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Article

Financial outcomes of adolescent and young adult cancer survivors: a longitudinal population-based registry study

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Abstract

Background: The patterns and determinants of long-term income among adolescent and young adult (AYA) cancer survivors, and the differences compared with peers, have not yet been fully explored. This study investigated the long-term effects of cancer on the income of AYA cancer survivors.

Methods: The Netherlands Cancer Registry identified all AYA cancer patients (aged 18-39 years) diagnosed in 2013 and alive 5 years postdiagnosis. Clinical data of the selected AYA patients were linked to individual, administrative real-world labor market data of Statistics Netherlands. The control group consisted of a random sample of individuals of the same age, sex, and migration background without cancer. Data on 2434 AYA cancer patients and 9736 controls were collected annually from 2011 until 2019. Changes in income level were measured and compared with the control group using difference-in-difference regression models.

Results: AYA cancer survivors experience, on average, an 8.5% decrease in annual earnings, relative to the control population. The effects are statistically significant and permanent ($P < .01$). Younger AYAs (those aged 18-25 years 15.5% income reduction), married cancer survivors (12.3%), females (11.6%), those diagnosed with stage IV disease (38.1%), and central nervous system (15.7%) cancer patients experienced the largest decline in income, on average, relative to controls, all else constant.

Conclusion: Although dependent on the sociodemographic and clinical characteristics, a cancer diagnosis at AYA age has significant implications on the income of cancer patients. Awareness of vulnerable groups and the development of policies to mitigate the financial impact of cancer are critical.

Across the globe, approximately 1.2 million adolescents and young adults (AYAs), defined as individuals between the ages of 15 and 39 years, are diagnosed with cancer annually (1). AYAs, diagnosed with cancer, are faced with a unique set of challenges and have to deal with a twofold burden. First, the disease of cancer and its treatment often lead to long-term and late physical (eg, fatigue, neuropathy, second cancers, cardiovascular disease), psychosocial (eg, posttraumatic stress, social isolation), and cognitive (eg, impairments in attention and memory) health problems (2-4). Second, AYA patients are confronted with the developmental challenges that characterize adolescence and young adulthood, such as finishing education, starting a career, becoming financially independent, moving out of the parental home, forming a romantic relationship, and having a family (5,6). The ability of AYAs to achieve these milestones is severely impeded by the physical, psychosocial, and cognitive effects related to cancer and its treatment (6-8).

Compared with other age groups, and because of their life stage, AYAs are particularly vulnerable to the adverse economic effects of cancer treatment, also known as financial toxicity (9). AYAs diagnosed with cancer often experience severe financial setbacks such as a lower family income, higher direct out-of-pocket medical costs, depletion of assets, and a work-related productivity loss in comparison to AYAs without cancer (10-12). Beyond this immediate impact, cancer can also compromise the long-term earning potential of AYAs and contributes to financial distress that lasts long into survivorship (9).

Although there is a growing research emphasis on AYAs with cancer, economic studies investigating the labor market outcomes of cancer survivors have mainly focused on adult cancer survivors with prediagnosis employment (13-15). Little is known about the financial outcomes of AYA cancer survivors. The existing studies further suffer from several methodological weaknesses as mentioned by Teckle and colleagues (12). Firstly, income and employment data among AYA cancer survivors are often self-reported. Self-reported data are prone to systematic misreport, because individuals are, for example, uncomfortable disclosing their true income (16). Moreover, recall bias has a

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substantial effect on the validity of self-reported data. Secondly, some of the previous studies are cross-sectional in design; thus, changes in the determinants of income and employment status of cancer survivors cannot be evaluated over time (17). Thirdly, previous studies have used current or short-term employment (eg, 6 to 12 months) as opposed to longitudinal employment over a longer period of time (eg, 5 years) (17). Fourthly, only a limited number of studies used a control group from the general population; thus, relative effects were not taken into account (18). Fifthly, a majority of the previous research has been focused on US cancer survivors. The effects of cancer on labor market outcomes depend, to some extent, on the institutional setting, in particular the welfare system, labor market policies, and the coverage of health-care insurance. The findings presented in previous studies are, therefore, unlikely to be fully generalizable to other countries. Finally, few studies used population-based data and often had small sample sizes, thereby suffering from selection bias further reducing the generalizability of the findings.

Therefore, using a large, population-based set of longitudinal registry data of AYA cancer patients from the Netherlands, diagnosed in 2013, the objectives of this study were to 1) investigate the long-term effect on income of AYA cancer survivors, in particular with regard to the level of gross annual income, and 2) understand how different sociodemographic and clinical factors, such as age at diagnosis and type of cancer, contribute to the level of income of AYAs after the diagnosis of cancer.

Methods

Datasets and study sample

The present study used register data from the Netherlands Cancer Registry (NCR). This registry includes disease-specific and treatment-related data of all patients diagnosed with cancer in the Netherlands since 1989. Patients were individually linked using personal identifiers to register data on sociodemographic and work-related characteristics, income, and employment status from Statistics Netherlands (CBS). This data register contains rich labor outcomes of any given individual in the Netherlands. In addition to the individual linkage of the NCR and CBS, we have composed a reference sample from the general population, which was also based on register data from CBS.

Inclusion criteria for the cohort of AYA cancer patients were the following: 1) being diagnosed with cancer at AYA age (18-39 years) in the year 2013 using the *International Classification of Diseases for Oncology*, 2) AYA cancer being their first cancer diagnosis, and 3) being alive 5 years after diagnosis. As pediatric oncology in the Netherlands is for those aged 0-18 years, for this study, AYAs are defined as those aged 18-39 years at initial cancer diagnosis. These inclusion and exclusion criteria resulted in a patient sample of 2434 people (see Figure 1).

From CBS, a population-based reference cohort was randomly selected that was comparable in terms of age, sex, and migration background and matched to the AYA cancer patients using a 1:4 ratio. This resulted in a reference sample consisting of 9736 people. The total study sample (ie, the cancer patient sample and reference sample together) consisted of 12 170 people (see Figure 1). Data for the AYA cancer patients and the controls were collected annually from 2011 until 2019. AYA cancer patients were matched to the control population in the year of diagnosis (2013).

Study measures

Sociodemographic and work-related characteristics were retrieved from register data. Specifically, the data are based on information from the Tax and Customs Administration of the government of the Netherlands and the Municipal Personal Records Database. Cancer-related characteristics were retrieved from the NCR.

Sociodemographic characteristics

The following sociodemographic characteristics were used: age at baseline, sex (ie, male and female), education level achieved, migration background, and marital status. We used the following age group strata: 18-25, 26-32, and 33-39 years. We distinguished between the following levels of education achieved: primary education (referring to compulsory education), secondary education (high school or vocational education), and tertiary education (universities and polytechnics). A binary variable was used to indicate whether individuals had a migration background and whether they were married. A migration background is based on the birth country of the parents of an individual or of the birth country of the individual themselves. Individuals are said to have an immigration background if they are either a first-generation immigrant or a second-generation immigrant.

Cancer-related characteristics

For the patient population, the following cancer-related characteristics were used: type of cancer [ie, skin cancer, breast cancer, etc.; classified according to the third *International Classification of Diseases for Oncology* (19)], cancer stage (ie, I, II, III, and IV; classified according to TNM or Ann Arbor Code), and cancer treatment (ie, surgery, chemotherapy, radiotherapy, and targeted treatment).

Work-related characteristics

The following work-related characteristics at the individual level were used: the employment status and the annual gross income. Employment status was based on the main activity during the calendar year. A binary variable indicating whether or not the person was employed was used. For the purpose of this research, individuals are considered employed if they are employed full-time or in formal employment or self-employment. Those who are studying or at school are not considered full-time employed. For those who take time off to receive their therapy, they will be listed as employed given that they do not terminate their contract. The gross annual individual income refers to the total income from employment and all social security benefits, excluding child benefits. Income was measured in euros, and no adjustments were made for inflation. All work-related characteristics were observed annually from 2011 until 2019.

Statistical analyses

All variables were described as means and standard deviations (continuous data) or frequencies and percentages (categorical data). Analysis of variance (continuous data) and χ^2 tests (categorical data) were performed to compare characteristics of the total population, the patient cohort, and the control group.

The difference-in-differences (DiD) regression framework is used to estimate the average causal effect of cancer on income (20). DiD is a quasi-experimental design that makes use of longitudinal data from the patient and control groups to estimate the causal effect of cancer. This approach accounts for group-specific and time-specific effects. Taking the difference within

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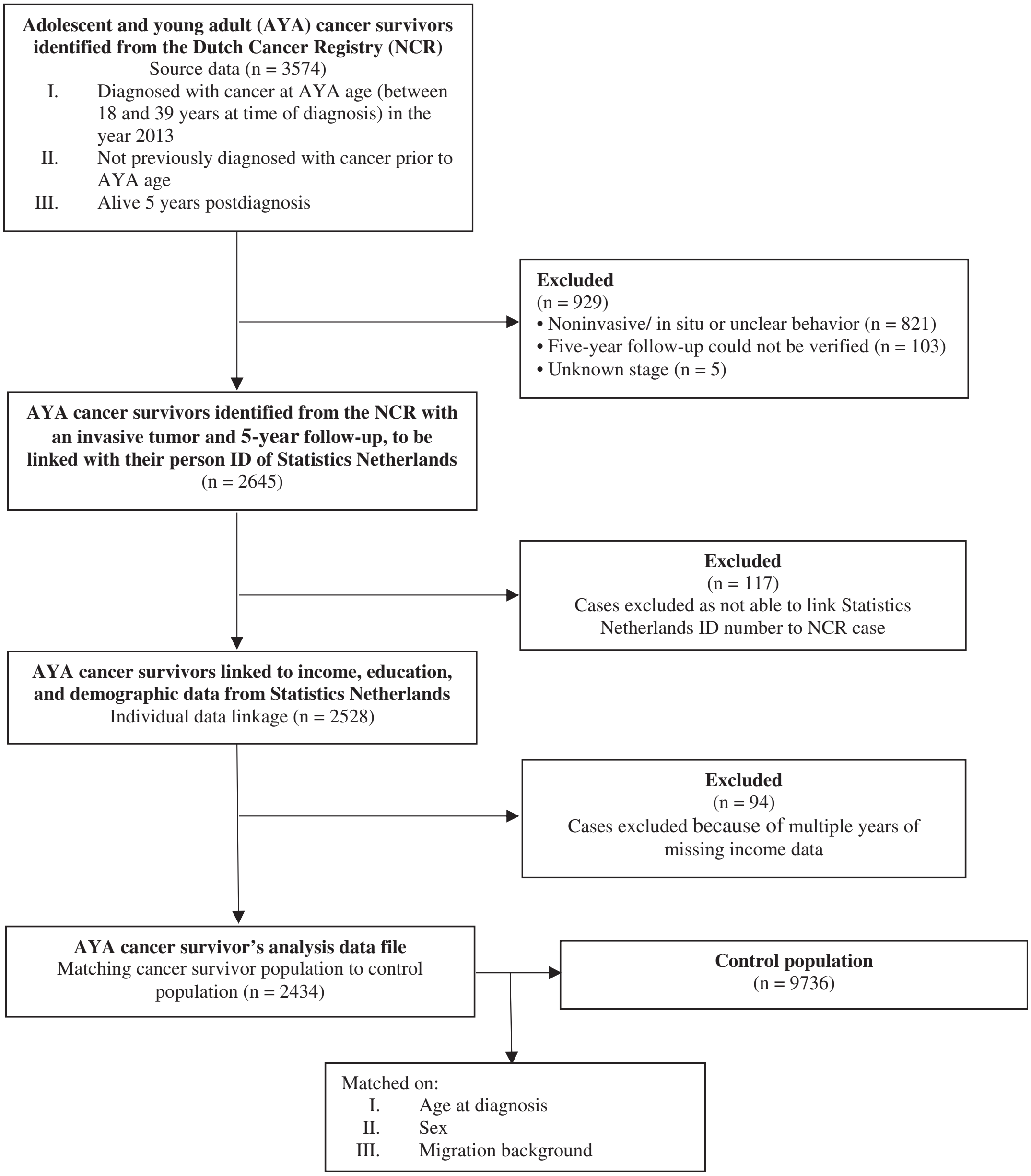

Figure 1. NCR data linked to income and demographic data from Statistics Netherlands. ID = identification number.

the patient and control population eliminates the systematic individual effects, and taking the difference between the 2 groups removes the common time trend.

The causal effect of cancer on income is technically referred to as the "average treatment effect of the treated"; going forward, we will refer to this as the "treatment effect." Following the recommendations of Abadie et al. (21), standard errors are clustered at the individual level, and the logarithm of gross annual income is the dependent variable of interest.

The triple DiD estimator was used to estimate the heterogeneous treatment effect (22). In other words, the triple DiD estimator was used to investigate how the treatment effect varies by specific sociodemographic characteristics, such as one's sex, age at diagnosis, marital status, and migration background. The heterogeneity of the treatment effect with regard to the stage of cancer diagnosed was investigated using a multicategory exposure model (23-25). Finally, the treatment effect was investigated separately for different subgroups of AYA patients, dependent on the type of cancer diagnosed. Supplementary Methods 1 and 2 (available online) provide more insight in the DiD analysis.

Missing data were imputed using the random forest supervised learning algorithm (26). All analyses were repeated removing individuals with missing data to confirm whether our estimates were influenced by the inclusion of missing values for predictors (<5% of all observations). All analyses were performed using STATA version 17. *P* values were 2-sided, with a *P* value less than .05 considered statistically significant.

Results

Descriptive statistics

The patient cohort is made up of 1412 females and 1022 males. This cohort is on average aged 31.6 years with 19% having a migration background. Patients are, on average, highly educated

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Table 1. Demographic and clinical characteristics of the AYA patient population and control population

Characteristics	Patients, No.[a] (n = 2434)	Controls, No. [a] (n = 9736)
Age in 2013, mean (SD), y	31.6 (5.8)	31.6 (5.8)
Sex		
Male	1025 (42)	4089 (42)
Female	1409 (58)	5647 (58)
Married	925 (38)	3602 (37)
Education		
Primary education	365 (15)	1460 (15)
Secondary education	1071 (44)	4284 (44)
Tertiary education	998 (41)	3992 (41)
Migration background	462 (19)	1850 (19)
Age at diagnosis, y		
18-25	427 (17.5)	—
26-32	751 (30.9)	—
33-39	1256 (51.6)	—
Cancer type		
Skin	507 (20.8)	—
Breast	490 (20.1)	—
Male genitalia	428 (17.6)	—
Hematologic	316 (13.0)	—
Female genitalia	190 (7.8)	—
Endocrine	123 (5.1)	—
Digestive organ	115 (4.7)	—
CNS	75 (3.1)	—
Bone cartilage	67 (2.75)	—
Urinary tract	49 (2.0)	—
Head and neck	42 (1.7)	—
Respiratory tract	22 (0.9)	—
Other	10 (0.4)	—
Stage at diagnosis[b]		
I	1341 (55.1)	—
II	534 (21.9)	—
III	230 (9.5)	—
IV	103 (4.2)	—
Unknown or unstaged	226 (9.3)	—

[a] Columns Patients and Controls provide the mean values of each variable in the year 2012, with the standard deviation in parentheses. CNS = central nervous system. Clinical characteristics for the control population are not applicable, as indicated here with a dash.
[b] Stage at diagnosis was determined using the Ann Arbor, Figo, and the standard cancer staging protocols defined by the *International Classification of Diseases for Oncology*, Third Edition, topography and histology codes (19).

with 41% completing tertiary education and 44% completing secondary education. In addition, 38% of patients are married.

After matching the population-based reference cohort on age, sex, and migration background with the patient population, all observable variables are similar prediagnosis between the control and the patient population (Table 1). Table 1 also provides an overview of the clinical characteristics of the AYA patient cohort. It should be noted that skin, breast, male genitalia, female genitalia, digestive organ, endocrine, and hematological cancers account for 90% of the cancers in the AYA age group, with the majority (55%) of cancers being diagnosed at stage I.

Patient vs control group in general

The trends in the average annual income and employment status of the patient and the control groups are illustrated in Figure 2. Pretreatment trends are similar among the AYA patient cohort and the control group. Following diagnosis in 2013, these trends, however, start to diverge.

Average income for the patient cohort is slightly higher prediagnosis but, relative to the control population, decreases afterward. The relative reduction in income of the patient cohort for a large part occurs in the years 2013 and 2014. Albeit stable after this period, the relative reduction in income appears permanent ($P = .003$).

Employment trends also appear similar pretreatment ($P = .405$). Following diagnosis, however, a statistically significant change in the employment status, relative to the control group, is observed ($P = .000$). The proportion of patients employed drops by approximately 8% compared with a 2% decrease in employment for the control group in the same period. Employment status for the patient population, despite not returning to its previous level, recovers slightly over time (Supplementary Figures 1-3, available online, provide the employment trends stratified by age group and gender).

Treatment effect on income

Table 2 shows the results for the effects of a cancer diagnosis on the logarithm of earnings. Table 2, column 1, provides the estimate of the treatment effect without individual-level fixed effects. The main coefficient of interest measures the interaction effect between patient and the posttreatment period. The coefficient of -0.095 indicates that cancer diagnosis on average decreases the earnings of an AYA patient by approximately 9.5% relative to the control group ($P < .01$).

The coefficient for the patients is often referred to as the baseline difference. It shows that before the cancer diagnosis took place, AYA patients had an income that was on average approximately 3.8% greater than the control population. Thus, on average, cancer diagnosis led to a reversal in the difference in mean income levels between these 2 groups.

Controlling for the observed demographic characteristics (sex, age, marital status, migration background, and educational level) hardly impacts the treatment effect (Table 2, column 2). Adjusting the model for these covariates leads to a decline in annual earnings of approximately 9.0%, relative to the control population, all else constant.

Column 3 of Table 2 shows the estimated impact of the cancer diagnosis when additionally controlling for unobserved time-constant individual effects. The estimated coefficient is negative and statistically significant, implying that AYA patients diagnosed with cancer experience on average approximately an 8.5% decline in earnings relative to the control population, all else constant. Although not statistically significantly different, the estimated treatment effect is slightly smaller than those estimated without individual fixed effects.

Heterogeneous treatment effects on income

Next, we examined whether the treatment effect is heterogeneous along several socioeconomic characteristics. This was done using an individual fixed-effect regression approach applied to the triple DiD framework. Estimation results are shown in Table 3.

Following cancer diagnosis, on average, women experience a greater decline in income than men. Relative to the control population, these individuals experience an approximate 11.6% decrease in income, all else constant. By contrast, male AYA patients experience, on average, a 4.5% reduction in earnings. Although the effect for females is more than twice as large as for males, the difference in treatment effects by sex was not statistically significant.

AYA patients between the ages of 18 and 25 years experience the greatest decline in income. These individuals experience an approximate 15.5% decrease in income, relative to the control group, all else constant. Opposed to this, AYA patients between the ages of 26-32 and 33-39 years experience a 7.9% and a 7.0% reduction in income, respectively.

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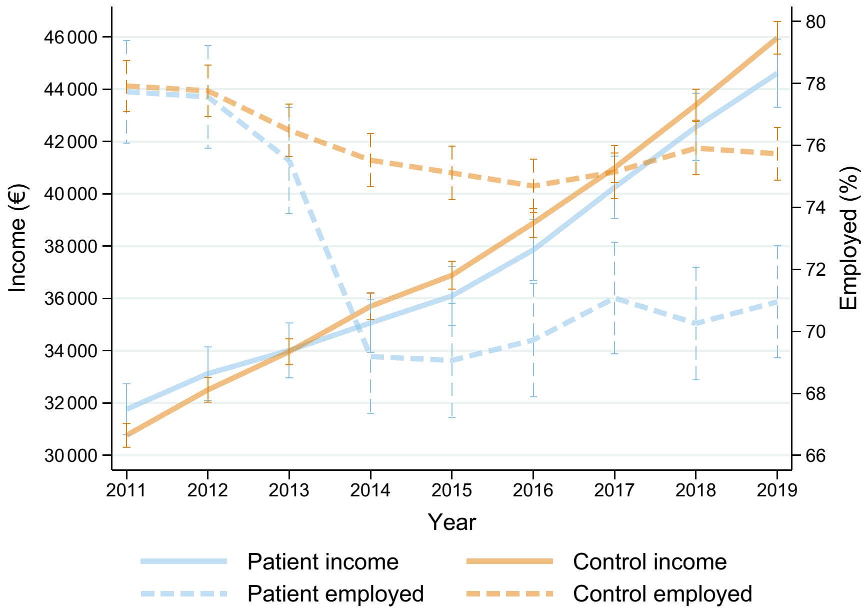

Figure 2. Average annual income (euros) and employment levels among the treated and the control population. Vertical bars depict the 95% confidence interval.

Table 2. Ordinary least squares (OLS) and fixed effects (FE) estimates of the average treatment effect on the income of the treated using the difference-in-difference regression framework[a]

	Column 1 OLS (n = 109 195)	Column 2 OLS (n = 109 195)	Column 3 FE (n = 109 195)
Patient	0.038 (0.043)	0.017 (0.039)	
Posttreatment	0.294[f] (0.014)	0.085 (0.052)	−0.280[f] (0.081)
Patient # post	−0.095[e] (0.032)	−0.090[e] (0.031)	−0.085[e] (0.031)
Age in 2013, y[b]			
26-32		0.363[f] (0.056)	
33-39		0.022 (0.094)	
Female		−0.729[f] (0.023)	
Migration background		−0.387[f] (0.042)	
Married		−0.335[f] (0.029)	−0.125[f] (0.023)
Highest level of education achieved[c]			
Secondary		0.567[f] (0.046)	0.912[f] (0.060)
Tertiary		1.179[f] (0.047)	1.637[f] (0.075)
Constant	9.74[f] (0.02)	8.04[f] (0.14)	

[a] OLS and FE regressions using individuals' logarithm of annual earnings as the dependent variable. Year fixed effects and age are omitted but controlled for and standard errors, shown in parentheses, are clustered at the individual level.
[b] Reference groups: 18-25 years.
[c] Primary education.
[d] $P < .05$, [e] $P < .01$, [f] $P < .001$.

AYA patients with a migration background were found to experience a smaller decline (2.6%) in income compared with those without a migration background (9.9%), all else constant. It should be noted, however, that the relatively small number of AYA patients with a migration background prevent statistically significant differences in the treatment effect from being observed between these 2 groups.

Finally, married AYA patients experience a larger treatment effect than their unmarried counterparts. Following a cancer diagnosis, the income of married AYA patients decreases by 12.3%, relative to married individuals in the control group, all else constant. Conversely, unmarried AYA patients experience, on average, a 6.5% reduction in annual earnings compared with the control group.

Treatment effect on income by clinical characteristics

Type of cancer. The treatment effect is investigated for those diagnosed with skin, breast, male genitalia, hematological, and central nervous system (CNS) cancer. These types of cancers account for more than 70% of all the diagnoses in the AYA age group. Although not statistically significant, the treatment effect on income is largest for those diagnosed with CNS cancer (-15.7%), this is followed by breast (-15.0%), hematological (-11.2%), male genitalia (-3.5%), and skin cancer (-2.2%) respectively (Table 4).

Of the cancer types investigated, the treatment effect was only statistically significant for those diagnosed with breast cancer. The average treatment effect experienced for these individuals (-15.0%) is statistically significant at the 5% level and is almost double the average treatment effect for all AYA patients (-8.5%).

Discussion

This population-based, long follow-up study showed that, following diagnosis, AYA cancer survivors reported statistically significantly lower income relative to the control population. The study's findings demonstrate that demographic and clinical characteristics statistically significantly predict the level of income of these survivors. The study found that age at diagnosis, marital

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Table 3. Heterogeneity of the treatment effect on income by sociodemographic variables[a]

	Sex Logarithm (SE)	Age Logarithm (SE)	Migration background Logarithm (SE)	Marital status Logarithm (SE)
Post	−0.166[b] (0.083)	0.347[d] (0.087)	−0.282[d] (0.082)	−0.161 (0.082)
Patient # Post	−0.045 (0.039)	−0.155 (0.091)	−0.099[b] (0.031)	−0.065 (0.037)
Patient # Post # Female	−0.071 (0.059)			
Patient # Post # Age				
Patient # Post # 26-32		0.076 (0.106)		
Patient # Post # 33-39		0.085 (0.098)		
Patient # Post # Migration background			0.073 (0.101)	
Patient # Post # Married				−0.058 (0.067)

[a] To economize on space, only the results for the parameters of interest are provided. This model also controls for year fixed-effects, group fixed effects, sex, age, education, marital status, the migration background, and several interaction terms. Standard errors are clustered at the individual level.
[b] $P < .05$, [c] $P < .01$, [d] $P < .001$.

Table 4. Subgroup fixed effects difference-in-difference analysis, investigating the treatment effect on income by type of cancer

	All Logarithm (SE)	Skin Logarithm (SE)	Breast Logarithm (SE)	Male genitalia Logarithm (SE)	Hematological Logarithm (SE)	CNS[a] Logarithm (SE)
Post	−0.280[c] (0.081)	−0.248 (0.153)	0.075 (0.198)	−0.455[b] (0.179)	−0.551[b] (0.251)	−0.074 (0.074)
Patient # post	−0.085[c] (0.031)	−0.022 (0.054)	−0.150[b] (0.074)	−0.035 (0.063)	−0.112 (0.088)	−0.157 (0.129)

[a] Fixed effects difference-in-difference regression to investigate the treatment effect by the type of cancer. The sex, migration background, age, level of education, marital status, time fixed effects, and group fixed effects are omitted but controlled for. The logarithm of annual earnings is the dependent variable, and standard errors are clustered at the individual level. CNS = central nervous system.
[b] $P < .05$, [c] $P < .01$, [d] $P < .001$.

status, and sex are important demographic factors that have an impact on the income of cancer survivors. Specifically, a lower income was reported for younger AYAs (aged 18-25 years at diagnosis), married cancer survivors, and females.

With regard to the age at diagnosis, economic reasoning could suggest that younger individuals are less likely to have prediagnosis full-time employment and are thus more heavily impacted by a cancer diagnosis. In many instances, these AYAs are unable to finish their education and are delayed when entering the workforce. Consequently, this likely has a negative impact on the long-term earnings potential for these individuals. Although out of the scope of this paper, further research should identify to which extent the treatment effect is mediated through education for young AYAs.

Differences in the treatment effect on level of income, by marital status, could be explained by differences in financial flexibility between these 2 groups of patients. Married individuals often have an employed partner and thus may not have a financial requirement to continue employment throughout cancer treatment. Ahn et al. (27) also found that a higher level of employment, among cancer survivors, is correlated with being single or separated, divorced, or widowed. Additional research is required to investigate the impact of cancer on household labor division and its spillover effects on household income.

Previous studies further show that female cancer survivors take statistically significantly longer sick leaves and reduce their working hours to a greater extent than their male counterparts (28). This adds further support to the existing hypothesis that the effect of health on income is an important determinant, which is more pronounced for females (29).

Unsurprisingly, the type of cancer and its stage also have statistically significant implications on the labor market outcomes for AYA cancer survivors. Like previous studies, the largest treatment effects were observed for AYAs diagnosed at a later stage. Jeon (15), for example, found that cancer patients with a low chance of survival experience a much greater decline (-27.7%) in income compared with those with a high chance of survival (-9.6%). With regard to the type of cancer, CNS cancer survivors experienced the largest decline in income, followed by breast, hematological, male genitalia, and skin cancer patients, respectively. The sharp decline in incomes observed for CNS survivors is likely attributed to the multiple, severe, long-term health problems these survivors generally experience (30,31). The results found in this study are in line with previous research in childhood cancer survivors (12,32-34).

Exploiting rich register data, this study was able to overcome the typical challenges associated with the interpretation of the causal relationship between health and labor market outcomes. In particular, this study used a population-based, longitudinal data set of all Dutch AYA cancer survivors diagnosed in 2013. Thus, the study was able to exploit a quasi-experimental design in which a DiD estimator allowed for causal interpretation. As well as the long follow-up period used and the population-based nature of this study, another strength of this research was that only data abstracted from governmental databases and medical records were used.

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To ensure validity of the results, it is important that the variation in income is not due to any time-varying factors, other than the treatment effect itself. Although this study controlled for many potential confounders in the relationship between cancer diagnosis and labor market outcomes, such as individual fixed characteristics and common time trends, there remains the possibility of bias arising from unobserved time-varying confounders. Such a bias could invalidate the causal interpretation of the treatment effect. For example, any impacts of policies or any other factors that are time-varying and lead to different outcomes for the patient and the control population would be included in the coefficient interpreted as the treatment effect. Most potential confounding candidates of cancer diagnosis on labor market outcomes are demographic characteristics, time trends, and observed variables known to confound this relationship, all of which were controlled for. Nevertheless, unmeasured time-varying confounding remains a possibility.

It should further be noted that the estimates of the treatment effect presented here could be underestimated. This study only considers AYA patients who survived 5 years postdiagnosis. The true treatment effect for all AYA patients, including those who passed away, is likely much larger. This is particularly the case for those diagnosed with an invasive cancer at a late stage. Moreover, the binary classification of employment as either full-time or non–full-time restricts the exploration of the nuanced reduction in employment levels among AYAs working part-time, but classified as non–full-time employed, thereby overlooking the multifaceted impact of the reemployment status on their overall employment experience.

The estimates of the treatment effect, with regard to income, are largely consistent with results in Moran, Short, and Hollenbeak (35); Jeon (15); Heinesen and Kolodziejczyk (36); and Vaalavuo (37). It is, however, important to note that the effects of cancer on labor market outcomes depend, to some extent, on the institutional setting, in particular the welfare system, labor market policies, and the coverage of health-care insurance. The findings presented in this research may not be generalized to other countries, particularly those with a different institutional setting.

Cancer history plays an important role in the economic wellbeing for the thousands of AYAs diagnosed with cancer annually. It is vital that the Dutch Ministry of Health, Welfare and Sport; the cancer care institutions; labor force organizations; disability programs; and industry develop policies to address the economic status of these individuals. To start, the International Late Effects of Childhood Cancer Guideline Harmonization Group recently developed evidence-based guidelines to harmonize the employment surveillance recommendations and recommends that all survivors of childhood and AYA cancer receive regular screening for their employment outcomes (38). Particular attention should be given to younger AYAs, females, married cancer patients, CNS cancer survivors, and those diagnosed at a late stage. Economic inequality can only be associated with hardship for survivors. The development of policies to mitigate the financial impact of the serious health shock associated with cancer is therefore critical.

Data availability

Restrictions apply to the availability of the data described in this paper. The data underlying this article were provided by the Netherlands Cancer Registry (NCR) and Statistics Netherlands (CBS) by permission. Data can be shared upon reasonable request to the corresponding author with permission of both the NCR and CBS.

Author contributions

Ties Siebinga, MSc (Formal analysis; Methodology; Software; Validation; Visualization; Writing—original draft; Writing—review & editing); Silvie Janssen, MSc (Conceptualization; Data curation; Project administration; Software; Supervision; Writing—review & editing); Anke W Boumans, MSc (Writing—review & editing); Mies van Eenbergen, PhD (Conceptualization; Funding acquisition; Writing—review & editing); Bettina Siflinger, PhD (Supervision; Writing—review & editing); Winette T.A. van der Graaf, MD, PhD (Funding acquisition; Supervision; Writing—review & editing), and Olga Husson, PhD (Conceptualization; Data curation; Funding acquisition; Investigation; Project administration; Resources; Supervision; Writing—review & editing)

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Conflicts of interest

The authors declare no conflict of interest.

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