PATIENT-REPORTED PRODUCTIVITY OUTCOMES

DO RESEARCHERS MEASURE WHAT EMPLOYERS CARE ABOUT?

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EXECUTIVE SUMMARY

Including patient-reported productivity outcomes (PRO-P) such as illness absences and job performance in clinical research could help demonstrate the productivity value of effective interventions. The few validated instruments that measure PRO-P are designed to communicate the economic burden of illness on employers by monetizing absenteeism and presenteeism data. Whether and how employers use PRO-P findings from clinical research, however, has not been documented.

We first conducted a literature review of 138 cancer studies to better understand clinical research approaches to measuring PRO-P.

- The results of the literature review indicated that while many cancer studies have included PRO-P, most did not use instruments best suited to communicating costs to employers.
- Work productivity was seldom reported in financial terms. The more typical focus was on quality of life.
- The most common PRO-P approach was an ad hoc survey developed by the researchers without reference to validated instruments. The most common validated instrument was the Work Ability Index, which allows for calculation of costs attributable to absence and productivity, but the reviewed studies generally did not use the survey items in this way.

Following the literature review, we convened an employer advisory board and conducted several individual interviews with health and benefits specialists to determine how employers used PRO-P and how it could be more useful to benefits decisions.

- Generally, discussants stated that they did not use PRO-P when making benefits decisions. They typically rely on disability claims data to determine the link between illnesses and absences.
- PRO-P information typically came to employers through benefits partners such as providers, insurance carriers, and absence management experts rather than directly from clinical research. Benefits partners tended to use PRO-P in combination with objective clinical data to assist employees with returning to work from a disability leave.
- Discussants noted the utility of PRO-P, particularly to determine the effectiveness of wellness programs, yet PRO-P was not widely available or applicable for employers—limiting its direct use.

Employers' low demand for PRO-P could reflect the absence of studies that meaningfully convert patient-reported productivity into business terms. By carefully considering their survey instruments, clinical researchers have an opportunity to cultivate employers' demand for their findings without sacrificing the ability to measure health, work ability, and quality of life outcomes important to patients.

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BACKGROUND

Patient-reported productivity outcomes (PRO-P) such as illness-related absences from work (absenteeism) and impaired job performance (often referred to as "presenteeism") can be used to show the business value of interventions that promote and sustain health. Nearly 60% of US adults have a chronic illness that can require medical treatment and limit activity.[1] Understanding how illnesses affect work productivity can help employers develop benefits packages that simultaneously meet employees' needs, contribute to their ability to attend work consistently and perform well on the job, and help bend the healthcare cost curve. One approach to demonstrating the impact of illness on business performance and the value of effective treatments is through measurement of patients' experiences with illnesses and treatments and the impact on their ability to work. Through surveys, interviews, and focus groups, PRO-P readily lend themselves to expressing the productivity burden of illness in terms of employers' economic losses.

A clearer understanding of how illness affects employees' abilities to attend work consistently and perform well on the job can help employers design health benefits that promote early diagnosis of diseases and access to effective treatments. At the same time, benefits decisions are ultimately business decisions. The challenge is designing benefits that are simultaneously evidence based; meet employees' needs, values, and preferences; and contribute to improved business performance.

USING PRO-P TO EXPRESS PRODUCTIVITY OUTCOMES IN ECONOMIC TERMS

Although many instruments exist for measuring employees' health and productivity,[2] Table 1 summarizes the approaches of three validated, reliable survey instruments designed explicitly for expressing PRO-P in economic terms: the Health and Productivity Questionnaire (HPQ),[3] the Work Limitations Questionnaire (WLQ),[4] and the Work Productivity and Activity Impairment Questionnaire (WPAI).[5] Although each takes slightly different measurement approaches, all permit the application of compensation (actual or average) to employees' responses about illness-related absences, presenteeism, and work impairment.

[1] Centers for Disease Control and Prevention. 2020. https://www.cdc.gov/chronicdisease/about/index.htm. Accessed 10/21/20.
[2] Gilleskie DB. *Evaluation of the Content of Publicly-available, Nationally-representative Datasets for Use in Measuring the Costs and Causes of Health-related Lost Work Time.* San Francisco: Integrated Benefits Institute;2007. https://www.ibiweb.org/resource/ibi-fellowship-report-2007-gilleskie/; Mattke S et al. A review of methods to measure health-related productivity loss. *American Journal of Managed Care.* 2007;13(4):211-7. PMID: 17408341; Zhang W, Bansback N, Anis AH. Measuring and valuing productivity loss due to poor health: A critical review. *Social Science & Medicine.* 2011;72(2):185-92. doi: 10.1016/j.socscimed.2010.10.026
[3] Kessler RC et al. The World Health Organization Health and Work Performance Questionnaire (HPQ). *Journal of Occupational and Environmental Medicine.* 2003;45(2):156-74. doi: 10.1097/01.jom.0000052967.43131.51
[4] Lerner D et al. The Work Limitations Questionnaire. *Medical Care.* 2001;39(1):72-85. doi: 10.1097/00005650-200101000-00009
[5] Reilly MC, Zbrozek AS, Dukes EM. The validation and reproducibility of a work productivity and activity impairment instrument. *PharmacoEconomics*. 1993;4(5):353-65. doi: 10.2165/00019053-199304050-00006

Table 1: Common approaches to measuring the productivity burden of illness

Measure	Approach	How to monetize	Instrument
Absenteeism	Hours or days/weeks/months missed due to illness	Apply daily or hourly compensation (wages and benefits)	HPQ WPAI
Presenteeism	Visual analog scale, 0–10 • Converts to % of time/effort Likert scale • Response options as % of time	Apply to annual compensation	HPQ WLQ WPAI
Work impairment	Qualitative • Ability to concentrate, sleep disturbance	Use as covariate in models of absenteeism or presenteeism	HPQ WLQ WPAI

For example, based on economic theories of marginal productivity that posit the value of an absence as equal to average wages,[6] applying daily compensation to absences measured in the HPQ (as days missed due to illness in the past four weeks, or the gap between actual and expected hours worked) and the WPAI (as hours missed in the past seven days) permits economic assessments of lost work time.

The HPQ and the WPAI also use a visual analog scale (VAS) to measure presenteeism by rating overall performance, usual performance, or performance of workers in similar positions, as well as qualitative work impairments. The WLQ measures presenteeism and impairment by creating four scales (time, physical, mental-interpersonal, and output demands) from 25 questions that use Likert scales of percentage of time (e.g., "None of the time" or "25% of the time"). In all three cases, employees' survey responses can be interpreted as percentages of time or effort—which by extension of marginal productivity theory[7] can be applied to daily or total compensation to estimate economic values.

HOW DO RESEARCHERS USE PRO-P IN CLINICAL STUDIES?

While the instruments summarized in Table 1 are designed to inform employers (as health plan sponsors and business operators) about illness-related lost productivity costs—and, by extension, about the financial value of effective treatments and well-managed conditions—their wider use in clinical research and evaluations is unclear. As such, many comparative effectiveness studies may miss an opportunity to address the business value of treatments in terms that resonate with an important stakeholder.

To understand whether the use of PRO-P in clinical research can demonstrate economic value, we conducted a literature review guided by two basic questions:

1. What are the common research approaches and instruments used to incorporate PRO-P among peer-reviewed cancer studies?

[6] Pauly MV et al. A general model of the impact of absenteeism on employers and employees. *Health Economics.* 2002;11(3):221-31. https://onlinelibrary.wiley.com/doi/abs/10.1002/hec.648. Accessed 1/12/21.
[7] Pauly MV et al. Valuing reductions in on-the-job illness: 'Presenteeism' from managerial and economic perspectives. *Health Economics.* 2008;17(4):469-85. doi: 10.1002/hec.1266

2. How do these approaches compare with health and productivity research targeted toward employers?

The overall purpose of the literature review is to make inquiries about the use of PRO-P in clinical studies. In addition to limiting the quantity of papers found in a review, cancer studies were chosen for productivity reasons as well. Although the incidence of cancer is low, employees with cancer lose more workdays than do employees with common chronic diseases, including arthritis, diabetes, heart disease, hypertension, lung disease, and stroke.[8] Additionally, improved cancer therapies allow more patients to work during treatments or to return to work (RTW) following treatments.[9] At the same time, both cancer symptoms and side effects of some treatments can make it difficult for some patients to fully resume their work activities or fully regain their ability to perform on the job.[10] While improved cancer treatments promise financial benefits for employees, their employers, and society at large, it is not clear how often direct productivity gains are included in the estimates of the net monetary benefits of cancer treatments.

DO EMPLOYERS FIND PRO-P USEFUL IN THEIR BENEFITS DECISIONS?

After completing the literature review of PRO-P in cancer studies, we convened an employer advisory board (EAB) for a focus group discussion and conducted interviews to discuss these findings and assess whether PRO-P approaches are valuable to the benefits decision-making process. In effect, this amounts to a third—perhaps most important—research question:

3. Whether or not it is expressed in economic terms, do employers find PRO-P useful when making benefits decisions?

[8] Vuong TD, Wei F, Beverly CJ. Absenteeism due to functional limitations caused by seven common chronic diseases in US workers. *Journal of Occupational and Environmental Medicine.* 2015;57(7):779-84. doi: 10.1097/JOM.0000000000000452
[9] de Boer AG et al. Long-term work retention after treatment for cancer: A systematic review and meta-analysis. *Journal of Cancer Survivorship.* 2020;14(2):135-50. https://dx.doi.org/10.1007%2Fs11764-020-00862-2
[10] Centers for Disease Control and Prevention. 2020. https://www.cdc.gov/chronicdisease/about/index.htm. Accessed 10/21/20.

METHODS

LITERATURE REVIEW

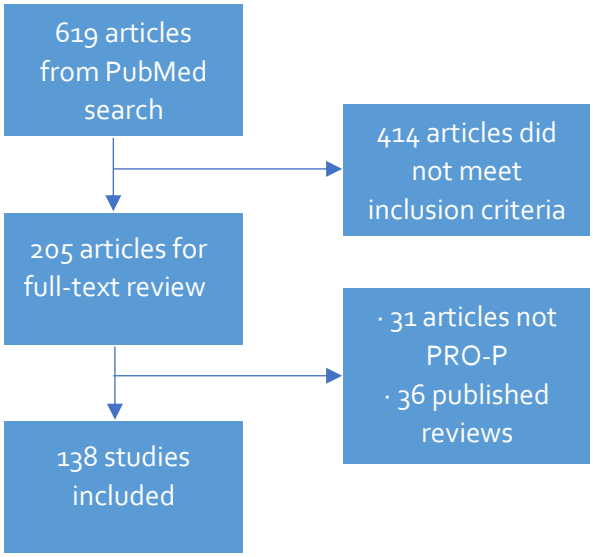
A PubMed[11] search was used to identify peer-reviewed journal articles from oncology studies featuring PRO-P. The search terms combined Mesh and text words commonly used in the fields of work productivity and oncology. Table 2 shows the exact search language used.

Table 2: PubMed search terms for work productivity and oncology literature review

("Absenteeism"[Mesh] or "absenteeism"[Text Word] or "sick day"[Text Word] or "work impairment"[Text Word] or "work ability"[Text Word] or "work productivity"[Text Word] or "sickness absence"[Text Word] or "illness absence"[Text Word] or "job performance"[Text Word] or "Presenteeism"[Mesh] or "Presenteeism"[Text Word]) AND ("Oncology"[Text Word] or "Neoplasms"[Mesh] or "Cancer"[Text Word] or "Tumor"[Text Word])

The search returned 619 articles. A review of the titles and abstracts by the main author (with PhD credentials) eliminated 414 articles that did not meet inclusion criteria due to at least one of the following reasons: (a) Not in English; (b) Not cancerous tumor (e.g., fibroids); (c) Other disease (e.g., rheumatoid arthritis); (d) Not of working age (e.g., childhood cancer); (e) Not cancer patients (e.g. healthcare workers); (f) No PRO-P (e.g., claims data); (g) Morbidity/mortality studies; (h) Qualitative; (i) Proposed study design; (j) Prevention study; or (k) Commentary/editorial.

Figure 1: Literature review flow chart



After full-text review by the main author and the co-authors (with PhD and MPH credentials), another 31 articles were eliminated for not using PRO. This process resulted in 138 included studies provided in the Appendix of this report.

Thirty-six published literature reviews were also identified in the search and reviewed by the main author and second author for any journal articles that focused on PRO-P in the oncology field. Figure 1 details this review process.

EMPLOYER DISCUSSIONS

To understand how employers use PRO-P data and to identify gaps in PRO-P information needed to support benefits planning, we convened an online EAB focus group and conducted a series of one-on-

[11] National Library of Medicine. National Center for Biotechnology Information. https://pubmed.ncbi.nlm.nih.gov

one interviews. Participants included benefits, disability, and health specialists experienced with the design and purchase of employee health benefits or the development of their respective employer's health benefits strategy. The EAB began with a summary of the literature review findings, followed by a moderated conversation structured around four questions:

1. "Do self-reported measures such as functional limitations and job performance resonate when you are thinking about the health and performance of your own workers?"
2. "When evaluating your company's health programs or benefits strategy, is it necessary to put health and productivity in financial terms?"
3. "What self-reported or patient-reported outcomes has your company used to understand the health of its employees?"
    - "How do you use this information when you are considering the business value of your health benefits?"
4. "What kinds of patient-reported or self-reported information would help you make more informed benefits decisions but is currently not in the market?"
    - "What is the preferred source of this information?"

One-on-one interviews were also conducted with other benefits, disability, and health specialists using the same discussion structure. A designated notetaker attended the EAB and all interviews, and notes were further contributed by the moderator or interviewer. These notes were used to identify and organize themes that emerged from the discussions.

RESULTS

The detailed findings from all 138 reviewed articles are provided in an evidence table at the end of this report. In addition to author, year, and country of study origin, the evidence table includes information about study population and design, productivity instruments, specific PRO items, treatment modality, and symptoms measured. Findings relevant to PRO-P from each study were also summarized to provide evidence of productivity.

STUDY POPULATIONS

Study designs focused mostly on cancer patients (123 studies) with a range of different cancer types. Caregivers of cancer patients were identified in 12 studies. Six studies included the spouses or partners of cancer patients. Breast cancer was mentioned directly in the study population of 48 studies; prostate cancer was mentioned in 14 studies, lung cancer in four, and bladder cancer in one. Forty-five studies had inclusion criteria requiring the study population to be employed.

STUDY DESIGN

The most common study design—cross-sectional surveys—was used in 68 studies. Twenty-four studies employed a case control design, which most often compared cancer patients with healthy, cancer-free controls usually within the general population. Two of these case control studies compared caregivers of cancer patients with non-caregivers. Thirty-seven longitudinal studies surveyed participants at least twice over the study period. There were eight clinical trials, seven of which were randomized; among these randomized trials, three focused on work-related interventions (e.g., vocational rehab), three on symptoms (e.g., treating depression), and one on a treatment for thyroid cancer patients. Additionally, there was one case study.

PRODUCTIVITY INSTRUMENTS

Table 3 summarizes the instruments identified, the number of studies in which the instrument or approach was identified (frequency), and the main measures of each instrument. While variations of PRO-P instruments have been developed for some specific diseases—such as the WPAI for allergic rhinitis (WPAI-AS)[12]—no instruments were identified specifically for cancer. The most common approach to PRO-P was an ad hoc survey to address study-specific research questions (45 studies) rather than the administration of an established, validated survey instrument. Ad hoc surveys can include researchers' own questions and/or adapt versions of PRO-P without reference or rationale for the question wording or approach. When administering their own instrument, researchers typically combined selected items from one or more validated instruments with or without providing reference to the original source. Among studies using a validated instrument, the Work Ability Index (WAI) [13] was the most frequent, referenced in 40 studies. The WPAI was referenced in 20 studies, the WLQ in 13, and

[12] Reilly MC, Tanner A, Meltzer EO. Work, classroom and activity impairment instruments: Validation studies in allergic rhinitis. *Clinical Drug Investigation.* 1996;11(5):278-88.
[13] Ilmarinen J. The Work Ability Index (WAI). *Occupational Medicine*. 2007;57(2):160. https://doi.org/10.1093/occmed/kqm008

the HPQ in 2. Seven studies used data from validated surveys used in population-based reporting (i.e., Medical Expenditure Panel Survey [MEPS] or National Health Interview Survey [NHIS]). An additional 28 instruments were featured at least once in 38 different studies.

Table 3: Most common productivity instruments featured in oncology literature review

Instrument	Frequency	Measures
Ad hoc surveys	45	Created new PRO-P measures or adapted PRO-P measures without reference
Work Ability Index	40	Current work ability, Physical demands, Number of diseases, Estimated work loss, Sickness absence, Work capacity, Mental resources
Work Productivity and Activity Impairment	20	Absenteeism, Presenteeism, Overall work impairment, Daily activity impairment
Work Limitations Questionnaire	13	Time demands, Physical demands, Mental-interpersonal demands, Output demands
General Nordic Survey (QPS Nordic)	5	Importance of work, Job demands
Questionnaire on the Experience and Evaluation of Work (VBBA)	5	Physical workload, Work stress
Return-to-Work Self-Efficacy (RTWSE)	4	Belief in ability to handle aspects of returning to work such as meeting job demands
Population-based (MEPS, NHIS)	7	Absenteeism (workdays lost), employment status
Other (e.g., HPQ)	39	29 different instruments

WORK PRODUCTIVITY OUTCOMES

Several different productivity and work-related outcomes were used in cancer studies. In 61 studies, a version of employment status was included, consisting of full- or part-time work, not working/unemployment, on leave, disability pension, and/or early retirement. Questions about absenteeism in 63 studies asked about the number of missed workdays, duration of sick day/incidental absences, and/or duration or date of sick leave or RTW. Presenteeism was also measured in different ways: from work impairment, presenteeism scales (e.g., WLQ), perceived job performance, performance on days worked when bothered by illness to treatment side effects that had an impact on productivity. Seventeen studies calculated productivity losses, yet only four studies used compensation data that were reported by the patient.

Other work-related outcomes included work limitations and ability, as well as health-related quality of life (HRQoL). Work limitations referred to items such as the importance of work to the patient, work satisfaction, and RTW self-efficacy (including work-related questions like ability to cope or concentrate). Fifty-nine studies included items on work ability or inability. Job demands included items on type of work, shift work, time pressure, and physical demands (or manual labor). HRQoL had items

ranging from role functioning scales to work/life balance (e.g., work disruptions) to psychosocial issues (e.g., perceived social support at work) to work posture.

Table 4: The Work Ability Index

Item	Question	Scoring of responses
Current work ability compared with lifetime best	Assume that your work ability at its best has a value of 10 points. How many points would you give your current work ability?	0–10, where 0 means completely unable to work
Work ability in relation to job demands	How do you relate your current work ability with respect to the **physical** demands of your work? How do you relate your current work ability with respect to the **mental** demands of your work?	1 (very poor) – 5 (very good)
Number of current diseases diagnosed by a physician	List of more than 50 different diseases and injuries	5 or more diseases = 1; 4 diseases = 2; 3 diseases = 3; 2 diseases = 4; 1 disease = 5; No disease = 7
Estimated work impairment	Is your illness or injury a hindrance to your job?	1 (entirely unable to work) – 6 (no hindrance/no disease)
Sickness absenteeism	How many whole days have you been off work because of a health problem (disease or health care) during the past year (12 months)?	100–365 days = 1; 25–99 days = 2; 10–24 days = 3; Up to 9 days = 4; None at all = 5
Self-prognosis of work ability	Do you believe that—from the standpoint of your health—you will be able to do your current job **two years from now**?	Unlikely = 1 Not certain = 4 Relatively certain = 7
Mental resources	Have you recently been able to enjoy your regular daily activities? Have you recently been active and alert? Have you recently felt yourself to be full of hope for the future?	Response: 0 (never) – 4 (often) Sum of 0–3 = 1 Sum of 4–6 = 2 Sum of 7–9 = 3 Sum of 10–12 = 4

Most studies that analyzed work ability used the WAI, in whole or in part (e.g., using only the first item comparing current work ability with lifetime best). Table 4 describes the WAI items, questions, and scoring of responses. Summing these scores can produce a final range of 7 to 49, with lower scores indicating a lower work ability. Although the WAI was not monetized in any identified study, in principle the item "Current work ability compared with lifetime best" representing presenteeism and sickness absenteeism could be expressed in economic terms with the inclusion of wage information or assumptions.

OTHER INFORMATION INCLUDED

Treatment modality and symptoms can influence productivity and were extracted into the results table when provided. If no treatments or symptoms were recorded in the table, these categories were not mentioned, not specified, or not PRO. Treatment modality was included in a total of 101 studies, which typically focused on whether a patient had undergone chemotherapy, radiation, and/or surgery.

Information about symptoms was found in a total of 122 studies from more than 80 different validated instruments. Common symptoms included fatigue, quality of life (QoL), co-morbidities, depression, and anxiety. Evidence of productivity provides a summary of main findings that often include associations of treatment and symptoms with productivity.

PUBLISHED REVIEWS

The 36 published systematic reviews, or reviews that identify, assess, and extract data to summarize all literature relevant to a research question or specific topic, were evaluated for additional peer-reviewed cancer studies that included PRO-P. Although this process led to the review of an additional 300 abstracts, the authors did not further include any of these studies in the results table for the following three reasons: (1) Some studies did not follow the same initial inclusion criteria outlined above in Methods (i.e., not original cancer research articles with PRO-P); (2) many of these studies seemingly used ad hoc surveys for work productivity, which would not provide more details about productivity instruments; and (3) work productivity was often not a main research variable and the included survey items were limited, usually resembling simple items such as employment status (employed or unemployed).

SUMMARY OF EMPLOYER DISCUSSIONS

Three corporate health benefits professionals participated in a 90-minute EAB focus group discussion, and subsequent half-hour interviews were conducted with three additional benefits specialists. Themes that emerged from the discussions are summarized below.

PRO-P HAS NOT BEEN A TOP PRIORITY FOR BENEFITS DECISION-MAKERS

Although benefits professionals agreed that PRO-P could produce valuable insights, these data are not always available or considered in benefits decisions. Benefits decisions are reviewed annually and consider many elements, including company size and employee type (e.g., salary versus hourly). Specialists develop plans by closely following market trends, obtaining direct input from board members and executives, and taking cues from benchmarking data such as the Great Place to Work employee engagement surveys.[14]

Instead of PRO-P, employers often rely on "more objective" absence data from sources such as disability claims from carriers and third-party administrators and from payroll data that provide use of sick time. Self-reported absence data from surveys typically are not used. Year-over-year trends in diagnoses, cost of claims, and number of emergency room visits and hospitalizations leading to absences are paid close attention. Presenteeism can be difficult for employers to define and measure, which can make defending its use to leadership challenging. One discussant noted that because costs and returns on investment were assigned a high priority in their company, reporting PRO-P in financial terms could draw unwanted attention to the high costs that employers pay for benefits and give the impression of a negative return on investment.

Employers tend to develop their disability leave and RTW programs without regard to disease states (although mental health and musculoskeletal disorders may be exceptions). Certain diseases, such as cancer, may occur in only a small number of employees yet can incur higher costs in benefits. PRO-P data on

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[14] Great Place to Work. https://www.greatplacetowork.com/solutions/employee-surveys

performance could be included for these small groups of employees to also determine trends. While some employers can amend benefits plans to accommodate certain diseases to avoid progression that can be even more costly, other employers may focus on decreasing risk through wellness and prevention programs to avoid targeting their health plans to specific diseases. Although focusing on trends is important, specialists need to be mindful of spending their time on a small number of employees when benefits plans cannot be targeted.

PRO-P USE IS OFTEN THROUGH THIRD-PARTY SOURCES TO ASSIST EMPLOYEES

Discussants noted that their companies rely on claims data and the expertise of partners to develop benefits strategies for the general employee population. They normally do not collect or analyze PRO-P data directly, receiving it instead from partners such as providers, disability carriers, pharmacy benefits managers, and absence management experts. On the other hand, it was noted that a patient-centered approach (which considers each patient's needs, preferences, and values in developing care plans) combined with objective measures such as medical records could be valuable in developing RTW guidelines, approving leave dates, and providing supportive and flexible accommodations where possible. For these purposes, patient-reported outcomes would be essential. For example, if an employee is hesitant to return to work, the employer could consult the employee's doctor to see what would work best, such as a few hours per day or a couple of days per week rather than full-time.

Because long-term absences due to severe illnesses affect only a small number of employees, PRO-P can also be used by absence management experts on an individual basis to advise benefits specialists in turn. One discussant mentioned that this team effort provides guidance for the employer when it comes to company policy and benefits rather than the employer's making these decisions without expert input.

PRO-P COULD BE BENEFICIAL IN TRACKING EMPLOYEE HEALTH AND WELLNESS

Employers tend to lack detailed individual data about their employees' health and productivity metrics. Health and benefits specialists most often have access to aggregate data from surveys administered through wellness programs (such as weight management, physical activity, and diabetes care management). These programs were considered important for helping employees recognize potential health problems but typically have been limited. Because positive changes in employees' health acquired through company wellness programs can take time, some employers do not receive their wellness program data for years after the program is implemented. Additionally, aggregate data do not allow employers to link health data to performance to show the relationship between health and productivity.

Discussants noted that PRO-P measures could be used to track the effects that programs have on health and productivity in real time. For example, employers want to ensure that employees take their medications correctly to manage their health and avoid hospital and emergency room visits. Additionally, discussants recognized that if people can manage their own health, they may be more productive at work, and they saw the potential role of self-reported measures in this process. Because claims data show only the sickest employees who take leave, discussants indicated that using PRO-P can provide health and productivity details about all employees and indicate whether health plans are continuing to provide appropriate coverage.

Several barriers could prevent employers' use of PRO-P

Discussants mentioned several barriers to using PRO-P. First, there was a common perception that objective health data (i.e., information contained in claims or health records) are more valuable than self-reported data. For example, consistently collected clinical data can show trends in medical conditions (e.g., decreasing hemoglobin A1C in six-month increments for a diabetes management program). Objective measures were also more readily available to employers than PRO-P measures.

Second, measures important to employers, such as absence and loss of productivity, are not always included in clinical research, limiting their applicability. Certain treatments could affect job performance, particularly in safety-sensitive occupations; other measures, such as fitness for duty (i.e., meeting the physical and mental job requirements to work) and the ability of employees to do their jobs, could be included in clinical studies to appeal to employers.

Third, some discussants questioned the validity of self-reported measures—in the belief that respondents do not always respond accurately or truthfully rather than due to distrust of researchers' statistical validation methods. For example, observed differences between an employee's self-reported performance and their supervisor's evaluation of their performance raises concern that employees might not accurately assess their ability to work through episodes of poor health.

Fourth, discussants noted that PRO-P measures can be difficult for employers to collect, especially when employees work from home and will continue to do so to some extent after the pandemic. With minimal use of PRO-P by benefits specialists already, there was inconsistency in the expectation of which department was responsible for collecting these items and what information would be most important and convincing to employers to use.

Other sources of PRO-P that could be useful to employers

Discussants mentioned some PRO-P sources that could be useful when developing benefits strategies but which were unavailable or difficult to obtain. Impact surveys from executives, benchmarking data, and population survey data were noted as potentially useful sources of information. PRO-P data collected consistently from multiple employers within industry verticals could serve as useful benchmarks and may encourage other companies to request similar data from benefits partners. It was also noted that claims data might not differentiate between physical and mental health concerns, emphasizing the need for PRO-P to evaluate such aspects as pain and psychological distress. PRO-P questions targeting mental health (e.g., Patient Health Questionnaire-9), as well as questions about function and activities of daily living, could be collected from population-based surveys to allow for comparisons based on employee health.

DISCUSSION

Conducting a literature review on PRO-P in oncology studies and discussing the results and uses of PRO-P with experienced benefits professionals provided different perspectives on the advantages and disadvantages of using PRO-P to communicate the business value of health. The peer-reviewed oncology literature does not typically use PRO-P instruments that facilitate the communication of illness-related productivity burdens in terms of economic losses to employers. Oncology researchers have relied heavily on ad hoc surveys that frequently did not reference validated PRO instruments or provide a justification of their use of certain questions or instruments. Although certain productivity instruments have been designed for specific diseases and conditions, we were surprised that an instrument designed specifically for cancer was lacking. Most studies were cross-sectional in design, providing patients with a survey at just a single point in time. Very few studies collected PRO-P as part of randomized controlled trials—the typical gold standard of study designs. When assessed, instruments to assess work productivity used various measures to assess absenteeism and presenteeism, but they rarely monetized any findings and often used variables that were not self-reported. The greater number of work-related questions surrounding limitations and mental and physical health indicate a focus of PRO-P on QoL rather than economic burden within cancer studies.

The current research on health and productivity is not framed to communicate with employers but rather to understand productivity among researchers; this is particularly noted with the widespread use of the WAI—the most used validated instrument—which focuses on HRQoL. This instrument can also represent economic burden through absenteeism and presenteeism items and further collection of wage data, which would be useful for employers.

When asking discussants about the literature review findings, they found PRO-P to be important and are receptive to using it; there was, however, a lack of exposure to PRO-P among employers. PRO-P is not commonly used to structure benefits directly; rather, it is typically used by other parties—such as doctors, disability carriers, and pharmacy benefits managers—in combination with objective data to show clinical improvement and to work with ill employees individually to help them return to work.

While carriers and experts may use PRO-P to guide specialists, trends in absence data were reported to be more helpful in determining the costliest disease states and the programs that could be effective in assisting employees with their health. Health and wellness programs typically collect PRO-P from employees, but it is presented as aggregate data, preventing the ability to link to individual absence data and therefore ultimately unable to show the connection of productivity to health. Some additional barriers held specialists back from using PRO-P, including skepticism of the validity of productivity data. Self-reported productivity measures, however, are nevertheless found to be valid and reliable.[15]

[15] Kessler RC et al. The World Health Organization Health and Work Performance Questionnaire (HPQ). *Journal of Occupational and Environmental Medicine.* 2003;45(2):156-74. doi: 10.1097/01.jom.0000052967.43131.51; Lerner D et al. The Work Limitations Questionnaire. *Medical Care.* 2001;39(1):72-85. doi: 10.1097/00005650-200101000-00009; Reilly MC, Zbrozek AS, Dukes EM. The validation and reproducibility of a work productivity and activity impairment instrument. *PharmacoEconomics*. 1993;4(5):353-65. doi: 10.2165/00019053-199304050-00006

GUIDANCE FOR USING PRODUCTIVITY OUTCOMES IN CLINICAL RESEARCH

Our findings show that PRO-P appear to be underutilized by employers. While oncology research has used PRO-P to illustrate productivity burdens for cancer patients and has shown some promising results for employment outcomes when undergoing early treatment, health and benefits specialists do not often use this method to support benefits decisions. Illustrating the mechanism that researchers use to show the financial burden of treatment and poor health on productivity may be of interest to employers in the future.

Using the following three guidelines in research would ensure that findings are more relevant to employers:

1. Choose self-reported measures that show clinical improvement and can be monetized.
2. Include absences and apply compensation to demonstrate the financial burden of illness and the value of effective treatments.
3. Link study participants to objective measures such as disability claims. Obtain these data by working with subjects drawn from an employer population where possible.

APPENDIX

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Amir et al., 2007 UK[1]	Cancer patients employed at time of diagnosis, judged by GP as suitable for return to work	Cross-sectional	Ad hoc survey	RTW; Duration of sickness absence leave; Quality of working life after RTW	Surgery, chemo, radiation, and/or hormone therapy		Employees who had surgery or sick leaves <12 months were more likely to RTW. Employees who had surgery were more likely to have leave durations <6 months compared to surgery with additional treatments. Employees who had to reduce their work hours due to illness were more likely to report that their working life deteriorated.
Bains et al, 2012 UK[2]	Colorectal cancer patients employed at diagnosis	Longitudinal	RTWSE WAI	Job self-efficacy (confidence in performing activities); Current work status (working, not working); Employment type (manual, non-manual); Work ability (3 items)	Surgery, chemo, or combination	Fatigue (FSS); Depression (BDI); QoL (FACT)	Treatment type, RTW self-efficacy, fatigue, quality of life associated with work ability at different time points; however, only treatment impacted work ability over all time points. Employees receiving chemo or combination therapy more likely to be working across the study.
Besen et al. 2017 USA[3]	Employees diagnosed with cancer	Longitudinal	PSID	Functional limitations in ability to work (yes, no); Receipt of Social Security Disability income		Chronic health conditions (arthritis, cancer, emotional, nervous or psychiatric problems, heart attack, heart disease)	Compared to respondents without a cancer diagnosis, employees who first reported cancer two years after a baseline survey had higher rates of functional limitations. Cancer patients had higher rates of SSD income two years after their first reporting of cancer.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Bielik et al. 2020 Slovakia[4]	Ovarian cancer patients	Longitudinal	EQ-5D	Work ability (ability to perform usual activities)		Comorbidities; HRQoL and Symptoms (QoL-OV28); Health care delivery; Future expectations	Current work ability was higher than at diagnosis yet lower than work ability at full health. Current work ability was strongly correlated with current HRQoL.
Bloom et al. 1993 USA[5]	Hodgkin's lymphoma and testicular cancer patients and their partners	Cross-sectional	Ad hoc survey	Total work problems (combination of inability to work at former pace, inability to finish tasks, and inability to concentrate)	Lymphadenectomy, radiation, or radiation and chemo combined	Outcomes: Physical (e.g., fatigue; POMS); Psychological (e.g., mood; POMS, CES-D); Social (e.g., smoker)	Compared to patients with testicular cancer, Hodgkin's patients were more likely to report an inability to work at former pace.
Boccia et al. 2007 USA[6]	Cancer patients who were anemic and receiving chemotherapy	Clinical Trial (16 week single-arm, open-label study)	WPAI	Impairment in work productivity and in regular activities	Injections of darbepoetin alfa	Hemoglobin levels; Overall health; Adverse events; Fatigue (FACT-F); Energy, health, and ability (EOHA)	Work productivity improved among patients <65 years old over time.
Boele et al. 2020 Netherlands[7]	Glioma patients with at least mild depressive symptoms and their family caregivers	RCT (internet-based therapy for depressive symptoms)	SF-HLQ	Absenteeism; Presenteeism (Days worked when bothered by health problems and performance scale (1-10) on days bothered); Impediments to employment; Indirect costs (wage NOT PRO)	Internet-based self-help for depression	Glioma symptoms (EORTC QLQ-C30); Depression (CES-D); Cognitive functioning (MOS); Fatigue (CIS); Comorbidities	Productivity losses over 4-weeks were higher for patients. Productivity losses among caregivers increased with levels of fatigue and patients' tumor grade.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Borget et al. 2007 France[8]	Patients with thyroid carcinoma first treated by thyroidectomy and radioiodine ablation	Longitudinal	Ad hoc survey	Absenteeism (duration of sick leave)	Recombinant human thyroid-stimulating hormone (rhTSH) or thyroid hormone withdrawal		Compared to patients treated by withdrawal, patients treated with rhTSH were less likely to require sick leave and had shorter sick leave durations and lower sick day costs.
Bottcher et al., 2013 Gemany[9]	Cancer patients enrolled in an occupational rehab program	Longitudinal	ERI SIBAR	Work status (RTW, unemployed, or disability pension); Absenteeism (duration of sick leave in past 12 months); Subjective amount of effort spent at work and the reward gained in return; Work ability (full, limited, or no ability to work at last job before beginning rehab); Need for rehab (early retirement risk, occupational stress, subjective need for rehab, occupational rehab recommended)	Surgery, chemo, radiation, and/or hormone therapy	Anxiety and depression (HADS)	Compared to patients who did not RTW, cancer patients who RTW after one year had lower ERI and were more likely to report full work ability at their last job prior to rehab.
Bradley et al, 2002 USA[10]	Long-term cancer survivors	Cross-sectional	HRS CPS	Employment status (full- or part-time, retired, disabled, not working); Job changes; Hours worked per week; Functional limitations; Reduced work schedule; Absenteeism	Radiation, surgery, chemo, combination, or none		Half of patients reduced their workloads due to treatments. Colon cancer patients were most likely to reduce their workloads. One quarter of working cancer patients reported cancer and treatments interfered with work tasks.
Bradley et al., 2006 USA[11]	Women diagnosed with breast cancer and men diagnosed with prostate	Longitudinal	Ad hoc survey	Absenteeism (days missed from work from diagnosis until study interview); Job characteristics (employer size, physical activity at work, paid sick leave available); Leave of absence (yes, no)	Surgery, radiation, chemo, hormone therapy, combination, or none		Prostate cancer patients missed less workdays than breast cancer patients. Breast cancer patients who received a combination of surgery, radiation, and chemotherapy missed the most days, followed

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	cancer employed full-time at diagnosis						by prostate cancer patients with a combination of surgery, hormone therapy and radiation.
Bradley et al, 2013 USA[12]	Married women with breast cancer and cancer-free, controls from CPS	Case Control	Ad hoc survey	Hours worked (weekly hours, change in hours, decreased hours); Stopped working (yes, no)	Following surgery or after initiating chemo or radiation		Compared to a cancer-free control group, husbands of breast cancer patients were more likely to have stopped working and/or decreased their weekly working hours at 2-months after treatment.
Brick et al., 2019 USA[13]	Post-menopausal women with breast cancer	Longitudinal	WLQ	Percentage of at-work productivity loss (index score created from each subscale and converted to percentage)	Enrolled prior to initiating anastrozole therapy and chemo	Depression (BDI); Anxiety (POMS); Fatigue (ESS); Cognitive and physical functioning (PAOFI)	Compared to a healthy control group, cancer patients had higher levels of at-work productivity loss at baseline (after surgery, but before chemotherapy and/or anastrozole therapy). This difference declined 6-months after the baseline.
Butturini et al, 2011 Italy[14]	Patients with left pancreatectomy	Longitudinal	Ad hoc survey	Time to resume normal activities (number of weeks between hospital discharge and date of RTW full-time)	Open or laparoscopic left pancreatectomy	Tumor size; Pathology; Perioperative details; Postoperative complications	Patients being treated with an open left pancreatectomy RTW in about twice the amount of time that those with a laparoscopic surgery.
Carlsen et al., 2013 Denmark[15]	Women with breast cancer who had survived at least 5 years and RTW, and women without breast cancer	Case control	WAI	Current work ability (1st item)		Fatigue; Anxiety and depression (HADS)	Fatigue, anxiety, and depression were all associated with reduced work ability, but was stronger among those with a history of cancer; Poor support from colleagues was also related to greater impaired work ability for cancer survivors

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Chari et al., 2019 USA[16]	Adults with relapsed/refractory multiple myeloma	Cross-sectional	WPAI:SHP	Absenteeism (work time missed), presenteeism (impairment at work), lost productivity (absenteeism + presenteeism), daily activity impairment	Current oral or injectable with or without oral	Performance status (ECOG); Treatment Satisfaction (TSQM-9)	Employed patients reported a decrease in work and activity impairment.
Cheng et al., 2016 Hong Kong[17]	Employed women with breast cancer (Stage 1-3 and at least 6 months of treatment) or cancer-free with musculoskeletal injury, or without either	Case Control	CSC-W21 WLQ	Work-related cognitive problems (working memory, executive functioning); Degree of work limitation including four subscales (time demands, physical demands, mental-interpersonal demands, output demands)	surgery, radiation, surgery + radiation, surgery + radiation + chemotherapy	Anxiety and depression (HADS); HRQoL (EORTC QLQ-C30); Disease stage; Time since completing primary cancer treatment	Employed women with breast cancer reported the highest number of cognitive symptoms of all three groups, despite no significant differences in WLQ scores among groups.
Cheung et al., 2009 Canada[18]	Patients with non-Hodgkin's Lymphoma	Cross-sectional	WPAI:GH	Absenteeism (hours absent from work due to health problems or for other reasons, hours worked over past 30 days); Impact of health problems on work productivity and daily activities; WPAI items: absenteeism, presenteeism, lost productivity (absenteeism + presenteeism), daily activity impairment	Prior therapies: none, radiation, stem cell transplant, rituximab, chemo, other, combination	HRQoL (EQ-5D) to measure health related quality of life; remission	More patients worked prior to diagnosis than after; no significant work disruption for absenteeism, presenteeism, lost productivity or daily activity impairment; working patients missed approximately 2 days of work in the preceding month due to illness
Cheung et al., 2017 Hong Kong[19]	Breast cancer survivors	Cross-sectional	WAI adapted QPS Nordic	Work Ability: Current work ability, continue to work in next 2 years, current ability to handle physical and mental work; impediment to work ability (e.g., physical or mental work load); Work-related information: effect of cancer on current work, sick leave paid and taken, job changes, current work history (position, years, weekly	Current treatment (yes, no); Chinese medicine (yes, no)	Comorbidities; Physical activity, nutrition, health responsibility, stress management (HPLP); physical, psychological, and spiritual well-being and social concern	Breast cancer survivors were more likely to work with higher physical and psychological health, greater working ability before diagnosis or during treatment, and mastery of work.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
				hours, shift work, employment status, disclosure diagnosis); QPS Nordic subscales: Job demands, control at work, mastery of work, social interaction, work motives		and support (QOL-CS)	
Chua et al., 2016 Singapore[20]	Informal caregivers of advanced cancer patients	Cross-sectional	WPAI	Employment status (employed, unemployed) and type; Absenteeism, presenteeism, overall work impairment, activity impairment		Caregiving tasks; Caregiver burden (ZBI); Caregiver QoL (CQOLC); Depression (CES-D)	Informal caregivers reporting higher caregiver burden had more impaired work, lower QoL, and higher rates of depression than those with lower burden.
Cleeland et al., 2014 USA[21]	Patients with recurrent or metastatic breast cancer	Cross-sectional	WPAI:SPH	Work productivity (absenteeism, presenteeism, overall work impairment) and activity impairment	First-line hormonal therapy or chemo and/or targeted therapy	Symptoms (MDASI); Overall HRQoL; Functioning and distress (ALS)	Increased symptoms, reduced functioning, and reduced HRQoL were all associated with decreased work productivity among advanced breast cancer patients.
Couwenberg et al., 2020 Netherlands[22]	Rectal cancer patients and general population controls	Case Control	WAI	Work ability overall score and individual items: work demands (mental, physical, both), current work ability, work ability in relation to job demands, number of diagnosed illnesses, impairment due to disease, sick leave over past 12 months, work ability prognosis in 2 years' time, vitality status (enjoyment in regular daily activities, feelings of being active and fit, confidence in future)		Number of comorbidities; tumor location and stage;	Compared to controls, rectal cancer patients at diagnosis had lower work ability scores across items except 'confidence in future' and were likely to report poorer work ability up to 2 years after diagnosis. However, these differences improved over time. Differences in sick leave and impairments due to illness were most pronounced over time.
Dahl et al., 2016 Norway[23]	Prostate cancer survivors who were active in the workforce	Cross-sectional	WAI	Current work ability (1st item)	Radiotherapy, hormones, and/or radical prostatectomy	Urinary leakage; Bowel problems; Hormonal problems	Survivors reporting the best work ability had a radical prostatectomy at least three years prior and reported no urinary leakage or oncological treatment after the prostatectomy.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Dahl et al., 2019 Norway[24]	Adults who had cancer during young adult years (19-39 years) with a good prognosis	Cross-sectional	WAI	Employment status: employed (full- or part-time work, on sick leave) vs unemployed (work assessment allowance, disability pension, student, homemaker); Current work ability (1st item)	Minimal surgery; Local treatment (major surgery, radiotherapy); systemic treatment-only (chemo, endocrine); systemic and other treatment	Long-term adverse effects; Fatigue (FQ); Anxiety and depression (HADS); Self-rated health (EORTC QLQ-C30); Obesity (BMI); Daily smoking; Comorbidities	An increased number of adverse effects, cardiovascular disease, and decreased health were associated with unemployment. Systematic treatment, increased number of adverse effects, cardiovascular disease, decreased health, increased fatigue, and increased depression were associated with decreased current work ability.
Dahl et al., 2020 Norway[25]	Men with prostate cancer	Cross-sectional	WAI	Employment status (full- or part-time work, retired, sick leave/rehab, disability pension, student, unspecified); Current work ability (1st item)	Robot-assisted laparoscopic prostatectomy; treatment failure	Anxiety and depression (HADS); Neuroticism (EPQ); Comorbidity; Self-rated health	Patients with low/moderate work ability were less likely to be working full time and more likely to be retired than those with high work ability.
Dahl, et al 2020 Norway[26]	Long-term survivors of cervical cancer (LSCC)	Cross-sectional	WAI	Work status (On disability pension, in paid work); Current work ability (1st item)	Conization; Major surgery; Chemo-radiation; Combination	Fatigue (FQ); Anxiety (HADS); Depression (PHQ-9); Chemo-induced neurotoxicity (SCIN); HRQoL (EORTC QLQ-C30)	LSCC patients were twice as likely to receive a disability pension than among Norwegian females. LSCC patients in paid work reported higher work ability than LSCC patients on disability pensions.
de Barros et al., 2019 France[27]	Patients with chronic myeloid leukemia treated with tyrosine kinase inhibitors	Longitudinal	Ad hoc survey	Employment status (seeking a job, receiving disability pension, working, student); Employment type; Weekly work hours; Modifications in professional activity (e.g., long period sick leave, reduction in work hours)	Imitinib, Dasatinib, Nilotinib	Adverse drug reactions (CTCAE); Number of comorbidities; Circumstances of diagnosis; Disease phase	Patients working without modification in professional activity 2 years after diagnosis reported fewer comorbidities and adverse drug interactions one and two years after diagnosis than patients who were working with modifications.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
de Boer et al., 2008 Netherlands[28]	Patients with a primary diagnosis of cancer, employed at the time of diagnosis, and on sick leave	Longitudinal	WAI VBBA	Time to RTW after sick leave; Current work ability (first three items); Physical workload and work stress	surgery, radiotherapy or radiotherapy + surgery, chemo or chemo + radiotherapy and/or surgery	Physical complaints, psychological distress, and QoL (RSCL); Fatigue (MFI); Sleep quality (PSQI); Depression (CES-D); Cognitive Dysfunction (CFQ)	The time taken to RTW at 18 months were related to work ability, QoL, fatigue, physical complaints, cognitive functioning, physical workload, work stress, cancer type, and treatment measured at 6 months. Patients with higher work ability scores were more likely to RTW sooner.
de Boer et al., 2011 Netherlands[29]	Patients with a primary diagnosis of GI cancer in paid employment at the time of diagnosis	Cross-sectional	WAI	Employment status; Employment-related factors: complaints worse, influenced cancer occurrence, work-related problems/support, willing to work; Current sick leave (yes/no, related to cancer, contact with occupational doctor); Current work ability (first three items)		Fatigue (MFI); Burden of disease (DT)	Patients who were not taking sick leave at the time of diagnosis reported better work ability and less fatigue than those who were taking sick leave.
Doll et al., 2016 USA[30]	Women with newly diagnosed gynecologic cancer and planned surgery	Longitudinal	WAI	Employment status (yes, no); Currently working (yes, no); Current work ability (1st item)	Procedure: MIS, laparotomy, debulking, radical hysterectomy, bowel surgery; Adjuvant therapy	HRQoL scales (FACT-GP), Physical and mental global health, anxiety, and depression (PROMIS); BMI	Women without complications from surgery RTW at 1 month at a greater rate and had a higher work ability than those who did have complications.
Drolet et al., 2005 Canada[31]	Employed women with or without a diagnosis of breast cancer	Case control	Ad hoc survey	Working conditions (weekly hours, type of job, self-employed, union member); Absenteeism (number of absences from work for 4 or more consecutive weeks, duration of absences, reason)	Partial mastectomy, axillary dissection, radiotherapy, chemo, and/or hormone therapy, adjuvant treatment	Diagnosed medical problems or conditions limiting activities; Invaded axillary nodes at diagnosis	Breast cancer survivors took more time away from work than those who did not have cancer in the first year after diagnosis; however, 3 years after diagnosis there was no difference between disease-free survivors and women who were never diagnosed with cancer.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Duijts et al., 2017 Netherlands[32]	Employed cancer survivors who had finished treatment	Longitudinal	WAI VBBA JCQ	Current work ability (1st item); Physical workload and need for recovery; Supervisor and coworker social support; Change in employment status (continuous not working or working, positive or negative change)	surgery, radiotherapy, chemo, and/or hormonal therapy	HRQoL (EORTC QLQ-C30); Physical limitations (SIP); Fatigue (FACIT-F); Depression (CES-D); Coping (UCL);	Cancer survivors with higher current work ability were associated with greater odds of continuing to work one year later. The positive change group reported the best scores on symptoms measured.
Duijts et al., 2017 UK[33]	Cancer and heart attack survivors	Longitudinal	Ad hoc survey	Employment status (not at work, at work); Expectation of being at work (chances you will be working after certain age); Job satisfaction (e.g., job security, control and freedom at work)		Minor psychiatric disorders (GHQ); Participation; Depression (CES-D); QoL (CASP19)	There were no significant differences between expectation of work for cancer and heart attack survivors.
Dumas et al., 2016 France[34]	Five-year survivors of childhood cancer between 25-65 years old	Cross-sectional	Ad hoc survey	Employment status (employed, unemployed seeking work or due to health, other – student, homemaker, or retired); Occupational status	Chemo and radiotherapy, chemo only, radiotherapy only, neither		Cancer survivors were less often unemployed seeking work than the general population, yet they had higher rates of health-related unemployment.
Dumas et al., 2020 France[35]	Employed women with stage I-III breast cancer	Longitudinal	Ad hoc survey	RTW; Occupational class; Working hours (full- or part-time); work-life imbalance (personal or professional life more important or equal)	Radiotherapy, surgery, and systemic (chemo, hormone therapy, and/or trastuzumab)	Comorbidities (CCI); Adverse events (CTCAE); Physical toxicities (EORTC QLQ-BR23); Anxiety and depression (HADS)	Breast cancer survivors were less likely to RTW when they were had stage III breast cancer, reported comorbidities, worked part-time and had lower occupational class.
Dunberger et al, 2010 Sweden[36]	Survivors of gynecological cancer treated with pelvic radiotherapy	Longitudinal	Ad hoc survey	Ability to work (specific to fecal incontinence)	Surgery, radiotherapy, or combination	Anxiety and Depression; QoL; Social functioning; Symptom intensity and duration; Health	Patients reporting fecal incontinence were more likely to report an inability to work.
Dussel et al., 2011	Parents of children who died from	Cross-sectional	Ad hoc survey	Work disruptions (family member cut back on work/quit work/forego overtime to care for child, yearly		Financial hardship (cost of financial hardship, take job	Most families reported at least one parent cut back on work to care for their child, and about a

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
USA and Australia[37]	cancer at least one year prior to data collection			income lost by quitting/cutting back on work)		to help pay, forego big purchase, sell property/take loan/ incur credit card debt, fundraising)	third reported two family members cut back.
Ehrmann-Feldman et al., 1987 Canada[38]	Five-year cancer survivors who are employed or looking for work (cured) and matched cancer patients with poor prognosis and controls with no cancer history	Case control	Ad hoc survey	Absenteeism; Willingness to reveal medical history to prospective employer; Denial of standard work benefits; Discrimination by employer (yes, no)		Fatigue; Psychologic problems; Social stigma	Fatigue was ranked as the most important problem when RTW for both cancer groups (cured and poor prognosis). Absenteeism was ranked as the second by the cured group but ranked last of the measured metrics by the poor prognosis group. Willingness to reveal medical history was significantly higher for poor prognosis patients.
Ekwueme et al., 2016 USA[39]	Employed women with breast cancer	Cross-sectional	NHIS	Work (missed days in last 12 months) and home (days in bed more than half the day in last 12 months) productivity loss; Total productivity costs (NOT PRO)		Smoking status, alcohol use, BMI, Comorbidities	Younger women (18-44 years) reported higher work and home productivity loss compared to older women (45-64 years).
Emmanouilidis et al., 2013 Germany[40]	Adults diagnosed with differentiated thyroid cancer five weeks after thyroidectomy	Randomized trial (stimulation or hypothyrodism from L-T_4 withdrawal)	Ad hoc survey	Impaired job performance related to symptoms of hypothyroidism; Sick leave from surgery to first radio ablative treatment	Recombinant human thyrotropin (rhTSH) and radio ablative treatment	11 clinical symptoms (e.g., fatigue, constipation, cold or rough skin); lab measurements (e.g., thyroxin)	The average sick-leave time was longer and job performance rated worse for patients in the hypothyroidism group compared to rhTSH receivers
Ferrier et al, 2020 France[41]	Patients with early stage breast cancer employed at diagnosis	Cross-sectional	Ad hoc survey	Sick leave (days); Part-time RTW (days); Early retirement; Job type; Indirect costs (calculated from lost working days and wages)	Surgery, radiation, chemo, or endocrine therapy	Invasive cancer	Lost workdays were highest among patients with invasive cancer, mastectomy, or chemo.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Feuerstein et al., 2007 USA[42]	Employed adult brain tumor survivors and employed adults without life threatening illness or major chronic disease	Case control	WLQ	Work limitations; Job related questions: type of employment, length of time at current job/last job, frequency of "stress at work", days missed from work for any reason	Surgery, radiation, and/or chemo	Anxiety and Depression (HADS); Problem-solving (SPSI-R); Fatigue (MFSI-SF); Cognitive function (CSC-W21); Physical activity (BRFSS); Smoking; Nutrition; Sleep	Work limitations and number of days missed from work were greater for brain tumor survivors than adults without any chronic diseases.
Finkelstein et al., 2009 USA[43]	Respondents without cancer, respondents with cancer (active cancer, follow-up cancer, and no cancer care claims for the survey year)	Case control	MEPS	Employment (yes, no), missed workdays		Comorbidities	Low employment and missed workdays were more frequent for those with cancer compared to those without cancer. Those with active cancer care have the greatest decrease in employment and missed workdays, though there were no differences for no cancer care to those without cancer.
Fosså & Dahl, 2015 Norway[44]	Prostate cancer patients with relapse after treatment and their partners	Cross-sectional	Ad hoc survey	Work force participation (yes, no); Reduction in work ability (VAS; no: 0-5; yes: 6-10)	Robotic or open radical prostatectomy or pelvic radiotherapy with or without hormone manipulation	Adverse effects; General health, global QoL, social/leisure, and family life (VAS); Sexual, urinary, and bowel (EPIC-26); posttreatment partnership	Work force participation was higher among prostate cancer patients who received a radical prostatectomy compared to high dose radiotherapy. Reduced work ability was significantly higher among radiotherapy patients.
Frederix et al., 2013 Sweden	Women with breast cancer	Cross-sectional	WPAI-GH	Employment status (full- or part-time, retired, sick leave/unable to work, student, other); Absenteeism (work time missed), Presenteeism		Health states: stable disease, diarrhea, fatigue, anemia,	Women with current cancer reported worse work productivity outcomes than women who recently completed

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
and Netherlands[45]				(impairment at work), work productivity loss (absenteeism + presenteeism), daily activity impairment		leukopenia, anorexia, skin rash, decrease in LVEF, progressive disease	cancer treatment in Sweden and the Netherlands.
Gomez-Molinero et al, 2020 Spain[46]	Breast cancer survivors and healthy controls	Case control	WAI	Work status (self-employed, employed, unemployed, on sick leave); Overall work ability score	(neo) adjuvant chemotherapy	Perceived emotional intelligence (TMMS-24)	Compared to healthy controls, breast cancer survivors had lower work ability. Mood repair levels indirectly mediate the association between breast cancer and work ability.
Gonzalez et al., 2018 USA[47]	Employees with or without a history of breast or prostate cancer	Cross-sectional	Ad hoc survey	Absenteeism (full or partial days missed in past month due to physical or mental health); Overall job performance (scale from 0-10) in past 4 weeks	Current (yes, no)	Sleep disturbance	Cancer patients undergoing treatment had increased absenteeism, particularly when affected by sleep disturbance.
Goren et al., 2014 France, Germany, Italy, Spain, UK[48]	Caregivers for an adult relative with cancer and non-caregivers	Case control	WPAI	Employment status (employed full-time, part-time, or self-employed, disabled, unemployed); Absenteeism, presenteeism, overall work impairment (absenteeism + presenteeism), daily activity impairment		Alcohol; Exercise; Smoking; Comorbidity (CCI); BMI; stess-related comorbidities (e.g., depression); HRQoL (SF-12); Healthcare resource use	Absenteeism, presenteeism, overall work impairment, and daily activity impairment were higher among caregivers of an adult with cancer compared to non-caregivers.
Gregorowitsch et al., 2019 Netherlands[49]	Breast cancer patients indicated to receive adjuvant radiotherapy and cancer-free women in the population	Case control	WAI	Each work ability item and overall work ability score; Type of employment (permenant, temporary, contractor, other, unknown); Weekly working hours; Shift work; Job content (physically and/or psychologically demanding)	Neo-adjuvant systematic treatment; Surgery; Axillary procedure; Adjuvant chemo and/or endocrine	Estrogen and HER2 receptor status	Women with no history of cancer in the general Dutch population had a higher overall work ability score than women with breast cancer.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
					therapy; radiotherapy		
Gudbergsson, Fosså, & Dahl et al., 2008 Denmark, Finland, Iceland, Norway[50]	Patients with a breast, prostate, or testicular cancer diagnosis who completed treatment 2-6 years prior with no relapse	Case control	UWES WAI DCSQ	Weekly work hours; Work engagement (vigor, dedication absorption; 17 items); Current work ability, current physical and mental work ability (first three items); Job strain (demand, control, support; 17 items)	Local surgery, radiotherapy, adjuvant chemo, and/or hormone treatment	Global health status and QoL (SF 12), Anxiety and depression (HADS); Neuroticism and extraversion (EPQ-18); Comorbidities (WAI); Symptom scale	Cancer survivors reported worse work ability (current, physical and mental), though did not differ to non-cancer individuals in working hours per week, demands, control, and in most work engagement domains, except for vigor.
Gudbergsson, Fosså, & Dahl et al., 2008 Denmark, Finland, Iceland, Norway[51]	Patients with a breast, prostate, or testicular cancer diagnosis who completed treatment 2-6 years prior with no relapse	Longitudinal	WAI DCSQ	Change in work situation due to cancer: employer, occupation, work tasks, unemployment, or pensioning; Sick leave time (weeks); Current work ability, current physical and mental work ability (first three items); Job strain (demand, control, support; 17 items)	Local surgery, radiotherapy, adjuvant chemo, and/or hormone treatment	Global health status and QoL (SF 12), Anxiety and depression (HADS); Neuroticism (EPQ-18); Comorbidities (WAI); Symptom scale	Cancer survivors that had a work change had poorer current, physical, and mental work ability than survivors with no work change. Only mental work ability remained significant in multivariate analysis.
Gudbergsson, Fosså, & Dahl et al., 2011 Denmark, Finland, Iceland, Norway[52]	Males and females that are either breast, prostate, or testicular cancer survivors or have no history of cancer	Case control	WAI QPS Nordic	Weekly working hours; Current work ability, physical and mental work ability (first three items); Communication/support score (support from colleagues and supervisors, supervisors' appreciation of work achievement; 5 items)	Surgery, radiotherapy, chemo, and/or hormone treatment; surveillance program for testicular cancer	Global health status and QoL (SF 12), Anxiety and depression (HADS); Neuroticism and extraversion (EPQ-18); Comorbidities (WAI); Outcome expectations (LOT-R); Symptom score	Mental work ability was higher for male and female controls compared to cancer survivors. Physical work ability was increased among male controls compared to survivors, yet there was no difference between female controls and survivors.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Gudbergsson et al., 2011 Norway[53]	Cancer patients employed at diagnosis and at time of survey	Cross-sectional	WAI SFSS	Weekly work hours; Sick leave duration; Current work ability, physical and mental work ability (first three items); Reduced physical or mental work ability caused by cancer; Social support at work (by supervisors and colleagues); Changes of physical or mental demands at workplace; Change of employment due to cancer	Surgery, radiotherapy, chemo, hormone treatment, other, or combined; use of medication (yes, no)	Self-rated health status; Overall QoL; Comorbidities (WAI); Need for and/or offered/used rehabilitation services	Combined cancer treatment, mental and current work ability, and supervisor support were associated with longer sick leave among employed cancer patients.
Gupta et al., 2018 USA[54]	Adults with multiple myeloma	Cross-sectional	WPAI	Employment status (employed, unemployed); Absenteeism, presenteeism, overall work productivity loss (absenteeism + presenteeism), daily activity impairment	Oral therapy; Radiation; stem cell transplant; Number of treatment changes	Functional ability; Health status and QoL (FACT-MM); Treatment adherence (MMAS-4); Temporal and financial burden	Most patients with multiple myeloma were not employed, and those who were employed reported high work productivity impairment.
Guy et al., 2016 USA[55]	Adult survivors of childhood cancer and adults with no reported history of cancer	Cross-sectional	NHIS	Functional limitations at work due to health; Productivity loss: employed, unable to work, days lost from work, days spent in bed ; Annual productivity costs: employment disability, missed workdays, days spent in bed due to health in past year (wages NOT PRO)		Health status; Functional limitations (personal care or routine needs, any limits); Comorbidities	Cancer survivors were less likely to be employed and more likely to have functional limitations at work, be unable to work, and spend more days in bed because of health than individuals without a history of cancer.
Haiderali et al., 2011 USA[56]	Patients being treated by oncologists receiving MEC or HEC (chemo regimens)	Cross-sectional	WPAI-NV	Employment status (full- or part-time, on paid or unpaid medical leave, not employed); How nausea and vomiting affects a patient's ability to work and perform regular activities; Indirect costs: Lost productivity costs (mean weekly hours by occupation and wages NOT PRO)	Highly or moderately emetogenic chemo; type and dose of antiemetic prophylaxis and rescue medications	Severity of health care use for nausea and vomiting; Impact of nausea and vomiting on daily functioning (FLIE); Medical costs (NOT PRO)	Those with severe nausea and vomiting had greater indirect costs for both missed work and lost productivity than those with mild symptoms. The total costs for patients receiving HEC were not significantly different from those receiving MEC.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Hailu et al., 2013 Ethiopia[57]	Patients with cervical cancer	Cross-sectional	Ad hoc survey	Indirect costs (opportunity cost of lost working time): Duration of complaint (days), missed workdays, time for transportation, duration of hospital stay, amount of wages lost		Direct medical costs (consultation, investigations, costs of drugs)	Cervical cancer patients had a median illness duration of 180 days, with an average of over 150 missed workdays, four of which were related to hospital stay.
Hanly et al., 2019 Ireland[58]	Employed prostate cancer survivors between 2-5 years post-diagnosis	Cross-sectional	Ad hoc survey	Temporary or permanent absenteeism; Reduced hours; Presenteeism (% work productivity impaired by cancer); Productivity costs with national and self-reported wages			Missed workdays were mostly due to permanent absenteeism followed by temporary absenteeism, reduced hours, and then presenteeism to total 427 average days lost from work.
Hartung et al., 2018 Germany[59]	Adult patients with leukemia, lymphoma, multiple myeloma and not permanently out of work	Longitudinal	WAI	RTW; On sick leave; Shift work; Changes in employment (employer change, change in weekly hours, retraining); Overall work ability score; subjective prognosis of gainful employment (belief you will work until the legal retirement age)	Chemo, stem-cell transplant, surgery, and/or radiation	Daily performance (KPS)	Mean work ability significantly increased 6 months after treatment, but not between 6-12 months after treatment. Subjective prognosis of gainful employment was correlated to work ability at 6 and 12 months.
Hasan Shiri et al., 2018 Iran[60]	People with cancer	Cross-sectional	Cancer stigma questionnaire	Job status (employed, unemployed, housewives, retired); Job performance may decrease even after successful cancer treatment (One item, 4-point Likert scale)	Had received at least one treatment (e.g., chemo, radiation, surgery)	Stigma scores (12 items; cancer stigma questionnaire)	More than half of cancer patients agreed that job performance would decrease even after successful treatment. There was no significant association between stigma and job status.
Holm et al., 2013 Norway[61]	Patients who had an artificial urinary sphincter implant	Cross-sectional	WAI	Current work ability (1st item)	Radical prostatectomy	Sexual, urinary and bowel functions (EPIC-26); QoL (SF-12); Surgery satisfaction; Anxiety and depression	Patients with a better QoL had improved work ability than patients with a poor QoL.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
						(HADS); Neuroticism (EPQ)	
Hubbard et al., 2013 Scotland[62]	Employed women with breast cancer and first treated with surgery	Pilot RCT (Case management vocational rehab or usual care)	Ad hoc survey	sick day leave, left or remained in paid employment, job role, hours worked	Surgery only, Surgery + radiotherapy, Surgery + chemotherapy + radiotherapy	HRQoL (FACT-B); Fatigue (FACIT-F)	Those in the intervention group reported over 50 fewer days of sick leave over 6 months post-surgery, though this difference was not significant
Jagsi et al., 2017 USA[63]	Women employed at diagnosis with stages 0-II breast cancer	Cross-sectional	Ad hoc survey	Missed workdays; employment related characteristics: full v part time status, work hours, paid sick leave, disability benefits, flexible work schedule; Income lost due to time off work	Chemo and/or radiotherapy, Surgery type; Axillary lymph node dissection	Health status; Comorbidities;	Women who were more likely to stop working were those in poor health, had chemotherapy, surgical treatment, no paid sick leave, disability benefits, or no flexible work schedule.
Jassem et al., 2015 France, Germany, Italy, Spain, UK[64]	Caregivers of an adult relative with lung cancer and non-caregivers	Case control	WPAI	Absenteeism, presenteeism-related impairment, overall work impairment (absenteeism + presenteeism), daily activity impairment; Indirect work productivity loss costs (wages NOT PRO)		Alcohol; Exercise; Smoking; Comorbidity (CCI); BMI; stess-related comorbidities (e.g., depression); HRQoL (SF-12); Healthcare resource use	Caregivers reported higher rates of presenteeism-related work impairment, overall work impairment and activity impairment; caregivers reported higher annual indirect costs with presenteeism-related impairment and overall work impairment.
Kärki et al., 2005 Finland[65]	Patients who had surgery for breast cancer without remission	Longitudinal	Ad hoc survey	Work status (in work, pensioned, on sick leave, students or unemployed); Change in work status from 6 to 12 months	Surgery type; Radiation, chemo, and/or hormonal therapy; post-op physio	Impairment of body functions and structures; Activity and sleep function (Scale for Breast Cancer Patients)	More patients with breast saving operations were working 6 months after surgery than those with a modified radical mastectomy.
Kiserud et al., 2016 Norway[66]	Lymphoma survivors at least 18 years old at treatment	Cross-sectional	WAI	Employment status (employed or not employed); Current work ability, physical and mental work ability (first three items)	High-dose chemo with autologous stem cell transplant	Somatic comorbidity; Fatigue (FQ); Anxiety and depression (HADS);	The rate of employment declined after diagnosis and after treatment; work ability was reported to be higher in those who were employed.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
						HRQoL (SF-36); negative affectivity and social inhibition (DS14); cognitive problems	
Lavigne et al., 2008 USA[67]	Employed women with stage I-III breast cancer who received radiation and finished all treatment at least 1 year prior	Cross-sectional	WLQ	Lost work productivity: WLQ Productivity Index Score, self-reported absences	Chemo, surgery, radiation, adjuvant hormonal therapy, gabapentin	Fatigue, poor mental health, and overall health (SF-36); Comorbidities; Hot flashes	Cancer survivors have a work productivity lower than the norm of healthy workers. Fatigue and hot flashes were associated with work productivity.
Leensen et al., 2017 Netherlands[68]	Patients employed at the time of cancer diagnosis and treated with chemo starting a rehab program at baseline	Longitudinal	WAI RTWSE WLQ	RTW; Importance of work; Current work ability (1st item); Self-efficacy regarding RTW; Work limitation demands scales; Work-related variables: years in current and paid employment, company size, shift work	surgery, radiotherapy, hormone treatment, and/or radiotherapy + hormone treatment	Muscle strength and cardiorespiratory fitness; Fatigue (MFI); Physical activity (SQUASH); HRQoL (EORTC-QLQ-C30)	RTW increased over time, as did perceptions of importance of work, work ability, and self-efficacy regarding RTW. Patients reported an increase in WLQ demands of time management, physical tasks, and production after 6 months but not after 18 months.
Lerner et al., 2010 USA[69]	Female employees with or without HPV cervical lesions	Case control	WLQ JCQ	WLQ absenteeism (hours missed in past 2 weeks) and presenteeism tasks; Productivity costs (wages NOT PRO); Job demands and control; Work-related: occupation, usual work hours, industry, company size	Procedures since diagnosis	Depression (PHQ-9); Bodily pain; Reproductive history; Current birth control; Gynecological symptoms	Women with cervical lesions performed worse on time management, mental/interpersonal and output tasks and were absent from work more often compared to the control group.
Lewis et al., 2008	Women diagnosed	Cross-sectional	DOII	Job-related concerns		Depression (CES-D); Quality of marital	Spouses were more likely to be depressed if they had job-

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
USA[70]	with breast cancer within 8 months and their male spouse of at least 6 months					relationship (DAS); Interpersonal Disconnection (MIS); Concern for wife's well-being, diminished social activities, altered sexual activity, and feeling excluded by medical team (DOII); Confidence to manage breast cancer and emotionally support wife; Illness-related uncertainty (Coherence Scale)	related concerns (in addition to increased fears of wife's well-being, increased uncertainty about their future, or in less well-adjusted marriages).
Lindbohm et al., 2012 Denmark, Finland, Iceland, Norway[71]	Patients with breast, testicular, or prostate cancer or lymphoma with a good prognosis and healthy controls	Case control	WAI QPS Nordic Social Impact Scale	Occupation type; Current work ability (1st item); Psychological and social work factors: social climate at work, commitment to the work organization, support from supervisors and co-workers; Lacking job resources: avoidance behavior by colleagues or supervisor, avoidance of informing		Chronic conditions or injuries	Work ability was decreased for breast cancer survivors compared with healthy women and was also lower with higher supervisor avoidance behavior and increased number of disease or injuries.
Luo et al., 2019 USA[72]	Women with advanced breast cancer (stage III or IV) and their caregivers	RCT (Reflexology intervention vs attention control)	HPQ	Employment status (employed, retired, other); Absolute Absenteeism (difference between expected vs actual hours worked); Relative Absenteeism (ratio between absolute absenteeism and expected hours worked); Absolute Presenteeism (self-rated performance 0-100); Relative Presenteeism (ratio of own	Chemo with or without hormonal therapy vs hormonal therapy alone	Healthcare visits and cost (CHSPCF); 13 symptoms (e.g., pain, fatigue; MDASI); Physical functioning (PROMIS); QoL (QLI)	Patients who received reflexology had better productivity (increased absolute presenteeism) in weighted unadjusted models and less productivity loss (less relative absenteeism) in unweighted adjusted models compared to the control group.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
				performance and the usual performance of workers in similar job)			
Manne et al., 2015 USA[73]	Females with early stage breast cancer (i.e., ductal carcinoma in situ or stage I, II, or IIIa) and their spouses	Cross-sectional	HPQ	Three scales: Work situation (employment status), absenteeism (workdays missed, 4 items), presenteeism (low work productivity, 7 items, and poor work performance, 1 item)	Surgery (mastectomy or breast-conserving); Current status (chemo, radiation)	Spouse relationship satisfaction (DAS); Spouse health and healthcare use; Spouse and patient cancer-specific distress (IES); Patient functional impairment (CARES) and medical status (ECOG)	Greater disease severity was associated with lower spouse productivity and work performance, which was mediated by spouse cancer-related distress. Patients with higher functional impairment increased spouse absenteeism and productivity. Spouses' poor health was also associated with decreased productivity.
Månsson et al., 2019 Sweden[74]	Long-term sickness absentees (4 to 8 months)	Cross-sectional	Ad hoc survey	Self-estimated ability to RTW		Positive/negative encounters with healthcare workers; General health	Absentees with a cancer diagnosis were proportionally more impacted by positive encounters and less impacted by negative encounters in their ability to RTW compared to other diagnoses.
Mazanec et al., 2011 USA[75]	Informal caregivers of adult patients with stages II to IV pancreatic cancer or stages III or IV lung, GI, or gynecologic cancer	Cross-sectional	WPAI	Absenteeism, presenteeism, overall work impairment, daily activity impairment due to caregiving	Currently receiving (yes, no)	Caregiver health promotion behavior; Caregiver burden (CRA); Caregiver mood state (POMS); Caregiver perceived social support (MOS-SSS); Caregiver physical health status;	Reduced overall work productivity was directly related to increased hours of caregiving, higher cancer stage, caregiver anxiety, caregiver depression, and caregiver perceived burdens of financial problems, disrupted schedule, and health problems. Increased activity impairment was directly related to increased hours of

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
						Patient functional status (ECOG)	caregiving and worse functional status of the patient.
Mazanec et al., 2016 USA[76]	Ambulatory patients with Stage I, II, or II colon cancer and their family caregivers	Longitudinal	WPAI	Absenteeism, presenteeism, overall work impairment, daily activity impairment due to caregiving	Surgery with or without chemo	Patient and caregiver patient activation measure (PAM, CPAM); Caregiver self-efficacy; Depression, anxiety, fatigue (PROMIS); Symptom distress (MSAS-SF); Physical Activity (IPAQ-SF); Physical health status and HRQoL	Only lower scores for patient activation, or self-management, were associated with increased overall work impairment.
McGrath et al., 2017 Australia[77]	Middle-aged (45-64 years) employees with colorectal cancer	Longitudinal	WLQ	Work limitations subscale domains (Time management, physical demands mental-interpersonal concerns, output demands); Productivity loss (weighted sum of 4 subscales); Occupation type	Surgery (laparoscopic or open), stoma, chemo, radiation		Majority of patients reported no work limitations across domains. No significant changes were seen across domains over time (from 6 to 12 months after diagnosis). About half reported no productivity loss.
Mehnert & Koch, 2013 Germany[78]	Cancer patients who were enrolled in a cancer rehabilitation program at baseline	Longitudinal	Burger, Dietsche, Morfeld & Koch (2001	RTW after rehabilitation (weeks); Self-perceived work ability; Sick leave duration (days); Intention to and expected period of RTW; Job requirements (e.g., schedules; 10 items); Work satisfaction (12 items); Perceived employer accommodation; Perceived threat of job loss	Curative or palliative treatment intention; Surgery, radiation, chemo, and/or hormonal therapy	Daily performance (KPS); Pain (BPI); Anxiety and depression (HADS); Fear of recurrence (FoP-Q-SF); Physical and mental QoL (SF-36); Social support (ISSS)	Patients with a higher stage and receiving palliative treatment were less likely to RTW one year after rehabilitation. In models, less advanced cancer stage, higher daily performance, shorter duration of sick leave, intention to RTW, perceived employer accommodation, and job requirements all predicted RTW one year after rehabilitation.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Mehnert et al., 2017 Germany[79]	Cancer patients who were enrolled in a cancer rehabilitation program at baseline	Longitudinal	Burger, Dietsche, Morfeld & Koch (2001)	Early retirement; Sick leave; Absenteeism (< 90 days, ≥90 days); Perceived work ability; Desire to retire early; Work satisfaction; Workplace characteristics; Perceived work productivity (considerably reduced or worse, moderately reduced or better)	Surgery, radiation, chemo, and/or hormonal	Daily performance (KPS); Pain (BPI); Anxiety and depression (HADS); Fear of recurrence (FoP-Q-SF); QoL (SF-36); Distress (DT)	Patients on sick leave, absenteeism of at least 90 days, desire to retire early, lower work satisfaction, and lower work productivity were more likely to retire early one year after rehabilitation.
Mesa et al., 2018 USA[80]	Patients with Polycythemia Vera	Longitudinal	WPAI-SPH	Absenteeism, presenteeism, overall work impairment, daily activity impairment	Currently undergoing treatment and under physician care	Symptom burden (MPN-SAF TSS); Health-related QoL (EORTC QLQ-C30)	Notable work productivity and activity impairments in the 7 days prior to assessment – descriptive results.
Moskowitz et al., 2014 USA[81]	Cancer survivors who completed primary treatment and employed at time of or since diagnosis	Cross-sectional	Ad hoc survey	Work ability (unable to work full time, the same as before cancer, or work at all); Work sustainability (had ever lost or left job due to cancer); Work support (e.g., earned respect) and problems (e.g., treated poorly)	Radiation, chemo, hormonal, and/or surgery	Symptom burden (e.g., fatigue); Well-being (e.g., Comorbidity) Functional limitations (e.g., cognitive)	Among cancer survivors, increased work problems and functional limitations were directly associated with limited work ability. Increased work problems were also directly related to work sustainability.
Mujahid et al., 2010 USA[82]	Women with primary ductal carcinoma in situ or invasive breast cancer (Stage 0-III) with oversampled Black and Latina women	Cross-sectional	Ad hoc survey	Missed work (one month or less, more than one month, stopped working); Work status (full- or part-time); Paid sick leave or flexible schedule available at diagnosis	Surgery (lumpectomy, mastectomy), chemo, and/or radiation	Comorbidities	Women with breast cancer who were racial/ethnic minorities, received chemo, had a mastectomy, and did not have flexible work schedules available were more likely to stop working.
Musti et al., 2018 Italy[83]	Women who had undergone	Cross-sectional	Ad hoc survey	RTW (yes, no); Profession, sector, and contract type; Perceived work ability (same or reduced compared	Other interventions at breast (yes,	Drugs or surgery for non-cancer related causes;	After undergoing surgery, women with breast cancer who had a mastectomy, more work

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	breast cancer surgery (breast-conserving or mastectomy) and were employed at diagnosis and at enrollment			to before diagnosis); Barriers to RTW; Sick leave duration (months); Information on work facilitations (yes, no); Adjustment of working conditions (e.g., flexibility, reduced hours); Consult work physician; Support from employer and colleague; Feeling of discrimination; Difficulty in obtaining work leave	no); Lymph node dissection (yes, no); Chemo, hormone, or radiation; Post-surgery treatment	Physical or psychological problems before breast cancer diagnosis	adjustments, consulted work physicians, less support from employers and colleagues, and experienced discriminated were associated with reduced work ability.
Nachreiner, Shanley, & Ghebre, 2013 USA[84]	Gynecological cancer patients diagnosed within 2 years of study and employed at diagnosis	Cross-sectional	Ad hoc survey	Performing job tasks (e.g., lifting heavy loads, concentration) frequency and if limited by cancer or treatment	Surgery, chemo, and/or radiation		Patients undergoing chemo were more limited in their ability to do tasks. Patients undergoing radiation more likely to report limitations in physical tasks and keeping up with others, while patients undergoing chemo more likely to report limitations in analytic tasks.
Ness et al., 2005 USA[85]	Survivors of childhood cancer who survived at least 5 years after diagnosis and their siblings	Case control	LTFU	Impairment or problem keep you from holding a job or attending school	Radiation, chemo, and/or surgery; or unknown	Physical performance; Limited personal care skills; Limited routine activities; Medical late effects	Cancer survivors were more likely to report poor health that prevented them from attending school or work compared with siblings.
Neudeck et al., 2017 Switzerland[86]	Patients diagnosed and treated for differentiated thyroid carcinomas and their partners	Cross-sectional	Ad hoc survey	Employment status; RTW after hospital discharge (days); Work impairment post radioactive iodine treatment (RAI; 0-10 scale) and reasons (e.g., difficulty concentrating, tired faster); Current work ability and workload; Reduced workload after diagnosis (hours); Sick leave past 12 months (days)	Surgery and RAI	Anxiety (BAI); Depression (BDI); Fatigue (BFI); QoL (WHO QoL); Hormone status	Majority of patients and their partners reported impairment in work ability. Patients with a reduced workload were more likely to have increased fatigue and decreased physical QoL compared to patients with no change in their workload.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Nilsson et al., 2013 Sweden[87]	Women with breast cancer, no pre-surgical chemo and distant metastasis, and employed at diagnosis	Cross-sectional	Adjustment Latitude Scale National Working Life Cohort SFSS	Current sick leave (grade and length); Perceived work adjustment (e.g., can you slow pace, 6 items); Cancer-related social support at work (e.g., supervisor show sympathy, 6 items); Perceived social support at work (2 items); Work status at diagnosis; Years at current employer; Disclosure of diagnosis at work; Strenuous work posture	Final axillary surgery; Planned postop chemo		Among women with breast cancer, reduced work adjustment and lower perceived supervisor social support were associated with sickness absence.
Nilsson et al., 2015 Sweden[88]	Women who had breast cancer surgery with no pre-surgical chemo or distant metastasis	Longitudinal	QPS Nordic LISAT-11 WAI National Working Life Cohort	Importance of work; Satisfaction with vocational situation; Current work ability, current physical and mental work ability (first three items); Social support from supervisor and colleagues at baseline			Among women with breast cancer, higher physical and mental/social work ability, as well as increased colleague social support, increased vocational satisfaction. Increased colleague support also increased importance of work.
Nilsson et al., 2020 Norway[89]	Men with prostate cancer who were treated with radical prostatectomy or active surveillance	Cross-sectional	WAI	Work status (employed, unemployed, retired); Current work ability (1st item)	Postoperative radiotherapy	Number of comorbidities; HRQoL (EORTC QLQ-C30); Fatigue (FQ); Anxiety and depression (SCL-5); Personality (DS-14); Fear of recurrence (CARQ); Self-rated health (EQ-5D)	Among men with prostate cancer, reduced health status, increased fatigue, increased anxiety/depression were associated with reduced work ability.
Nordstrom, Nyman, & Theorell, 1990	Patients who had surgery for ileal conduit urinary diversion due	Cross-sectional	Ad Hoc Survey	Employment status (full, part, no RTW); Type of work before and after surgery (white vs blue collar); Reason for not resuming occupational activities; Frequency and cause of disability pension	Surgery		RTW or receiving full disability pension did not differ by diagnostic group or types of work. Patients with bladder cancer were more likely to have decreased work ability

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Sweden[90]	to bladder carcinoma or incontinence and/or bladder disfunction						compared to patients with incontinence/bladder disfunction.
Ohno et al., 2020 Japan[91]	Participants in the NHWS who were caregivers of adults with cancer or other conditions and non-caregivers	Case control	WPAI	Absenteeism, presenteeism, overall work productivity loss (absenteeism + presenteeism), daily activity impairment; Annual indirect costs (wages NOT PRO)		Stress-related comorbidities (e.g., depression); HRQoL (SF-12); Health status (EQ-5D)	Caregivers of cancer patients had increased presenteeism, overall work productivity loss, and total indirect costs compared to non-caregivers.
Ohno et al., 2020 Japan[92]	Participants in the NHWS who reported a diagnosis of any cancer type or had no history of cancer	Case control	WPAI	Absenteeism, presenteeism, overall work productivity loss (absenteeism + presenteeism), daily activity impairment; Weekly absenteeism, presenteeism, and indirect costs (wages NOT PRO)	Currently using prescribed medication (no/yes)	Comorbidities (CCI); BMI; Smoking; Alcohol; Vigorous physical activity; Currently taking steps to lose weight; Stress-related comorbidity (e.g., depression); HRQoL (SF-12); Health status (EQ-5D)	Patients with any type of cancer had increased absenteeism compared to those with no history of cancer. Additionally, patients receiving prescription medication had higher WPAI than both controls and cancer patients not receiving medications.
Ohta et al., 2017 Japan[93]	Workers at an IT company	Cross-sectional	WAI BJSQ	Overall work ability score; Job stressors (e.g., workload); Job stress reaction (e.g., psychological stress response); Social support; Satisfaction with job and daily life; Sickness absence data for the next year (NOT PRO)		Distress (GHQ)	Not cancer-specific study: Cancer diagnosis was one of the reasons for sickness absence. Among IT workers, reduced WAI scores predicted sickness absence in the next year.
Ortega et al., 2018 Brazil[94]	Employed women with no breast cancer history and women	Case Control	WLQ WPAI-GH	Presenteeism demand scales; Absenteeism, presenteeism Overall productivity loss (absenteeism + presenteeism), daily activity impairment	Surgery (breast-conserving, mastectomy, reconstruction);	BMI	Women who had mastectomies and breast-conserving surgeries had decreased presenteeism and a loss of productivity in comparison to women with

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	with breast cancer who had surgery at least 1 year prior				Radiation and/or chemo		breast reconstruction and no history of cancer. Loss of productivity was observed by WPAI-GH but not WLQ.
Passik & Kirsh, 2005 USA[95]	The spousal caregivers of cancer patients with chemo-induced anemia and fatigue	Cross-sectional	Ad Hoc Survey	Absenteeism scale (days missed, sick leave, reduced work hours, reduced work responsibilities)	Treatment for patient fatigue	Patient: depression (ZSDS), fatigue (BFI), rating of fatigue, daily activity level, QoL (VAS); Caregiver: fatigue (FSI), insomnia and energy (NRS), activity level (ALRS), strain (CSI), depression (ZSDS), relationship satisfaction (DAS)	Spousal caregivers missed a significant amount of work time during the study. Those with increased caregiver strain were more likely to participate in less work.
Pearce et al., 2015 Ireland[96]	Primary head and neck cancer survivors at least 8 months post-diagnosis	Cross-sectional	Ad Hoc Survey	Employment status and occupation; Weekly hours worked pre- and post-diagnosis; Time taken off work following diagnosis (months); Indirect costs for time off and reduced work hours (wage NOT PRO)	Chemo, radiation, and/or surgery		Survivors took an average of 9 months off from work and nearly half participated in the workforce after diagnosis. Indirect costs varied by calculation approach.
Petersson et al., 2011 Sweden[97]	Women who had recently undergone breast cancer surgery with no pre-surgical chemo or distant metastasis	Cross-sectional	Ad Hoc Survey	Employment status at diagnosis; Strenuous work posture; Length and type (i.e., full or part-time) of sick leave after surgery		Comorbidities; General health (EORTC QLQ C30)	More women who had breast cancer surgery on sick leave had jobs with strenuous postures compared to those not on sick leave. Poor general health in the past 7 days and compared to 6 months ago were also associated with sick leave.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Petersson et al., 2013 Sweden[98]	Women who had recently undergone primary breast cancer surgery with no pre-surgical chemo or distant metastasis	Cross-sectional	LISAT-11 UWES	Importance of work; Work satisfaction (rewarding, vocational satisfaction, change profession, change employment); Dedication to work (e.g., my work inspires me, 3 items); Current sick leave; Employment status at diagnosis			Women on sick leave had less vocational satisfaction and wanted to change their profession than those not on sick leave. When adjusting for other variables, decreased vocational satisfaction was associated with sick leave.
Petersson et al., 2018 Sweden[99]	Women who had undergone primary breast cancer surgery (mastectomy or breast-conserving) with no pre-surgical chemo or distant metastasis	Longitudinal	Ad Hoc Survey	Expected RTW; Sickness absence (full and part-time; number of survey times on); Occupational status at diagnosis (employed, disability pension, unemployed, parental leave, sick leave, and/or student)	Axillary surgery (lymph node biopsy, clearance surgery); Planned (chemo, radiation, and/or endocrine)		Among women who had undergone breast cancer surgery, mastectomy, axillary clearance surgery, and planned chemo were associated with sickness absence over time.
Poirier, 2005 USA[100]	Cancer patients prior to starting radiation therapy at baseline	Longitudinal	Ad Hoc Survey	Employment Status (full- or part-time at diagnosis, start and end of treatment, follow-up); Weekly hours; Sick leave benefits (i.e., sick time, vacation time, earned time off, or STD)	Surgery (major, minor, biopsy, none); Number of medications; Treatment site; Chemo (prior, concurrent, both, or none)	Comorbidities; Fatigue (BFI); State characteristics: sleep disturbances, exercise, pain, treatment-related side effects	Patients with sick leave benefits were more likely to have worked at the beginning of treatment and adjusted or stopped work altogether during treatment. Pain, fatigue, and side effects were associated with less hours worked. Availability of sick benefits increased hours worked.
Rifkin et al., 2020 USA[101]	Patients with newly diagnosed multiple myeloma	Case control	WPAI-SHP	Employment status (employed, unemployed, medically unable to work); Absenteeism, presenteeism, overall productivity loss	Stem cell transplant; Prior/current treatment mode (oral,	Functional impairment (ECOG PS); Treatment satisfaction with medication	The work impairment mean was higher among patients using injectables compared to patients using oral treatment.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
				(absenteeism + presenteeism), daily activity impairment	injectable, none); Number of agents in current therapy	(TSQM-9); Time burden;	
Rizzo et al., 2016 USA[102]	Individuals and their spouses with or without prostate cancer (PC) participating in MEPS	Case control	MEPS	Employment status and type; Number of workdays missed in previous year due to illness or injury, or mental or emotional problem; Lost productivity costs using employee wage data; Availability of sick pay; Probability of being unemployed and of missing working days (calculations)		Comorbidities	Patients with PC and their spouses had increased likelihood of not working compared to couples without PC. Having PC was correlated with missed workdays and increased absenteeism.
Robinson Jr et al., 2017 International[103]	Patients with multiple myeloma who relapsed or became refractory to at least one treatment	Longitudinal	NHIS	Employment status (working, full-time, not working due to disease, retired, early retirement, disability); Disease-driven absenteeism (days); Global productivity (how much disease affected daily productivity at home, school, or work in past 4 weeks on a scale of 0-100)	Prior treatment history; Current treatments including pain meds and for anemia	HRQoL (EORTC QLQ C30); Fatigue (FACIT); Pain (BPI); Clinical test results (e.g., hemoglobin); Healthcare visits	Among patients with refractory multiple myeloma, pain, fatigue, and EORTC functioning were associated with global productivity.
Rogers, Orav, & Black, 2001 USA[104]	Patients with brain tumors	Cross-sectional	Modified 10-point Likert QoL scale	Ability to do housework or job		Well-being, mood, function, pain, nausea, appetite, social activities, anxiety, self-care, social supports, sleep, concentration, memory, energy	Among patients with brain tumors, decreased ability to perform housework or job was associated with tumor severity and predicted increased mortality risk.
Rosbjerg et al., 2020 Denmark[105]	Employees on sick leave who underwent chemo for a newly	Longitudinal	RTWSE	Belief in ability to handle different aspects of returning to work on meeting job demands, modifying tasks, and communicating needs (scale 0-10, overall mean score); Job	Intention (curative, palliative, adjuvant, neo-adjuvant);	Depression (BDI); Fatigue (FACIT-F); Performance (ECOG)	In unadjusted models, employees undergoing treatment for cancer with high RTWSE returned to work earlier than those with low RTWSE. In

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	diagnosed cancer or had no chemo during last 24 months due to relapse			type (sedentary, physical, mixed); Perceived support from workplace	Number of modalities in addition to chemo		adjusted models, those with palliative care intentions returned to work later.
Rosenberg et al., 2015 USA[106]	Patients who have undergone hematopoietic cell transplantation (HCT)	Cross-sectional	Ad Hoc Survey	Work status (full- or part-time outside the home, student, work at home, not working/retired due to health, unemployed); Work/school missed in the past three months because of health (days); Permanent disability due to health	Transplant type	Resilience (CD-RISC); HRQoL (MOS-SF); Distress (CTXD); Post traumatic growth (PTGI); Get on with life	Among patients who underwent HCT, lower resilience scores were associated with being unable to work.
Serletti & Moran, 1997 USA[107]	Patients who underwent free vs pedicled TRAM flap breast reconstruction surgery	Case control	Ad Hoc Survey	Time required to RTW (weeks)	Hospital length of stay; Symmetry and satisfaction of reconstruction; Chemo and/or radiation	Abdominal strength and overall fitness as % of preoperative function; Complications	There was no statistically significant difference in RTW time among patients who underwent the free vs the pedicled TRAM flap procedure.
Shelby, Golden-Kreutz, & Andersen, 2008 USA[108]	Patients with regional breast cancer (Stage II or III) with PTSD or Subsyndromal PTSD or No PTSD	Case control	Ad Hoc Survey	Felt emotionally unable to work	Breast-conserving surgery or modified radical mastectomy; Chemo and/or radiation	PTSD checklist; Mental disorders (SCID-NP); Life Stressor Checklist; Daily performance (KPS); QoL disruption (SF-36)	Patients with regional breast cancer who had PTSD or subsyndromal PTSD were more likely to report being unable to work than patients with no PTSD.
Sherwood et al., 2008 USA[109]	Family caregivers of patients with primary malignant brain tumors	Cross-sectional	Ad Hoc Survey	Employment status (full- or part-time or not working); Lost hours from work (yes, no)	Chemo and radiation vs radiation only	Care recipient's physical function (Involvement with ADL/IADL scale), neuropsychological function (NPI-Q);	Caregivers were more likely to have lost hours from work when their care recipient had a more limited ability to perform instrumental activities of daily living. An increase in the

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
						Caregiver depression (CES-D), burden (CRA), and Mastery Scale	number of months since diagnosis was also associated with lost hours of work among caregivers.
Soejima et al., 2020 Japan[110]	Employed adults who were childhood cancer survivors and had more than 5 years since diagnosis and at least one year since treatment	Cross-sectional	WLQ	Presenteeism subscales; Productivity Loss Score (weighted sum of all four subscales); Employment status (full- or part-time); Occupation type; Job stress (current work situation under too much stress)		Number of physical late effects	Employees who survived childhood cancer and had multiple physical effects had higher output, physical demands, and productivity loss scores compared to employed survivors with no effects.
Steinbach et al., 2006 Germany[111]	Patients with glioblastoma who have survived for at least 5 years from diagnosis	Case study	EORTC-QLQ C30	Employment status (full or part time, not working); QoL role functioning scale (ability to work, perform activities of daily life, and participate in leisure activities)	Radiation, chemo, surgery (gross total resection or biopsy), and/or medication	QoL (EORTC-QLQ C30); Daily performance (KPS); Neurologic deficit; Seizures; Memory (BKW and WMS); Intelligence (HAWIE); Attention (TAP)	Most glioblastoma survivors in this case study were not working. The role functioning scale had the greatest means decrease in functioning observations.
Syrjala et al., 2004 USA[112]	Patients with leukemia or lymphoma who were having first myeloablative hematopoietic cell transplant (HCT)	Longitudinal	Ad Hoc Survey	Date of RTW; Employment status outside of home (full-time work, full-time school, or part-time school with part-time work)		Physical limitations (SIP); Depression (BDI); Distress (Cancer Treatment Distress scale); Extensive chronic graft vs host disease (GVHD)	Female patients who underwent HCT had a significant delay in RTW. Additionally, patients who acquired GVHD had a nonsignificant trend towards RTW later.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Tachi et al., 2016 Japan[113]	Employed breast cancer patients who received outpatient chemo for the first time	Longitudinal	WPAI-GH	Presenteeism (2 items): Average hours per day unable to perform job due to side effects of treatment, How much did the side effects affect your productivity while you were working (1-10); Rate and amount of labor loss calculated; Absenteeism (NOT PRO)		QoL scores (EQ-5D and QOL-ACD); Side effects of chemo	After breast cancer patients completed outpatient chemo, decreased QoL (measured via QOL-ACD scores) was associated with increased presenteeism, which was led by the activity subscale.
Tamminga et al., 2013 Netherlands[114]	Employed female breast and gynecological cancer patients who had been treated with curative intent and on sick leave	RCT Hospital-based work support intervention	SF-36 WAI WLQ VBBA	Importance of work (VAS); Current work ability (1st item); Impaired work functioning if RTW (overall work productivity); Physical workload; Work-related items: Position at work, shift work, years in current position, company size; RTW (rate and days); Productivity loss cost (net number of hours sick leave multiplied by estimated price of productivity loss by age and gender – NOT PRO)	Treatment mentioned yet not specified	Fatigue (MFI); Depression (CES-D); Self-efficacy (ALCOS); QoL (SF-36)	RTW rates, time from sick leave to RTW, work ability, work functioning, QoL, and costs did not differ between the intervention and control groups among female breast and gynecological cancer employees at one-year follow-up.
Tamminga et al., 2019 Netherlands[115]	Females who were treated for breast cancer and have survived 5-10 years post diagnosis	Cross-sectional	WAI	Adverse work outcome (working >20% less, paid work in combination with early retirement/disability benefits /unemployment/sick leave, no paid employment, or stopped working); Type of contract (permanent or not); Physical demanding job; Feeling supported at work during treatment and after; Work-related factors prior to diagnosis: satisfaction with work, being motivated to work, work being challenging, desire to work less if financially feasible, ability to adjust working hours to life situation; Work-related factors since diagnosis: Participation in RTW program, attitude towards work (importance);	Surgery, axillary node dissection, chemo, radiotherapy, hormone therapy	Number of comorbidities; HRQoL (SF-36); Impact of cancer negative and positive scales (Impact of Cancer questionnaire); Breast cancer-related complaints (sum of cognitive, menopause, pain, sleep, lymphedema, fatigue)	Among breast cancer survivors, reporting that work had become less important was associated with an adverse work outcome. Increased total work ability, feeling supported at work, and adjusting work hours decreased the probability of adverse work outcomes.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
				Current work ability, current physical and mental work ability (first three items)			
Tamminga et al., 2019 Netherlands[116]	Employed female breast and gynecological cancer patients who had been treated with curative intent and on sick leave	RCT Hospital-based work support intervention	SF-36 WAI WLQ VBBA	Importance of work (VAS); Current work ability, current physical and mental work ability (first three items); Impaired work functioning (overall work limitations); Physical workload; Work-related variables: Position at work, type of contract, shift work, years in current position, company size; RTW (rate, days)	Chemo, radiation, surgery, and/or hormone treatment	Comorbidity; Fatigue (MFI); Depression (CES-D); Self-efficacy (ALCOS); QoL (SF-36)	RTW rates, time from sick leave to RTW, work ability, work functioning, QoL, and costs did not differ between the intervention and control groups at two-years follow-up. RTW rates were higher than national registries. Receiving chemo and low work ability were associated with delayed full RTW.
Tangka et al., 2013 USA[117]	US residents who were treated for cancer in the year prior to participation	Repeated cross-sectional	MEPS	Occupation type; Missed workdays because of illness; average annual number of missed workdays, absenteeism costs (and by state, wage NOT PRO)	Not specified		After adjustment for personal characteristics, the rate of missed workdays was nearly three times higher for people with cancer compared to those without cancer.
Tangka et al., 2020 USA[118]	Young adult women (18-39 years) who received a breast cancer diagnosis	Cross-sectional	Ad hoc survey	Employment status current and during diagnosis; Employment type; Job benefits (such as paid sick leave, disability, and accommodations like flexibility); Employer support; Employment impacts (e.g., changed jobs, lost job, retired early, took time)	Access to treatment	Comorbidities; Out-of-pocket and other costs; Quality of care	Descriptive results for job-related variables. Common employment concerns for young adult women with breast cancer were increased paid and unpaid time off, job performance, and staying at job.
Taskila et al., 2007 Finland[119]	Employed survivors with no advanced lymphoma, prostate, testicular, or breast cancers	Cross-sectional	WAI QPS Nordic	Occupation type; Current work ability (1st item); Impaired physical and mental work ability due to cancer; Support from supervisors and co-workers (3 items); Social climate at work (1 item);	Chemo or other treatment (endocrine therapy, radiotherapy,	Comorbidities including injuries	Cancer survivors with more comorbidities and had chemo had increased impaired work ability. Higher commitment to the work organization and co-worker support among women

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	and cancer-free referents			Commitment to the work organization (1 item)	and/or surgery)		decreased impaired work ability.
Thorsen et al., 2016 Norway[120]	Employed female cancer patients at risk of sick leave who completed primary treatment who began RTW program at baseline	Longitudinal	Ad hoc survey	Work status (full-time, part-time, on sick leave, work assessment allowance); Change in work status (improved or not improved since baseline)		Lifestyle factors: Obesity, somatic and musculoskeletal comorbidities, daily smoking, and physical activity index; HRQoL and Functioning (EORTC QLQ-C30); Fatigue (FQ)	The majority of female cancer patients who completed a RTW program improved their work status six months after baseline. Fatigue measured by EORTC QLQ-30 was associated with unimproved work status. All functioning scores increased among patients with improved work status.
Torp, Nielsen, & Gudbergsson, 2012 Norway[121]	Cancer patients who had been treated for invasive cancer and employed at diagnosis and at survey	Cross-sectional	SFSS WAI	Work status: Work position, self-employment, part- or full-time work; Physical demands at work (nonmanual, manual); Psychosocial work factors: Psychological demands (enough time to complete work tasks), decision latitude (e.g., opportunities to learn new things at work), social support; Cancer-related support at work (supervisor/colleague support, contact with occupational health service), Worksite adjustments (e.g., changed weekly hours), Work ability (Reduced physical and mental ability, coping well with physical and mental, current)	Current treatment (surgery, radiotherapy, endocrine therapy, and other)	Comorbidities including injuries	Among cancer patients, chemo, comorbidities, being self-employed, working part-time, and increased psychological demands were associated with decreased total work ability. Colleague support increased total work ability.
Torp et al., 2017 Norway[122]	Cancer patients who had been treated for invasive cancer and	Cross-sectional	WAI	Work status: Salaried or self-employed, in work, pensioned, part- or full-time work; Sick leave (yes, no); Change in working hours (increased/reduced since diagnosis); Cancer-related change in main job;	Current treatment (surgery, radiotherapy, endocrine	Comorbidities including injuries; Financial change caused by cancer; Self-rated health	Among cancer patients, those who were self-employed were more likely to have reduced work hours, more occupational changes, and lower total work ability than salaried employees.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	employed at diagnosis			Physical demands at work (nonmanual, manual); Psychosocial work factors: Mental demands (work tempo and enough time to complete work tasks), decision latitude; Current work ability, current physical and mental work ability (first three items)	therapy, and other)	status; Overall QoL	Among self-employed cancer patients, reduced work hours and negative cancer-related financial change both mediate the negative effect on total work ability.
Ullrich et al., 2020 Germany[1][23]	Patients with prostate cancer who were employed before undergoing radical prostatectomy treatment and participated in a comprehensive cancer rehab program	Cross-sectional	SIBAR WAI ERI	Expected RTW (immediately, number of months, not at all); Work status (full or part-time); Intention to apply for disability, perceived ability to return to former job, duration of sick leave in 12 months before rehab, occupational stress, subjective need for rehab; Current work ability compared to lifetime best (1st item); Subjective amount of effort spent at work and reward gained in return	Rehab program average 12 hours of weekly therapeutic procedures	Anxiety and depression (HADS); HRQoL functioning and symptoms (EORTC QLQ-C30)	Among prostate cancer patients beginning a rehab program, lower subjective work ability, perceived inability to return to former job, and intention to apply for disability increased the expectation of delaying RTW.
van Muijen et al., 2013 Netherlands[124]	Employed cancer patients on work disability benefit at 24 months of sick leave	Longitudinal	Ad hoc survey	Level of work disability (wage loss less than 80% vs 80% or more; NOT PRO); RTW expectations (perception of work ability by worker and by healthcare provider); Work-related characteristics: Job demands (shift work, heavy physical or mental demands, time pressure), job tenure, company size, work status (yes, no); Support on RTW (by occupational health service, employer, none); Experience influence on RTW (substantial, some, none); Employer		Perceived health status and history of perceived health	Among cancer patients on work disability, not experiencing influence on RTW and a decreased perception of work ability by healthcare providers was associated with a higher level of disability.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
				accommodation (adjustment of tasks, hours, or none)			
van Muijen et al., 2014 Netherlands[125]	Employed cancer patients approaching 24 months of sick leave and not actively receiving chemo or radiotherapy	Cross-sectional	WAI	Level of work disability (wage loss less than 80% vs 80% or more; NOT PRO); Work-related determinants: Type of job, job tenure (years), weekly hours, shift work, managerial tasks, number of supervised co-workers, work demands (psychological, physical, or both), company size, work ability expectations, work status (working, not working), actual number of working hours; Current work ability, current physical and mental work ability (first three items)	Previous surgery, radiotherapy, chemo, hormone therapy, bone marrow transplant, immunotherapy	Extensive disease (lymph nodes, metastasis); Being disease-free; Number of comorbidities; Physical symptom burden (SIP); Fatigue (FACIT-F); Depression (CES-D); Global health (EORTC-QLQ-C30)	Among cancer patients on sick leave for 24 months, hormone therapy, metastasis, increased physical symptoms, physical work demands, and low current work ability were associated with a higher level of work disability.
van Muijen et al., 2017 Netherlands[126]	Employed cancer patients approaching 24 months of sick leave, applied for a work disability benefit, and not actively receiving chemo or radiotherapy	Longitudinal	WAI	Current work ability (1st item); Work-related determinants: Type of job, Shift work; Work demands (psychological, physical, or both); Managerial tasks; Work status; Level of work disability and vocational rehab trajectory during sick leave (NOT PRO)	Previous surgery, chemo, hormone therapy	Fatigue (FACIT-F); Extensive disease (lymph nodes, metastasis); Being disease-free; Number of comorbidities; Physical symptom burden (SIP); Depression (CES-D); Coping (UCL); Global health (EORTC-QLQ-C30)	Among cancer patients on sick leave for 24 months at baseline, work ability one year later was predicted by having chemotherapy, being free of disease, increased physical symptoms, global health, work ability at baseline, and increased level of disability.
van Muijen et al., 2019 Netherlands[127]	Employed cancer patients approaching 24 months of sick leave and not actively	Cross-sectional	WAI	Current work ability (1st item); Work-related characteristics: Having paid work, job hours, job tenure, kind of job exposure (psychic or physical), temporary contract, shift work, commercial services	Previous surgery, chemo, and/or hormone therapy	Fatigue (FACIT-F); Number of comorbidities; Physical symptom burden (SIP); Depression (CES-D); Coping (UCL); QoL	Among cancer patients on sick leave for 24 months, reduced current work ability and more physical limitations were associated with not having paid work.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	receiving chemo or radiotherapy					and Global health (EORTC-QLQ-C30); Functional limitations (FAL)	
Van Waart et al. 2017 Netherlands[128]	Patients undergoing adjuvant chemo for breast cancer in either low intensity physical activity (PA), higher PA, or usual care	RCT	Ad hoc survey	Work status (full- or part-time, other); Absence (sick leave days); Indirect costs (wages NOT PRO)	Mastectomy, breast-conserving surgery, lymph node dissection, and/or radiotherapy	Comorbidity; General and physical fatigue (MFI); Cardio-respiratory fitness; Muscle strength	Compared to usual care, PA interventions did not reduce absenteeism costs.
Von Ah et al. 2017 USA[129]	Breast cancer survivors	Cross-sectional	WAI	Employment status (full- or part-time); Occupation Type; Change in employment; Overall work ability score	Type of treatment received	Fatigue (AFI)	Patients with more attentional fatigue reported lower work ability.
Von Ah, Storey, & Crouch, 2018 USA[130]	Employed patients with stage I-IIIa breast cancer with at least 1 year since adjuvant treatment	Cross-sectional	WAI WLQ Intent to Turnover Scale Self-focused Emotional Labor Scale	Overall work ability score; Work productivity subscales; Employment status (full or part-time); Intent to turnover (3 items); Emotional work demands when dealing with interpersonal transactions in the workplace (6 items)	Type of adjuvant therapy (surgery, chemo, radiation); Anti-hormonal medication (Tamoxifen, Aromatase inhibitor)	Perceived cognitive impairment and ability (FACT-Cog3)	Among breast cancer survivors, higher perceived cognitive impairment was associated with decreased work ability, work performance (time, physical, and mental), and work productivity. Higher perceived cognitive ability was associated with increased work ability, time management and mental demands, and work productivity.
Vuong, Wei, & Beverly, 2015 USA[131]	Adults randomly selected from the civilian non-	Cross-sectional	NHIS	Absenteeism (workdays missed due to illness in past year); Work status (4 items; hours worked or usually worked weekly and months employed in previous year)		Functional limitations: any difficulty performing 12 activities (e.g.,	The average number of mean workdays lost was significantly higher among adults with cancer than those without cancer. Those with cancer was

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
	institutionalized US population					walking, leisure activities) and due to chronic condition	the second highest (behind arthritis) in extra workdays lost and lost income per year, although a much smaller prevalence.
Wennman-Larsen et al., 2013 Sweden[132]	Women who underwent breast cancer surgery in previous 12 weeks	Cross-sectional	Ad hoc survey	Current sick leave (yes, no); Work posture (3 items; strenuous vs not strenuous)		Breast and arm symptoms (e.g., pain, sensitivity – EORTC QLQ-BR23)	Strenuous work posture, higher level of breast and arm symptoms, and type of surgery were associated with being on sick leave among women who had breast cancer surgery.
Wolvers et al., 2018 Netherlands[133]	Cancer patients (except testicular) who received chemo	Longitudinal	WAI RTWSE	Current work ability (1st item); Job self-efficacy; Importance of work; RTW (days of sick leave); Work-related variables: type of contract, weekly hours, years in current and paid employment, shift work, works at large company	Surgery, radiotherapy, and/or hormone treatment	General fatigue (MFI)	Higher self-efficacy among chemo patients results in less time until full RTW.
Wolvers et al., 2018 Netherlands[134]	Cancer patients (except testicular) who received chemo	Longitudinal	WAI VBBA	Current work ability (1st item); Perceived physical demands; Work-related variables: days of sick leave, current work status, type of contract, weekly hours, years in current and paid employment, shift work, works at large company	Surgery, radiotherapy, and/or hormone treatment	General, physical, mental, reduced activity, and reduced motivation fatigue (MFI)	A reduction in general fatigue among cancer patients receiving chemotherapy results in an increase in perceived work ability over time. Additionally, a reduction in physical and mental fatigue was associated with increased work ability over time.
Wood et al., 2019 France, Germany, Italy[135]	Caregivers of patients with stage IIIb or IV non-small lung cell cancer	Cross-sectional	WPAI-GH	Employment status (full- or part-time, unemployed, student, homemaker, retired); Work impairment: work time missed, impairment while working, overall work impairment, daily activity impairment		Patient and caregiver health status (EQ-5D); Caregiver burden (ZBI)	About a third of caregivers were employed full time, and almost 9% reduced their job or dropped out of work; caregivers reported missed work time, overall work impairment, impairment while working and activity impairment.

Authors, Country	Study Population	Study Design	Productivity Instrument	PRO Items	Treatment Modality	Symptoms Measured	Evidence for productivity
Wood et al., 2019 France, Germany, Italy[136]	Patients with stage IIIb or IV non-small lung cell cancer and their informal caregivers	Cross-sectional	WPAI-GH	Employment status (full- or part-time, unemployed, student, homemaker, retired); Work impairment: work time missed, impairment while working, overall work impairment, daily activity impairment		Patient and caregiver health status (EQ-5D); Caregiver burden (ZBI); Patient functional status (ECOG)	Declines in patient functional status were associated with increasingly poor WPAI domains; patient's declining functional status is also related to increased activity impairment and burden for caregivers.
Zanville et al., 2016 USA[137]	Women with non-metastatic breast cancer	Longitudinal	FACT-GOG-Ntx	Functional well-being subscale: Perceived ability to work (5-point Likert scale); Employment status (full- or part-time);		Chemotherapy-induced peripheral neuropathy symptoms (FACT-GOG-Ntx)	Receiving chemo during treatment was related to lower work ability; severity of hand numbness, hand discomfort, weakness, trouble hearing, and difficulty feeling the shape of small objects was related to work ability at 1 month, but only the presence of weakness was related to work ability at 1 year.
Zeng et al., 2017 China[138]	Employed women with stage I-III breast cancer diagnosis for at least 2 years and women with musculoskeletal work injuries and cancer-free	Cross-sectional	WLQ CSC-W21	Job-related variables: job type, job status (full- or part-time), job stress, time in current job (months); Work productivity loss score and subscales; Work task related cognitive symptoms and three subscales (working memory, executive functioning, attention)	surgery, radiation, surgery + radiation, surgery + radiation + chemo	Anxiety and Depression (HADS); HRQoL (EORTC QLQ-C30)	Breast cancer survivors lower productivity across all measures: time management, physical demands, mental-interpersonal demands, output demands, and productivity loss score than the non-cancer group.

Ad Hoc Survey: set of questions or health risk assessment specifically designed for the study

Productivity Instruments: BJSQ: Brief Job Stress Questionnaire; CSC-W21: Cognitive Symptom Checklist; DCSQ: Demand-Control-Support Questionnaire; DOII: Demands of Illness Inventory; EQ-5D: EuroQol-5 Dimension; ERI: Effort-Reward Imbalance at Work Questionnaire; HPQ: Health Productivity Questionnaire; HRS: Health and Retirement Survey; JCQ: Job Content Questionnaire; LISAT-11: Life Satisfaction Questionnaire-11 items; LTFU: Long-Term Follow-Up Study MEPS: Medical Expenditure Panel Survey; NHIS: National Health Interview Survey; PSID: Panel Study of Income Dynamics; RCT: Randomized Controlled Trial; RTWSE: Return to Work Self-efficacy; SF-HLQ: Short-form

Health and Labor Questionnaire; SFSS: Structural-Functional Social Support Scale; SIBAR: Screening Instrument Work and Occupation; UWES: Utrecht Work Engagement Scale; VBBA: Questionnaire on the Experience and Evaluation of Work (Dutch); WAI: Work Ability Index; WLQ: Work Limitations Questionnaire; WPAI: Work Productivity and Activity Impairment Questionnaire-SPH: Specific Health Problem

Symptoms and Other Measures. AFI: Attentional Fatigue Index; ALCOS: General Self-Efficacy Scale (Dutch); ALRS: Activity Level Rating Scale; ALS: Activity Level Scale (from the Rotterdam Symptom Checklist); BAI: Beck Anxiety Inventory; BDI: Beck Depression Inventory; BFI: Brief Fatigue Inventory; BKW: Bielefelder katehorielle Wortlisten; BPI: Brief Pain Inventory; BRFSS: Behavioral Risk Factor Surveillance Survey; CARES: Cancer Rehabilitation Evaluation System; CARQ: Concerns about Recurrence Questionnaire; CASE: Cancer Self-Efficacy Scale; CCI: Charlson Comorbidity Index; CD-RISC 10: Connor-Davidson Resilience Scale 10 item; CES-D: Center for Epidemiologic Studies Depression; CFQ: Cognitive Failures Questionnaire; CHSPCF: Conventional Health Service and Productivity Costs Form; CQOLC: Caregiver Quality of Life Index; CRA: Caregiver Reaction Assessment; CSI: Caregiver Strain Index; CTCAE: Common Terminology Criteria for Adverse Events; CTXD: Cancer and Treatment Distress; DAS: Dyadic Adjustment Scale; DS14: Type D Personality Scale; DT: Distress Thermometer; ECOG: Eastern Cooperative Oncology Group performance status scale; EORTC QLQ-C30: European Organization for Research and Treatment of Cancer-Core Quality of Life Questionnaire, version 3.0 (-BR23: Breast Cancer Module); EOHA: Energy and Overall Health Assessment; EPIC-26: Expanded Prostate Cancer Composite; EPQ: Eysenck Personality Inventory; ESS: Epworth Sleepiness Scale; FACIT: Functional Assessment of Chronic Illness Therapy; FACT: Functional Assessment of Cancer Therapy (-B: Breast Cancer; -Cog3: Cognitive Version 3; -F: Fatigue; -GOG-Ntx: Gynecological Oncology Group-Neurotoxicity; -GP: General Population); FAL: Functional Ability List; FLIE: Functional Living Index-Emesis; FoP-Q-SF: Fear of Recurrence Questionnaire; FQ: Fatigue Questionnaire; FSI: Fatigue Symptom Inventory; FSS: Fatigue Severity Scale; GHQ: General Health Questionnaire; HADS: Hospital Anxiety and Depression Scale; HAWIE: Wechsler Adult Intelligence Scale; HPLP: Health-Promoting Lifestyle Profile; HRQOL: Health-Related Quality of Life; IES: Impact of Event Scale; IPAQ-SF: International Physical Activity Questionnaire-Short Form; ISSS: Illness-Specific Social Support Scale; KPS: Karnofsky Performance Score; LOT-R: Life Orientation Test-Revisited; MDASI: M.D. Anderson Symptom Inventory; MFI: Multidimensional Fatigue Inventory; MIS: Mutuality and Interpersonal Sensitivity; MOS-SSS: Medical Outcomes Social Support Survey; MPN-SAF TSS: Myeloproliferative Neoplasm Symptom Assessment Form Total Symptom Score; MSAS-SF: Memorial Symptom Assessment Scale-Short Form; NPI-Q: Neuropsychiatric Inventory-Questionnaire; NRS: Numeric Rating Scale; PAOFI: Patient Assessment of Own Functioning Inventory; PHQ-9: Patient Health Questionnaire-9 items; POMS: Profile of Mood States; PROMIS: Patient Reported Outcomes Measurement Information System; PSQI: Pittsburgh Sleep Quality Index; QLI: Quality of Life Index; QoL-OV28: Quality of Life (-CS: Cancer Survivor; -OV28: Ovarian Cancer 28 items); RSCL: Rotterdam Symptom Checklist; SCID-NP: Structured Clinical Interview for DSM-IV, nonpatient version; SCIN: Scale for Chemotherapy-Induced Long-Term Neurotoxicity; SF-36: Short Form Health Survey-36 items (-12: 12 item); SCL-5: Hopkins Symptom Checklist; SIP: Sickness Impact Profile; SPSI-R: Social Problem Solving Inventory; SQUASH: Short Questionnaire to Enhance Health Enhancing Physical Activity; TAP: test for attention functions; TSQM-9: Treatment Satisfaction Questionnaire for Medication; UCL: Utrecht Coping List; VAS: Visual Analog Scale; WHO QoL: World Health Organization Quality of Life Questionnaire; WMS-R: Wechsler Memory Scale III; ZBI: Zarit Burden Interview; ZSDS: Zung Self-Rating Depression Scale

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