



Population-based cancer survivorship research: Experiences from Germany and the Netherlands



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ABSTRACT

Research into the well-being of cancer survivors in the post-treatment phase can face the potential challenge of identifying and recruiting survivors. Population-based cancer registries can address this challenge. Through linkage with national and state cancer registries, Germany and the Netherlands have a long history of conducting population-based survivorship studies. The CAESAR study from Germany and the PROFILES registry from the Netherlands are examples of large and comprehensive population-based survivorship studies assessing the well-being of (long-term) cancer survivors. This paper briefly describes the contributions studies such as CAESAR and PROFILES have made to cancer survivorship research at the patient, clinical, research, and societal level. Potential barriers associated with population-based survivorship research and directions are also discussed.

1. Introduction

A significant number of adult individuals are now living with cancer as a chronic illness. In 2012, more than 32 million individuals worldwide, including 9.7 million in Europe, were still alive 5 years after their cancer diagnosis [1]. This number is expected to increase substantially in the coming years due to the combined factors of an aging population, increased cancer incidence, and improved cancer detection and treatments [2,3]. The downside of the success of improved treatments is that while many cancer survivors are free of cancer, they may not necessarily live in good health. Cancer treatments can be debilitating and cancer survivors may have an increased risk for a range of adverse short- and long-term physical and psychosocial effects associated with cancer and its treatment [4]. Consequently, the well-being of this rapidly growing group living with a history of cancer is a topic of critical relevance as reflected in the commission of this special issue from the European Organisation for Research and Treatment of Cancer (EORTC).

2. Cancer survivorship

There is currently no consensus on the definition of a cancer survivor [5,6]. According to the US National Coalition for Cancer

Survivorship (NCCS), an individual is considered a cancer survivor from the time of diagnosis through the balance of his or her life [7]. On the other hand, EORTC defines cancer survivor as an individual who has been diagnosed with cancer, has completed primary treatment (with exception of maintenance therapy), and has no evidence of active disease [8]. Cancer survivorship research therefore covers a wide spectrum encompassing physical, psychosocial, and economic issues of cancer impacting the well-being of survivors, beyond the acute diagnosis and treatment phases [9]. For instance, as survivors live longer, they are also more likely to experience late effects of their cancer and treatment, such as comorbidity or second primary cancers [4]. Furthermore, cancer survivorship research includes issues related to access and delivery of health care, and follow up care.

2.1. Patient-reported outcomes (PRO) data

Survivorship research generally incorporates both clinical and PRO data [10]. PRO data is defined as *any* report of a patient's health status *provided directly by the patient without amendment* or interpretation from a clinician or others [11]. PRO is an umbrella term that covers information on symptoms (e.g. fatigue), functioning (e.g. physical functioning, sexual functioning), health status, psychological distress/well-

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being (e.g. depression, fear of recurrence, benefit finding), and overall health-related quality of life (HRQL) [12]. Based on the definition of PRO, it can also include information on health behaviors (e.g. physical activity), perceptions of quality of cancer care, health care utilization, and economic issues or challenges facing cancer survivors such as loss of income, return to work, difficulties obtaining financial services such as insurance, loans or mortgages [13,14].

2.2. Challenges of survivorship research

Although there is increased attention into the (long-term) needs and care of cancer survivors [15], research in the post-treatment survivorship phase still lags behind studies conducted during active treatment [16]. It can be a challenge to identify and recruit survivors in the post-treatment period to participate in cancer survivorship research [17].

3. Population-based cancer survivorship research

Population-based cancer registries can be a useful resource to overcome the challenge of identifying and recruiting cancer survivors, especially long-term survivors, for post-treatment research [18]. Cancer registries can be at national, state or regional level. Advantages of using cancer registries for survivorship studies include the wide geographic reach, large potential sample of survivors included into the registry regardless of treating facility, and the wealth of routinely collected demographic and clinical data (e.g. date of diagnosis, cancer stage) [19,20]. These advantages have been optimized for use in cancer survivorship studies [18]. Population-based survivorship studies are therefore expected to have better external validity and generalizability when compared with clinical studies.

3.1. Models of registry-based survivorship studies

Currently there are two models of registry-based studies [18]. In the first model, the cancer registry is used as a sampling frame from which potential study participants are identified. Once identified, these survivors are sent a PRO questionnaire. The collected PRO data are subsequently linked with the clinical data registered by the cancer registry. The second model collects PRO from sampled participants before linkage with a cancer registry.

This paper will briefly describe the range of survivorship research conducted through population-based cancer registries with focus on the experiences of Germany and the Netherlands. The coverage of studies will not be exhaustive but will focus on the authors' experiences in conducting research among adult long-term cancer survivors.

4. Population-based cancer survivorship research in Germany and the Netherlands

Germany and the Netherlands have a long history of conducting cancer survivorship research using population-based cancer registries [18]. The following briefly describes two of the largest and most comprehensive population-based survivorship studies assessing the well-being of (long-term) cancer survivors.

4.1. Germany

The CAESAR (Cancer survivorship: a multi-regional population-based) study was initiated between 2008 and 2009 to describe the needs and the physical, psychological, and economic well-being of 7000 long-term survivors of breast, colorectal or prostate cancer [21]. Cancer survivors diagnosed between January 1994 and June 2004 as registered in the participating cancer registries, and aged 20–75 years at diagnosis were eligible. Participants completed a comprehensive list of internationally validated questionnaires assessing domains as outlined in Fig. 1.

CAESAR consists of a “core” sample of cancer survivors ($n = 4174$) sampled and recruited from 5 population-based state cancer registries (Bremen, Hamburg, North Rhine-Westphalia, Rhineland-Palatinate and Saarland) in Germany between 2009 and 2011. It is further complemented by three existing population-based survivor cohorts from the German states of Saarland (VERDI and ESTHER-II) and Schleswig-Holstein (OVIS). The three pre-existing cohorts are briefly described below.

VERDI (*‘Verlauf der diagnostischen Abklärung und der Lebensqualität bei Krebspatienten’* Course of diagnostics and quality of life in cancer patients) is a prospective population-based study of individuals living in Saarland who were diagnosed with breast, colorectal or prostate cancer between October 1996 and February 1998. Participants were recruited from all hospitals in Saarland and adjacent districts. The primary aim of the study was initially to evaluate diagnostic work-up in cancer patients [22,23] but was successfully converted to a survivorship study with PRO assessments at 1, 3, 5 and 10 years after diagnosis [24–28].

ESTHER-II (*‘Epidemiologische Studie zu Chancen der Verhütung, Früherkennung und optimierten Therapie chronischer Erkrankungen in der älteren Bevölkerung’* Epidemiological investigations of the chances of preventing, recognizing early and optimally treating chronic diseases in an elderly population) is a large prospective clinical study that included residents of Saarland newly diagnosed with common forms of cancer, including breast, colorectal and prostate, between January 2001 and December 2003 [29]. Individuals diagnosed with the three indicated cancers who were not included in the ESTHER-II study were identified via Saarland cancer registry for inclusion into the CAESAR study to maximize representativeness and increase power.

Both the VERDI and ESTHER-II cohorts were followed-up in 2008 whereby respondents completed a list of internationally validated questionnaires that was similar to those completed by the CAESAR core sample.

OVIS (*‘Onkologische Versorgung in Schleswig-Holstein’* Oncological Care in Schleswig-Holstein) included individuals diagnosed with melanoma, breast or prostate cancer between 2001 and 2003 as registered in the Schleswig-Holstein cancer registry. The study was initially designed to study differences in health care utilization and its impact on HRQL [30]. For the CAESAR study, only individuals diagnosed with breast or prostate cancer were re-contacted in 2009.

The cancer registries participating in the CAESAR study provided detailed demographic and clinical details. A follow-up to CAESAR study is currently in preparation and will include the collection of information on primary cancer treatment via the attending physician.

4.2. Netherlands

The PROFILES (Patient Reported Outcomes Following Initial treatment and Long-term Evaluation of Survivorship) registry was set up in 2009 for the purpose of collecting comprehensive longitudinal PRO from a dynamic cohort of cancer survivors [31]. The range of PRO collected is based on the conceptual model as outlined in Fig. 1. Potential participants for PROFILES studies are sampled from the Netherlands Cancer Registry (NCR). Participants have the option of completing either an online or a paper version of the PRO questionnaire [32]. Collected PRO data are linked with routinely registered clinical and vital status data accessed from the NCR. With a data set of PRO from over 20,000 survivors of various cancers, the PROFILES registry has been acknowledged as a unique infrastructure for the population-based study of cancer survivorship [33,34]. More information on the PROFILES registry is available on its website (www.profilesregistry.nl).

5. Contributions of population-based research to cancer survivorship

Population-based studies of (long-term) cancer survivorship have contributed significantly to the increasing awareness to the reduced or

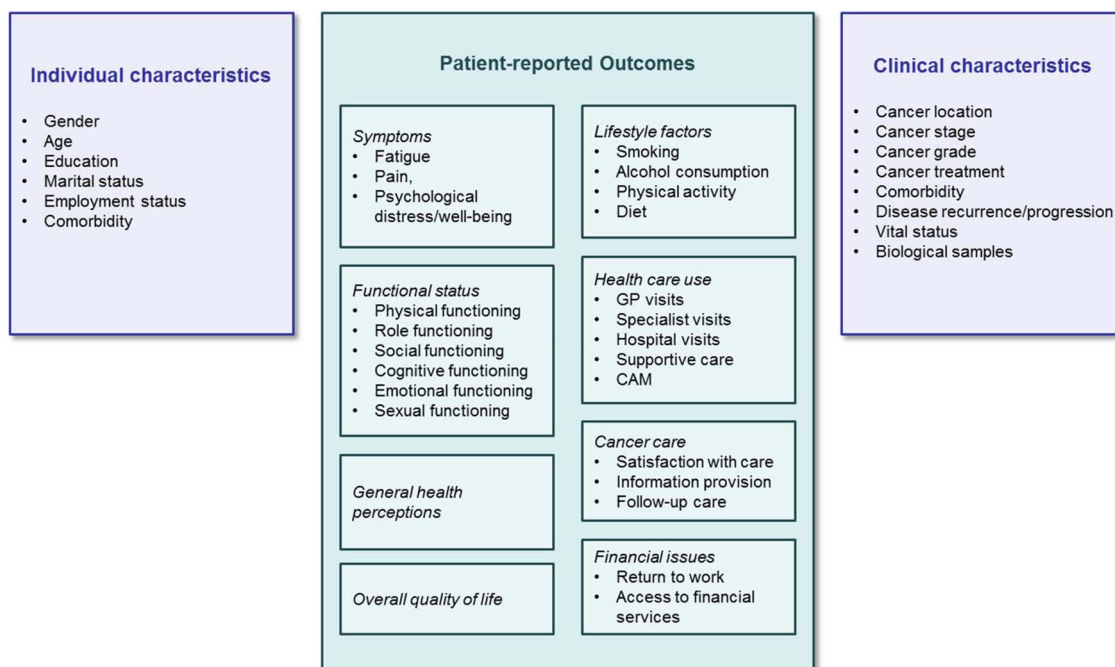


Fig. 1. Range of data that are collected in population-based cancer survivorship studies such as CAESAR and PROFILES. Model adapted from Wilson and Cleary [10]. CAM: complementary/alternative medicine

declining well-being of cancer survivors years after treatment is completed.

5.1. For patients

With the growing focus on individualized and better care delivery, PRO are considered a tool to facilitate patient-doctor communication in daily oncology practice [35]. In a pilot study of 45 survivors of lymphoma selected from the PROFILES registry, 80% replied that they would like to receive feedback on their questionnaire answers on domains such as HRQL and symptoms in relation to answers provided by their peers or by normative controls [36]. Of the respondents who wanted PRO feedback, most found the information useful and felt that it reassured them of their own functioning in relation to a ‘normal’ individual. Providing survivors with personalized feedback on symptoms also has the potential to increase knowledge. In turn, this may help empower survivors to initiate discussion about their symptom burden with their health care provider, improving symptom management and outcomes. Currently, PROFILES is conducting the *Lymphoma Intervention (LIVE)* trial, whose objective is to examine whether providing feedback to survivors on their PRO and access to a web-based self-management intervention named *Living with lymphoma* will increase self-management skills and satisfaction with information, and reduce psychological distress [37].

5.2. For clinical practice

Many new cancer therapies only have marginal benefit on survival but may have a lasting debilitating effect on survivors’ well-being. Furthermore, results from clinical studies such as randomized control trials can have problems with external validity [38]. As such, PRO collected through population-based survivorship studies can augment clinical results by providing externally valid data to assess quality of care. For example, 6-month adjuvant oxaliplatin-based chemotherapy (CAPOX or FOLFOX) is the current standard treatment for low-risk stage III colon cancer. However oxaliplatin is associated with accumulative, dose-dependent neurotoxicity [39,40] which can persist many years after treatment termination with negative impact on HRQL

[41]. At the 2017 American Society of Clinical Oncology annual meeting, it was recommended that oxaliplatin treatment can be reduced to 3 months from the standard 6 months without survival disadvantage following results from pooled analyses of several large international clinical trials [42]. Combining results on the long-term well-being of colon cancer survivors from randomized trials [42] and PROFILES studies [39,41] could provide a more rounded picture to inform clinical care.

5.3. For research

A unique feature of CAESAR and PROFILES population-based survivorship cohorts is the availability of PRO data from a normative non-cancer population [43,44]. This allows the determination of residual functional impairments and symptom burden that can be attributed to cancer and its treatment, rather than to the aging process and prevalence of comorbid diseases. PROFILES has recently made available longitudinal 5-year normative data on the EORTC Quality of Life Core Set Questionnaire (EORTC-QLQ-C30) [45].

Studies from both CAESAR and PROFILES have shown that persistent deficits in HRQL remain in some cancer survivors many years after cancer diagnosis when compared with individuals without cancer. A recent CAESAR study showed that detriments to HRQL can persist more than a decade after cancer diagnosis and is more pronounced among younger survivors, when compared with age-matched non-cancer controls [43]. Similarly, in PROFILES it was observed that younger survivors of multiple myeloma [46], diffuse large B cell lymphoma [47] and colon cancer [48] reported poorer HRQL when compared with age-matched normative controls.

Both CAESAR and PROFILES welcome collaboration with other research groups. PROFILES has an open access policy to its data and registry system for research purposes (www.profilesregistry.nl).

Besides linkage of PRO data with cancer registries to access clinical data, recently PROFILES data was successfully linked with EORTC to study possible trial effects on long-term HRQL of lymphoma survivors [49]. Also, PROFILES data have recently been linked with pharmacy data which showed that breast cancer survivors who were treated for anxiety *before* cancer were more likely to develop cardiovascular

disease during cancer survivorship [50]. These linkages can open new fields of research activities.

5.4. For society

Population-based cancer survivorship studies can help generate discussion at the societal level on challenges faced by survivors that is rarely addressed in clinical studies, such as return to work or financial issues following a cancer diagnosis. Previous PROFILES studies have reported on changes to work [51] and difficulties accessing health and life insurance, and mortgages especially among younger Dutch long-term cancer survivors [52]. The results on difficulties accessing financial services generated much interest and was reported in the national press [53]. Besides national attention, the issue of financial impact of cancer is also addressed at European level. It was a key topic of discussion at the 2nd Cancer Survivorship Summit hosted by EORTC in April 2016 [54].

6. Issues associated with population-based cancer survivorship research

Although using a population-based cancer registry to conduct cancer survivorship studies has its stated advantages, there are potential barriers to consider. A common barrier is related to the issue of sampling and recruitment of survivors. Although cancer registries often have a national/state mandate to collect clinical data such as date of diagnosis or cancer characteristics, such mandates often do not extend to contacting survivors for survivorship studies. The initial contact with participants to PROFILES studies are through the attending physician. In the case of CAESAR, state regulations required that different methods were used to contact survivors, e.g. direct contact from cancer registry, initial contact via the treating physician or the study physician affiliated with the University. These different recruitment methods could have influenced response rates particular to each of the participating cancer registries. Also, the new General Data Protection Regulation (GDPR) for the European Union member countries will enter into force in May 2018 [55]. While strengthening the protection of the privacy of EU citizens, the GDPR could also potentially hamper the response rates to population-based survivorship studies.

While cancer registries can collect a wealth of clinical data and have regular updates on vital status, contact information might not be updated from time since diagnosis. Experience from PROFILES indicated that younger cancer survivors were more likely to have moved or changed address in the interim between cancer diagnosis and start of survivorship study. These survivors could not be contacted and invited for study participation.

As with any observational studies, population-based survivorship studies also run the risk of selection and response bias. It is possible that respondents to the CAESAR and PROFILES studies tend to be in better health than non-respondents.

Another consideration is the amount and quality of clinical data registered by the cancer registry. The cancer registries in Germany and The Netherlands are members of the European Network of Cancer Registries (ENCR) which issues guidelines to ensure completeness of data reporting by member cancer registries. The ENCR also operates a common data portal for quality control of cancer registry data (www.encreu.eu).

7. Future directions

Through efforts from agencies such as the ENCR, clinical data collected by cancer registries have been harmonized, facilitating the study of cancer trends at national and international level. However comparison of HRQL of survivors recruited from different registries can be a challenge as different PRO instruments are often used. However CAESAR and PROFILES have a core set of PRO assessment comprising

the EORTC QLQ-C30 questionnaire and augmented with cancer-specific modules. Furthermore, the EORTC survivorship module is now in phase III testing [56], with contributions from the CAESAR and PROFILES study teams. These developments open up the exciting possibility of international comparison of the well-being of cancer survivors.

As it has been described above, cancer registries on a national or state level usually do not have a mandate to contact survivors for survivorship studies. In recognition of the importance of PRO, the new cancer registration act in the state of Baden-Württemberg, Germany, has been amended to enable the Baden-Württemberg Cancer Registry to contact survivors for research purposes and to collect PRO [57].

8. Conclusion

Both the CAESAR study and the PROFILES registry have utilized the advantages of cancer registries to conduct large-scale population-based survivorship studies with great success. The use of a common set of validated EORTC questionnaires and the EORTC cancer survivorship questionnaire in the near future opens up an exciting new vista of international collaboration in cancer survivorship research.

Conflict of interest

None.

References

- [1] International Agency for Research on Cancer: GLOBOCAN, Estimated Cancer Incidence, Mortality and Prevalence Worldwide in 2012, (2012) http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx. Accessed 30 October 2017.
- [2] Krebs in Deutschland 2011–2012, Cancer in Germany 2011–2012, Robert Koch Institut, Berlin, 2015.
- [3] C. Allemani, H.K. Weir, H. Carreira, et al., Global surveillance of cancer survival 1995–2009: analysis of individual data for 25,676,887 patients from 279 population-based registries in 67 countries (CONCORD-2), *Lancet* 385 (2015) 977–1010.
- [4] P.A. Ganz, Why and how to study the fate of cancer survivors: observations from the clinic and the research laboratory, *Eur. J. Cancer* 39 (2003) 2136–2141.
- [5] A. Surbone, M.A. Annunziata, A. Santoro, et al., Cancer patients and survivors: changing words or changing culture? *Ann. Oncol.* 24 (2013) 2468–2471.
- [6] L. Dirven, L.V. van de Poll-Franse, N.K. Aaronson, et al., Controversies in defining cancer survivorship, *Lancet Oncol.* 16 (2015) 610–612.
- [7] National Coalition for Cancer Survivorship: <http://www.canceradvocacy.org/>. Accessed 26 September 2017.
- [8] E.C. Moser, F. Meunier, Cancer survivorship: a positive side-effect of more successful cancer treatment, *EJC* 12 (Suppl) (2014) 1–4.
- [9] National Cancer Institute <https://cancercontrol.cancer.gov/ocs/statistics/definitions.html>. Accessed 21 November 2017.
- [10] I.B. Wilson, P.D. Cleary, Linking clinical variables with health-related quality of life: a conceptual model of patient outcomes, *JAMA* 273 (1995) 59–65.
- [11] US Department of Health and Human Services Food and Drug Guidance for Industry, Patient-reported Outcomes: Use in Medical Product Development to Support Labeling Claims, (2009) <https://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm193282.pdf>. Accessed 29 Nov 2017.
- [12] C.B. Harrington, J.A. Hansen, M. Moskowitz, et al., It's not over when it's over: long-term symptoms in cancer survivors – a systematic review, *Int. J. Psychiatry Med.* 40 (2010) 163–181.
- [13] C.M. Alfano, J.H. Rowland, Recovery issues in cancer survivorship: a new challenge for supportive care, *Cancer J.* 12 (2006) 432–443.
- [14] N.M. Aziz, Cancer survivorship research: state of knowledge, challenges and opportunities, *Acta Oncol.* 46 (2007) 417–432.
- [15] J.P. Harrop, J.A. Dean, E.D. Paskett, Cancer survivorship research: a review of the literature and summary of current NCI-designated cancer center projects, *Cancer Epidemiol. Biomarkers Prev.* 20 (2011) 2042–2047.
- [16] J.Z. Ayanian, P.B. Jacobsen, Enhancing research on cancer survivors, *J. Clin. Oncol.* 24 (2006) 5149–5153.
- [17] P.A. Ganz, S.R. Land, C. Antonio, et al., Cancer survivorship research: the challenge of recruiting adult long term cancer survivors from a cooperative clinical trials group, *J. Cancer Surviv.* 3 (2009) 137–147.
- [18] M.S.Y. Thong, F. Mols, K.D. Stein, et al., Population-based cancer registries for quality-of-life research, *Cancer* 119 (2013) 2109–2123.
- [19] D.M. Parkin, The evolution of the population-based cancer registry, *Nat. Rev. Cancer* 6 (2006) 603.
- [20] D.M. Parkin, The role of cancer registries in cancer control, *Int. J. Clin. Oncol.* 13 (2008) 102–111.
- [21] V. Arndt, L. Koch-Gallenkamp, H. Bertram, et al., Rationale, design and implementation of the CAESAR study – a multi-regional, large-scale population-based

- study on long-term cancer survivors, Presented at the European Cancer Rehabilitation & Survivorship Symposium (ECRS), Copenhagen, 2016.
- [22] V. Arndt, T. Sturmer, C. Stegmaier, et al., Provider delay among patients with breast cancer in Germany: a population-based study, *J. Clin. Oncol.* 21 (2003) 1440–1446.
- [23] V. Arndt, T. Sturmer, C. Stegmaier, et al., Patient delay and stage of diagnosis among breast cancer patients in Germany – a population based study, *Br. J. Cancer* 86 (2002) 1034–1040.
- [24] V. Arndt, H. Merx, C. Stegmaier, et al., Restrictions in quality of life in colorectal cancer patients over three years after diagnosis: a population based study, *Eur. J. Cancer* 42 (2006) 1848–1857.
- [25] V. Arndt, C. Stegmaier, H. Ziegler, et al., A population-based study of the impact of specific symptoms on quality of life in women with breast cancer 1 year after diagnosis, *Cancer* 107 (2006) 2496–2503.
- [26] V. Arndt, C. Stegmaier, H. Ziegler, et al., Quality of life over 5 years in women with breast cancer after breast-conserving therapy versus mastectomy: a population-based study, *J. Cancer Res. Clin. Oncol.* 134 (2008) 1311.
- [27] L. Jansen, A. Herrmann, C. Stegmaier, et al., Health-related quality of life during the 10 years after diagnosis of colorectal cancer: a population-based study, *J. Clin. Oncol.* 29 (2011) 3263–3269.
- [28] L. Koch, L. Jansen, A. Herrmann, et al., Quality of life in long-term breast cancer survivors – a 10-year longitudinal population-based study, *Acta Oncol.* 52 (2013) 1119–1128.
- [29] M. Löw, C. Stegmaier, H. Ziegler, et al., Epidemiologische Studie zu Chancen der Verhütung, Früherkennung und optimierten Therapie chronischer Erkrankungen in der älteren Bevölkerung (ESTHER-Studie), *Dtsch med Wochenschr* 129 (2004) 2643–2647.
- [30] R. Pritzkeleit, A. Waldmann, H. Raspe, et al., The population-based oncological health care study OVIS – recruitment of the patients and analysis of the non-participants, *BMC Cancer* 8 (2008) 311.
- [31] L.V. van de Poll-Franse, N. Horevoorts, M.V. Eenbergen, et al., The Patient Reported Outcomes Following Initial treatment and Long term Evaluation of Survivorship registry: scope, rationale and design of an infrastructure for the study of physical and psychosocial outcomes in cancer survivorship cohorts, *Eur. J. Cancer* 47 (2011) 2188–2194.
- [32] N.J.E. Horevoorts, P.A.J. Vissers, F. Mols, et al., Response rates for patient-reported outcomes using web-based versus paper questionnaires: comparison of two invitation methods in older colorectal cancer patients, *J. Med. Internet Res.* 17 (2015) e111.
- [33] *Lancet Oncology: cancer survivors: still room for improvement*, *Lancet Oncol.* 12 (2011) 609.
- [34] N. Corsini, J. Fish, I. Ramsey, et al., Cancer survivorship monitoring systems for the collection of patient-reported outcomes: a systematic narrative review of international approaches, *J. Cancer Surviv.* 11 (2017) 486–497.
- [35] L.Y. Yang, D.S. Manhas, A.F. Howard, et al., Patient-reported outcome use in oncology: a systematic review of the impact on patient-clinician communication, *Support. Care Cancer* 26 (2018) 41–60.
- [36] S. Oerlemans, L.P. Arts, N.J. Horevoorts, et al., Am I normal? The wishes of patients with lymphoma to compare their patient-reported Outcomes with those of their peers, *J. Med. Internet Res.* 19 (2017) e288.
- [37] L.P.J. Arts, L.V. van de Poll-Franse, S.W. van den Berg, et al., Lymphoma InterVEntion (LIVE) – patient-reported outcome feedback and a web-based self-management intervention for patients with lymphoma: study protocol for a randomised controlled trial, *Trials* 18 (2017) 199.
- [38] P.M. Rothwell, Factors that can affect the external validity of randomised controlled trials, *PLoS Clin. Trials* 1 (2006) e9.
- [39] A.J.M. Beijers, F. Mols, V.C.G. Tjan-Heijnen, et al., Peripheral neuropathy in colorectal cancer survivors: the influence of oxaliplatin administration. Results from the population-based PROFILES registry, *Acta Oncol.* 54 (2015) 463–469.
- [40] A.J.M. Beijers, F. Mols, G. Vreugdenhil, A systematic review on chronic oxaliplatin-induced peripheral neuropathy and the relation with oxaliplatin administration, *Support. Care Cancer* 22 (2014) 1999–2007.
- [41] F. Mols, T. Beijers, V. Lemmens, et al., Chemotherapy-induced neuropathy and its association with quality of life among 2- to 11-year colorectal cancer survivors: results from the population-based PROFILES registry, *J. Clin. Oncol.* 31 (2013) 2699–2707.
- [42] ASCO, Risk-based Approach to Chemotherapy Duration Recommended for Stage III Colon Cancer, (2017) <https://am.asco.org/risk-based-approach-chemotherapy-duration-recommended-stage-iii-colon-cancer>. Accessed 16 December 2017.
- [43] V. Arndt, L. Koch-Gallenkamp, L. Jansen, et al., Quality of life in long-term and very long-term cancer survivors versus population controls in Germany, *Acta Oncol.* 56 (2017) 190–197.
- [44] L.V. van de Poll-Franse, F. Mols, C.M. Gundy, et al., Normative data for the EORTC QLQ-C30 and EORTC-sexuality items in the general Dutch population, *Eur. J. Cancer* 47 (2011) 667–675.
- [45] Mols F, Husson O, Oudejans M, et al. Reference data of the EORTC QLQ-C30 questionnaire: Five consecutive annual assessments of 2000 representative Dutch men and women [submitted]. 2017.
- [46] M.W.M. van der Poel, S. Oerlemans, H.C. Schouten, et al., Elderly multiple myeloma patients experience less deterioration in health-related quality of life than younger patients compared to a normative population: a study from the population-based PROFILES registry, *Ann. Hematol.* 94 (2015) 651–661.
- [47] M.W.M. van der Poel, S. Oerlemans, H.C. Schouten, et al., Quality of life more impaired in younger than in older diffuse large B cell lymphoma survivors compared to a normative population: a study from the population-based PROFILES registry, *Ann. Hematol.* 93 (2014) 811–819.
- [48] S. Verhaar, P.A.J. Vissers, H. Maas, et al., Treatment-related differences in health related quality of life and disease specific symptoms among colon cancer survivors: results from the population-based PROFILES registry, *Eur. J. Cancer* 51 (2015) 1263–1273.
- [49] M.S.Y. Thong, M. Kicinski, C. Coens, et al., A population-based approach to compare patient-reported outcomes of long-term Hodgkin's lymphoma survivors according to trial participation: a joint study from the Patient-Reported Outcomes Following Initial Treatment and Long-term Evaluation of Survivorship registry and European Organisation for Research and Treatment of Cancer, *Eur. J. Cancer Prev.* 26 (2017) S223–S228.
- [50] D. Schoormans, L. van de Poll-Franse, P. Vissers, et al., Pharmacologically treated anxiety but not depression prior to cancer diagnosis predicts the onset of cardiovascular disease among breast cancer survivors, *Breast Cancer Res. Treat.* 166 (2017) 259–266.
- [51] F. Mols, M.S. Thong, G. Vreugdenhil, et al., Long-term cancer survivors experience work changes after diagnosis: results of a population-based study, *Psychooncology* 18 (2009) 1252–1260.
- [52] F. Mols, M.S. Thong, P. Vissers, et al., Socio-economic implications of cancer survivorship: results from the PROFILES registry, *Eur. J. Cancer* 48 (2012) 2037–2042.
- [53] Effting M: [Geen hypotheek of verzekering na kanker] No mortgage or insurance after cancer., *De Volkskrant*. <https://www.volkskrant.nl/magazine/-geen-hypotheek-of-verzekering-na-kanker~a3100502/>. Accessed 4 December 2017, 2011.
- [54] L. Liu, P. O'Donnell, R. Sullivan, et al., Cancer in Europe: death sentence or life sentence? *Eur. J. Cancer* 65 (2016) 150–155.
- [55] EUGDPR: <https://www.eugdpr.org/eugdpr.org.html>. Accessed 16 December 2017.
- [56] EORTC Quality of Life: <http://groups.eortc.be/qol/survivorship>. Accessed 16 December 2017.
- [57] Hermann S, Friedrich S, Bezold K, et al. [Unterstützung von Forschungsvorhaben durch das Krebsregister Baden-Württemberg] Support of research projects by the Cancer Registry of Baden-Württemberg. Presented at the Annual Meeting of the German Society for Epidemiology (DGEpi), Lübeck, Germany, 2017.