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Socioeconomic differences in health-related quality of life among cancer survivors and comparison with a cancer-free population: a PROFILES study

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Abstract

Purpose This study investigates the association between socioeconomic position (SEP) and health-related quality of life (HRQoL) in a cross-sectional cohort among cancer survivors and compares with cancer-free people.

Methods Survivors of colorectal, hematological, gynecological, prostate, thyroid cancer, and melanoma diagnosed 2000–2014 were identified in the PROFILES registry, and an age- and sex-matched cancer-free population were identified in the CentER panel. HRQoL, education, and comorbidity were self-reported. Street-level income and clinical factors were obtained from Statistics Netherlands and the Netherlands Cancer Registry. Multivariable logistic regression was used to examine associations of SEP (measured by education and income) and impaired HRQoL among cancer survivors and the cancer-free population, adjusting for age, sex, and time since diagnosis.

Results We included 6693 cancer survivors and 565 cancer-free people. Cancer survivors with low versus medium SEP more frequently reported impaired HRQoL (odds ratio (OR) range for all HRQoL outcomes, 1.06–1.78 for short education and 0.94–1.56 for low income). Survivors with high compared to medium SEP reported impaired HRQoL less frequently (OR range for all HRQoL outcomes, 0.46–0.81 for short education and 0.60–0.84 for low income). The association between SEP and HRQoL was similar in the matched cancer-free population.

Conclusion Low SEP was associated with impaired HRQoL in both cancer survivors and cancer-free people.

Implications for Cancer Survivors Targeted care is warranted for cancer survivors with impaired HRQoL, especially among those with low SEP.

Keywords Cancer survivors · Socioeconomic factors · Quality of life

Introduction

Social inequality in health is a major public health issue [1]. Studies have shown that cancer patients with lower socioeconomic position (SEP) are more likely to be diagnosed with advanced stage disease, less likely to receive recommended or curative cancer treatments, and have worse survival [2–11], with SEP referring to the social and economic factors that influence a persons' position within a society [12]. Less is known about socioeconomic differences in health after cancer, even though at least a third of cancer survivors develop problems with impaired functioning, fatigue, and pain [13, 14].

To date, few studies have investigated the relation between SEP and health-related quality of life (HRQoL) among cancer survivors [15–19]. Research has predominantly focused

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on survivors after breast, prostate, and colorectal cancer, with study populations ranging from 246 to 2235 participants and have shown that survivors with lower SEP report worse HRQoL than survivors with higher SEP [15–19]. One study did compare HRQoL between cancer survivors and a cancer-free population [15], but no studies compared social inequality in HRQoL among survivors and cancer-free people. Comparisons to cancer-free populations are valuable in evaluating the specific impact of cancer and its treatment on socioeconomic differences in HRQoL. Hence, we still need a better understanding of socioeconomic differences in HRQoL among cancer survivors, to help the development of strategies and use of limited resources to target interventions to those who are most in need.

In the present study, we investigated the association between SEP, measured as both education and income, and HRQoL in a large population-based cross-sectional cohort of survivors after colorectal, hematological, gynecological, prostate, thyroid cancer, and melanoma up to 12 years after diagnosis and compared with an age- and sex-matched cancer-free population.

Methods

Study design and setting

We used data from the Patient-Reported Outcomes Following Initial treatment and Long-term Evaluation of Survivorship (PROFILES) registry for secondary analyses. The PROFILES registry (http://www.profilesregistry.nl) is an ongoing collection of information on patient-reported outcomes (PROs) first started in 2008, which includes data on several population-based cohorts of cancer survivors, which can be linked with clinical information within the Netherlands Cancer Registry (NCR) [20].

Study population

The current study encompassed several population-based cohorts from the PROFILES registry; survivors after colorectal, hematological (non-Hodgkin lymphoma, Hodgkin lymphoma, chronic lymphocytic leukemia, and multiple myeloma), gynecological (ovarian and endometrial cancer), prostate, thyroid cancer, and malignant melanoma diagnosed 2000–2014. Survivors were included between May 2009 and October 2015 and were diagnosed between 2 weeks and 12 years ago at time of inclusion. Eligible participants had to be 18 years or older at time of diagnosis. Cancer survivors were not invited to participate if they were in transition to terminal care or had severe psychopathological disorders according to medical specialists. Ethical approvals were obtained for all participants through consent forms [20].

We obtained information on the cancer-free population from a cohort of 2040 people from the general Dutch population (CentER panel) [21], who had completed a set of questionnaires in 2011 comparable to the PRO data collected in the PROFILES registry. This cohort is considered to be representative for the Dutch-speaking population in the Netherlands [21]. We matched the cancer-free population to the cancer survivors to ensure similar distributions, and strata on age (10-year intervals) and sex were formed to make the most optimal selection. Within each stratum, a number of people in the cancer-free population was randomly matched according to the "strata frequency distribution" of the cancer survivors.

Socioeconomic and demographic factors

For both cancer survivors and the matched cancer-free population, two measures were used as proxies for SEP: level of education and the median household income on street-level. Information about median household income at six-digit postal code levels was used from 2016, each covering on average 17 households, and divided into nine categories based on the income levels of the whole Dutch population. These data were provided by Statistics Netherlands and linked to the NCR. Education and cohabitation status was assessed in the questionnaires, while information on age at time of questionnaire completion and sex was obtained from the NCR (for categorization of variables, see Supplementary table 1).

Clinical factors

Information on clinical factors (i.e., stage at diagnosis, primary treatments) was obtained from the NCR. Comorbidity was self-reported in the questionnaire through an adapted version of the Self-Administered Comorbidity Questionnaire [22] (for categorization of variables, see Supplementary table 1).

Health-related quality of life

HRQoL was measured by the EORTC QLQ-C30 questionnaire [23], which consists of one global quality of life scale, five functioning scales (physical, role, cognitive, emotional, and social functioning), three symptom scales (fatigue, pain, and nausea/vomiting), and six single items (dyspnea, appetite loss, insomnia, constipation, diarrhea, and financial difficulties). All scales and single items were scored from 0 to 100 according to EORTC guidelines [24], with higher values implying better functioning or more symptoms. Impaired functioning and symptoms were defined using the EORTC QLQ-C30 thresholds for clinical importance, whereby all HRQoL functioning and symptom domains, except for

global quality of life, were dichotomized by clinically relevant cut-off values [25]. Items which assess acute disease- or treatment-related symptoms (nausea and vomiting, constipation, appetite loss, and diarrhea) were excluded as they have often resolved themselves among cancer survivors [26].

Statistical analyses

The prevalence of cancer survivors and cancer-free people who reported impaired functioning or symptoms stratified by SEP was calculated. We used directed acyclic graphs (DAGs) to visually represent the directed association we hypothesized between SEP and HRQoL and to identify potential confounders (Supplementary Fig. 1) [27, 28]. Logistic regression models were used to compute the associations between SEP and HRQoL among cancer survivors and the cancer-free population with adjustment for age (continuous), sex, and time since diagnosis (continuous) (for cancer survivors only). In sub-analyses, we further adjusted for stage at diagnosis and repeated the logistic regression analyses for colorectal, hematological, gynecological, and prostate cancer survivors separately. Analyses among survivors of melanoma and thyroid cancer were not performed due to the small sample size. All statistical analyses were conducted in R (version 4.1.2).

Results

Study participants

Of the 10,400 cancer survivors who were initially identified in the PROFILES registry, 1035 had unverifiable address and could not be contacted. Of the 9365 cancer survivors who did receive an invitation to participate in the survey, 6693 responded (response rate = 71%) (Fig. 1). Of the 2040 cancer-free individuals in the CentER panel, 181 were excluded because they had cancer, 451 were excluded because they were part of the same household, and 130 were excluded because they were under the age of 18 at the time of completing the questionnaire. The remaining 1278 cancer-free individuals were matched to our cancer survivor population on age and sex, resulting in the inclusion of 565 matched cancer-free individuals.

Respondents had a mean age of 67 years at time of questionnaire completion, with a mean survival time of 4.2 years, the majority were men (59%), about a third had two or more comorbidities (36%), and most had a partner (77%). Most respondents had a medium education (60%), while less had short (17%) or long education (23%). Similarly, most respondents had a middle income (54%), and fewer had a low (17%) or a high income (30%), while those with a non-verifiable address had considerably lower incomes than respondents (30% had a low income, 51% had a middle, and 19% had a high income) (Supplementary table 2).

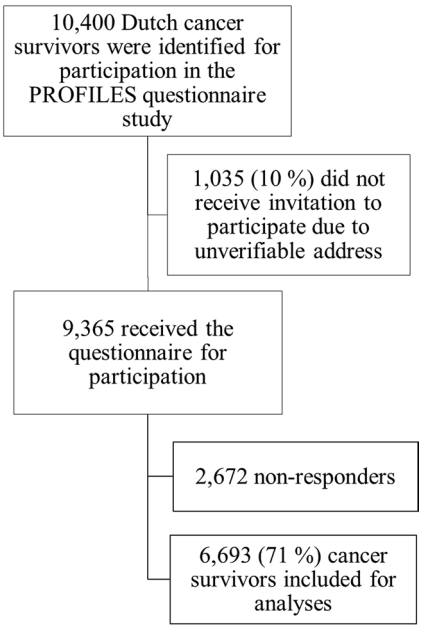

Fig. 1 Flowchart of the study population including survivors after colorectal, hematological, gynecological, prostate, thyroid cancer, and melanoma

Cancer-free people were younger (mean age of 61 years), and more had no morbidity compared to respondents (38% vs. 31%). The cancer-free population were somewhat higher educated (5% had short, 57% medium, and 38% long education), while income levels were similar to those of the respondents (16% had low, 51% middle, and 33% high income) (Table 1).

Social inequality in HRQoL

Crude prevalence showed that cancer survivors with low SEP more frequently reported impaired HRQoL than survivors with medium or high SEP, both when measured by education and income (Fig. 2). This socioeconomic gradient was also observed for all HRQoL outcomes, except insomnia, in the cancer-free population, when SEP was measured by income. Nevertheless, a substantially higher percentage of cancer survivors reported impaired HRQoL compared to the cancer-free population (Fig. 2).

In adjusted analyses, cancer survivors with low SEP had higher odds ratios (ORs) for impaired HRQoL than survivors with medium SEP (Fig. 3). Specifically, statistically

Table 1 Sociodemographic and clinical characteristics of Dutch cancer survivors diagnosed between 2000 and 2014 and a cancer-free population, by cancer type

Characteristics	Colorectal cancer $n=2618$ *n* (%)	Hematological cancer $n=1860$ *n* (%)	Gynecological cancer $n=585$ *n* (%)	Prostate cancer $n=1196$ *n* (%)	Thyroid cancer $n=189$ *n* (%)	Melanoma $n=245$ *n* (%)	Total cancer population $n=6693$ *n* (%)	Cancer-free population $n=565$ *n* (%)
Age at questionnaire, years: mean (SD)	69.4 (9.5)	63.4 (14.0)	65.5 (10.8)	71.4 (7.3)	55.2 (15.1)	60.0 (13.6)	67.0 (11.7)	61.3 (10.1)
Sex								
Men	1445 (55)	1125 (60)	-	1196 (100)	51 (27)	110 (45)	3927 (59)	329 (58)
Women	1173 (45)	735 (40)	585 (100)	-	138 (73)	135 (55)	2766 (41)	236 (42)
Education[a*]								
Short	518 (20)	273 (15)	104 (18)	181 (15)	18 (10)	18 (8)	1112 (17)	26 (5)
Medium	1564 (60)	1099 (60)	375 (66)	693 (59)	109 (58)	150 (62)	3990 (60)	323 (57)
Long	507 (20)	454 (25)	93 (16)	304 (26)	61 (32)	73 (30)	1492 (23)	216 (38)
Missing	29	34	13	18	1	4	99	-
Income[b*]								
Low	457 (18)	317 (17)	113 (19)	167 (14)	25 (13)	33 (13)	1112 (17)	88 (16)
Middle	1422 (54)	975 (53)	308 (53)	656 (55)	101 (54)	121 (50)	3583 (54)	288 (51)
High	737 (28)	564 (30)	163 (28)	373 (33)	63 (33)	90 (37)	1990 (30)	186 (33)
Missing	2	4	1	-	-	1	8	3
Partner								
Yes	1980 (76)	1401 (77)	401 (70)	997 (84)	146 (77)	199 (83)	5124 (77)	417 (74)
No	616 (24)	430 (23)	174 (30)	186 (16)	43 (23)	42 (17)	1491 (23)	148 (26)
Missing	22	29	10	13	-	4	78	-
Comorbidity[c]								
0	729 (30)	565 (33)	173 (31)	339 (29)	56 (31)	107 (44)	1969 (31)	216 (38)
1	796 (32)	578 (33)	177 (32)	409 (36)	57 (31)	67 (27)	2084 (33)	172 (31)
≥ 2	920 (38)	582 (34)	202 (37)	398 (35)	68 (38)	70 (29)	2240 (36)	176 (31)
Missing	173	135	33	50	8	1	400	1
Time since diagnosis, years: mean (SD)	5.2 (2.8)	3.3 (2.2)	2.2 (3.3)	4.0 (1.3)	5.9 (2.7)	4.2 (1.6)	4.2 (2.6)	
Time since diagnosis								
< 5 years	1418 (54)	1478 (79)	472 (81)	908 (76)	84 (44)	175 (71)	4529 (68)	
5–12 years	1200 (46)	382 (21)	113 (19)	288 (24)	105 (56)	70 (29)	2164 (32)	
Stage[d]								
I	705 (27)	356 (28)	340 (62)	166 (14)	99 (53)	189 (79)	1855 (31)	
II	976 (38)	317 (24)	44 (8)	683 (57)	31 (17)	36 (15)	2087 (35)	
III	783 (30)	242 (19)	127 (23)	231 (19)	38 (20)	11 (5)	1432 (24)	
IV	115 (5)	376 (29)	38 (7)	112 (9)	18 (10)	2 (1)	661 (11)	
Missing	39	569**	1	4	3	7	658	
Primary treatment[e]								
Surgery	2590 (99)	-	567 (97)	361 (30)	188 (99)	245 (100)	3951 (59)	
Radiotherapy	761 (29)	463 (25)	76 (13)	428 (36)	137 (72)	-	1865 (28)	
Systemic therapy	1035 (40)	1281 (69)	284 (49)	395 (33)	3 (2)	-	2998 (45)	
Active surveillance/ no therapy	4 (0)	386 (21)	-	241 (20)	1 (1)	-	632 (9)	

[a]Education: categorized as short (no/primary school), medium (lower general secondary education/vocational training), and long education (pre-university education/high vocational training/university)

[b]Income: categorized as low (first to third decile), middle (fourth to seventh decile), and high income (eight to tenth decile)

[c]Comorbidity: self-reported and categorized into no comorbidity, one comorbidity, and two or more comorbidities

[d]Stage: classified by TNM version 5, 6, or 7 according to time of diagnosis for survivors after colorectal, gynecological, prostate, thyroid cancer, and melanoma and by Ann Arbor Code for cancer survivors after hematological cancers

[e]Treatment: classified into surgery, systemic therapy (chemo-, targeted, immune, and hormone therapy), radiotherapy, and no treatment/active surveillance. Combinations possible

[*]There was no strong indication of a correlation between education and income (Kendall rank correlation test = 0.26)

[**]High number of missing because stage for indolent subtypes of hematological cancers were not registered

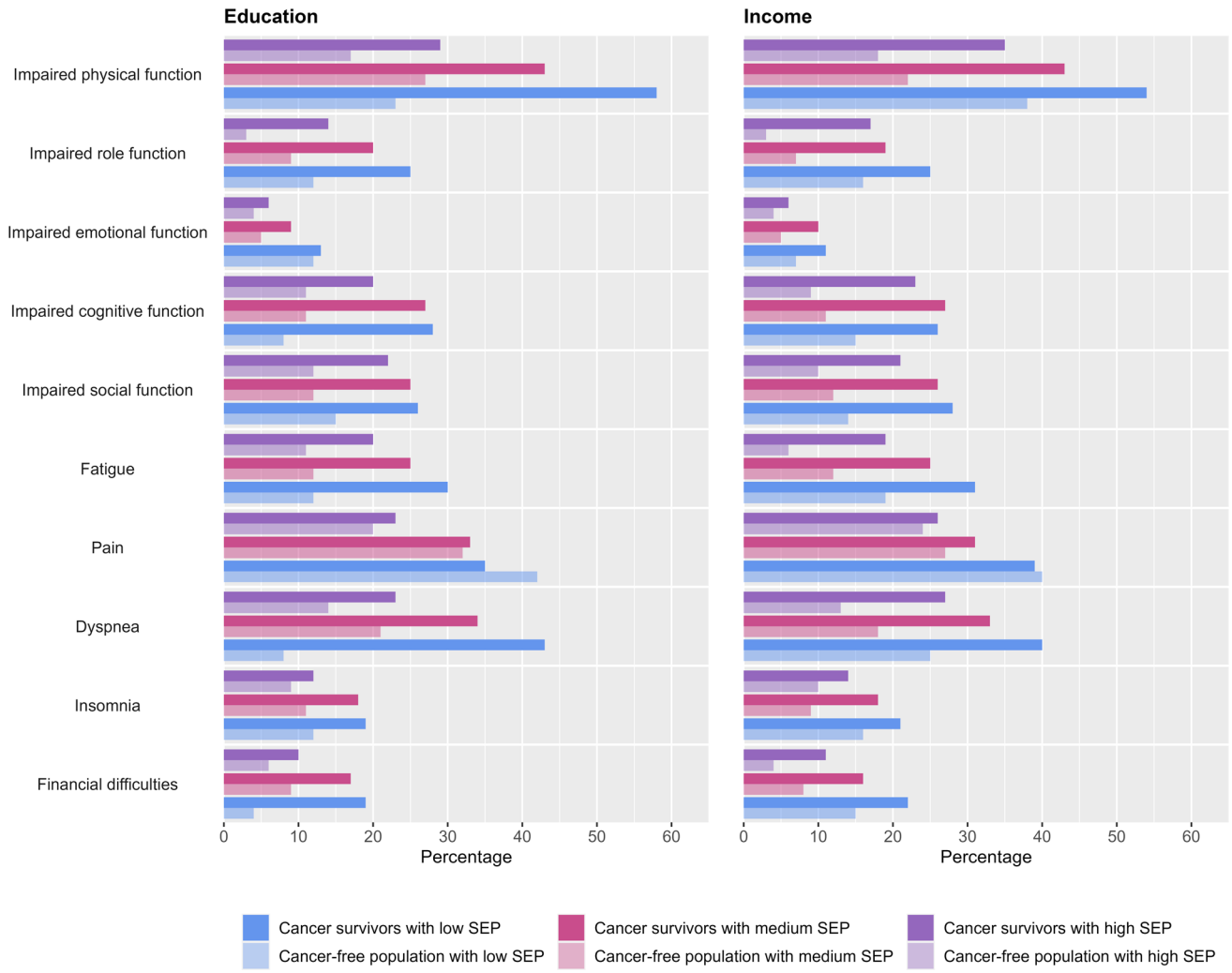

Fig. 2 Prevalence (%) of cancer survivors and a cancer-free population who report impaired functioning and symptoms, by SEP measured by education and income

significant higher risk of impaired physical, role, and emotional functioning, fatigue, dyspnea, and financial difficulties was observed for survivors with short versus medium education (ORs ranging between 1.27 and 1.78). Statistically significant higher risk of impaired physical and role functioning, fatigue, pain, dyspnea, insomnia, and financial difficulties was observed for survivors with low versus middle income (ORs ranging between 1.21 and 1.56). Likewise, cancer survivors with high SEP had statistically significant lower ORs for all HRQoL functioning and symptoms than survivors with medium SEP: ORs ranged from 0.46 to 0.81 for survivors with long education and from 0.60 to 0.84 for survivors with high income. Estimates from a sub-analysis with adjustment for cancer stage at diagnosis did not differ (Supplementary table 3), and we did not observe any differences in estimates from analysis stratified by short- and long-term survivors (>5 years and 5–12 years since diagnosis) (results not shown).

Among the matched cancer-free population, we observed significantly higher ORs for cancer-free individuals with a low compared to middle income for physical and role functioning (Fig. 3). For the other HRQoL scales, no statistically significant differences were observed, but the trend generally showed that cancer-free individuals with low SEP had a higher OR for impaired HRQoL than those with medium SEP. As the number of people with a short education ($n=26$) or low income ($n=88$) in the matched cancer-free population was low, we reran analyses on the non-matched cancer-free population ($n=1278$) (Supplementary table 4). In that analysis, we found statistically significant higher ORs for impaired physical, role, emotional, and social functioning, fatigue, insomnia, and financial difficulties for cancer-free

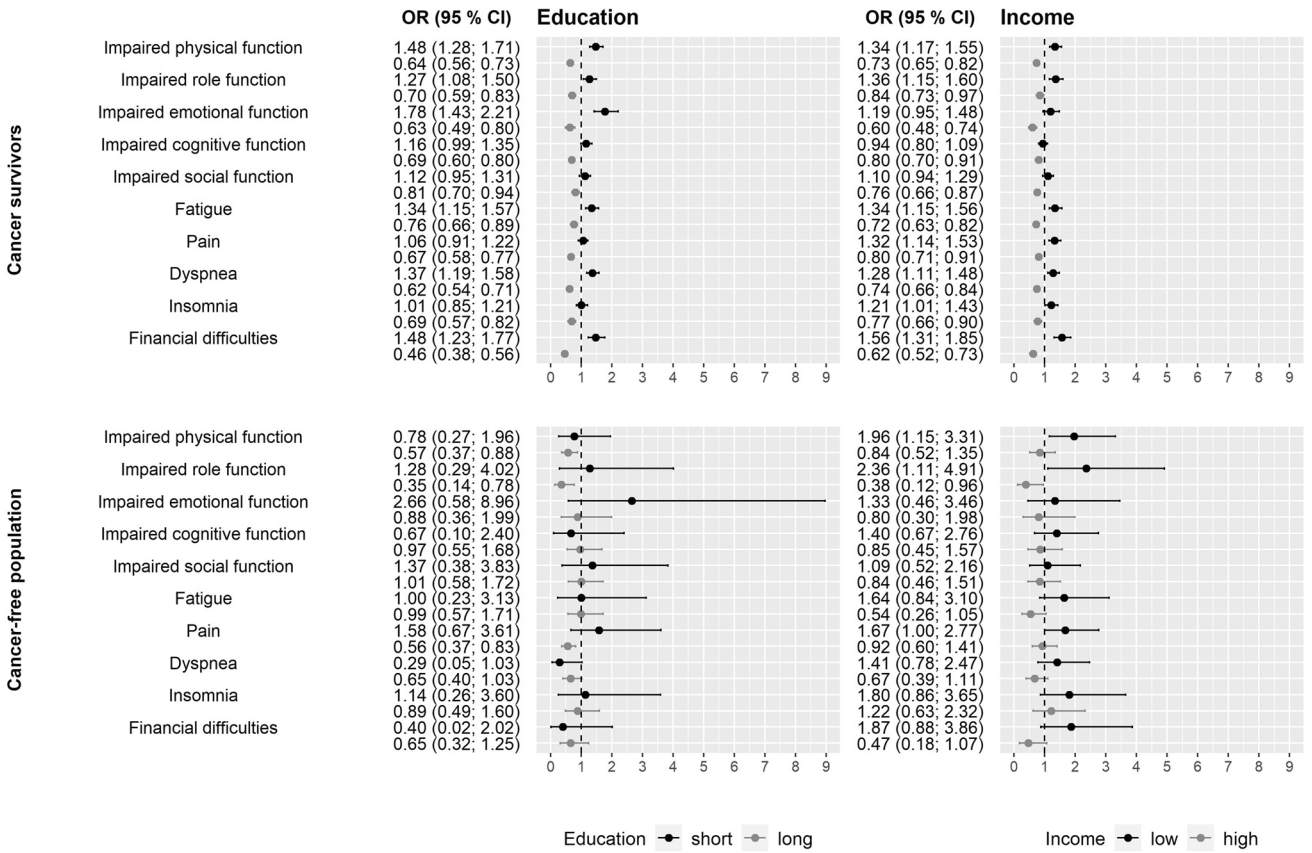

Fig. 3 Association between SEP and impaired HRQoL among cancer survivors ($n=6693$) and a cancer-free population ($n=565$). Medium SEP (medium education or middle income) is the reference for all estimates. Analyses are adjusted for time since diagnosis (cancer survivors only), age, and sex. OR, odds ratio; CI, confidence interval

people with a low compared to a middle-income level (Supplementary table 4). There were statistically significant lower ORs for impaired physical and role functioning, pain, dyspnea, and financial difficulties among cancer-free peoples with high versus medium education (Supplementary table 4).

Social inequality in HRQoL by cancer site

Cancer survivors with low SEP had a higher crude prevalence of impaired functioning and symptoms, except among survivors after gynecological cancers and melanoma where the overall socioeconomic gradient was less pronounced and only observed for some HRQoL outcomes (Supplementary Fig. 2, Supplementary Fig. 3).

In adjusted analyses, survivors after colorectal and hematological cancers with low compared to medium SEP had higher ORs for impaired HRQoL (Supplementary Fig. 4). Similar patterns of increased ORs for prostate cancer survivors with low SEP was observed, though most estimates were not statistically significant (Supplementary Fig. 4). Gynecological cancer survivors with low SEP did not statistically significantly differ from survivors with medium SEP (Supplementary Fig. 4), likewise when stratifying the analyses for ovarian and endometrial cancer (results not shown). Overall, the ORs for impaired HRQoL for survivors with low SEP were more increased among survivors with hematological cancer compared to the other cancer sites (Supplementary Fig. 4).

Discussion

This is one of the largest cross-sectional studies examining the association between SEP and HRQoL among cancer survivors and among an age- and sex-matched cancer-free population. Considerably more survivors with low SEP report impaired HRQoL compared to survivors with medium or high SEP, also in adjusted analyses including age, sex, time since diagnosis, and stage. We observed this association for the total sample and in stratified analyses for survivors after colorectal, hematological, and prostate

cancer but not among gynecological cancer survivors. These socioeconomic disparities in HRQoL were similar to those observed in a cancer-free population.

Our findings are in line with previous studies among 246 to 2235 cancer survivors, which demonstrated that survivors with lower SEP had an increased risk of impaired HRQoL [15–19]. When comparing cancer sites, survivors after hematological cancer showed larger socioeconomic differences in the risk of impaired HRQoL than survivors after colorectal, gynecological, and prostate cancer. This might be explained by differences in treatment and stage between these cancers. Most hematological cancer patients had received systemic therapies (69%) and frequently undergo several lines of chemo-/immunotherapy, whereas, for example, almost all gynecological cancer patients had received surgery (97%). Previous studies have shown socioeconomic disparities in the chance of receiving systemic therapy [11, 29–32], and systemic therapy can affect HRQoL [33, 34]. Hence, it might be that socioeconomic differences in received treatment among patients further enhance socioeconomic differences in HRQoL among survivors. Clinicians in the field of hematology should be aware of their patients' risk for impaired HRQoL overall, focusing on patients with low SEP.

Among the age- and sex-matched cancer-free population, we also observed an association between SEP and HRQoL, although not always statistically significant. As the number of age- and sex-matched cancer-free people with a short education or low income was small, we reran the analyses including all participants of the non-matched cancer-free population ($n = 1278$), resulting in a similar and statistically significant pattern as observed among the cancer survivors.

Even in a country with full health insurance coverage and equal access to healthcare, we observed socioeconomic differences in HRQoL among cancer survivors. To diminish socioeconomic disparities and maximize long-term outcomes, clinicians are advised to anticipate impaired HRQoL among cancer survivors, especially among those with low SEP. With a growing group of cancer survivors, it will become increasingly necessary to identify survivors at risk of impaired HRQoL to ensure that supportive care is provided to those in need. Routine symptom monitoring has proven to be effective and screening tools or instruments to identify cancer patients with low SEP or vulnerable cancer patients in clinical practice could help target patients in need. One tool was developed to identify vulnerability in lung cancer patients [35]. Development of a more generic tool, which can screen cancer patients for vulnerability across different cancer sites might be needed, incorporating other factors such as comorbidities, lifestyle factors, and social support that are known to be associated with HRQoL [13, 36–38].

Strengths and limitations

Strengths of this study include a large population-based sample of cancer survivors from different cancer sites, spanning from 2 weeks to 12 years since diagnosis, and our use of validated HRQoL measures, and clinical cut-off values tailored to each functioning and symptom. In addition, we included information on clinical characteristics and income through linkage to the NCR.

Some limitations should be noted. First, with the cross-sectional design, we cannot determine changes in HRQoL over time. To identify specific groups of cancer survivors at risk for persistent impaired HRQoL, longitudinal data are required. Second, the SEP indicator income was based on average income levels from 2016 of a residential area at the time of cancer diagnosis, measured by street-level postal-codes. Survivors might thus have been incorrectly classified in terms of income, especially if they have moved residence after their cancer diagnosis. Furthermore, we do not have information on the stability of the median household income in the inclusion period between 2009 and 2015. However, SEP is a complex concept and can be measured in different ways. In the present study, we found that both education and income as indicators of SEP were related to the risk of impaired HRQoL. Even though educational level was self-reported, and income was based on information from Statistics Netherlands, analyses gave similar results. Hence, both indicators provided appropriate measures of SEP, at least in a Dutch context. Third, reporting might differ by factors associated with participating in the questionnaire, such as age, income, and education. Cancer survivors with short education and low income were underrepresented in our study population, and thus, our results might be affected by a socioeconomic bias in the response rate of the questionnaire. We expect that the overall HRQoL scores would have been even lower if more survivors with low SEP had participated. Fourth, even though we matched cancer survivors with cancer-free individuals on age and sex, the mean age of cancer survivors was 6 years older than that of cancer-free individuals. We therefore still adjusted the analyses for age, keeping the impact on our findings to a minimum. Fifth, we could not ascertain when people were diagnosed with comorbid disorders in relation to their cancer diagnosis. Therefore, we cannot conclude whether impaired HRQoL is solely due to comorbidity, cancer, cancer treatment, or a combination thereof.

Conclusion

Even in a country with equal access to healthcare, socioeconomic differences in the risk of impaired HRQoL at clinically relevant levels among cancer survivors exist.

Identifying survivors with impaired HRQoL by routine screening and needs assessment is crucial to ensure adequate supportive care and prevent a broadening of socioeconomic inequalities. Long-term health outcomes of survivors with low SEP may be maximized by devoting extra attention to this group of survivors in the years following cancer treatment.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11764-023-01494-y.

Author contribution Conceptualization: AKGL, SO, LvdP; Data curation: AKGL, SO; Methodology: AKGL, SO, MA, LvdP; Formal analysis: AKGL; Investigation: AKGL, SO, LvdP, NE; Writing – original draft preparation: AKGL; Writing – review and editing: SO, LvdP, TKK, SOD, MA, NE; Supervision: SO, LvdP; Project administration: SO; Funding: LvdP.

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Data availability The PROFILES registry data has been freely available since 2011, according to the Findable, Accessible, Interoperable, Reusable (FAIR) data principles for non-commercial (international) scientific research, which are subject only to privacy and confidentiality restrictions. Data is made available through Questacy (DDI 3.x XML), which can be accessed by the PROFILES registry website (http://www.profilesregistry.nl). The quality guidelines that are formulated in the "Data Seal of Approval" (http://www.datasealofapproval.org) document, developed by Data Archiving and Networked Services (DANS), are followed in order to arrange optimal long-term data warehousing and dissemination.

Declarations

Ethics approval Ethical approvals for the questionnaire and methodology were obtained locally for all study participants.

Consent to participate Informed consent was obtained from all individual participants in the study.

Competing interests The authors declare no competing interests.

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