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Impact of a cancer diagnosis on educational, employment, health-related quality of life, and social outcomes among young adults: A matched cohort study of 401 cancer survivors aged 15–24 in England

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ABSTRACT

Background: Globally, cancer incidence is rising fastest among young people. Existing literature on acute health shocks, including cancer diagnoses, focuses on older working-aged adults.
Methods: Matched cohort study involving 401 young cancer survivors (aged 15–24) in the BRIGHTLIGHT study and 765 UK Household Longitudinal Study controls without cancer between 2013 and 2018. Participants were matched on sex, age, ethnicity, index of multiple deprivation (IMD) quintile, non-cancer health conditions, and follow-up duration. Regression models assessed economic, educational, social, health-related quality of life (HRQoL), and mental health outcomes at 6(T1), 12–18(T2), and 24–36 months (T3) post-diagnosis.
Results: Compared to matched controls, those with cancer were: less likely to be in employment, education, or training at T1 (OR = 2.03, $p < 0.001$) but not at T3 (OR = 0.96, $p = 0.18$), because transitioning from unemployment or economic inactivity into education was more common (24 % vs 3 % between T1 and T3); less likely to live in parental households at T1 (OR = 0.54, $p < 0.001$) and T3 (OR = 0.59, $p < 0.001$); and more likely to experience relationship breakdown (23 % vs 12 % between T1 and T3). Differences in mental health and HRQoL declined over time (mean difference compared to matched controls: T1: −0.07, $p < 0.001$; T2 and T3: −0.01 $p \geq 0.55$). Economic outcomes, mental health and HRQoL utility scores were persistently worse among more severe cancer cases.
Conclusions: Despite having initially poorer health and economic outcomes, cancer survivors in this cohort caught up with their peers within 3 years. Linked clinical data showed those with more severe diagnoses were affected most, indicating scope for improved psychosocial and economic support.

1. Introduction

Acute health shocks, such as cancer diagnoses, have wide ranging and long-term social and economic impacts among working-age people (Jones et al., 2020). However, few studies have examined the impacts of health shocks in young people (i.e. those aged 15–24 years (United Nations, 2023)), despite this being a critical period that shapes adult life. Cancer diagnoses can lead to prolonged absences from education and work, and withdrawal from social activities (McGrady et al., 2024), resulting in missing crucial milestones such as high school graduation, university enrolment, career establishment, independent living, and the formation of adult relationships (Vetsch et al., 2018). These milestones may influence the formation of longer-term economic, social and health trajectories (Hullmann et al., 2016; Sawyer et al., 2012).

A current global policy concern is the rising incidence of cancer (Alvarez et al., 2022; Torre et al., 2016), which has increased by 22 percent among young people in the UK between 1990 and 2019 - faster than in any other age group (Cancer incidence by age, 2021). Combined with higher remission rates and declining mortality rates (Keegan et al., 2024), attributed in part to improved diagnosis and treatment (Janssen et al., 2021; Liu et al., 2018; O'Hara et al., 2015; van Der Meer et al., 2020), it is increasingly important to understand how a cancer diagnosis affects both immediate and long-term economic and social outcomes (Jones et al., 2020; Gupta et al., 2018; Lenhart, 2019). A particular

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concern is rising economic inactivity in young people due to ill-health, and the possibility of them never coming back to work (IfE, 2023; Resolution Foundation, 2024).

Evidence on economic, social, and health outcomes in young people post cancer-survival is sparse (Bradford et al., 2022). Globally, there are only five panel data studies of cancer survivors aged under-40 drawing longitudinal comparisons with matched control groups without cancer (Brinkman et al., 2019; Daniel et al., 2019; Gibson et al., 2015; Jörngården et al., 2007; Siebinga et al., 2023). Of these only one study addresses economic and financial outcomes (Siebinga et al., 2023), and only one includes health utility outcomes (Jörngården et al., 2007). There are no matched-control studies covering outcomes across all three domains of education/employment, health, and social well-being. There are also no studies that have examined how a cancer diagnosis affects the transitions young people make between outcome categories over time. For example, establishing how cancer influences the likelihood of people moving from periods of economic inactivity to full time work or education later in life.

This study aimed to determine how a cancer diagnosis affected the lives of 401 cancer survivors aged 15–24. By comparing these individuals to a matched control group with similar underlying characteristics but without cancer, we sought to answer the following research questions:

RQ1. How does a cancer diagnosis affect changes in education, employment, marital/cohabiting relationships and living status among young people when compared to matched peers without cancer?

RQ2. How does a cancer diagnosis affect trajectories of health-related quality of life (HRQoL) and mental health among young people when compared to matched peers without cancer?

RQ3. Using linked clinical data, how does cancer severity influence these outcomes?

2. Materials and methods

2.1. Data sources

Two cohort studies were used. Data on cancer survivors (the exposure group) came from BRIGHTLIGHT, which recruited 1114 people aged 13–24 years at cancer diagnosis (ICD-10 codes C00-C97) from 97 English National Health Service (NHS) hospitals. This encompassed approximately one fifth of new cases in England within this age group over the 30-month recruitment period (Taylor et al., 2019). Data collection occurred through five self-complete surveys (Wave 1 to 5) at approximately 6-, 12-, 18-, 24-, and 36-months post-diagnosis which were also linked to clinical records. Wave 1 data were collected between January 2013 and September 2015 through face-to-face administered surveys and subsequent waves were administered online or by telephone. Following the United Nations definitions of 'Youth' (United Nations, 2023) we included only those aged 15–24 years. Our analyses were also limited to cancer survivors i.e. including only those who had completed the Wave 1 survey (T1 in our study) *and* provided a longer-term follow-up at either Wave 4 or 5 (T3), collected between 2015 and 2018. For RQ2 and RQ3, mid-point outcomes were also

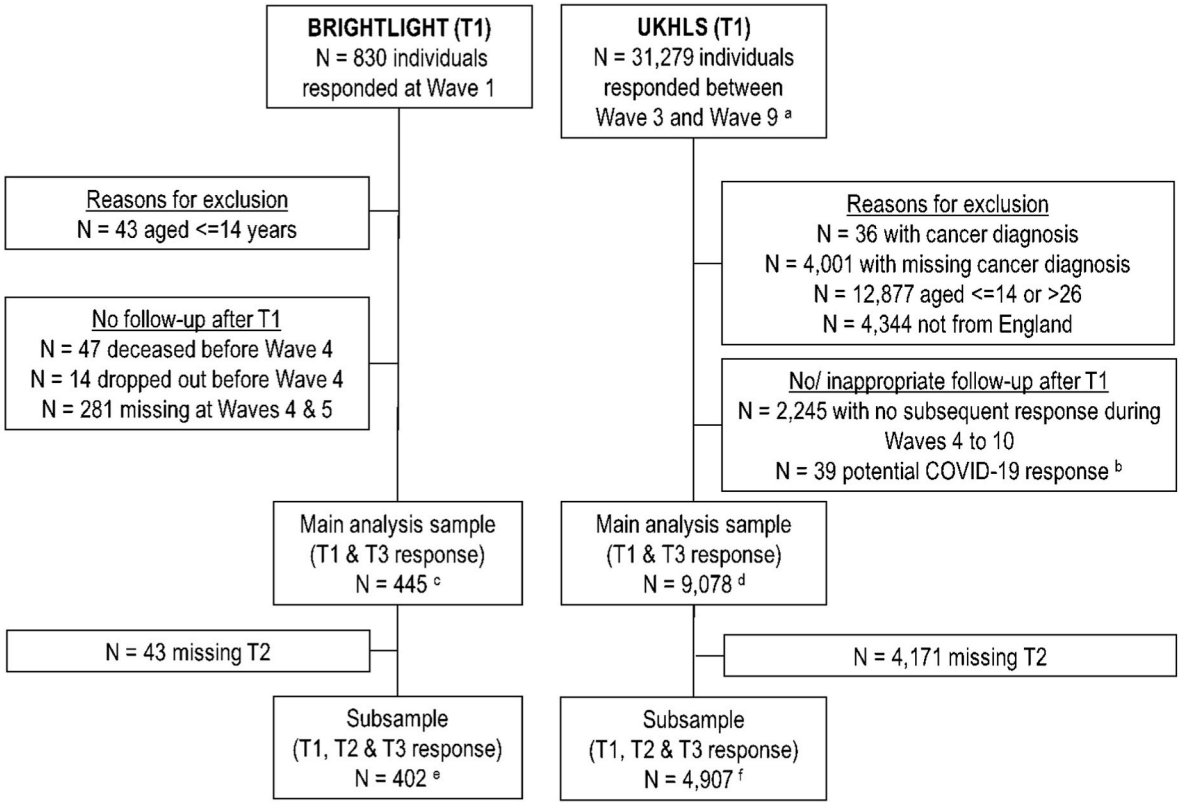

Fig. 1. The BRIGHTLIGHT study dates were from 2012 (recruitment) to 2018 (final data collection Wave 5). The UKHLS sample includes data from Wave 3 (2011–2013) to Wave 10 (2018–2020). a: UKHLS T1 responses obtained from: Wave 3, N = 4445 (49 %); Wave = 4, N = 1010 (11 %); Wave 5, N = 677 (8 %); Wave 6, N = 1243 (14 %); Wave 7, N = 671 (7 %); Wave 8, N = 569 (6 %); and Wave 9, N = 463 (5 %). b: Potential COVID-19 responses classified for any responses after January 2020. c: BRIGHTLIGHT T3 responses obtained from: Wave 4, N = 142 (32 %); and Wave 5, N = 303 (68 %). d: UKHLS T3 responses obtained from: Wave 4, N = 1492 (16 %); Wave 5, N = 2267 (25 %); Wave 6, N = 1719 (19 %); Wave 7, N = 1023 (11 %); Wave 8, N = 886 (10 %); Wave 9, N = 631 (7 %); and Wave 10, N = 1060 (12 %). e: BRIGHTLIGHT T2 response obtained from: Wave 2, N = 84 (21 %); and Wave 3, N = 318 (79 %). f: UKHLS T2 responses obtained from: Wave 4, N = 2187 (45 %); Wave 5, N = 916 (19 %); Wave 6, N = 389 (8 %); Wave 7, N = 575 (12 %); Wave 8, N = 378 (8 %); Wave 9, N = 462 (9 %); and Wave 10, N = 462 (9 %).

assessed for the subsample who responded to Wave 2 or Wave 3 (T2) (Fig. 1).

Data on young people without cancer (the matched control group) came from the UK Household Longitudinal Survey (UKHLS), a nationally representative household panel survey initiated in 2009 (Wave 1) with annual follow-up and comprising over 100,000 individuals (Understanding Society, 2009). The UKHLS and BRIGHTLIGHT involved similar survey methodology and overlapping questionnaire items collecting various health, social and demographic data during the same time period. Our analysis included English UKHLS participants aged 15–24 during waves 3 to 9 (T1 in our study) who provided at least one additional survey response during UKHLS waves 4 to 10 (T3) up to 3-years later (aged 18–27), mirroring the criteria and study dates for our exposure sample (Fig. 1). UKHLS participants who self-reported any current or previous cancer diagnosis were excluded.

2.2. Variables

Outcome and sociodemographic control variables were derived from self-report questionnaire responses, and clinical variables were obtained in BRIGHTLIGHT from healthcare records (Taylor et al., 2019). Full variable descriptions are provided in Appendix 1.

2.2.1. Economic and social outcomes

At each time point, employment status was categorised as follows (Jones et al., 2020): work, if in full-time or part-time employment, self-employment, or paid training without education (United Nations, 2023); education, if in education and part-time employment/not in employment; and (McGrady et al., 2024) not in any form of education, employment, or training (NEET), or off work long-term due to sickness or disability.

Education level was defined by the UK curriculum structure (Jones et al., 2020): key stage four (KS4) or below which includes high school education up to age 16 (United Nations, 2023); key stage five (KS5) which includes post-16 college education; and (McGrady et al., 2024) higher education which includes post-18 university courses. Additionally, BRIGHTLIGHT data captured individuals' current year of study at school (this was not reported in UKHLS).

Social outcomes were measured using two dichotomous variables identifying whether participants were in serious relationships (defined as marriages, civil partnerships or cohabiting), and whether they lived in their parental households (defined as living with their parents, foster parents or relatives). These variables were derived based on responses to a variety of survey questions on relationships and living arrangements in BRIGHTLIGHT and UKHLS.

2.2.2. HRQoL and mental health

Each dataset utilised different self-report instruments to measure HRQoL. BRIGHTLIGHT used the EQ-5D-3L (Oppe et al., 2007) and UKHLS used the 12-item Short Form Health Survey (SF-12) (Brazier and Roberts, 2004). To enable comparison between the studies a UK-based mapping algorithm was used to convert SF-12 responses to a corresponding EQ-5D-3L health state (Gray et al., 2006). In both datasets, health utility values were assigned to the EQ-5D-3L health states using the recommended UK time-trade-off valuation study (Dolan, 1997).

Similarly, BRIGHTLIGHT and UKHLS administered different mental health questionnaires, which could not support direct comparisons across the cohorts. Our outcome variables for BRIGHTLIGHT were anxiety and depression, assessed using the anxiety (HADS-A) and depression (HADS-D) subscales of the Hospital Anxiety and Depression Scale (HADS) separately. We used a threshold score of 8 or more to identify subclinical cases on each of the HADS-A and HADS-D scales (van Erp et al., 2022; Wu et al., 2021). The UKHLS includes the General Health Questionnaire-12, consisting of 12 questions related to mental distress (Goldberg and Williams, 1988). We identified cases using a total score threshold of 4 or more (Pierce et al., 2020).

2.2.3. Sociodemographic control variables

Sociodemographic control variables were obtained at the time of cancer diagnosis for BRIGHTLIGHT and at T1 for UKLHS, and consisted of: participants' gender/sex (male or female); ethnicity (white British or not white British); highest education qualification (none, GCSE (i.e. KS4), A-level (i.e. KS5), and higher education e.g. degree); index of multiple deprivation (IMD) quintile ranging from 1 (most deprived) to 5 (least deprived); and presence of any long-term non-cancer health conditions (LTC) (yes, no). The LTCs comprised consistently listed conditions in both BRIGHTLIGHT and UKHLS, including infections, cardiovascular, pulmonary, kidney, liver, neurological, and doctor-diagnosed mental health conditions, but excluding disabilities and visual/hearing problems. Additional control variables included participants' age in years at cancer diagnosis (BRIGHTLIGHT only), age at T1 (both cohorts), duration (months) between cancer diagnosis and T1 (BRIGHTLIGHT only), and duration (months) between T1, T2 and T3 (both cohorts).

2.2.4. Cancer severity

A severity of illness index which captures differences in staging criteria and treatment burden across different cancer types (Taylor et al., 2019) was used to define two categories of cancer severity (least and intermediate/most severe) (BRIGHTLIGHT only). For instance, the least severe cancers include stage 1–3 germ cell tumours, stage 1–2 soft tissue sarcomas, non-Hodgkin's lymphomas and melanomas, and stage 1 carcinomas.

2.3. Matching

Matching of BRIGHTLIGHT and UKHLS participants involved a combination of propensity score matching and exact matching using "MatchIt" in R (Version 4.2.2). Since participants' age is a key determinant of school year, education, and work outcomes, exact matching was used for age (years) at T1 and the follow-up duration (time between T1 and T3 measured in 6-month intervals). Other matching variables were gender, ethnicity, LTC, highest qualification, and IMD (condensed into quintiles 1, 2, and 3+ to improve matching performance). We evaluated various matching specifications and selected the best performing by analysing diagnostic plots (Zhang et al., 2019). The final specification used a 1:2 ratio (BRIGHTLIGHT: UKHLS), a nearest neighbour without replacing algorithm, and a generalised linear regression model with a Probit link function.

2.4. Statistical analyses

The statistical analyses incorporated propensity score sample weights and measured the average treatment effect on the treated (ATT), i.e. assessing the marginal impact of a cancer diagnosis relative to the matched controls. This is the recommended approach for rare exposures like cancer in young people (Hajage et al., 2016).

Logistic regression models were used for the RQ1 analysis, with categorical outcomes dichotomised as follows: economic activity (NEET/sick/disabled = 1, not NEET/sick/disabled = 0), relationship status (not married or cohabiting = 1, married or cohabiting = 0), living arrangements (living with parents = 1, not living with parents = 0). Ordinary least squares (OLS) models were used for the RQ2 HRQoL analysis. Regression models were adjusted for exposure status (RQ1 and RQ2) or cancer severity (RQ3), along with all previously listed control variables.

Additionally we analysed how participants transitioned over time by exploring the proportion of people in each outcome category at T3 conditional on their status at T1. We included transitions in the T3 regression models by adding T1 outcome status as an explanatory variable and an interaction term between exposure status and the T1 outcome to establish how cancer influenced transitions. As there were a disproportionate number of younger participants with the most severe

cancers, we conducted a sensitivity analysis for RQ3, limiting the sample to participants aged 18 or over. Finally, for the RQ1 analyses, we also assessed if BRIGHTLIGHT participants were behind in their education by comparing their current year of study at school with their expected school year, given their age and assuming continuous education without breaks.

3. Results

3.1. Sample selection

In total, 401 BRIGHTLIGHT participants were matched to 765 UKHLS controls, with substantial improvements in balance between the control variables pre- and post-matching (Appendix 2). The post-matching sample was well balanced (Table 1), with standardised mean differences below the recommended threshold of 0.1 (Appendix 2). Of the 445 BRIGHTLIGHT participants, 44 were unmatched due to strict criteria on age and follow-up duration, and were removed from the analysis sample. There was no evidence that this biased the sample as indicated by similar distributions of propensity scores in the matched and unmatched samples (Appendix 2).

3.2. Education, employment and social outcomes (RQ1)

3.2.1. Education and employment

At T1, fewer BRIGHTLIGHT participants were in education or employment compared to matched controls. By T3, the gap in employment had narrowed, while differences in education had reversed, with a higher proportion of BRIGHTLIGHT participants studying (Table 2). In the logistic regression models, significantly more BRIGHTLIGHT participants were sick, disabled or NEET at T1 (odds ratio (OR) = 2.03, $p < 0.001$) but there were no differences at T3 (OR = 0.96, p = 0.184) (Table 3).

Table 1
Variables used in matching (post matching values with sample weights included).

Characteristic	BRIGHTLIGHT, N = 401	UKHLS, N = 765[a]
Age at first outcome		
Mean (SD)	20.8 (2.8)	20.8 (2.8)
min, max	15.0, 25.0	15.0, 25.0
Time to final outcome, days		
Mean (SD)	827.8 (182.8)	838.7 (219.3)
Min, max	367.0, 1444.0	271.0, 1251.0
Gender [b]		
Male, N (%)	225.0 (56.1)	429.2 (56.1)
Female, N (%)	176.0 (43.9)	335.8 (43.9)
Ethnicity [b]		
Not White British, N (%)	52.0 (13.0)	99.20 (13.0)
White British, N (%)	349.0 (87.0)	666.8 (87.0)
Long term health condition [b]		
No, N (%)	333.0 (83.0)	635.3 (83.0)
Yes, N (%)	68.0 (17.0)	129.7 (17.0)
Highest qualification [b]		
None, N (%)	18.0 (4.5)	45.8 (6.0)
GCSEs or equivalent, N (%)	119.0 (29.7)	220.3 (28.8)
A-levels or equivalent, N (%)	170.0 (42.4)	307.1 (40.1)
Degree or equivalent, N (%)	94.0 (23.4)	191.7 (25.1)
Index of multiple deprivation (IMD) quintile [b]		
1 (most deprived), N (%)	70.0 (17.5)	154.5 (20.2)
2, N (%)	67.0 (16.7)	139.3 (18.2)
3, N (%)	76.0 (19.0)	153.6 (20.1)
4, N (%)	96.0 (23.9)	155.5 (20.3)
5 (least deprived), N (%)	92.0 (22.9)	162.2 (21.2)

[a] UKHLS frequencies (N) may not be integers because they incorporate propensity score weights. The weights are derived from the inverse probability of treatment assignment (1/propensity score or 1/(1-propensity score)).
[b] Data obtained for BRIGHTLIGHT at date of cancer diagnosis and for UKHLS at T1.

These differences over time (between T1 and T3) between the cancer and non-cancer groups were driven by differences in the likelihood of participants transitioning between various economic activities. The BRIGHTLIGHT sample were both more likely to remain in education (57 % vs 49 %) and much more likely to return to education (24 % vs 3 %) at T3 after being sick, disabled or NEET during T1 than the UKHLS matched controls (Fig. 2). This difference in transitions was reflected by a statistically significant interaction term (OR = 0.24, $p < 0.05$) between cancer diagnosis and being sick disabled or NEET at T1 (Table 3).

We note the majority of BRIGHTLIGHT participants returned to education to study for university degrees or equivalent (n = 28, 85 %), with the remainder studying at KS5 (n = 5, 15 %). There was some evidence of a delay in education within the BRIGHTLIGHT cohort at T1 and T3, but this was mainly in higher education levels where people may have taken gap years (Appendix 3).

3.2.2. Social outcomes

The majority of BRIGHTLIGHT and UKHLS participants lived in their parental household at T1 and T3 (Table 2), with BRIGHTLIGHT participants being less likely to do so than UKHLS participants at T1 (OR = 0.54, $p < 0.001$) and T3 (OR = 0.59, $p < 0.001$). In the model exploring how cancer influenced transitions (Table 3, model c), cancer was a statistically significant predictor of transition (OR = 4.28), with a significant interaction with living status at T1 (OR = 0.12, $p < 0.001$). This indicates BRIGHTLIGHT participants were more likely to transition both to and from their parental household between time points (Table 3, Fig. 2).

The majority of BRIGHTLIGHT and UKHLS participants were not in a marital or cohabiting relationship at T1 (86 % and 83 %), with rates decreasing slightly by T3 (79 % and 72 %). Differences between the cohorts were not statistically significant (Table 3). However, BRIGHTLIGHT participants were significantly more likely to be single at T3 after adjusting for relationship status at T1, indicating a cancer diagnosis is associated with increased relationship transitions. BRIGHTLIGHT participants were both slightly more likely to end relationships and less likely to form new relationships (Fig. 2). A cancer diagnosis appeared to equally impact both of these transitions as there was no significant difference in the interaction term between cancer status and T1 relationship status.

3.3. HRQoL and mental health (RQ2)

Unadjusted HRQoL and mental health trajectories between T1 and T3 showed substantial improvements for the BRIGHTLIGHT sample but remained constant for the UKHLS sample (Fig. 3). In the OLS regression models, HRQoL was significantly worse for BRIGHTLIGHT participants versus matched controls at T1 (−0.07, $p < 0.001$), but almost identical at T2 (−0.01, p = 0.623) and T3 (−0.01, p = 0.548).

3.4. Cancer severity (RQ3)

Participants with intermediate/more severe cancers had generally worse outcomes than those with less severe cancers, with some gaps widening over time (see Appendix 4 for full RQ3 results). They recorded significantly worse HRQoL at T1 (−0.07, $p < 0.01$) and T3 (−0.10, $p < 0.001$); significantly more HADS depression cases at T1 (OR = 2.04, $p < 0.01$) and T3 (OR = 2.16, $p < 0.05$); were significantly more likely to be NEET, sick or disabled at T1 (OR = 2.03, $p < 0.01$) and T3 (OR = 2.17, $p < 0.01$). There were, however, no significant differences in HADS anxiety cases, living status or relationships by cancer severity at either T1 or T3. Additionally, we observed several differences in transitions between economic status at T1 and T3 by cancer severity (Appendix 4, Figure A4.1), but the interaction term for economic transitions was not statistically significant in the adjusted logistic regression results. All results by cancer severity were consistent when restricting the analysis

Table 2
Outcomes in the matched sample at T1 and T3, including sample weights.

	T1		T3	
	BRIGHTLIGHT N = 401	UKHLS[a] N = 765	BRIGHTLIGHT N = 401	UKHLS[a] N = 765
Employment status				
In employment, N (%)	142.0 (35.5)	359.6 (47.0)	225.0 (57.4 %)	495.1 (64.8)
In education, N (%)	113.0 (28.2)	258.5 (33.8)	104.0 (26.5 %)	145.9 (19.1)
Sick or disabled, N (%)	46.0 (11.5)	7.6 (1.0)	31.0 (7.9 %)	14.3 (1.9)
NEET, N (%)	99.0 (24.8)	139.2 (18.2)	32.0 (8.2 %)	108.7 (14.2)
(Missing), N	1.0	0.0	9.0	1.0
Education status (current year of study) [b]				
KS4 or below, N (%)	14.0 (10.9)	54.4 (21.3)	1.0 (0.9)	0.0 (0.0)
KS5, N (%)	55.0 (42.6)	92.5 (36.2)	28.0 (25.7)	25.8 (20.8)
Higher education, N (%)	60.0 (46.5)	108.7 (42.5)	80.0 (73.4)	98.2 (79.2)
Missing[c], (N)	272.0	509.0	292.0	641.0
Living arrangements (lives with parents)				
No, N (%)	99.0 (24.7)	148.8 (19.5)	165.0 (42.1)	261.4 (34.2)
Yes, N (%)	302.0 (75.3)	616.2 (80.5)	227.0 (57.9)	503.6 (65.8)
(Missing), N	0.0	0.0	9.0	0.0
Relationship status				
Married/cohabiting, N (%)	54.0 (13.7)	128.8 (16.9)	81.0 (20.7)	188.9 (27.9)
Not married/cohabiting, N (%)	339.0 (86.3)	635.3 (83.2)	311.0 (79.3)	490.3 (72.2)
(Missing), N	8.0	1.0	9.0	86.0
HRQoL				
EQ-5D-3L[d], mean, (SD)	0.78 (0.2)	0.85 (0.2)	0.85 (0.21)	0.85 (0.18)
(Missing), N	0.0	64.0	11.0	103.0
Mental Health				
HADS-A cases				
Yes, N (%)	154.0 (38.4)	NA	123.0 (33.1)	NA
No, N (%)	247.0 (61.6)	NA	249.0 (66.9)	NA
(Missing), N	0.0	NA	29	NA
HADS-D cases				
Yes, N (%)	71.0 (17.7)	NA	48.0 (12.9)	NA
No, N (%)	330.0 (82.3)	NA	324.0 (87.1)	NA
(Missing), N	0.0	NA	29.0	NA
GHQ-12 cases				
Yes, N (%)	NA	145.0 (20.3)	NA	148.8 (22.4)
No, N (%)	NA	569.4 (79.7)	NA	514.1 (77.6)
(Missing)	NA	48.0	NA	105.0

NEET = not in education employment or training, KS4 = Key stage 4, KS5 = Key stage 5, HRQoL = health related quality of life, EQ-5D-3L = EuroQol 5 dimension 3 level questionnaire, HADS-A = hospital anxiety and depression - anxiety subscale, HADS-D = hospital anxiety and depression – depression subscale, GHQ-12 = general health questionnaire 12.

[a] UKHLS frequencies (N) are not be integers because they incorporate propensity score weights. The weights are derived from the inverse probability of treatment assignment (1/propensity score or 1/(1-propensity score)).

[b] May include some participants who also reported being in employment if they are in full time employment and part time education.

[c] Missing values include participants who are not currently in education.

[d] Responses for UKHLS participants are mapped from SF-12 to EQ-5D-3L.

sample to people aged 18 or over (Appendix 5).

4. Discussion

This is the first UK-based study comparing health, economic, and social outcomes between young people with cancer and a matched control group (Bradford et al., 2022). While similar studies have been conducted in the USA (Brinkman et al., 2019) and the Netherlands (Siebinga et al., 2023), ours is the first panel study globally to assess outcomes in all three domains, and the first study to explore how a cancer diagnosis and cancer severity influences transitions in outcome status over time (Bradford et al., 2022).

HRQoL was notably lower for young people 6-months post-diagnosis but this improved and converged with controls after 2 years, with similar positive trends in mental health trajectories. Our finding aligns with existing studies on both the immediate and longer term health impacts of cancer in young people, including improvements over time documented among a total of 209 cancer survivors across three studies from the Netherlands (Bekkering et al., 2012), Croatia (Gregurek et al., 2009), and Sweden (Jörngården et al., 2007). Nevertheless, some studies also identified longer-lasting health impacts of cancer (Stein et al., 2008; Strongman et al., 2019) which is likely partially explained by differences in the age profiles, cancer type, and severity. Over 80 % of our sample reported completing treatment or not requiring further treatment at the T3 interview, whilst only 3 % reported new treatments or changes to treatment indicative of recurrence. In our subgroup with more severe diagnoses HRQoL and treatment outcomes remained persistently worse.

Similarly, we found that differences in the likelihood of being out of work or education observed at 6-months were no longer present 2-years post diagnosis. This was driven by more young people with cancer re-entering education, often at university level, and aligns with qualitative literature suggesting cancer can delay key milestones whilst also prompting re-evaluation of personal aspirations and provide further motivation to achieve economic success (Barnett et al., 2016; Grinyer, 2007). A quantitative study in the Netherlands involving 2572 cancer survivors and 10,108 matched controls (aged 18 to 39) also attributed lower employment and earnings 5-years post survival to a higher number of people still in education (Siebinga et al., 2023). The study also identified higher unemployment rates among those who experienced more severe cancer diagnoses or invasive treatment (Siebinga et al., 2023).

Table 3
Regression models predicting economic, social and HRQoL outcomes at T1 and T3.

Outcome	Model A T1	Model B T3	Model C T3 + interaction
[1]	n = 1165	n = 1156	n = 1155
Sick, disabled or NEET (0/1) [a]***, OR, [95 % CI OR]***			
Cancer diagnosis (0/1)	2.76 ***	0.78 ns	1.24 ns
	[2.08, 3.67]	[0.55, 1.12]	[0.53, 1.22]
Sick, disabled or NEET at first assessment (0/1)	NA	NA	5.76 ***
			[2.16, 21.07]
Interaction: Cancer diagnosis (0/1)* Sick, disabled NEET at first assessment (0/1)	NA	NA	0.24 *
			[0.06, 0.75]
[2]	**n = 1157**	**n = 1069**	**n = 1061**
Not married or cohabiting (0/1)[a]***, OR, [95 % CI OR]***			
Cancer diagnosis (0/1)	1.06 ns	1.30 ns	2.48 *
	[0.75, 1.51]	[0.94, 1.80]	[1.01, 6.14]
Not married or cohabiting at first assessment (0/1)	NA	NA	33.99 ***
			[17.93, 69.52]
Interaction: Cancer diagnosis (0/1)* Not married or cohabiting at first assessment (0/1)	NA	NA	0.48 ns
			[0.18, 1.29]
[3]	**n= 1166**	**n= 1157**	**n = 1157**
Living with parents (0/1) [a]***, OR, [95 % CI OR]***			
Cancer diagnosis (0/1)	0.54 ***	0.59 ***	4.28 **
	[0.39, 0.76]	[0.45, 0.77]	[1.61, 12.59]
Living with parents (0/1)	NA	NA	100.65 ***
			[45.33, 266.36]
Interaction: Cancer diagnosis (0/1) * Living with parents at first assessment (0/1)	NA	NA	0.12 ***
			[0.04, 0.35]
[4]	**n= 1102**	**n= 1052**	**NA**
Health-related quality of life [b]***, Mean, [95 % CI]***			
Cancer diagnosis (0/1)	−0.07 ***	−0.01 ns	NA
	[-0.10, −0.05]	[-0.03, 0.02]	

Covariates: *Model A, B, C*: age at diagnosis/first outcome (years), gender (male/female), white British ethnicity (yes/no), IMD quintile (1–5), highest qualification (none/GCSE/A-level/degree), other long term health conditions (yes/no); *Model B & C*: follow up duration (months).
Statistical significance: ***p < 0.001, **p < 0.01, *p < 0.05, ns = not statistically significant.
OR (odds ratios) are exponentials of regression coefficient, the coefficient for the interaction is a ratio of OR.
[a] logistic regression.
[b] OLS regression.

Our finding of a significantly increased rate of change in residential status among cancer survivors than matched controls could be due to personal factors such as pursuit of autonomy and frustration with family environments (Hilton et al., 2009; Kent et al., 2012; Miedema et al., 2007), but was also likely driven by decisions to study at higher education. Still, it is unclear why cancer survivors were consistently less likely to live with their parents, given qualitative interviews indicating that some young people prefer living in parental households for emotional or financial support during treatment. Our finding of no difference in the likelihood of marital or cohabiting relationships, but challenges in establishing and maintaining relationships for young people with cancer compared to matched controls, could be partially explained by ongoing emotional trauma, feelings of alienation, reduced fertility and sexual functioning. These are frequently cited as barriers to initiating and sustaining new relationships during cancer treatment (Kent et al., 2012; Carpentier et al., 2011; Hauken et al., 2019; Patterson et al., 2012).

Our research holds implications for healthcare, social, and economic policies. The observed improvements in outcomes may be partially attributable to the UKs free at the point of use healthcare and tailored, age-appropriate cancer services such as specialised Teenage and Young Adult Principal Treatment Centres, which provide additional support in education and employment. These centres were accessed by one third of BRIGHTLIGHT participants (Taylor et al., 2019).

Our results highlight the importance of addressing the specific needs of those with severe and debilitating cancers, who experienced poorer mental and physical health and were less likely to return to work or education. Disparities in outcomes by cancer severity may be due to factors such as prolonged treatment durations, recurrence, or health conditions like chronic fatigue (Butt et al., 2008; Pugh et al., 2016). In our sample, 16.8 % of those with intermediate or severe cancers were still receiving treatment at T3, compared to 2.4 % of those with less severe diagnoses. Due to sample size limitations, we could not able to formally analyse these impacts. Future research in larger populations could explore the role of disease status in social reintegration, guiding targeted policies and financial support to reduce inequalities among those facing significant early-life challenges.

Strengths of the study, compared to existing cancer literature, include the multi-domain outcomes which contained HRQoL, as well as employing a matched control group and longitudinal data. Causal inference is arguably better supported in matched controlled studies of cancer (and other acute health shocks) compared to conditions that develop gradually over time, due to the unanticipated timing of onset and reduced exposure to measurement bias (Jones et al., 2020). We benefited from a bespoke dataset collected through a clinical setting, involving a large sample of young cancer survivors. This sample size far exceeds those typically available in general population surveys previously used in studies of acute health shocks. For example, Jones et al. (2020) (Jones et al., 2020) defined health shocks as occurring at 30-years or older as there were so few younger people in the UKHLS who experienced one.

Nevertheless, our dataset was insufficient to support the analysis of heterogeneity, including by age subgroups, cancer type, treatment and disease factors like recurrence, and economic deprivation, as well as potential bidirectional effects between health, mental health, economic, and social outcomes. Future studies would benefit from larger sample sizes to assess these bidirectional relationships, as well as additional pre-diagnosis information to support more robust causal inference using methods like difference-in-differences. Longer-term follow-up is also needed to capture impacts of cancer that may not occur until later adulthood and to understand how higher education influences employment and earnings trajectories over time (Leach et al., 2015).

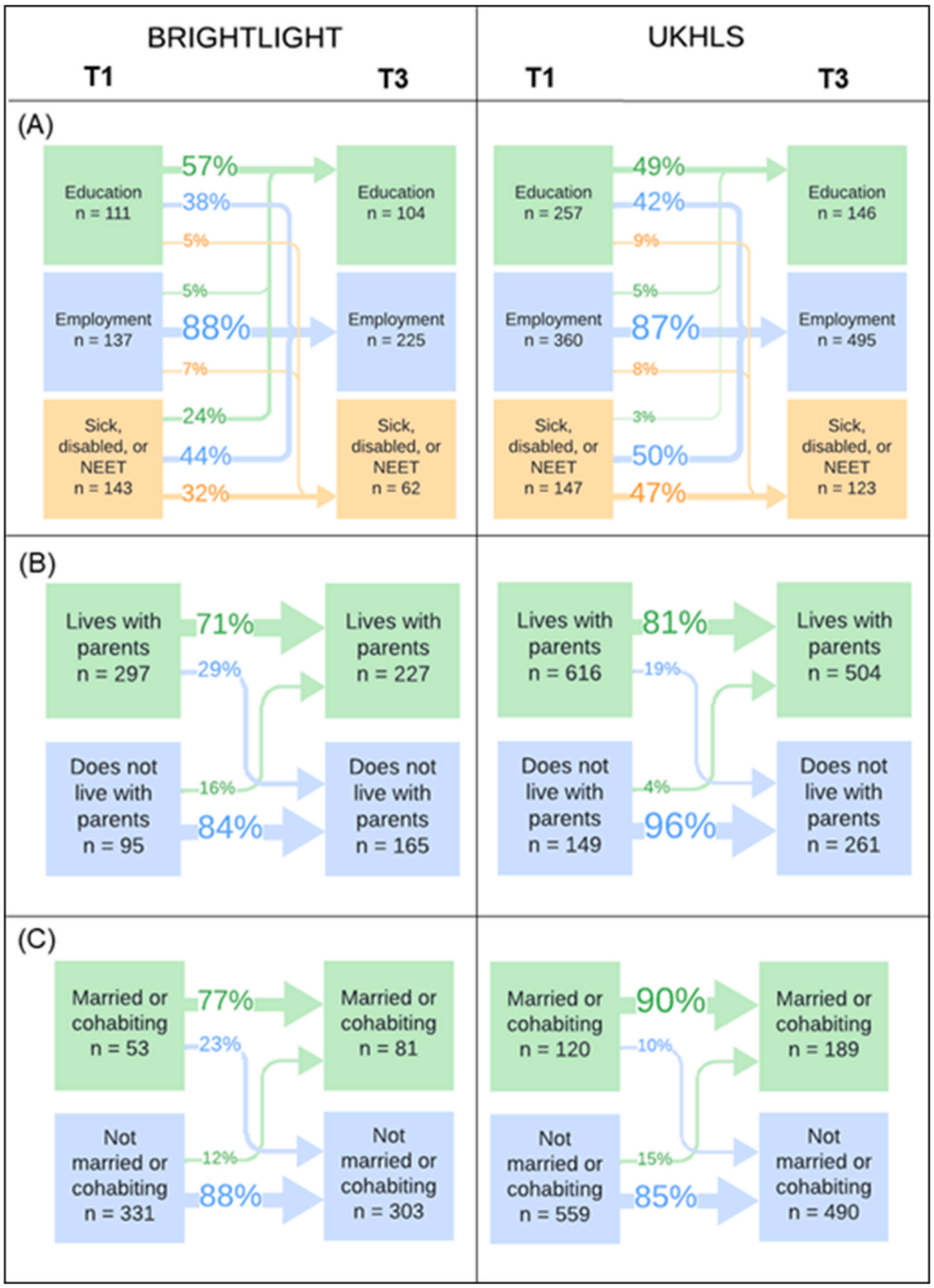

Fig. 2. Reports the percentage of people transitioning between outcome categories from T1 to T3 for employment and education (A), living arrangements (B), and relationship status (C) outcomes. Percentages account for propensity score weights.

Future research would benefit from more closely aligned mental health and HRQoL measures in the matched dataset.

Finally, our study did not examine potential economic, social, and mental health challenges in parents and close family members supporting young cancer survivors. Primary caregivers in the BRIGHLIGHT cohort have reported a need for additional financial support and experience psychological distress at the time of diagnosis (Martins et al., 2021; Pettitt et al., 2022). Further research is needed to explore long-term spillover effects, with comparisons to appropriate control groups.

5. Conclusion

A cancer diagnosis is an example of an acute, unanticipated health shock. Understanding the post-survival impact of cancer among young people is increasingly important given rising incidence rates and positive survival trends. Our study found substantial short-term impacts following a cancer diagnosis across economic, educational, health,

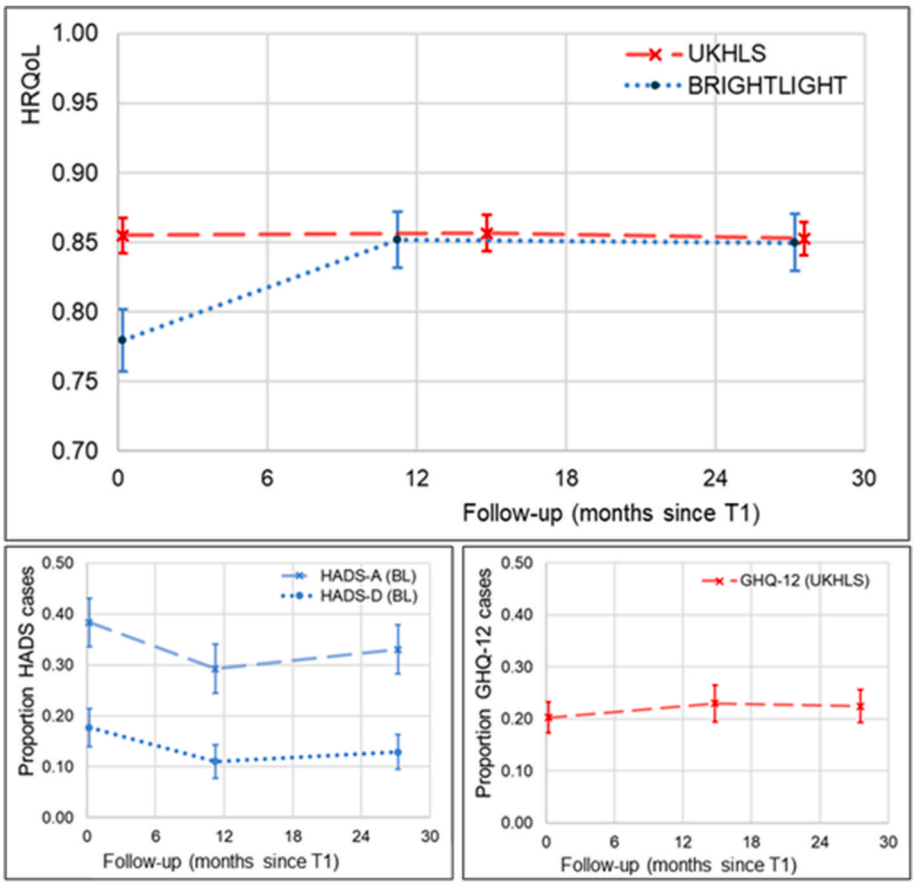

Fig. 3. Health related quality of life (HRQoL) measured from responses to the EQ-5D-3L for BRIGHTLIGHT and the Short Form-12 (SF-12) mapped to the EQ-5D-3L for UKHLS. Mental health measured using Hospital Anxiety and Depression (HADS) scales for BRIGHTLIGHT, and the General Health Questionnaire 12 (GHQ-12) for UKHLS.

mental health, and social outcomes. However, economic and health outcomes improved and were equivalent to peers without cancer by three years post-diagnosis. Changes in economic activity were driven by cancer survivors re-entering education, often at the university level, following periods of unemployment or sick/disability leave. Our research suggests that young people may be particularly responsive to education and employment interventions post-treatment as they form new life goals. We also identified persistent impacts among those with the most severe cancer diagnoses, indicating a need for targeted policies and financial support to address widening health and social inequalities.

CRediT authorship contribution statement

R. Mattock: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **A. Martin:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition, Conceptualization. **A.E. Beckett:** Writing – review & editing, Funding acquisition, Conceptualization. **O.C. Lindner:** Writing – review & editing, Validation, Conceptualization. **D. Stark:** Writing – review & editing, Methodology, Funding acquisition, Conceptualization. **R.M. Taylor:** Writing – review & editing, Funding acquisition, Data curation, Conceptualization.

Ethics approval and consent to participate

This study used data originally collected in the BRIGHTLIGHT and UKHLS studies.

BRIGHTLIGHT was approved by London Bloomsbury Research Ethics Committee (11/LO/1718) and the Confidentiality Advisory Group (ECC 8-05(d)/2011).

The University of Essex Ethics Committee has approved all data collection on Understanding Society main study, COVID-19 surveys and innovation panel waves, including asking consent for all data linkages except to health records. Requesting consent for health record linkage was approved at Wave 1 by the National Research Ethics Service (NRES) Oxfordshire REC A (08/H0604/124), at BHPS Wave 18 by the NRES Royal Free Hospital & Medical School (08/H0720/60) and at Wave 4 by NRES Southampton REC A (11/SC/0274). Approval for asking consent for health record linkage and for the collection of blood and subsequent serology testing in the March 2021 wave of the COVID-19 study was obtained from London – City & East Research Ethics Committee (21/HRA/0644). Approval for the collection of biosocial data by trained nurses in Waves 2 and 3 of the main survey was obtained from the National Research Ethics Service (Understanding Society – UK Household Longitudinal Study: A Biosocial Component, Oxfordshire A REC, Reference: 10/H0604/2). The biosocial data collection at IP12 'Understanding Society Health Innovation Panel: Biomeasure and health data collection from the Innovation Panel of the UK Household Longitudinal Study' was approved by East of England – Essex Research Ethics Committee, Ref 19/EE/0146.

Consent for publication

Not applicable.

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Competing interests

The authors declare no conflicts of interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2025.118078.

Data availability

The authors do not have permission to share data.

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