	0.9
Kaposi sarcoma	7 (0.0)	0.0	0 (0.0)	0.0	1 (0.0)	0.0	6 (0.1)	0.0
Unspecified soft tissue sarcoma	74 (0.5)	0.1	12 (0.8)	0.1	32 (0.7)	0.1	30 (0.4)	0.2
Germ cell and trophoblastic neoplasms	800 (5.7)	1.5	89 (5.8)	0.7	365 (8.5)	1.6	346 (4.2)	1.9
Germ cell and trophoblastic neoplasms of gonads	719 (5.1)	1.4	70 (4.6)	0.5	331 (7.7)	1.4	318 (3.8)	1.8
Germ cell and trophoblastic neoplasms of nongonadal sites	81 (0.6)	0.2	19 (1.2)	0.1	34 (0.8)	0.1	28 (0.3)	0.2
Intracranial	7 (0.0)	0.0	5 (0.3)	0.0	1 (0.0)	0.0	1 (0.0)	0.0
Other nongonadal sites	74 (0.5)	0.1	14 (0.9)	0.1	33 (0.8)	0.1	27 (0.3)	0.2

(Continued on following page)

TABLE A1. The Crude No. of Cases and the Age-Adjusted Incidence Rates (per 100,000 population) of Cancers Diagnosed in Adolescents and Young Adults in Jordan, 2000-2017 (N = 14,115) (Continued)

Classification	15-39 Years		15-19 Years		20-29 Years		30-39 Years	
	Crude No. (%)	Rate	Crude No. (%)	Rate	Crude No. (%)	Rate	Crude No. (%)	Rate
Melanoma and skin carcinomas	351 (2.5)	0.7	18 (1.2)	0.1	89 (2.1)	0.4	244 (2.9)	1.4
Melanoma	97 (0.7)	0.2	4 (0.3)	0	37 (0.9)	0.2	56 (0.7)	0.3
Skin carcinomas	254 (1.8)	0.5	14 (0.9)	0.1	52 (1.2)	0.2	188 (2.3)	1.0
Carcinomas	7,118 (50.4)	14.4	246 (16.1)	1.9	1,553 (36.3)	6.8	5,319 (64.0)	29.9
Thyroid carcinoma	1,510 (10.7)	2.9	86 (5.6)	0.7	560 (13.1)	2.5	864 (10.4)	4.8
Other carcinomas of head and neck	496 (3.5)	1.0	80 (5.2)	0.6	130 (3.0)	0.6	286 (3.4)	1.6
Nasopharyngeal carcinoma	230 (1.6)	0.4	63 (4.1)	0.5	74 (1.7)	0.3	93 (1.1)	0.5
Other sites in lip, oral cavity, and pharynx	159 (1.1)	0.3	10 (0.7)	0.1	40 (0.9)	0.2	109 (1.3)	0.6
Nasal cavity, middle ear, sinuses, larynx, and other and ill-defined head and neck	107 (0.8)	0.2	7 (0.5)	0.1	16 (0.4)	0.1	84 (1.0)	0.5
Carcinoma of trachea, bronchus, and lungs	197 (1.4)	0.4	3 (0.2)	0.0	39 (0.9)	0.2	155 (1.9)	0.9
Carcinoma of breast	2,591 (18.4)	5.4	1 (0.1)	0.0	326 (7.6)	1.4	2,264 (27.3)	12.8
Carcinoma of genitourinary tract	763 (5.4)	1.5	25 (1.6)	0.2	167 (3.9)	0.7	571 (6.9)	3.2
Carcinoma of kidney	143 (1.0)	0.3	7 (0.5)	0.1	26 (0.6)	0.1	110 (1.3)	0.6
Carcinoma of bladder	190 (1.3)	0.4	5 (0.3)	0.0	44 (1.0)	0.2	141 (1.7)	0.8
Carcinoma of gonads	185 (1.3)	0.4	11 (0.7)	0.1	54 (1.3)	0.2	120 (1.4)	0.7
Carcinoma of cervix and uterus	219 (1.6)	0.5	2 (0.1)	0.0	37 (0.9)	0.2	180 (2.2)	1.0
Carcinoma of other and ill-defined sites in genitourinary tract	26 (0.2)	0.1	0 (0.0)	0.0	6 (0.1)	0.0	20 (0.2)	0.1
Carcinoma of GI tract	1,346 (9.5)	2.7	37 (2.4)	0.3	276 (6.5)	1.2	1,033 (12.4)	5.8
Carcinoma of colon and rectum	835 (5.9)	1.7	27 (1.8)	0.2	150 (3.5)	0.7	658 (7.9)	3.7
Carcinoma of stomach	283 (2.0)	0.6	3 (0.2)	0.0	69 (1.6)	0.3	211 (2.5)	1.2
Carcinoma of liver and intrahepatic bile ducts	59 (0.4)	0.1	7 (0.5)	0.1	14 (0.3)	0.1	38 (0.5)	0.2
Carcinoma of pancreas	61 (0.4)	0.1	0 (0.0)	0.0	9 (0.2)	0.0	52 (0.6)	0.3
Carcinoma of other and ill-defined sites in GI tract	108 (0.8)	0.2	0 (0.0)	0.0	34 (0.8)	0.1	74 (0.9)	0.4
Carcinoma of other and ill-defined sites, NOS	215 (1.5)	0.4	14 (0.9)	0.1	55 (1.3)	0.2	146 (1.8)	0.8
Adrenocortical carcinoma	11 (0.1)	0.0	0 (0.0)	0.0	5 (0.1)	0.0	6 (0.1)	0.0
Carcinoma of other and ill-defined sites, NOS	204 (1.4)	0.4	14 (0.9)	0.1	50 (1.2)	0.2	140 (1.7)	0.8
Miscellaneous specified neoplasms, NOS	284 (2.0)	0.6	25 (1.6)	0.2	92 (2.2)	0.4	167 (2.0)	0.9
Other pediatric and embryonal tumors, NOS	29 (0.2)	0.1	5 (0.3)	0.0	16 (0.4)	0.1	8 (0.1)	0.0
Wilms tumor	4 (0.0)	0.0	1 (0.1)	0.0	2 (0.0)	0.0	1 (0.0)	0.0
Neuroblastoma	11 (0.1)	0.0	1 (0.1)	0.0	9 (0.2)	0.0	1 (0.0)	0.0
Other pediatric and embryonal tumors, NOS	14 (0.1)	0.0	3 (0.2)	0.0	5 (0.1)	0.0	6 (0.1)	0.0
Other specified and embryonal tumors, NOS	255 (1.8)	0.5	20 (1.3)	0.2	76 (1.8)	0.3	159 (1.9)	0.9
Paranglioma and glomus tumors	13 (0.1)	0.0	1 (0.1)	0.0	4 (0.1)	0.0	8 (0.1)	0.0
Other specified gonadal tumors	30 (0.2)	0.1	6 (0.4)	0.0	11 (0.3)	0.0	13 (0.2)	0.1
Myeloma, mast cell tumors, and miscellaneous lymphoreticular neoplasms, NOS	54 (0.4)	0.1	1 (0.1)	0.0	11 (0.3)	0.0	42 (0.5)	0.2
Other specified neoplasms, NOS	158 (1.1)	0.3	12 (0.8)	0.1	50 (1.2)	0.2	96 (1.2)	0.5
Unspecified malignant neoplasms	230 (1.6)	0.4	25 (1.6)	0.2	72 (1.7)	0.3	133 (1.6)	0.7
Unclassified	5 (0.0)	0.0	1 (0.1)	0.0	1 (0.0)	0.0	3 (0.0)	0.0

NOTE. Cancers are classified according to the full SEER AYA site recode/WHO 2008.

Abbreviations: AYA, adolescents and young adults; NOS, not otherwise specified; PNET, primitive neuroectodermal tumor.

TABLE A2. The Female-To-Male Age-Adjusted Incidence Rate Ratios of Cancers Diagnosed in Adolescents and Young Adults in Jordan, 2000-2017 (N = 14,115)

Classification	15-19 Years		20-29 Years		30-39 Years	
	Rate Ratio (95% CI)	P	Rate Ratio (95% CI)	P	Rate Ratio (95% CI)	P
Leukemias	0.58 (0.45 to 0.75)	< .001	0.73 (0.59 to 0.89)	.002	0.91 (0.75 to 1.09)	.31
Acute lymphoid leukemia	0.52 (0.36 to 0.73)	< .001	0.48 (0.32 to 0.70)	< .001	0.88 (0.55 to 1.39)	.64
Acute myeloid leukemia	0.74 (0.46 to 1.17)	.21	1.09 (0.78 to 1.51)	.65	0.76 (0.55 to 1.04)	.083
Chronic myeloid leukemia	0.43 (0.12 to 1.32)	.17	0.66 (0.42 to 1.02)	.062	1.29 (0.91 to 1.83)	.17
Other and unspecified leukemias	0.62 (0.24 to 1.52)	.36	0.64 (0.31 to 1.26)	.21	0.72 (0.43 to 1.20)	.23
Lymphomas	1.28 (1.07 to 1.54)	.007	1.13 (1.00 to 1.28)	.056	0.79 (0.69 to 0.91)	< .001
Non-Hodgkin lymphoma	0.82 (0.58 to 1.17)	.30	0.94 (0.76 to 1.17)	.61	0.74 (0.61 to 0.89)	.002
Hodgkin lymphoma	1.53 (1.23 to 1.90)	< .001	1.24 (1.06 to 1.45)	.006	0.85 (0.70 to 1.04)	.12
CNS and other intracranial and intraspinal neoplasms	0.68 (0.45 to 1.01)	.057	0.85 (0.67 to 1.07)	.17	0.74 (0.60 to 0.92)	.006
Astrocytoma	0.85 (0.46 to 1.55)	.67	0.83 (0.59 to 1.17)	.30	0.65 (0.49 to 0.87)	.003
Specified low-grade astrocytic tumors	2.08 (0.30 to 23.00)	.65	0.91 (0.40 to 2.06)	.96	0.63 (0.26 to 1.46)	.33
Glioblastoma and anaplastic astrocytoma	0.89 (0.38 to 2.08)	.93	0.91 (0.55 to 1.49)	.78	0.65 (0.44 to 0.95)	.024
Astrocytoma, NOS	0.57 (0.17 to 1.67)	.38	0.66 (0.34 to 1.27)	.24	0.68 (0.40 to 1.12)	.13
Other gliomas	1.04 (0.28 to 3.89)	1.00	0.59 (0.32 to 1.07)	.083	1.06 (0.65 to 1.74)	.90
Ependymoma	0.09 (0.00 to 0.65)	.008	0.58 (0.20 to 1.56)	.34	0.38 (0.11 to 1.11)	.083
Medulloblastoma and other PNETs	0.61 (0.20 to 1.67)	.41	1.47 (0.83 to 2.67)	.21	0.75 (0.30 to 1.78)	.61
Medulloblastoma	0.47 (0.13 to 1.48)	.24	1.35 (0.63 to 2.93)	.51	0.61 (0.19 to 1.81)	.47
Supratentorial PNET	2.08 (0.11 to 122.77)	.97	1.69 (0.65 to 4.71)	.33	1.11 (0.21 to 5.97)	1.00
Other specified intracranial and intraspinal neoplasms	1.04 (0.08 to 14.35)	1.00	0.53 (0.12 to 1.97)	.44	2.42 (0.77 to 8.90)	.15
Unspecified malignant intracranial and intraspinal neoplasms	0.65 (0.17 to 2.25)	.63	1.19 (0.38 to 3.86)	.94	0.60 (0.22 to 1.50)	.33
Osseous and chondromatous neoplasms	0.58 (0.42 to 0.79)	< .001	0.64 (0.47 to 0.87)	.003	0.66 (0.41 to 1.02)	.064
Osteosarcoma	0.86 (0.54 to 1.35)	.56	0.55 (0.32 to 0.94)	.026	1.08 (0.43 to 2.76)	1.00
Chondrosarcoma	0.21 (0.00 to 1.86)	.24	1.47 (0.61 to 3.70)	.47	0.46 (0.17 to 1.11)	.090
Ewing tumor	0.48 (0.28 to 0.79)	.003	0.37 (0.20 to 0.65)	< .001	0.88 (0.32 to 2.34)	.96
Other specified and unspecified bone tumors	0.15 (0.02 to 0.65)	.005	1.18 (0.58 to 2.42)	.74	0.42 (0.13 to 1.16)	.11
Soft tissue sarcomas	0.84 (0.51 to 1.36)	.52	0.89 (0.67 to 1.18)	.45	0.92 (0.72 to 1.17)	.50
Fibromatous neoplasms	1.56 (0.37 to 7.52)	.71	0.97 (0.52 to 1.81)	1.00	1.02 (0.64 to 1.64)	1.00
Rhabdomyosarcoma	0.43 (0.15 to 1.09)	.079	1.40 (0.54 to 3.77)	.58	1.03 (0.36 to 2.93)	1.00
Other soft tissue sarcomas	1.04 (0.53 to 2.04)	1.00	0.81 (0.56 to 1.15)	.24	0.87 (0.64 to 1.17)	.36
Specified soft tissue sarcoma	1.20 (0.53 to 2.74)	.77	0.86 (0.57 to 1.29)	.50	0.87 (0.63 to 1.21)	.44
Specified (excluding Kaposi sarcoma)	1.20 (0.53 to 2.74)	.77	0.88 (0.58 to 1.31)	.57	0.94 (0.67 to 1.30)	.75
Kaposi sarcoma	NA	NA	0.00 (0.00 to 40.01)	1.00	0.00 (0.00 to 0.91)	.038
Unspecified soft tissue sarcoma	0.74 (0.19 to 2.72)	.83	0.65 (0.29 to 1.39)	.30	0.84 (0.37 to 1.83)	.77
Germ cell and trophoblastic neoplasms	0.58 (0.37 to 0.92)	.018	0.26 (0.20 to 0.34)	< .001	0.13 (0.09 to 0.18)	< .001
Germ cell and trophoblastic neoplasms of gonads	0.45 (0.25 to 0.76)	.002	0.18 (0.13 to 0.24)	< .001	0.06 (0.03 to 0.10)	< .001
Germ cell and trophoblastic neoplasms of nongonadal sites	1.43 (0.52 to 4.10)	.59	2.91 (1.31 to 7.08)	.006	2.71 (1.14 to 7.13)	.021
Intracranial	0.26 (0.01 to 2.63)	.40	0.00 (0.00 to 42.29)	1.00	0.00 (0.00 to 44.38)	1.00
Other nongonadal sites	2.60 (0.75 to 11.36)	.16	3.25 (1.42 to 8.35)	.003	3.08 (1.25 to 8.63)	.011

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TABLE A2. The Female-To-Male Age-Adjusted Incidence Rate Ratios of Cancers Diagnosed in Adolescents and Young Adults in Jordan, 2000-2017 (N = 14,115) (Continued)

Classification	15-19 Years		20-29 Years		30-39 Years	
	Rate Ratio (95% CI)	P	Rate Ratio (95% CI)	P	Rate Ratio (95% CI)	P
Melanoma and skin carcinomas	0.40 (0.11 to 1.20)	.11	0.78 (0.50 to 1.21)	.29	0.97 (0.75 to 1.26)	.88
Melanoma	0.35 (0.01 to 4.32)	.66	0.99 (0.49 to 2.00)	1.00	1.97 (1.11 to 3.59)	.019
Skin carcinomas	0.42 (0.10 to 1.44)	.21	0.65 (0.35 to 1.18)	.17	0.79 (0.58 to 1.07)	.13
Carcinomas	1.47 (1.13 to 1.91)	.003	2.78 (2.48 to 3.11)	< .001	3.45 (3.24 to 3.68)	< .001
Thyroid carcinoma	5.84 (3.21 to 11.49)	< .001	4.46 (3.61 to 5.56)	< .001	4.38 (3.70 to 5.21)	< .001
Other carcinomas of head and neck	0.73 (0.45 to 1.16)	.20	0.68 (0.47 to 0.98)	.039	0.61 (0.47 to 0.78)	< .001
Nasopharyngeal carcinoma	0.68 (0.40 to 1.16)	.17	0.60 (0.36 to 0.99)	.046	0.57 (0.36 to 0.89)	.011
Other sites in lip, oral cavity, and pharynx	0.69 (0.14 to 2.93)	.80	1.06 (0.54 to 2.07)	.98	0.92 (0.62 to 1.36)	.72
Nasal cavity, middle ear, sinuses, larynx, and other and ill-defined head and neck	1.39 (0.23 to 9.47)	.96	0.36 (0.08 to 1.18)	.10	0.36 (0.21 to 0.60)	< .001
Carcinoma of trachea, bronchus, and lungs	0.00 (0.00 to 2.52)	.27	0.58 (0.28 to 1.17)	.14	0.57 (0.40 to 0.80)	.001
Carcinoma of breast	NA	NA	69.01 (29.29 to 214.09)	< .001	103.99 (69.20 to 164.44)	< .001
Carcinoma of genitourinary tract	2.21 (0.90 to 5.92)	.088	2.76 (1.95 to 3.97)	< .001	2.10 (1.76 to 2.51)	< .001
Carcinoma of kidney	6.24 (0.76 to 287.15)	.11	1.21 (0.52 to 2.86)	.77	0.86 (0.58 to 1.28)	.51
Carcinoma of bladder	0.26 (0.01 to 2.63)	.40	0.45 (0.22 to 0.88)	.018	0.14 (0.08 to 0.23)	< .001
Carcinoma of gonads	2.77 (0.67 to 16.24)	.20	27.31 (7.19 to 231.75)	< .001	25.31 (10.51 to 79.53)	< .001
Carcinoma of cervix and uterus	NA	NA	NA	NA	NA	NA
Carcinoma of other and ill-defined sites in genitourinary tract	NA	NA	5.24 (0.59 to 246.80)	.19	6.47 (1.85 to 34.45)	.001
Carcinoma of GI tract	0.71 (0.34 to 1.43)	.39	1.03 (0.81 to 1.31)	.87	1.02 (0.90 to 1.16)	.75
Carcinoma of colon and rectum	0.61 (0.25 to 1.42)	.29	1.03 (0.74 to 1.44)	.92	1.07 (0.91 to 1.25)	.42
Carcinoma of stomach	NA	NA	1.22 (0.74 to 2.02)	.48	0.95 (0.72 to 1.26)	.78
Carcinoma of liver and intrahepatic bile ducts	0.42 (0.04 to 2.54)	.49	0.60 (0.16 to 2.00)	.51	0.56 (0.26 to 1.14)	.12
Carcinoma of pancreas	NA	NA	2.10 (0.45 to 12.93)	.46	1.08 (0.60 to 1.93)	.90
Carcinoma of other and ill-defined sites in GI tract	NA	NA	0.74 (0.34 to 1.53)	.47	1.09 (0.67 to 1.77)	.80
Carcinoma of other and ill-defined sites, NOS	0.58 (0.15 to 1.92)	.47	1.10 (0.62 to 1.94)	.83	1.28 (0.91 to 1.80)	.16
Adrenocortical carcinoma	NA	NA	4.34 (0.42 to 213.63)	.33	0.57 (0.05 to 3.92)	.80
Carcinoma of other and ill-defined sites, NOS	0.58 (0.15 to 1.92)	.47	0.98 (0.54 to 1.77)	1.00	1.32 (0.93 to 1.87)	.12
Miscellaneous specified neoplasms, NOS	1.56 (0.66 to 3.88)	.37	1.89 (1.21 to 2.98)	.004	1.76 (1.27 to 2.45)	< .001
Other pediatric and embryonal tumors, NOS	0.26 (0.01 to 2.63)	.40	1.77 (0.58 to 5.92)	.39	1.83 (0.36 to 11.78)	.62
Wilms tumor	0.00 (0.00 to 40.58)	1.00	1.05 (0.01 to 83.67)	1.00	0.00 (0.00 to 40.40)	1.00
Neuroblastoma	0.00 (0.00 to 40.58)	1.00	3.78 (0.71 to 37.29)	.15	NA	NA
Other pediatric and embryonal tumors, NOS	0.52 (0.01 to 9.99)	1.00	0.69 (0.06 to 6.06)	1.00	2.22 (0.32 to 24.55)	.59
Other specified and embryonal tumors, NOS	2.43 (0.88 to 7.71)	.096	1.91 (1.17 to 3.18)	.008	1.76 (1.26 to 2.46)	< .001
Paraganglioma and glomus tumors	NA	NA	1.05 (0.08 to 14.56)	1.00	1.03 (0.19 to 5.59)	1.00
Other specified gonadal tumors	5.20 (0.58 to 246.06)	.20	4.69 (0.97 to 44.72)	.056	13.31 (1.92 to 570.00)	.002

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TABLE A2. The Female-To-Male Age-Adjusted Incidence Rate Ratios of Cancers Diagnosed in Adolescents and Young Adults in Jordan, 2000-2017 (N = 14,115) (Continued)

Classification	15-19 Years		20-29 Years		30-39 Years	
	Rate Ratio (95% CI)	<i>P</i>	Rate Ratio (95% CI)	<i>P</i>	Rate Ratio (95% CI)	<i>P</i>
Myeloma, mast cell tumors, and miscellaneous lymphoreticular neoplasms, NOS	NA	NA	0.24 (0.03 to 1.15)	.085	0.73 (0.37 to 1.41)	.39
Other specified neoplasms, NOS	1.46 (0.40 to 5.82)	.72	2.71 (1.42 to 5.43)	.001	2.35 (1.51 to 3.75)	< .001
Unspecified malignant neoplasms	0.49 (0.18 to 1.20)	.13	1.00 (0.61 to 1.63)	1.00	2.25 (1.55 to 3.31)	< .001
Unclassified	0.00 (0.00 to 40.58)	1.00	0.00 (0.00 to 42.29)	1.00	2.07 (0.11 to 122.23)	.96

Bold *P* values are statistically significant (≤ 0.05)

NOTE. Cancers are classified according to the full SEER AYA site recode/WHO 2008.

Abbreviations: AYA, adolescents and young adults; NA, not applicable; NOS, not otherwise specified; PNETs, primitive neuroectodermal tumors.