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Factors influencing physical activity in individuals with head and neck cancer - a scoping review

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Abstract

Background: Higher physical activity levels are associated with better quality of life in people with head and neck cancer. Despite this positive association, most individuals with these cancer types have a sedentary or low-activity lifestyle. Limited knowledge exists regarding the factors that influence physical activity in this group.

Objectives: We reviewed and mapped the available literature on factors that may influence participation in physical activities in people with head and neck cancer.

Design: This scoping review included a comprehensive literature search of six databases (CINHAL, the Cochrane Library, EMBASE, PsycINFO, MEDLINE and Scopus) up until July 2023. We included qualitative and quantitative studies that investigated factors related to physical activity participations in individuals with head and neck cancer.

Results: Of the 1351 publications, we included 19 in our review. Publications mainly focused on barriers to physical activity, with some studies reporting facilitators and collecting data on patients' and healthcare professionals' views on physical activity participation. Most research teams made recommendations for promoting physical activity in people with head and neck cancer.
Characteristics associated with activity levels included age, cancer type and stage, morbidity level and attitude towards being active. Prevalent barriers consisted of health-related factors, including fatigue, pain, and nutritional issues, alongside personal and environmental impediments such as time constraints, lack of interest, or motivation. Facilitating factors for physical activity included perceived or experienced mental and health-related benefits. Consensus among patients, healthcare professionals, and researchers highlighted the necessity for enhanced information and education, emphasizing individualized approaches to promote physical activity throughout the cancer continuum.

Conclusions: Numerous factors affect physical activity in individuals with head and neck cancer. Future research should concentrate on screening and addressing risk factors for sedentary behaviour and activity barriers and on optimal design and delivery of interventions to incorporate physical activity promotion into the care pathway.

Keywords: scoping review, head and neck cancer, physical activity, influencing factors, barriers, facilitators

Abbreviations: PA: physical activity, HNC: head and neck cancer

Strengths and limitations of this study

- this scoping review presents a comprehensive overview based on quantitative and qualitative results
- expert knowledge was compiled by including recommendations and suggestions from study authors and healthcare professionals
- a broad concept of different PA modalities included everyday activities, and supervised or unsupervised exercise
- no quality assessment of the included studies was performed

Background and Rationale

Head and neck cancer (HNC) ranks as the seventh most prevalent cancer type worldwide with its incidence growing [1]. The primary risk factors for head and neck cancer include persistent tobacco and alcohol consumption, as well as infection with the human papillomavirus for pharyngeal cancer [1]. Most HNCs are diagnosed in stage III or IV, prompting extensive treatments involving a combination of surgery and radiation therapy, potentially complemented by chemotherapy [2]. Individuals diagnosed with HNC face a more than twofold risk for disabilities compared to those with other cancer diagnoses [3] and exhibit higher levels of frailty [4]. HNC treatments can substantially increase morbidity due to treatment toxicity. Functional deficits related to swallowing and speaking, along with disfigurement following surgery and radiation, can significantly impact the quality of life for individuals with HNC [5,6]. In comparison to other cancer survivors, individuals with a HNC diagnosis are almost twice as likely to commit suicide [7].

Physical activity (PA) is defined as "any bodily movement produced by skeletal muscles that result in energy expenditure". Exercise is a purposeful and organized form of PA, characterized by repetition and designed to enhance or preserve physical fitness and overall health [8]. A growing body of evidence demonstrates the positive effects of physical activity (PA) and exercise in individuals affected by cancer. Regular PA and exercise can improve many treatment side effects, enhance overall health and quality of life [9–11]. Accordingly, guidelines advise to integrate PA into the treatment and survivorship care of individuals with cancer [12–15]. Nevertheless, several factors hinder the implementation of these recommendations, including personal, social, environmental, and health-related factors. Commonly cited barriers encompass treatment side effects, time constraints, or inadequate information [16,17]. Depenbusch et. al [18] demonstrated that 30-60% of individuals diagnosed with various cancer types encounter structural barriers for PA.

Research findings indicate positive effects of PA and exercise interventions on the overall health status and quality of life among patients with HNC [19–21]. Higher activity levels are associated with better quality of life [22]. Nevertheless, individuals with HNC are especially susceptible to low activity levels or sedentary behaviour [23,24]. Already prior to diagnosis this group appears to have low activity levels [23]. Barriers for being physically active include physical or psychological factors such as treatment-related side effects that interfere with PA, lack of knowledge, and poor motivation [25]. Research exploring the contextual and influencing factors of PA in patients with HNC remains limited. Recent reviews have primarily focused on identifying barriers to and facilitators for engaging in PA [25,26]. A more comprehensive understanding of this topic is essential to inform the development of programs and

interventions aimed at promoting PA in individuals with HNC in the future. The research questions for our scoping review were as follows: 1. What factors are associated with PA in patients diagnosed with HNC? 2. What are known barriers to and facilitators for PA in this population? 3. What beliefs, perceptions, and views do patients diagnosed with HNC express regarding PA? 4. What recommendations do healthcare professionals and researchers have for promoting PA in this group?

Methods

We conducted a scoping review to explore and map the existing literature on factors that influence PA participation in patients with HNC. Our methods were based on Arksey and O'Malley's framework [27], best practice guidance by Peters et al [28], and the PRISMA guideline extension for scoping reviews [29].

Search strategy and eligibility criteria: we adopted a broad search strategy for three concepts: 1. head and neck cancer; 2. influencing factors, e.g., views, beliefs, barriers, and facilitators; 3. PA, exercise, or physical training. A medical librarian (MG) reviewed our search strategy. One researcher (MS) used the EBSCO host interface to execute the search in the CINHAL, Medline, and APA PsychINFO databases, and then searched in Embase, Scopus, and the Cochrane Library. The full search strategy is available in supplement S1. MS hand searched the reference lists of all included articles for additional relevant publications and added these for full text screening if they met inclusion criteria. To locate full-text articles for study protocols, poster abstracts, or study register entries, we conducted searches using the author's name and study title on Google Scholar or the website of the authors' affiliation. If unsuccessful, we contacted the authors. We last searched on July 5th, 2023.

Publications were eligible for inclusion if they focused on patients with HNC or incorporated a subgroup analysis specific to this population. In addition, the concept of PA had to be analysed in the publication, either including everyday PA or targeted and planned PA such as exercise. Finally, the publication had to address influencing factors for PA. We excluded studies on thyroid or oesophageal cancer [1] and full texts that were not in English or German. We placed no limit on study design or publication date.

Study selection: We imported our search results into the review tool Covidence [30]. The screening of titles and abstracts was conducted independently by two reviewers (MS, NM), who screened a common set of 20 titles and 10 abstracts to align their judgments. Full-text screening was performed independently by three reviewers (MB, MS, RE), who collectively screened the first five full-text articles to calibrate inclusion decisions for the scoping review.

The reviewers subsequently convened three more times to discuss and resolve any conflicts that arose during the screening process.

Data extraction and charting: MS extracted data about study characteristics such as design, study aim, and population. To address our research questions, we extracted data on personal, social, environmental, and health-related factors that influenced PA, as well as information on barriers, facilitators, views, and beliefs. For studies containing quantitative data, we charted their results descriptively. In cases involving qualitative data, we performed a basic content analysis [31] by deductively allocating concepts or characteristics into categories [32]. Healthcare professionals' or researchers' suggestions were extracted either from qualitative study results or the discussion sections of the studies.

Results

Literature search results: our literature search retrieved 1351 publications. After removing duplicates, we screened 650 studies following our predefined screening protocol (Fig 1). Through the screening of references during or after the full-text review, we identified and added 18 additional studies; we contacted one research team to obtain unpublished data. We ultimately reviewed the full text of 79 studies and included 19 included in our review.

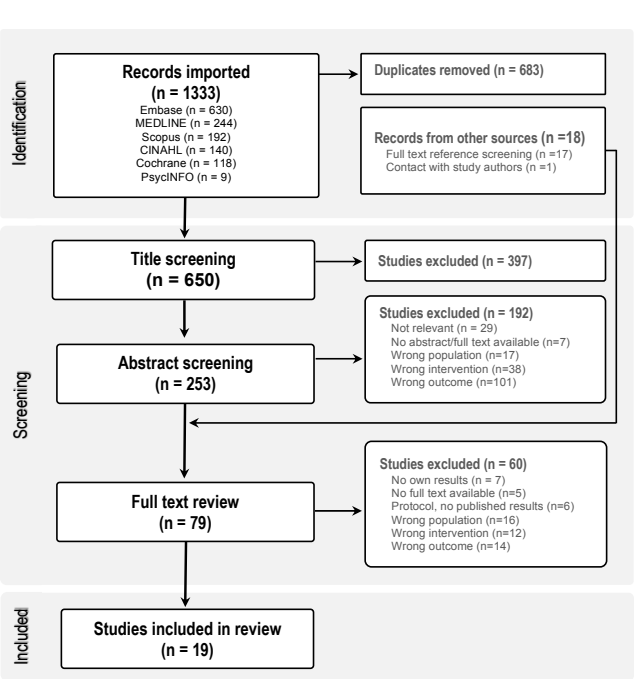

Figure 1: PRISMA flowchart on study inclusion

Table 1: Overview of included studies

Study - Country	Aim of Study	Study Type/Design	Participants
Björklund 2008 [33] - SE	to explore health promotion from the perspective of individuals with HNC	semi-structured individual interviews	n= 8 patients, 1-9 months after diagnosis
Duffy 2008 [34] - US	to analyze 5 health behaviors (smoking, problem drinking, nutrition, physical activity, and sleep) in the first year after diagnosis.	prospective, cohort study with online survey and chart review	n= 283 patients, within first year of diagnosis
Rogers L. 2008 [35] - US	to determine the most frequent and important physical activity barriers reported by HNC patients	cross-sectional study with questionnaires and chart review	n= 59 patients, 86% on treatment, 14% off treatment
Rogers L. 2009 [36] - US	to explore exercise counseling and programming preferences	cross-sectional study with survey and chart review	n= 90 patients, 33% < 4 months and 67% > 4 months since treatment
Rogers L. 2015 [37] - US	to determine psychometric properties of different scales (on barriers, expectations, enjoyment, goal setting) including item reduction and to explore associations between constructs and PA levels	cross-sectional study with survey	n= 101 patients; mean months since HNC diagnosis: 26.4 (SD± 43.9)
Zhao 2016 [38] - US	to assess the benefits of a resistance and walking exercise intervention during and shortly after chemo-radiotherapy; and to assess self-reported and actual activity and barriers to exercise	pilot controlled trial	n= 20 patients; 11 intervention, 9 control,
Henry 2016 [39] - CA	to explore needs and experiences of HNC patients regarding behavioral change (tobacco use, alcohol misuse, diet, exercise, and UV protection), as well as the barriers and facilitators to change	focus group interviews	n= 29 patients; time since diagnosis: mean of 18.7 months (SD± 12.3)
Jackson 2017 [40] - CA	to examine the exercise preferences and barriers of HNC survivors and explore how these factors changed with exposure to an exercise intervention	mixed-method study: questionnaires and interviews	n= 60 patients for questionnaires, n= 22 for interviews; 27,9 (SD±6.5) months since diagnosis,
Buffart 2018 [41] - NL	to identify social-cognitive correlates of PA using the theory of planned behavior model in addition to demographic, clinical, and lifestyle-related correlates	cross-sectional study with survey	n= 416 patients (combination of two studies); median time since treatment: 54 months (IQR: 33-120)
Midgley 2018 [42] - GB	to establish exercise preferences, barriers, and perceived benefits among HNC survivors and to investigate the level of interest in participating in an exercise program.	cross-sectional study with questionnaire pack	n= 437 patients; median time since diagnosis: 43 months (IQR:30–58)
Rogers S. 2019 [43] - GB	to relate responses to activity and recreation domains to clinical characteristics and PA intensity as well as perceived barriers and feeling able to participate in an exercise program	cross-sectional study with questionnaire pack	*same sample as Midgley 2018 [42]*
Felser 2020 [44] - DE	to evaluate the feasibility and impact of a low- to medium-intensity exercise intervention on physical function and quality of life	feasibility study	n= 12 patients; 67% more >5 years, 33% <5 years since diagnosis
Daun 2022 [45] - CA	to understand patient and health care professional perspectives on the role of multiphasic exercise prehabilitation	semi-structured interviews	n= 20 interview participants, (10 patients; mean 10.5 (SD± 8.6) days to surgery & 10 HCPs)
Hanika 2022 [46] - GB	to explore health-related behavioral changes and to identify barriers and motivators to achieving health recommendations	interviews with open and closed questions	n= 20 patients, post- treatment
Kok 2022 [47] - NL	to assess the feasibility of a tailored exercise program for HNC patients during chemo-radiotherapy	feasibility study	n= 34 patients with locally advanced HNC, during treatment
Rogers S. 2022 [48] - UK	to get insight into how and why HNC patients would be interested in participating in an exercise program.	semi-structured telephone interviews	n= 22 patients; *subsample of Midgley 2018 [42]*
Sealy 2021 [49] - NL	to explore HNC survivors' views on PA and to analyze self-perceived PA levels compare to objectively measured PA.	mixed methods study	n= 9 patients before surgery with curative intent
Kok 2023 [50] - NL	to explore preferences and expectations of an exercise intervention during chemo-radiotherapy and to identify factors influencing adherence, retention, and compliance	semi-structured interviews (pre- & post intervention)	n= 14 patients; *subsample of Kok 2022 [46]*
Ntoukas 2023 [51] - CA	to test the feasibility and safety of a heavy lifting strength training program	feasibility study	n= 9 patients; time since surgery: <5 years: 3 (33%), ≥5 years: 6 (67%)

(Abbreviations: CA: Canada, DE: Germany, GB: United Kingdom, HCP: healthcare professionals, HNC: head and neck cancer, IWR: interquartile range, NL: the Netherlands, PA: physical activity, SD: standard deviation, SE: Sweden, US: the United States of America)

Characteristics of included studies: All included studies were published within the last 15 years, with nearly two-thirds (n = 12) published within the last five years. Geographically, the studies were predominantly conducted in North America and Europe, with the majority (five) conducted in the United States, followed by Canada, the United Kingdom, and the Netherlands (four each). Germany and Sweden each contributed one study. There were 11 quantitative studies [34–38,41–44,47,51], six qualitative studies [33,39,45,46,48,50], and two mixed-methods studies [40,49]. The majority (n = 13) had a cross-sectional design, reporting outcomes derived from surveys or standardized questionnaires. Some included additional data from medical chart review. Three publications were feasibility studies, and one was a controlled pilot trial. Qualitative and mixed-method studies were primarily based on individual interviews, with one exception utilizing focus group interviews [39] (see Table 1).

Description of study participants: Patients before, during, and shortly after medical treatment for HNC were included [35,38,45,47,49,50], as well as individuals within the first year after treatment, or during long-term care [33,34,36,37,39–44,46,48,51]. One study [45] included healthcare professionals. The quantitative studies analysed data from 1530 participants; qualitative studies analysed data from 122 participants (Table 1).

Factors associated with physical activity: Seven publications analysed associations between a variety of factors and PA levels [34,35,37,41–43,49]. Several factors were associated with lower or higher levels of PA. Non-modifiable factors, such as age, cancer type or stage, and pre-existing health conditions, were identified [34,35,43]. Modifiable factors included behaviour, attitude, interest, and intention [37,41,42,49] (Table 2).

Table 2: Associations between different factors and PA levels

PA correlates	Enjoyment, task self-efficacy, perceived barriers, symptom index, alcohol use, comorbidity scores [35]
Associated with lower PA level	*Directly after diagnosis:* stage III-IV cancer, low sleep quality, older age, not being married, having comorbidities, having oral cancer [34]; *at 1-year after diagnosis:* feeding tube dependency, low sleep quality, older age, not being married, having comorbidities, having cancer of the oral cavity [34]; being worried about harm of PA. [49]
Associated with higher PA level	Younger age, no unintentional weight loss, no comorbidities [41]; having a higher education level [43]; being committed to or motivated for PA [49]; self-efficacy and goal setting were significantly associated with meeting PA recommendations [37]
Associated with higher intention for PA	Individuals with a history of exercising, people with more positive attitudes, subjective norms and perceived behaviour control and perceived PA intention [41]
Associated with interest in PA	Individuals with medical conditions impeding PA participation were more interested than those not stating any conditions, age > 75 years was a strong indicator for not being interested; those not interested more often stated 'lack of enjoyment', 'exercise not a priority', 'exercise is boring' and 'lack of interest' as barriers to exercise [42]

(Abbreviations: PA: physical activity)

Barriers to and facilitators for physical activity participation: Of the 19 studies included in this analysis, 13 reported barriers to physical activity [37–40,42–44,46–51], while seven reported factors that facilitate engagement in physical activity [33,40,42,46,48–50].

The prevailing barriers to PA were primarily associated with health, treatment, or environmental factors, as outlined in Table 3. Fatigue or low energy ranked highest in health-related reasons for inactivity or decisions not to exercise [40,42,43,46,48–51]. Pain, both in general [42,43,46,49,50], and specifically in the head, neck, and shoulder region [48,51], as well as eating and feeding difficulties [37,40,42,43,48,50], hindered activity. Environmental barriers to PA were primarily related to work and family responsibilities [40,44,47,48,50]. Personal barriers to PA were mainly due to lack of time [40,44,47,48,50], motivation, interest, and intention [37,40,44,49]. Some participants mentioned laziness [46,48], and some feared worsening their condition [43,46].

Factors facilitating PA included an individuals' perception and experience of the health benefits, as well as support from their social network (Table 3). The most significant facilitators of PA engagement were feeling mentally and physically better [45,46,48–50], and experiencing or perceiving general health benefits [42,46,48,50]. PA was also enhanced by a sense of power and control and the positive feelings that resulted from activity [33,41,49,50]. Emotional and practical support from an individual's network, including partners and family members, was a major social factor that facilitated PA [33,46,49].

Patients' beliefs, perceptions, and views: Individuals with HNC acknowledged the benefits of PA and expressed the need for more information on how to become physically active. Study participants reported that PA contributed to their well-being, both physically and mentally [45,49], providing them with a sense of personal empowerment [33]. They were motivated to increase their activity levels to improve their physical and mental health, as well as their fitness levels [46]. They suggested that they would benefit from more education and information about recovering from the side effects of cancer treatment [45]. Exercising in a group was found to have the advantage of facilitating the exchange of information and discussion about experiences [40]. Patients did not associate their health behaviour with morbidity, and felt that the information they received to change their health behaviour was too focused on prevention rather than function [39].

Participants suggested that a tailored program to promote PA should consider personal preferences, address barriers, and enhance facilitators [45]. Additionally, they highlighted that

PA promotion programmes should be supervised by experts to minimize risk of injury and to enhance adherence and enjoyment [35]. Participants also emphasized that surgeons should support and encourage PA [45,48].

Healthcare professionals' and researchers' recommendations on PA promotion: healthcare professionals and researchers recommended the implementation of individualized screening and symptom management. The emphasis should be on reducing barriers and supporting behaviour change. Continuous education and information provision throughout the cancer continuum were identified as crucial for promoting PA (see Table 4).

The type and mode of delivery of PA interventions or programmes should be tailored to an individual's abilities, preferences, and goals [42,45,47,48,50]. Furthermore, PA programmes should be flexible and take place at locations convenient for the patient [40,50].

Many study teams recommended regular screening and adequate addressing of physical and psychological symptoms, and patients' perceived barriers [34,35,39,42,43,46,48–50]. Tailored and individualised approaches were suggested to help people with a HNC diagnosis to increase their PA levels [40,42,45,47,48]. PA interventions should be integrated into the HNC care pathway as usual care [42,45,50] and promoted by all members of the health care team [44,45,48]. To increase the self-efficacy and competence of people with HNC, standard care should include patient education about the benefits of PA and how to overcome barriers from the time of diagnosis onwards [43,45–48]. Healthcare professionals should also be educated to increase their awareness of the benefits of PA for patients. They should take an active role in motivating and facilitating PA to enhance patients' recovery [43,45,48]. Individuals diagnosed with HNC tend to overestimate their activity level and may require special guidance and referrals to exercise specialists to help them prioritize PA and change their behaviour [46,49].

Table 3: Barriers to and facilitators for physical activity participation in patients with head and neck cancer

	PA Barriers	PA Facilitators
Personal factors	**Characteristics**	
	• Older age [48]	
	Feelings/Emotions	
	• Low emotional well-being/distress [42,47,50]; • fear of injury and making the condition worse [43,46]; lack of confidence [44]; • feeling pressured by coaching approach [50]; intimidation by group format [40]	• Feeling mentally/physically better and more normal [45,46,49,50]; • positive feelings (contentment, power and control, confidence, self-esteem) [33,49,50]; • enjoyment of being outdoors [46] 12/31/2023 10:49:00 AM
	Attitude	
	• Lack of time [40,44,47,48,50] • lack of motivation/ interest/enjoyment [37]; lack of motivation [40,44]; • lack of intention, no interest or aversion towards more PA [49]; • overestimation of own PA levels [46]; • not having a preference concerning the source of counselling and exercise variability [36]	• Returning to normal life and better function as motivators [38,46]; • not feeling anxious and having experienced the benefits (after intervention)[40]; • using terms "movement" or "physical activity" rather than "exercise" [45]; • making you feel better, improved attitude [48]; • after exercise participation decreased barrier: "lack of interest" and "exercise is boring" [38]12/31/2023 10:49:00 AM
	Behaviour	
	• Missing structure and accountability after intervention [40]; • laziness [46,48]; • being sedentary, but confident to have adequate PA level [49]; • lacking prior experiences/sporty attitude, loss of self-control [50]	• Enjoyment by social environment and accountability to instructors and group [40]; • structured program [40]; • prior experiences/sporty attitude [50]; • most important motivator to continue exercise: beneficial, motivated, controllability [51]
	Beliefs/Expectations	
	• No need to increase PA levels, PA was considered irrelevant or pre-existing PA habits were considered sufficient. [49]	• Outcome expectations: improvement of overall physical health, giving a higher energy level, increasing flexibility, improving overall health [37]
Social factors	• Lack of company [43]	• Emotional and practical support from social network, [33,46,48–50]; • social aspect of PA [48,52]; • group setting and instructors created a positive atmosphere and a possibility to exchange and discuss experiences [40,44]; • commitment to study program, [50]; • personal coaching and empowerment with clear instruction, personalized intervention [50] • hobbies [46]
Environmental factors	• Work and family responsibilities [36,40,44,46,49]; • distance to training facility, lack of transportation or too time consuming [43,49,50]; • weather condition [36,46,49]; • a hostile exercise environment [36,46]; • financial problems/constraints [49,52]; • no or little advice on PA [42,49]; • content of exercise program unclear [50]; • HCPs approach and focus on prevention rather than on resuming function [42]	• External incentive, chemo dog [50]; • structure of daily life activities, home-based, simplicity of the intervention [50]
Health- or treatment related factors	• Fatigue or loss of energy [40,42,43,46,48–51]; • general pain [42,43,46,49,50], or pain specified to head, neck or shoulder [48,51]; • problems with eating/feeding [36,40,43,48,48,50]; • other physical complaints [40,47,48,50,51]; • general treatment toxicity [38,40,47,50]; • dry mouth or throat [36,42,43,48]; pre-existing health problems, comorbidities [43,48,53]; • general [42,46] or shoulder weakness, [42,43]; • difficulties with breathing [42,43]; experience of choking feeling during exercise [48]; • weight loss [50]; • hospital admittance [50]	• Experienced or perceived general health benefits [42,50,52,54]; • building up strength and fitness [42,46,48]; • increased energy levels, less fatigue [40]; • psychological benefits [46]; • reducing risk of disease [42]12/31/2023 10:49:00 AM

(Abbreviations: HCPs: healthcare professionals, PA: physical activity)

Table 4: Recommendations and suggestions for physical activity promotion in patients with head and neck cancer

Addressing symptoms and barriers:	• Address PA barriers and give patients advice on how to overcome them [42,43,46,48] • Physical impairments [34,39,49] and psychological factors (e.g. distress, anxiety, depression) need to be adequately addressed [50] • Symptoms or risk factors associated with low PA levels need to be covered [34,35] • If necessary rehabilitation should be recommended [34], ongoing support should be offered by specialist rehabilitation teams [46] • Referrals to specialists should be made for individuals with more needs/worries about exercise [49]
Providing information and education:	• Give education and training for HCP and patients to be aware of benefits of exercise [42,45,48] • Patient education about symptom management should be offered to enhance self-efficacy and PA [35] and access to resources relevant for recovery should be provided [45] • Focus should be put on personal goals and knowledge gaps about benefits and perceived barriers. [47] • Information on exercise should ideally be given soon after time of diagnosis [42] • Blended care or e-health apps can be helpful in providing patient-tailored information on activity level, personal goals and monitoring individual progress. [50]
Addressing behaviour, attitude, and intention:	• Health behaviour change interventions and psychological strength building should be offered to increase patient's self-efficacy and engagement [39,46] • Assistance by medical professionals or exercise specialist should be given to find a suitable type of PA [36,39] • Supporting the empowerment process is important, [41] some patients will need professional guidance to help prioritize PA [49] • Patient education about exercise benefits to increase confidence, competence, uptake and adherence [48] • Attention should be put on dealing with the lack of perceived ability to participate, an expert should guide them [36] • HCPs should improve awareness about actual PA levels of individuals [49] • Provide access to HCPs at treatment-end to guide lifestyle decisions [46] • Potential intention-behaviour gap needs to be considered [41] • Intention might need to be targeted; pedometers or accelerometers might improve awareness of actual PA levels [49] • The health behaviour history needs to be included in the survivorship care plan [39]
Support provided within the healthcare system:	• Exercise and PA interventions should be integrated within the oncological care pathway as usual care [42,45,50], they should start as early as possible [50]; and all members of the health care team should motivate and facilitate exercise as part of recovery [48] • There should be a culture shift towards more PA; and providing necessary prescriptions [45,46] • Exercise specialists should be involved in the care pathway. [45] • Surgeons should advise and encourage exercise participation [45,48]
Suggestions about PA intervention delivery:	*Type of intervention:* • Programs and interventions should be tailored to each patients abilities and preferences [42,45,47,48] • Collaborative, flexible, culturally sensitive, and individualized approaches are needed [48] • Exercise interventions should be tailored and personalized with regard to goal-setting, training type, intensity, setting and timing and should be incorporated in ADLs [50] • A flexible training programmes should be offered with check-in policy after several missed classes at the end stage of treatment [40] • Scheduling of exercise sessions need to be flexible around treatment appointments [50] *Location:* • When it is safe: home-based moderate intensity exercise should be included [36] • Training should be at a location to the patients' convenience [50] *Supervision:* • Supervision: supervision before treatment and remote supervision for home-based training during and shortly after chemo-radiotherapy [50] • It is assumed that attendance rate and effects are lower for unsupervised training interventions [44] • Patients should be monitored before and during exercise [47] • The physiotherapist can act as an important facilitator for motivation, mental support and increasing discipline to exercise [50] *Others:* • Exercise/PA should be combined with intensive nutritional support and monitoring [47] • Resources need to be built to support exercise into cancer survivorship and a in community-based settings [45] • Need for funding for exercise programmes (outside of study context) [45]

(Abbreviations: HCPs: healthcare professionals, PA: physical activity)

Discussion

The objective of our scoping review was to summarise the known factors that influence PA in people diagnosed with HNC, as well as to compile recommendations from individuals affected by HNC and experts in the field. A variety of personal, environmental, social, and health-related factors can influence PA positively or negatively. Patients and experts recommend that PA promotion should be integrated into the HNC treatment pathway. This should include providing information and education on how to manage symptoms and overcome barriers. Furthermore, PA promotion should actively support individual behaviour change, facilitating motivation and intention to increase PA levels.

Positive influence on or association with PA: This scoping review confirms that patients diagnosed with HNC are motivated to increase their PA to enhance their physical and mental health. Our findings align with studies indicating that PA is linked to an improved health status and an improved sense of control and satisfaction for patients [17,25,26]. Support from their social network is a major factor in facilitating PA for individuals affected. Therefore, interventions promoting PA should actively involve and encourage family members or other individuals from patients' networks to support PA. Osazuwa-Peters et al. 2019 [55] demonstrated that being married reduced mortality rates for people with HNC by one third, highlighting the significant positive impact of having a partner. Given that not every person with HNC has a close network or a significant other for support, these individuals may require additional support. Family and network involvement should be subject of further research, as it has the potential to improve the situation [56].

Negative influence on or association with PA: This review found an association between individual characteristics and PA levels. Personal and health-related factors were specifically linked to lower PA levels. This is consistent with a previous study which reported, that lower PA levels were associated with educational level, number of comorbidities, and tumour stage among newly diagnosed HNC patients [23]. The most common health-related barrier to PA in our review is fatigue. Fatigue, a prevalent issue for individuals with cancer, can be alleviated through exercise and PA [57]. Sharp et al. [58] demonstrated that almost one-third of HNC patients experienced clinically significant fatigue symptoms during the first year after diagnosis, with the peak occurring four months after diagnosis, affecting almost 45% of patients. International guidelines [59,60] recommend counselling for PA and exercise promotion. Further investigation into the potential of enhancing physical activity engagement through fatigue screening during and after the treatment phase is warranted. In our review pain and eating problems are also among the most commonly reported health-related barrier. According to a systematic review by van den Beuken et al [60], patients with HNC had a higher prevalence

of pain compared to those with other cancer types. Patients with oral cancer were found to be particularly susceptible to pain, with almost 70% affected [61]. Swallowing, eating, and feeding difficulties are also highly prevalent and specific to HNC, placing a significant burden on affected individuals [62], and feeding tubes may be required [63]. This area of concern has also been underscored in our review. The prolonged times required for eating or being fed through an enteral tube can contribute to the most common personal reason people with HNC cite for being inactive: lack of time. The shortage of time was frequently identified as a primary barrier to PA in various cancer types [26].

Suggestions and recommendations of people with HNC, healthcare professionals and researchers: the findings of this review suggest that PA should be an integral part of the treatment pathway for patients with HNC. In contrast to this recommendation, the clinical practice guideline for HNC of the National Comprehensive Cancer Network (NCCN) [64] in the United States and the ESMO guidelines of the European Society of Medical Oncology [65] have not yet incorporated this recommendation. Conversely, the American Cancer Society's HNC survivor guidelines [66] proposes PA for a later period during the cancer care continuum, asserting that primary care clinicians should recommend PA. It should be considered to actively promote PA during the treatment phase, providing clinicians with the opportunity for 'teachable moments' to assist patients with HNC in integrating PA into their daily activities [67,68].

Our review confirms that patients with HNC require customized programmes, consistent with the recommendations for PA promotion for patients affected by various cancer types [17,18,26]. However, it remains still unclear which intervention components are essential and when they should be delivered during the cancer journey to best address patients' needs. This scoping review affirms that healthcare professionals and researchers are convinced that more information and education on PA benefits should be provided to patients and professionals. Haussmann et al. [69] confirm that in-depth PA counselling is necessary to enhance PA levels in patients with cancer, but is rarely delivered to them.

Our results suggest that facilitating behaviour change should be further explored and targeted in tailored interventions for individuals with HNC. Some patients with HNC may not intend to change their PA behaviour because they believe that they are sufficiently active or overestimate their personal PA levels [46,49]. Low health literacy or lack of knowledge about the effects of health behaviours may hinder PA uptake; nearly 50% of patients with HNC were found to be insufficiently health literate in the sample analysed by Clarke et al. [70], which has also been associated with being less self-efficient. Educating patients with HNC about the

benefits of PA and providing access to interventions to promote self-efficacy, a precursor for behaviour change, may increase PA levels in this population [39,46].

Tailored interventions or PA programs align with patients' needs in reducing barriers to integrate PA into their lives, as demonstrated in the results of this review. Additionally, healthcare professionals are aware of PA benefits and the importance of screening risk factors for low PA levels during the HNC treatment pathway. However, there are currently no corresponding recommendations on how this should be implemented in clinical practise; this should be explored in more detail in the future.

Implications for further research: There are several topics that require further investigation to advance the implementation of physical activity promotion within the care continuum of individuals with head and neck cancer.

1. Understanding how, when, and by whom screening for relevant symptoms and barriers related to physical activity should be conducted.
2. Developing tailored information and effective education for individuals affected by HNC and for healthcare professionals involved in their care.
3. Improving understanding of the motivation for, intention to, and behaviour change towards increased physical activity in individuals with HNC.

Strengths and limitation: To our knowledge, this is the first review that incorporates the insights and recommendations from researchers in the analysis of literature on factors influencing PA in individuals with HNC. We summarize and consolidate evidence on PA in patients diagnosed with HNC, confirming the results on barriers and facilitators of previous research in this patient group [25,26].

The results of this scoping review should be interpreted cautiously because the concept of PA was defined broadly, and the context of PA was heterogeneous. The included studies investigated general PA, analysed exercise interventions within a study setting during treatment, or analysed PA after treatment was completed. Our goal was to compile influencing factors and recommendations from the literature and to suggest future exploration. Another limitation is that we did not execute a quality assessment for the included studies.

Conclusion

Personal, social, environmental, and health-related factors significantly influence PA participation of patients with HNC. These factors encompass personal characteristics like age and co-morbidities, as well as factors such as attitude, interest, and motivation. Treatment

side-effects and the overall health condition of individuals also play crucial roles. Further research is necessary to develop interventions that encourage patients' participation and overcome potential barriers. Research on PA for patients affected by HNC should consider implementation of PA interventions into the clinical pathways to improve healthcare professionals' engagement and reduce environmental barriers.

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Contributors MS carried out the literature search; MS and NM did the screening of all titles and abstracts; MS, MB and RE did the screening of full texts and the literature review, MS drafted the manuscript. RE, MB, MW assisted with data interpretation and drafting the manuscript. All authors read and approved the final manuscript.

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Competing interests None declared.

Data sharing statement Additional materials with the detailed search strategy and more detailed overview of included studies are available as supplements S1 and S2

Supplements:
- S1: Search strategy for all databases
- S2: Details on included studies S2

References:

1 Gormley M, Creaney G, Schache A, *et al.* Reviewing the epidemiology of head and neck cancer: definitions, trends and risk factors. *Br Dent J*. 2022;233:780–6. doi: 10.1038/s41415-022-5166-x

2 Johnson DE, Burtness B, Leemans CR, *et al.* Head and neck squamous cell carcinoma. *Nat Rev Dis Primer*. 2020;6:1–22. doi: 10.1038/s41572-020-00224-3

3 Warinner CB, Bergmark RW, Sethi R, *et al.* Cancer-Related Activity Limitations Among Head and Neck Cancer Survivors. *The Laryngoscope*. 2022;132:593–9.

4 Bras L, Driessen DAJJ, de Vries J, *et al.* Patients with head and neck cancer: Are they frailer than patients with other solid malignancies? *Eur J Cancer Care (Engl)*. 2020;29:e13170.

5 Parke SC, Langelier DM, Cheng JT, *et al.* State of Rehabilitation Research in the Head and Neck Cancer Population: Functional Impact vs. Impairment-Focused Outcomes. *Curr Oncol Rep*. 2022;24:517–32.

6 Hammermüller C, Hinz A, Dietz A, *et al.* Depression, anxiety, fatigue, and quality of life in a large sample of patients suffering from head and neck cancer in comparison with the general population. *BMC Cancer*. 2021;21:94.

7 Osazuwa-Peters N, Simpson MC, Zhao L, *et al.* Suicide risk among cancer survivors: Head and neck versus other cancers. *Cancer*. 2018;124:4072–9.

8 Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep Wash DC 1974*. 1985;100:126–31.

9 Cormie P, Zopf EM, Zhang X, *et al.* The Impact of Exercise on Cancer Mortality, Recurrence, and Treatment-Related Adverse Effects. *Epidemiol Rev*. 2017;39:71–92.

10 Schmitz KH, Campbell AM, Stuiver MM, *et al.* Exercise is medicine in oncology: Engaging clinicians to help patients move through cancer. *CA Cancer J Clin*. 2019;69:468–84.

11 McTiernan A, Friedenreich CM, Katzmarzyk PT, *et al.* Physical Activity in Cancer Prevention and Survival: A Systematic Review. *Med Sci Sports Exerc*. 2019;51:1252–61.

12 Campbell KL, Winters-Stone KM, Wiskemann J, *et al.* Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable. *Med Sci Sports Exerc*. 2019;51:2375–90.

13 Rock CL, Thomson CA, Sullivan KR, *et al.* American Cancer Society nutrition and physical activity guideline for cancer survivors. *CA Cancer J Clin*. 2022;72:230–62.

14 Cormie P, Atkinson M, Bucci L, *et al.* Clinical oncology society of australia position statement on exercise in cancer care. *Med J Aust*. 2018;209:184–7.

15 Hayes SC, Newton RU, Spence RR, *et al.* The Exercise and Sports Science Australia position statement: Exercise medicine in cancer management. *J Sci Med Sport*. 2019;22:1175–99.

16 Chan A, Ports K, Neo P, *et al.* Barriers and facilitators to exercise among adult cancer survivors in Singapore. *Support Care Cancer*. 2022;30:4867–78.

17 Clifford BK, Mizrahi D, Sandler CX, *et al.* Barriers and facilitators of exercise experienced by cancer survivors: a mixed methods systematic review. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2018;26:685–700.

18 Depenbusch J, Wiskemann J, Haussmann A, *et al.* Impact and Determinants of Structural Barriers on Physical Activity in People with Cancer. *Int J Behav Med*. 2022;29:308–20.

19 Bye A, Sandmael JA, Stene GB, *et al.* Exercise and Nutrition Interventions in Patients with Head and Neck Cancer during Curative Treatment: A Systematic Review and Meta-Analysis. *Nutrients*. 2020;12. doi: 10.3390/nu12113233

20 Samuel SR, Maiya AG, Fernandes DJ, *et al.* Effectiveness of exercise-based rehabilitation on functional capacity and quality of life in head and neck cancer patients receiving chemo-radiotherapy. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2019;27:3913–20.

21 Lynch PT, Horani S, Lee R, *et al.* Effectiveness of physical activity interventions in improving objective and patient-reported outcomes in head and neck cancer survivors: A systematic review. *Oral Oncol*. 2021;117:105253.

22 Huang S, Zhan Y, Jeon S, *et al.* Longitudinal associations among physical activity, inflammatory markers, and quality of life in patients with head and neck cancer. *Head Neck*. 2023;45:1952–66.

23 Douma JAJ, Leeuw IMV, Leemans CR, *et al.* Demographic, clinical and lifestyle-related correlates of accelerometer assessed physical activity and fitness in newly diagnosed patients with head and neck cancer. *Acta Oncol*. 2020;59:342–50.

24 Fang Y-Y, Wang C-P, Chen Y-J, *et al.* Physical activity and fitness in survivors of head and neck cancer. *Support Care Cancer*. 2021;29:6807–17.

25 Ning Y, Wang Q, Ding Y, *et al.* Barriers and facilitators to physical activity participation in patients with head and neck cancer: a scoping review. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2022;30:4591–601.

26 Doughty HC, Hill RA, Riley A, *et al.* Barriers to and facilitators of physical activity in adults living with and beyond cancer, with special emphasis on head and neck cancer: a systematic review of qualitative and mixed methods studies. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2023;31:471.

27 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;19–32.

28 Peters MDJ, Godfrey C, McInerney P, *et al.* Best practice guidance and reporting items for the development of scoping review protocols. *JBI Evid Synth*. 2022;20:953–68.

29 Tricco AC, Lillie E, Zarin W, *et al.* PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;169:467–73.

30 Covidence - Better systematic review management. Covidence. https://www.covidence.org/ (accessed 24 May 2022)

31 Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs*. 2008;62:107–15.

32 Peters MDJ, Marnie C, Tricco AC, *et al.* Updated methodological guidance for the conduct of scoping reviews. *JBI Evid Implement*. 2021;19:3–10.

33 Björklund M, Sarvimäki A, Berg A. Health promotion and empowerment from the perspective of individuals living with head and neck cancer. *Eur J Oncol Nurs Off J Eur Oncol Nurs Soc*. 2008;12:26–34.

34 Duffy SA, Khan MJ, Ronis DL, *et al.* Health behaviors of head and neck cancer patients the first year after diagnosis. *Head Neck*. 2008;30:93–102.

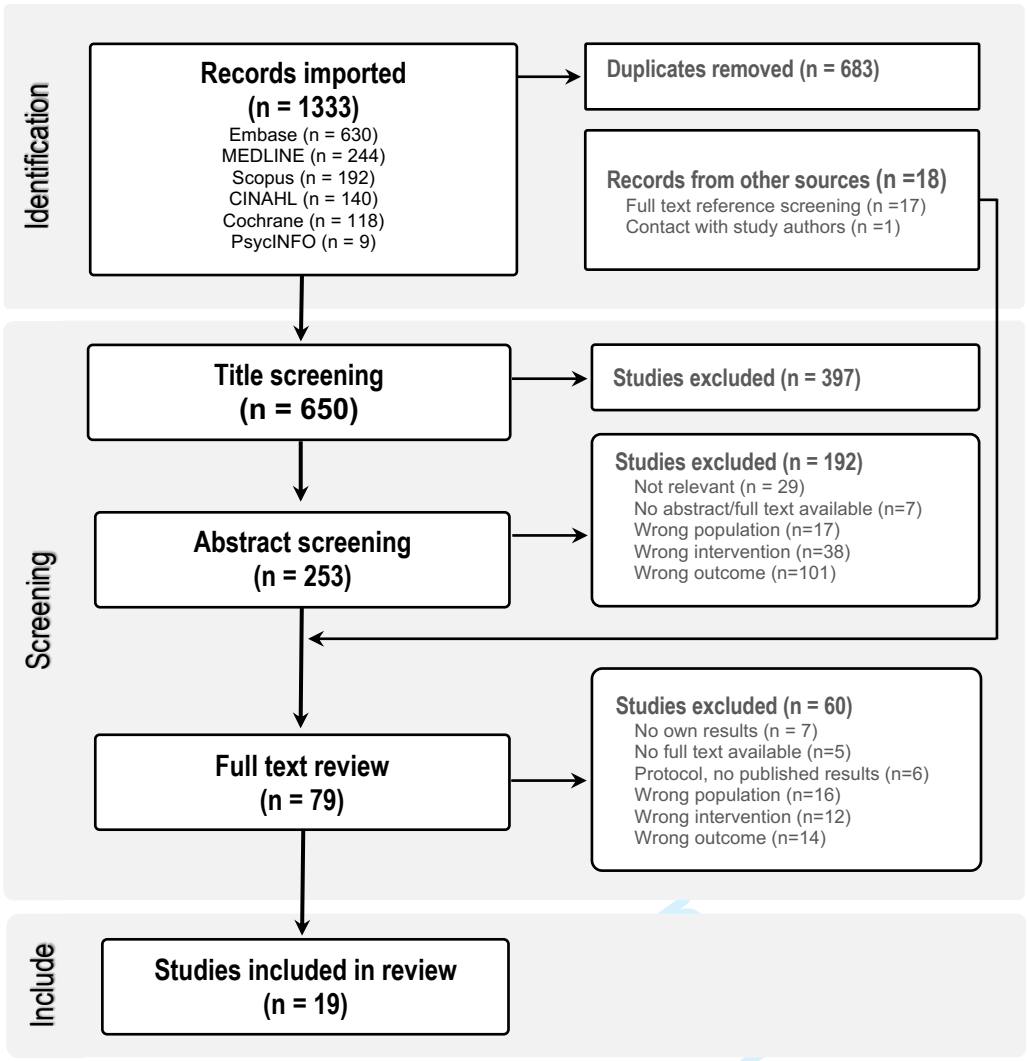
35 Rogers LQ, Courneya KS, Robbins KT, *et al.* Physical activity correlates and barriers in head and neck cancer patients. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2008;16:19–27.

36 Rogers LQ, Malone J, Rao K, *et al.* Exercise preferences among patients with head and neck cancer: prevalence and associations with quality of life, symptom severity, depression, and rural residence. *Head Neck*. 2009;31:994–1005.

37 Rogers LQ, Fogleman A, Verhulst S, *et al.* Refining Measurement of Social Cognitive Theory Factors Associated with Exercise Adherence in Head and Neck Cancer Patients. *J Psychosoc Oncol*. 2015;33:467–87.

38 Zhao SG, Alexander NB, Djuric Z, *et al.* Maintaining physical activity during head and neck cancer treatment: Results

of a pilot controlled trial. *Head Neck*. 2016;38 Suppl 1:E1086–96.
39 Henry M, Bdira A, Cherba M, *et al.* Recovering function and surviving treatments are primary motivators for health behavior change in patients with head and neck cancer: Qualitative focus group study. *Palliat Support Care*. 2016;14:364–75.
40 Jackson C, Dowd AJ, Capozzi LC, *et al.* A turning point: Head and neck cancer patients' exercise preferences and barriers before and after participation in an exercise intervention. *Eur J Cancer Care (Engl)*. 2018;27:1–13.
41 Buffart LM, de Bree R, Altena M, *et al.* Demographic, clinical, lifestyle-related, and social-cognitive correlates of physical activity in head and neck cancer survivors. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2018;26:1447–56.
42 Midgley AW, Lowe D, Levy AR, *et al.* Exercise program design considerations for head and neck cancer survivors. *Eur Arch Oto-Rhino-Laryngol Off J Eur Fed Oto-Rhino-Laryngol Soc EUFOS Affil Ger Soc Oto-Rhino-Laryngol - Head Neck Surg*. 2018;275:169–79.
43 Rogers SN, Travers A, Lowe D, *et al.* Importance of activity and recreation for the quality of life of patients treated for cancer of the head and neck. *Br J Oral Maxillofac Surg*. 2019;57:125–34.
44 Felser S, Behrens M, Liese J, *et al.* Feasibility and Effects of a Supervised Exercise Program Suitable for Independent Training at Home on Physical Function and Quality of Life in Head and Neck Cancer Patients: A Pilot Study. *Integr Cancer Ther*. 2020;19:1534735420918935.
45 Daun JT, Twomey R, Dort JC, *et al.* A Qualitative Study of Patient and Healthcare Provider Perspectives on Building Multiphasic Exercise Prehabilitation into the Surgical Care Pathway for Head and Neck Cancer. *Curr Oncol Tor Ont*. 2022;29:5942–54.
46 Hanika C, Porter N, Blick K, *et al.* Lifestyle choices following head and neck cancer treatment: A qualitative study. *Nutr Health*. 2022;2601060221106624.
47 Kok A, Passchier E, May AM, *et al.* Feasibility of a supervised and home-based tailored exercise intervention in head and neck cancer patients during chemoradiotherapy. *Eur J Cancer Care (Engl)*. 2022;31:e13662.
48 Rogers SN, Lowe D, Midgley AW. Patients' views of physical activity whilst living with and beyond head and neck cancer. *Int J Oral Maxillofac Surg*. 2022;51:323–31.
49 Sealy MJ, Stuiver MM, Midtgaard J, *et al.* Perception and Performance of Physical Activity Behavior after Head and Neck Cancer Treatment: Exploration and Integration of Qualitative and Quantitative Findings. *Int J Environ Res Public Health*. 2021;19. doi: 10.3390/ijerph19010287
50 Kok A, Passchier E, May AM, *et al.* Expectations and experiences of participating in a supervised and home-based physical exercise intervention in patients with head and neck cancer during chemoradiotherapy: a qualitative study. *Submitt Publ*. 2023.
51 Ntoukas SM, McNeely ML, Seikaly H, *et al.* Feasibility and safety of Heavy Lifting Strength Training in Head and Neck Cancer survivors post-surgical neck dissection (the LIFTING trial). *Support Care Cancer*. 2023;31. doi: 10.1007/s00520-023-07815-2
52 Hanika C, Porter N, Blick K, *et al.* Lifestyle choices following head and neck cancer treatment: A qualitative study. *Nutr Health*. 2022;2601060221106624.
53 Sealy MJ, Stuiver MM, Midtgaard J, *et al.* Perception and Performance of Physical Activity Behavior after Head and Neck Cancer Treatment: Exploration and Integration of Qualitative and Quantitative Findings. *Int J Environ Res Public Health*. 2021;19. doi: 10.3390/ijerph19010287
54 Rogers SN, Lowe D, Midgley AW. Patients' views of physical activity whilst living with and beyond head and neck cancer. *Int J Oral Maxillofac Surg*. 2022;51:323–31.
55 Osazuwa-Peters N, Christopher KM, Cass LM, *et al.* What's Love Got to do with it? Marital status and survival of head and neck cancer. *Eur J Cancer Care (Engl)*. 2019;28:e13022.
56 Zeng Q, Ling D, Chen W, *et al.* Family Caregivers' Experiences of Caring for Patients With Head and Neck Cancer. *Cancer Nurs*. 2023;46:E41–61.
57 Cramp F, Byron-Daniel J. Exercise for the management of cancer-related fatigue in adults. *Cochrane Database Syst Rev*. Published Online First: 2012. doi: 10.1002/14651858.CD006145.pub3
58 Sharp L, Watson L-J, Lu L, *et al.* Cancer-Related Fatigue in Head and Neck Cancer Survivors: Longitudinal Findings from the Head and Neck 5000 Prospective Clinical Cohort. *Cancers*. 2023;15:4864.
59 Fabi A, Bhargava R, Fatigoni S, *et al.* Cancer-related fatigue: ESMO Clinical Practice Guidelines for diagnosis and treatment†. *Ann Oncol*. 2020;31:713–23.
60 National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology - Cancer-Related Fatigue. 2023. https://www.nccn.org/professionals/physician_gls/pdf/fatigue.pdf (accessed 22 November 2023)
61 Khawaja SN, Jamshed A, Hussain RT. Prevalence of pain in oral cancer: A retrospective study. *Oral Dis*. 2021;27:1806–12.
62 Ringash J, Bernstein LJ, Devins G, *et al.* Head and Neck Cancer Survivorship: Learning the Needs, Meeting the Needs. *Semin Radiat Oncol*. 2018;28:64–74.
63 Vermaire J, Raaijmakers C, Monninkhof E, *et al.* The course of swallowing problems in the first 2 years after diagnosis of head and neck cancer. *Support Care Cancer*. Published Online First: 30 August 2022. doi: 10.1007/s00520-022-07322-w
64 Pfister DG, Spencer S, Adelstein D, *et al.* Head and Neck Cancers, Version 2.2020, NCCN Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw*. 2020;18:873–98.
65 ESMO. Clinical Practice Guidelines-Squamous Cell Carcinoma of the Head and Neck. 2020. https://www.esmo.org/guidelines/guidelines-by-topic/head-and-neck-cancers/squamous-cell-carcinoma-of-the-head-and-neck (accessed 22 November 2023)
66 Cohen EEW, LaMonte SJ, Erb NL, *et al.* American Cancer Society Head and Neck Cancer Survivorship Care Guideline. *CA Cancer J Clin*. 2016;66:203–39.
67 Karvinen K, Bruner B, Truant T. The Teachable Moment After Cancer Diagnosis: Perceptions From Oncology Nurses. *Oncol Nurs Forum*. 2015;42:602–9.
68 Bluethmann SM, Basen-Engquist K, Vernon SW, *et al.* Grasping the 'teachable moment': time since diagnosis, symptom burden and health behaviors in breast, colorectal and prostate cancer survivors. *Psychooncology*. 2015;24:1250–7.
69 Haussmann A, Ungar N, Tsiouris A, *et al.* Physical activity counseling to cancer patients: How are patients addressed and who benefits most? *Patient Educ Couns*. 2021;S0738-3991(21)00284-6.
70 Clarke N, Dunne S, Coffey L, *et al.* Health literacy impacts self-management, quality of life and fear of recurrence in head and neck cancer survivors. *J Cancer Surviv*. 2021;15:855–65.



Supplement S1: Search strategies for all included databases

The overall search concepts:

Concept 1:	**Concept 2:**	**Concept 3:**
head and neck cancer	influencing factors	physical activity

- Medline, APA PsycINFO, CINHAL via EBSCOhost

Concept 1:	TI ((head OR neck) N3 (neoplasm* OR cancer* OR tumo#r*)) OR AB ((head OR neck) N3 (neoplasm* OR cancer* OR tumo#r*)) OR TI ((oral cavity OR pharyn* OR laryn* OR lip*) N3 (neoplasm* OR cancer* OR tumo#r*)) OR AB ((oral cavity OR pharyn* OR laryn* OR lip*) N3 (neoplasm* OR cancer* OR tumo#r*)) OR "head and neck cancer" or "oral cancer" or "oropharyngeal cancer" or hnc
	AND
Concept 2:	(DE "Sedentary Behavior") OR (DE "Health Behavior") OR (DE "Health Belief Model") OR view* or belief* or perspective* or attitude* OR facilitator* OR barrier*
	AND
Concept 3:	(DE "Physical Activity") OR (DE "Physical Fitness") OR (DE "Athletic Training") OR (DE "Exercise") OR "physical activity" or exercise or fitness or "physical exercise"

- Embase

Concept 1:	('((head or neck) near/3 (neoplasm* or cancer or tumor* or tumour*)):ti,ab,kw' OR 'head and neck tumor'/exp OR ''oral cavity' or pharyn* or laryn* or lip* near/3 neoplasm* or cancer* or tumor* or tumour*:ti,ab,kw')
	AND
Concept 2:	('attitude to health'/exp OR 'health belief model'/exp OR belief*:ti,ab OR perspective*:ti,ab OR perception*:ti,ab OR attitude*:ti,ab OR view*:ti,ab OR barrier*:ti,ab OR facilitator*:ti,ab)
	AND
Concept 3:	('physical activity'/exp OR 'activity, physical':ti,ab OR 'physical activity':ti,ab OR 'exercise'/exp OR 'biometric exercise':ti,ab OR 'effort':ti,ab OR 'exercise':ti,ab OR 'exercise capacity':ti,ab OR 'exercise performance':ti,ab OR 'exercise training':ti,ab OR 'exertion':ti,ab OR 'fitness training':ti,ab OR 'fitness workout':ti,ab OR 'physical conditioning, human':ti,ab OR 'physical effort':ti,ab OR 'physical exercise':ti,ab OR 'physical exertion':ti,ab OR 'physical work-out':ti,ab OR 'physical workout':ti,ab OR 'sedentary lifestyle'/exp OR 'sedentary behavior':ti,ab OR 'sedentary behaviour':ti,ab OR 'sedentary life style':ti,ab OR 'sedentary lifestyle':ti,ab OR 'healthy lifestyle'/exp OR 'healthy life style':ti,ab OR 'healthy lifestyle':ti,ab OR 'sport'/exp OR 'sport':ti,ab OR 'sports':ti,ab)

- Scopus

Concept 1:	(TITLE-ABS-KEY ("head and neck cancer" OR hnc OR "oral cancer" OR "oropharyngeal cancer") OR TITLE-ABS-KEY ((head OR neck OR "oral cavity" OR pharyn* OR laryn* OR lip*) W/3 (neoplasm* OR cancer* OR tumor* OR tumour*))
	AND
Concept 2:	TITLE-ABS-KEY (belief* OR perspective* OR perception* OR attitude* OR view* OR barrier* OR facilitator*)
	AND
Concept 3:	TITLE-ABS-KEY ("physical activy" OR exersice OR "physical exercise" OR "physical fitness" OR "sedentary behavior" OR "sedentary behaviour" OR "health* behavior" OR "health* behaviour" OR "healthy lifestyle" OR "healthy lifestyle" OR "behavior change" OR "behaviour change"))

- The Cochrane Library

Concept 1:	#1	MeSH descriptor: [Head and Neck Neoplasms] this term only
	#2	(head OR neck) NEAR/3 (neoplasm* OR cancer* OR tumor* OR tumour*)
	#3	("oral cavity" OR pharyn* OR laryn* OR lip*) NEAR/3 (neoplasm* OR cancer* OR tumor* OR tumour*)
	#4	#1 OR #2 OR #3
Concept 2:	#5	belie* OR perspective* OR perception* OR attitude* OR view* OR barrier* OR facilitator*
	#6	MeSH descriptor: [Health Belief Model] this term only
	#7	MeSH descriptor: [Attitude to Health] this term only
	#8	MeSH descriptor: [Health Behavior] this term only
	#9	MeSH descriptor: [Healthy Lifestyle] this term only
	#10	MeSH descriptor: [Sedentary Behavior] this term only
	#11	#5 OR #6 OR #7 OR #8 OR #9 OR #10
Concept 3:	#12	MeSH descriptor: [Exercise] this term only
	#13	"physical activity"
	#14	MeSH descriptor: [Sports] this term only
	#15	MeSH descriptor: [Physical Fitness] this term only
	#16	MeSH descriptor: [Sedentary Behavior] this term only
	#17	MeSH descriptor: [Health Behavior] this term only
	#18	MeSH descriptor: [Healthy Lifestyle] this term only
	#19	"behavior change" OR "behaviour change"
	#20	#12 OR #13 OR #14 #15 OR #16 OR #17 OR #18 OR #19
Final search:	#21	#4 AND #11 AND #20

Supplement 2: Details of included studies

Year & first author	Study participants	Study type & design	Study aim	Quantitative outcome measures (relevant for scoping review)	Main findings (relevant for scoping review)
2008 Björklund	**n= 8** persons with HNC; 1-9 months post diagnosis male: 4, (age range: 52 to 83, mean: 63.3) female: 4 (age range: 61–69, mean: 65.8)	**Qualitative** study with semi-structured interviews	To shed light on health promotion from the perspective of individuals living with head and neck cancer	xxx	Main theme was regaining control and empower oneself: by dialogue with one's inner self by contact with social network and by means of contact with the environment.
2008 Duffy	**n= 283** newly diagnosed HNC patients male : 220 (77.7%), female: 63 (22.3%), mean age: 59,4 years (SD± 11.1)	**Quantitative**, prospective, cohort study, written survey, and medical record audit	To analyse 5 health behaviours (smoking, problem drinking, nutrition, physical activity, and sleep) of HNC patients in the first year after diagnosis	- Physical Activity scale for the Elderly (PASE) - demographics - clinical measures	*Factors significantly associated with lower PA levels at baseline and 1-year:* - lower sleep scores - older age - not being married - having moderate or severe comorbidities - having cancer of the oral cavity *Factors associated with lower baseline PA scores:* - having stage III or IV cancer *Factors associated with lower 1-year PA scores:* - while having a feeding tube
2008 Rogers L.	**n= 59** HNC patients during and after treatment; mean age 58 (SD± 12.8); male: 83% female: 17%,	**Quantitative, cross-sectional** study utilizing chart review and self-administered questionnaires	To determine the most frequent and important PA barriers reported by head and neck cancer patients	- demographic and medical variables - Godin Leisure-Time Exercise Questionnaire - Social cognitive theory constructs: confidence, barrier (for coping) self-efficacy, Task self-efficacy - Perceived PA barriers, - PA enjoyment - social support - role model exposure - depression (Center for Epidemiologic Studies Depression Scale) - symptom index (FACT: functional assessment of cancer treatment questionnaire)	*The strongest correlates of PA:* - enjoyment (r_s = 0.41; p = 0.002) - symptom index (r = −0.36; p = 0.006) - alcohol use (r_s = 0.36; p = 0.007) - task self-efficacy (r_s = 0.33; p = 0.013) - perceived barriers (r = −0.27; p = 0.047) - comorbidity score (r = −0.27; p = 0.042) Enjoyment and symptom index had independent associations with PA.
2009 Rogers L.	**n= 90** HNC patients 33% <4 months since treatment, 67% >4	**Quantitative, cross-sectional** chart review and	To determine the prevalence of specific exercise counseling	- exercise counseling & program preferences, - QoL,	- lack of preference was the most frequent option for counseling source (66%), counseling delivery (47%), and exercise variability (52%)

	months since treatment male:70 (78%) female: 20 (22%); age groups: <65 n = 58 (65%), >65 n= 32(35%)	self-administered survey	and programming preferences and to determine differences in these preferences based on quality of life, symptom severity, depression, and rural residence	- symptom severity, - depression, - rural residence, - demographic, medical and lifestyle covariates, - PA (Godin leisure time activity questionnaire)	- popular specific preferences included outdoors (49%), morning (47%), and alone (5%) - significant adjusted associations occurred for patients' interest with lower functional well-being, alone with higher functional well-being, and morning with higher total quality of life and emotional, social, and functional well-being - no significant associations occurred with symptoms, depression, or rural residence
2015 Rogers L.	**n= 101** (67 returned the 2. survey= 66%) mean months since diagnosis 26.4 (SD± 43.9); mean age: 60 years (SD± 12); male: 73%	**Quantitative**, cross-sectional, self-administered survey	Determine psychometric properties of different scales and perform item reduction to shorten the scales and to examine cross-sectional and prospective associations between the tested constructs and self-reported leisure-time exercise.	- barriers self-efficacy - perceived barriers interference - outcome expectations enjoyment, and - goal setting - Godin Leisure-Time Exercise Questionnaire	reduces items for barrier interference: - lack of interest, motivation, time, enjoyment, stamina (tire easily), - weather, no equipment, facilities or space to exercise, - pain or discomfort, fatigue, dry mouth or throat - exercise is not a priority, - family or work responsibilities, reduced items for outcome expectations: - improvement of overall physical health, - improving overall health - giving a higher energy level - increasing flexibility. Barriers self-efficacy and goal setting were significantly associated with meeting recommendations at baseline.
2015 Zhao	**n= 18** (intervention: 11, controls: 7), HNC patients beginning first-line chemo-radio therapy without surgery; age 57 years (SD± 7)	**Quantitative**, pilot controlled trial	Primary aim: to assess the benefits of a resistance and walking exercise intervention on muscle strength, functional mobility, and self-reported quality of life. Secondary aim: to assess other key endpoints (e.g. self-reported and actual activity and barriers to exercise).	- muscle strength - functional mobility - QoL, - body mass index - Physical Activity scale for the Elderly (PASE) - Actigraph (objective measure for PA) - barriers to exercise (34 items) - smoking, alcohol, diet - chemotoxicity	Most barriers showed no differences in change between groups, except at 7 weeks: - "lack of interest in exercise" as a barrier tended to be unchanged in the intervention group, but was significantly more of a barrier in the controls ($p < .05$) - "exercise being classified as boring" was also more of a barrier in the controls than in the intervention group ($p < .05$).
2016 Henry	**n= 29** patients with HNC diagnosis within the past 3 years with maximum variability sampling; male: n: 23 (79%), age 65 (SD± 10)	**Qualitative**, focus group interviews	To better understand the needs and experiences of HNC patients about five health behavioural change (HBC) topics (tobacco use, alcohol	xxx	Patient engagement was the main theme: - being proactive in rehabilitation - being informed by the medical team, in an optimistic & flexible way - seeking support when needed *Primary motivators for positive health behaviours:* - return to normal life and reclaim function.

			misuse, diet, exercise, and UV protection), as well as the barriers and facilitators to change. How to best tailor the intervention to meet the needs of HNC patients in terms of timing and content to be used in counselling.		*Barriers to patient engagement:* - emotional aspects (e.g., anxiety, depression, trauma, demoralization) - symptoms (e.g., fatigue, pain) - lack of information about HBC - healthcare providers' authoritarian approach in counselling on HBC
2017 Jackson	**n= 22**, patients during or shortly after completion of radiation therapy 82% male, mean age: 58.2 years (SD±5.6)	**Mixed-method**, self-administered retrospective questionnaires and follow-up semi-structured interviews	To examine the exercise preferences and barriers of HNC survivors and explore how these factors changed with exercise exposure.	- demographics - exercise levels - QoL - depression - symptom severity - pre- and post-exercise preferences - barriers	**Quantitative results:** *after participation in exercise intervention:* - significant decrease in typical barriers including lack of interest (p = .008), exercise as a priority (p = .039) and exercise not in routine (p = .004) - number of barriers experienced was negatively correlated with age, quality of life and minutes of resistance exercise training per week - significant increases in preference for exercising at a cancer centre (p = .031) and with other cancer survivors (p = .016) **Qualitative results:** *before participation in exercise intervention:* - preference: to exercise alone - barriers: lack of motivation, enjoyment, time and feeling anxious, cancer-related factors (including fatigue, depression) *after participation in exercise intervention:* - return to usual PA routines - preference on mode of delivery: to participate in group exercise to get information (e.g., on recovery and managing side effects) and to form a social support network and to increase motivation for exercise including the social accountability to other group members - preference on location: the hospital was considered convenient during treatment, but not afterwards
2018 Buffart	**n= 416**, median time since diagnosis 54 months (IQR 33;120); mean age: 66.6 (SD± 9.4) male: 339 (82%) female: 77 (18%)	**Quantitative**, cross-sectional survey study with self- reports of PA and social-cognitive factors (merged results of 2 studies)	To identify social-cognitive correlates of PA using the theory of planned behavior (TPB) and demographic, clinical, and lifestyle-related correlates	- self-reported PA (PASE: PA scale for the elderly & IPAQ: International PA questionnaire) - demographic factors, - treatment related factors - alcohol consumption exercise history	- PA intention was significantly higher in HNC survivors with a history of exercising, who had a more positive attitude, subjective norm, and perceived behavioural control. - patients with higher PA intention, higher perceived behaviour control, a lower age, and without unintentional weight loss or comorbidities had higher PA behaviour. - the model explained 22.9% of the variance in PA intention and 16.1% of the variance in PA behaviour

2018 Midgley	**n= 437**, median time since diagnosis 43 months (IQR 30;58) median (IQR) age at survey 66 (IQR 60;73) years, male: 74% of respondents *> same sample as Rogers 2019*	**Quantitative**, postal questionnaire survey	To establish exercise preferences, barriers, and perceived benefits among HNC survivors and to investigate the level of interest in participating in an exercise program, as well as factors associated with between-subject differences in the level of interest.	- exercise preferences - perceived exercise benefits - exercise barriers - Godin leisure time exercise questionnaire - University of Washington quality of life questionnaire - interest in participating in an exercise program	- most common exercise preferences: frequency of three times per week; moderate intensity; 15–29 min per bout. - most popular exercise types: walking (68%), flexibility exercises (35%), water activities/swimming (33%), cycling (31%), and weight machines (19%). - most common preferences where to exercise: at home (55%), outdoors (46%) and health club/gym (33%). - perceived exercise benefits relating to improved physical attributes were commonly cited, whereas potential social and work-related benefits were less well- acknowledged. - most common exercise barriers: dry mouth or throat (40%), fatigue (37%), shortness of breath (30%), muscle weakness (28%) difficulty swallowing (25%), shoulder weakness and pain (24%).
2019 Rogers S.	**n= 437**, median time since diagnosis 43 months (IQR 30;58) median (IQR) age at survey 66 (IQR 60;73) years, male: 74% of respondents *> same sample as MIdgley 2018*	**Quantitative**, postal questionnaire survey	To analyse patients' responses to the activity and recreation domains of the University of Washington Quality of Life Questionnaire (UW-QoL), and to relate them to clinical characteristics, intensity of leisure-time exercise/week, perceived barriers that interfere with exercise, and feeling able to participate in an exercise programme.	- Godin leisure time exercise questionnaire - UW-QoL questionnaire - clinical characteristics	- the main influencing factors were site (oropharynx), advanced stage (stage (T3-4), loaded nodes), radiotherapy and chemotherapy, composite stage, gastrostomy tube, and coexisting conditions - low (worse) scores in the UW-QoL activity and recreation domains were associated with little time spent exercising, low-intensity exercise, more barriers to exercising, and a lack of preference. - scores for both activity and recreation were lower in those who had had radiotherapy or chemotherapy, and who currently had a feeding tube or other medical conditions
2020 Felser	**n= 12**, long time survivors, > 5 years (n:8) <5 yrs n: 4); age mean 68 (range: 52-81); female: 6, male: 6	**Quantitative**, feasibility study	To evaluate the feasibility and impact of a low- to medium-intensity exercise intervention on physical function and QoL	- feasibility outcomes: intervention completion - fatigue - active ROM - mouth opening - flexibility - fall risk (short physical performance battery) - 6 minute walk test - demographic parameters - QoL	- 10 out of 12 participants completed the intervention (83%) with an average attendance rate of 83% - participants showed significant improvements in selected physical functions (better head rotation and walking distance, Qo) - Reasons for non-participation: lack of interest and distance to training facility and others (e.g. overlap with work, care/supervision of relatives/children)
2022 Daun	**n= 20** (n= 10 surgical HNC patients; n= 10 HCPs)	**Qualitative** research, embedded in a	To understand patient and HCP perspectives on the role of	xxx	Four main themes: - assessments are acceptable and necessary

	HCP n=10 (4 male, 6 female) surgeon: 4 (40%), oncology nurse: 2 (20%), physio: 1 (10%), unit manager: 1 (10%), clinical nurse educator: 1 (10%), unit nurse/research assistant: 1 (10%)	feasibility study, semi-structured interviews	multiphasic exercise prehabilitation considering unique needs across the surgical timeline for HNC patients		- value of exercise and its importance in clinical care (perception of exercise for physical and psychosocial outcomes) - the components of an ideal multiphasic exercise prehab program (the need for individualization; considering frequency, intensity, time and type of exercise) - key factors support implementation (education for patients and HCPs, the role of HCPs, need for a culture shift in cancer care)
2022 Hanika	**n= 20**, post-treatment HNC patients male: 14 (70%) female: 6 (30%), age at interview: 45-50: n=1 (5%), 51-60: n=5 (25%), 61–70 n=7 (35%) , 71–80 n=6 (30%) 81+: n=1 (5%)	**Qualitative** study with interviews	To explore health-related behavioural changes (PA, smoking, alcohol consumption, diet) if any, adopted by HNC survivors, further identifying barriers and motivators to achieving health recommendations.	xxx	- most participants (80%) made lifestyle changes following HNC treatment. - most prevalent changes: diet and alcohol intake - motivators: reducing cancer risk and ill-health, treatment side-effects - barriers: lack of motivation, support and misinformation, treatment side-effects - knowledge of health behaviours: widespread recognition of the “5 a day” message and harm of smoking. Other public health recommendations were less well-known; most participants (98%) were unaware of current alcohol guidelines, PA was overestimated
2022 Kok	**n= 34**, HNC patients during chemo-radiotherapy; median age: 58 years (IQR 35;70) male: 27 (79.4%), female: 7 (20.6%),	**Quantitative**, feasability study	Primary aim: To assess the feasibility of a tailored exercise programme for HNC patients during chemo-radiotherapy. Secondary aim: To assess changes from pre- to post-intervention	- feasibility outcomes: adherence, recruitment, retention, compliance - Secondary: muscle strength, body composition, QoL, fatigue, 6MWT, hand grip strength, 30second chair stand test - Reasons for declined participation, reasons for drop out	- overall adherence: 54%, - recruitment rate: 36% - retention rate 65% - compliance to the supervised intervention protocol: 66% - attendance to supervised sessions declined after treatment completion - shortly after treatment a high number of sessions were missed

2022 Rogers S.	**n= 22** 25 interviews held, data of 22 interview transcripts used: male: 13 female:9; age: <50= 3, 50–64= 13, >65= 6
	
	> stratified sample of Midgley 2018/Rogers 2019
		Qualitative, semi-structured telephone interviews that took place after the postal survey*	To get additional insight into how and why HNC patients would be interested in participating in an exercise programme.	xxx	Main themes:
					- perceived benefits
					  - psychological: making you feel better;
					  - Health benefits: keeping fit
					  - social aspects
					- barriers to exercise
					  - treatment side effects
					  - lack of time
					  - other health conditions
					- advice to others:
					  - exercise should be individualized to own capabilities
					  - do what geels good
					  - exercise in social groups or have someone accompany them during exercise

2022 Sealy	**n= 9** patients before surgery with curative intent; female: 4 male: 5 median age: 65 (IQR 52;67)	**Mixed-method** study, interviews and questionnaires	to explore HNC survivors' views on PA, including their self-perceived PA level, and to compare these with objectively measured PA.	- the Exercise Self-Efficacy Scale (ESES) questionnaire - self-reported PA (part ESES) - objectively measured PA (senseWearPro3), - stage of change - exercise screening instrument - Exercise Self-Regulation Questionnaire (SRQ-E) - relative autonomy index (RAI)	**Quantitative findings:** - moderate to very high confidence in self-efficacy to exercise - low level of internalized regulation of PA - 6 out of 8 participants were considered mostly sedentary - 5 participants met the minimum of 21min of PA at 3 MET intensity - self-perceived PA level is higher than actually measured PA - only 1 participant met the recommended guideline for PA **Qualitative findings:** 5 main themes in PA perception: - barriers and problems prioritizing PA - PA is part of daily-day life - no need to increase PA (lack of intention) - PA is associated with positive feelings or effects - limited social support and persuasion
2023 Kok	**n= 14** (2 lost to follow up for post intervention interviews) male: 11 female: 3 mean age: 57 years (SD± 8.7) *> subsample of Kok 2022*	**Qualitative**, semi-structured interviews pre and post intervention of a feasability study (Kok 2022)	To gain insight into preferences and expectations of patients with HNC before and after participating in an exercise intervention during chemo-radiotherapy & to identify factors influencing adherence, retention and compliance from a patients' perspective	xxx	Five main themes: - planning and time management - treatment toxicity - motivation to exercise - exercise intervention - supervision by a physiotherapist. Barriers: - intensity of treatment schedule - treatment toxicity Facilitators: - physical and emotional benefits, - social support, - simplicity of intervention - home-based setting of intervention

2023
Ntoukas
	n= 9
	HNC patients, time since neck dissection surgery : <5 years: 3 (33%), ≥5 years: 6 (67%);
	mean age: 63 years (SD ±11),
	male :7 (78%), female: 2 (22%)
		Quantitative, single-arm feasibility study	To test the feasibility and safety of a heavy lifting strength training program and to examine the preliminary efficacy for improving muscular strength, physical functioning, and patient-reported outcomes	- Godin Leisure Time Exercise Questionnaire (GLTEQ)
				- perceived benefits, barriers, and motivation for the program
					- median attendance: 96%
					- no barriers interfered severely with training participation
					- perceived benefits included:
					  - physical fitness & muscular strength
					  - improvement of fatigue and overall QoL
					  - sense of control over their health
					- weight lifted increased for squat/leg press, bench press, deadlift
					- no adverse events were reported
					- participants were motivated to continue with the training after the study
					- motivation was high at baseline and remained high post-intervention

HCP: health care professionals; HBC: health behaviour change; HNC: head and neck cancer; IQR: interquartile range; PA: physical activity; QoL: quality of life; SD: standard deviation

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

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Factors influencing physical activity in individuals with head and neck cancer - a scoping review

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Factors influencing physical activity in individuals with head and neck cancer

- a scoping review

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Abstract

Objectives: Higher physical activity levels are associated with better quality of life in people with head and neck cancer. Despite this positive association, most individuals with these cancer types have a sedentary or low-activity lifestyle. Limited knowledge exists regarding the factors that influence physical activity in this group. Therefore, we reviewed and mapped the available literature on factors that may influence physical activity in people with head and neck cancer.

Design: We conducted a scoping review based on the framework of Arksey and O'Malley and the PRISMA guideline extension for scoping reviews.

Data Sources: CINHAL, the Cochrane Library, EMBASE, PsycINFO, MEDLINE and Scopus were searched from inception until July 2023.

Eligibility criteria: We included qualitative and quantitative studies that stated factors such as barriers, facilitators, beliefs, perceptions, and views influencing physical activity in individuals with head and neck cancer. Furthermore, views and recommendations of healthcare professionals involved in the care of people affected by head and neck cancer and researchers in this domain were eligible for data extraction.

Data extraction and synthesis: Data was extracted and synthesized by one reviewer according to the predefined items including characteristics, barriers, facilitators, beliefs, perceptions, and views of people being affected and views and recommendations of experts. Quantitative data was charted descriptively, and qualitative data was analyzed and summarized using a basic content analysis approach.

Results: Of the 1351 publications, we included 19 in our review. Publications mainly focused on barriers to physical activity, with some studies reporting facilitators and collecting data on patients' and healthcare professionals' views on physical activity. Most research teams made recommendations for promoting physical activity in people with head and neck cancer.

Characteristics associated with activity levels included age, cancer type and stage, morbidity level and attitude towards being active. Prevalent barriers consisted of health-related factors, including fatigue, pain, and nutritional issues, alongside personal and environmental impediments such as time constraints, lack of interest, or motivation. Facilitating factors for physical activity included perceived or experienced mental and

health-related benefits. Consensus among patients, healthcare professionals, and researchers highlighted the necessity for enhanced information and education, emphasizing individualized approaches to promote physical activity throughout the cancer continuum.

Conclusions: Numerous factors affect physical activity in individuals with head and neck cancer. Future research should concentrate on screening and addressing risk factors for sedentary behaviour and activity barriers and on optimal design and delivery of interventions to incorporate physical activity promotion into the care pathway.

Keywords: scoping review, head and neck cancer, physical activity, influencing factors, health promotion

Abbreviations: PA: physical activity, HNC: head and neck cancer

Strengths and limitations of this study

- this scoping review presents a comprehensive overview based on quantitative and qualitative findings
- expert knowledge was compiled by including recommendations and views from healthcare professionals and researchers
- a broad concept of different PA modalities included everyday activities, and targeted physical activity such as exercise
- no quality assessment of the included studies was performed

Background and Rationale

Head and neck cancer (HNC) ranks as the seventh most prevalent cancer type worldwide with its incidence growing [1]. The primary risk factors for head and neck cancer include persistent tobacco and alcohol consumption, as well as infection with the human papillomavirus for pharyngeal cancer [1]. Most HNCs are diagnosed in stage III or IV, prompting extensive treatments involving a combination of surgery and radiation therapy, potentially complemented by chemotherapy [2]. Individuals diagnosed with HNC face a more than twofold risk for disabilities compared to those with other cancer diagnoses [3] and exhibit higher levels of frailty [4]. HNC treatments can substantially increase morbidity due to treatment toxicity. Functional deficits related to swallowing and speaking, along with disfigurement following surgery and radiation, can significantly impact the quality of life for individuals with HNC [5,6].

Physical activity (PA) is defined as "any bodily movement produced by skeletal muscles that result in energy expenditure"[7]. Everyday PA are all activities during leisure time, at work or during transport to get from one place to another [8]. This includes walking, climbing stairs, gardening, doing household chores and many other activities during daily life. Exercise is a targeted form of PA, that is purposeful and organized, characterized by repetition and designed to enhance or preserve physical fitness and overall health [7]. A growing body of evidence demonstrates the positive effects of PA and exercise in individuals affected by cancer. Regular PA and exercise can improve many treatment side effects, enhance overall health and quality of life [9–11]. Accordingly, guidelines advise to integrate PA into the treatment and survivorship care of individuals with cancer [12–15]. Nevertheless, several factors hinder the implementation of these recommendations, including personal, social, environmental, and health-related factors. Commonly cited barriers encompass treatment side effects, time constraints, or inadequate information [16,17]. Depenbusch et. al [18] demonstrated that 30-60% of individuals diagnosed with various cancer types encounter structural barriers for PA.

Research findings indicate positive effects of PA and exercise interventions on the overall health status and quality of life among patients with HNC [19–21]. Samuel et al. [22] showed that patients with HNC undergoing chemo-radiotherapy could achieve a significant improvement of their functional capacity, their quality of life and could prevent worsening of fatigue when following an intensive structured in-patient exercise rehabilitation programme for seven weeks followed by a home-based exercise programme for four weeks. An observational longitudinal study by Huang et al. [23] showed that higher activity levels were associated with better quality of life. Nevertheless, individuals with HNC are especially susceptible to low activity levels or sedentary behaviour [24,25]. Already prior to diagnosis this group appears to have low activity levels [24]. Barriers for being physically active include physical or

psychological factors such as treatment-related side effects that interfere with PA, lack of knowledge, and poor motivation [26]. Research exploring the contextual and influencing factors of PA in patients with HNC remains limited. Recent reviews have primarily focused on identifying barriers to and facilitators for engaging in PA [26,27]. A more comprehensive understanding of this topic is essential to inform the development of programs and interventions aimed at promoting PA in individuals with HNC in the future. The research questions for our scoping review were as follows: 1. What factors are associated with PA in patients diagnosed with HNC? 2. What are known barriers to and facilitators for PA in this population? 3. What beliefs, perceptions, and views do patients diagnosed with HNC express regarding PA? 4. What views and recommendations do healthcare professionals and researchers have for promoting PA in this group?

Methods

We conducted a scoping review to address our research question by exploring the existing knowledge and prior research on factors that influence PA in patients with HNC [28]. Our methods were based on Arksey and O'Malley's framework [29], best practice guidance by Peters et al [30], and the PRISMA guideline extension for scoping reviews [31].

Search strategy and eligibility criteria: we adopted a broad search strategy for three concepts: 1. head and neck cancer; 2. influencing factors including barriers, facilitators, beliefs, perceptions, and views; 3. PA, exercise, or physical training. A medical librarian (MG) reviewed our search strategy. One researcher (MS) used the EBSCO host interface to execute the search in the CINHAL, Medline, and APA PsychINFO databases, and then searched in Embase, Scopus, and the Cochrane Library. The full search strategy is available in supplement S1. MS hand searched the reference lists of all included articles for additional relevant publications and added these for full text screening if they met inclusion criteria. To locate full-text articles for study protocols, poster abstracts, or study register entries, we conducted searches using the author's name and study title on Google Scholar or the website of the authors' affiliation. If unsuccessful, we contacted the authors. We last searched on July 5th, 2023.

Publications were eligible for inclusion if they focused on patients with HNC or incorporated a subgroup analysis specific to this population. In addition, the concept of PA had to be analysed in the publication, either including everyday PA or targeted PA such as exercise. Finally, the publication had to address influencing factors for PA. These factors included barriers, facilitators, beliefs, perceptions, or views. We excluded studies on thyroid or oesophageal cancer [1] and full texts that were not in English or German. We placed no limit on study design or publication date.

Study selection: We imported our search results into the review tool Covidence [32]. The screening of titles and abstracts was conducted independently by two reviewers (MS, NM), who screened a common set of 20 titles and 10 abstracts to align their judgments. Full-text screening was performed independently by three reviewers (MB, MS, RE), who collectively screened the first five full-text articles to calibrate inclusion decisions for the scoping review. The reviewers subsequently convened three more times to discuss and resolve any conflicts that arose during the screening process.

Data extraction and charting: MS extracted data about study characteristics such as design, study aim, and population. To address our research questions, we extracted data on influencing factors such as barriers, facilitators, beliefs, views, and perceptions regarding PA for people affected by HNC. Further we extracted views and recommendations of healthcare professionals and researchers in the field. The data was sorted by personal, social, environmental, and health-related factors and characteristics that influenced PA. For studies containing quantitative data, we charted their results descriptively. In cases involving qualitative data, we performed a basic content analysis [33] by deductively allocating concepts or characteristics into categories [34]. Healthcare professionals' or researchers' suggestions were extracted either from qualitative study results or the discussion sections of the studies.

Patient and public involvement: for the design of the scoping review no patient or public involvement was applied. This review builds the basis for a subsequent project in which people affected by HNC and their family members will be interviewed to explore how a PA promotion program should be designed to best fit their needs.

Results

Literature search results: our literature search retrieved 1351 publications. After removing duplicates, we screened 650 studies following our predefined screening protocol (Fig 1). Through the screening of references during or after the full-text review, we identified and added 18 additional studies; we contacted one research team to obtain unpublished data. We ultimately reviewed the full text of 79 studies and included 19 in our review.

(Embedded Figure 1: PRISMA flowchart on study inclusion)

Table 1: Overview of included studies

Study - Country	Aim of Study	Study Type/Design	Type of PA	Participants
Björklund 2008 [35] - SE	to explore health promotion from the perspective of individuals with HNC	semi-structured individual interviews	everyday PA	n= 8 patients, 1-9 months after diagnosis
Duffy 2008 [36] - US	to analyze 5 health behaviors (smoking, problem drinking, nutrition, physical activity, and sleep) in the first year after diagnosis.	prospective, cohort study with online survey and chart review	everyday PA	n= 253 patients, within first year of diagnosis
Rogers L. 2008 [37] - US	to determine the most frequent and important physical activity barriers reported by HNC patients	cross-sectional study with questionnaires and chart review	everyday PA	n= 58 patients, 86% on treatment, 14% off treatment
Rogers L. 2009 [38] - US	to explore exercise counseling and programming preferences	cross-sectional study with survey and chart review	everyday PA	n= 90 patients, 33% ≤ 4 months and 67% > 4 months since treatment
Rogers L. 2015 [39] - US	to determine psychometric properties of different scales (on barriers, expectations, enjoyment, goal setting) including item reduction and to explore associations between constructs and PA levels	cross-sectional study with survey	everyday PA	n= 1011 patients; mean months since HNC diagnosis: 26.4 (SD± 43.9)
Zhao 2016 [40] - US	to assess the benefits of a resistance and walking exercise intervention during and shortly after chemo-radiotherapy; and to assess self-reported and actual activity and barriers to exercise	pilot controlled trial	targeted PA	n= 20 patients; 11 intervention, 9 control,
Henry 2016 [41] - CA	to explore needs and experiences of HNC patients regarding behavioral change (tobacco use, alcohol misuse, diet, exercise, and UV protection), as well as the barriers and facilitators to change	focus group interviews	everyday PA	n= 23 patients; time since diagnosis: mean of 18.7 months (SD± 12.3)
Jackson 2017 [42] - CA	to examine the exercise preferences and barriers of HNC survivors and explore how these factors changed with exposure to an exercise intervention	mixed-method study: questionnaires and interviews	everyday PA	n= 60 patients for questionnaires, n= 22 for interviews; 27.9 (SD± 19.6) months since diagnosis,
Buffart 2018 [43] - NL	to identify social-cognitive correlates of PA using the theory of planned behavior model in addition to demographic, clinical, and lifestyle-related correlates	cross-sectional study with survey	everyday PA	n= 476 patients (combination of two studies); median time since treatment: 54 months (IQR: 33-120)
Midgley 2018 [44] - GB	to establish exercise preferences, barriers, and perceived benefits among HNC survivors and to investigate the level of interest in participating in an exercise program.	cross-sectional study with questionnaire pack	everyday PA	n= 427 patients; median time since diagnosis: 43 months (IQR:30–58)
Rogers S. 2019 [45] - GB	to relate responses to activity and recreation domains to clinical characteristics and PA intensity as well as perceived barriers and feeling able to participate in an exercise program	cross-sectional study with questionnaire pack	everyday PA	*same sample as Midgley 2018 [44]*
Felser 2020 [46] - DE	to evaluate the feasibility and impact of a low- to medium-intensity exercise intervention on physical function and quality of life	feasibility study	targeted PA	n= 17 patients; 67% more than 5 years, 33% <5 years since diagnosis
Daun 2022 [47] - CA	to understand patient and health care professional perspectives on the role of multiphasic exercise prehabilitation	semi-structured interviews	targeted PA	n= 20 interview participants, (10 patients, mean 10.5 (SD± 8.6) days to surgery & 10 HCPs)
Hanika 2022 [48] - GB	to explore health-related behavioral changes and to identify barriers and motivators to achieving health recommendations	interviews with open and closed questions	everyday PA	n= 20 patients, post- treatment
Kok 2022 [49] - NL	to assess the feasibility of a tailored exercise program for HNC patients during chemo-radiotherapy	feasibility study	targeted PA	n= 30 patients with locally advanced HNC, during treatment
Rogers S. 2022 [50] - UK	to get insight into how and why HNC patients would be interested in participating in an exercise program.	semi-structured telephone interviews	targeted PA	n= 20 patients; *subsample of Midgley 2018 [44]*
Sealy 2021 [51] - NL	to explore HNC survivors' views on PA and to analyze self-perceived PA levels compare to objectively measured PA.	mixed methods study	everyday PA	n= 9 patients before surgery with curative intent
Ntoukas 2023 [52] - CA	to test the feasibility and safety of a heavy lifting strength training program	feasibility study	targeted PA	n= 9 patients; time since surgery: <5 years: 3 (33%), ≥5 years: 6 (67%)
Kok 2024 [53] - NL	to explore preferences and expectations of an exercise intervention during chemo-radiotherapy and to identify factors influencing adherence, retention, and compliance	semi-structured interviews (pre- & post intervention)	targeted PA	n= 14 patients; *subsample of Kok 2022 [46]*

(Abbreviations: CA: Canada, DE: Germany, GB: United Kingdom, HCP: healthcare professionals, HNC: head and neck cancer, IWR: interquartile range, NL: the Netherlands, PA: physical activity, SD: standard deviation, SE: Sweden, US: the United States of America)

Characteristics of included studies: All included studies were published within the last 15 years, with nearly two-thirds (n = 12) published within the last five years. Geographically, the studies were predominantly conducted in North America and Europe, with the majority (five) conducted in the United States, followed by Canada, the United Kingdom, and the Netherlands (four each). Germany and Sweden each contributed one study. There were 11 quantitative studies [36–40,43–46,49,52], six qualitative studies [35,41,47,48,50,53], and two mixed-methods studies [42,51]. The majority (n = 13) had a cross-sectional design, reporting outcomes derived from surveys or standardized questionnaires. Some included additional data from medical chart review. Three publications were feasibility studies, and one was a controlled pilot trial. Qualitative and mixed-method studies were primarily based on individual interviews, with one exception utilizing focus group interviews [41] (see Table 1). For more details on the included studies see supplement S2.

Description of study participants: Patients before, during, and shortly after medical treatment for HNC were included [37,40,47,49,51,53], as well as individuals within the first year after treatment, or during long-term care [35,36,38,39,41–46,48,50,52]. One study [47] included healthcare professionals. The quantitative studies analysed data from 1530 participants; qualitative studies analysed data from 122 participants (Table 1).

Factors associated with physical activity: Seven publications analysed associations between a variety of factors and PA levels, interest and intention for PA [36,37,39,43–45,51]. These factors included personal and health related characteristics of the person, but also their attitude, perception, and motivation.

Personal factors associated with PA levels included age [36,43], educational level [45], marital status [36], alcohol consumption [37], having worries about harm [51], being committed to or motivated for PA [51], setting goals or perceiving barriers, enjoying PA or being self-efficient [37,39]. Health related factors included cancer stage or type, sleep quality [36], having comorbidities [36,37,43], weight loss [43] or having a feeding tube [36]. Intention and interest for PA were influenced by the persons age, health condition [44] and attitude towards PA [43,44] or exercise history[43] The type and direction of the associations are presented in table 2.

Table 2: Associations between different factors and physical activity

PA correlates	Enjoyment, task self-efficacy, perceived barriers, symptom index, alcohol use, comorbidity scores [37]
Associated with lower PA level	*Directly after diagnosis:* stage III-IV cancer, low sleep quality, older age, not being married, having comorbidities, having oral cancer [36]; *at 1-year after diagnosis:* feeding tube dependency, low sleep quality, older age, not being married, having comorbidities, having cancer of the oral cavity [36]; being worried about harm of PA. [51]

Associated with higher PA level	Younger age, no unintentional weight loss, no comorbidities [43]; having a higher education level [45]; being committed to or motivated for PA [51]; self-efficacy and goal setting [39]
Associated with higher intention for PA	Individuals with a history of exercising, people with more positive attitudes, subjective norms and perceived behaviour control and perceived PA intention [43]
Associated with interest in PA	Individuals with medical conditions impeding PA were more interested than those not stating any conditions, age > 75 years was a strong indicator for not being interested; those not interested more often stated 'lack of enjoyment', 'exercise not a priority', 'exercise is boring' and 'lack of interest' as barriers to exercise [44]

(Abbreviations: PA: physical activity)

Barriers to and facilitators for physical activity: Of the 19 studies included in this analysis, 13 reported barriers to PA [39–42,44–46,48–53], while seven reported factors that facilitate engagement in PA [35,42,44,48,50,51,53].

The prevailing barriers to PA were primarily associated with health, treatment, or environmental factors, as outlined in Table 3. Fatigue or low energy ranked highest in health-related reasons for inactivity or decisions not to exercise [42,44,45,48,50–53]. Pain, both in general [44,45,48,51,53], and specifically in the head, neck, and shoulder region [50,52], as well as eating and feeding difficulties [39,42,44,45,50,53], hindered PA. Environmental barriers to PA were primarily related to work and family responsibilities [42,46,49,50,53]. Personal barriers to PA were mainly due to lack of time [42,46,49,50,53], motivation, interest, and intention [39,42,46,51]. Some participants mentioned laziness [48,50], and some feared worsening their condition [45,48].

Factors facilitating PA included an individuals' perception and experience of the health benefits, as well as support from their social network (Table 3). The most frequently stated facilitators of PA engagement were feeling mentally and physically better [47,48,50,51,53], and experiencing or perceiving general health benefits [44,48,50,53]. PA was also enhanced by a sense of power and control and the positive feelings that resulted from PA [35,43,51,53]. Emotional and practical support from an individual's network, including partners and family members, was a major social factor that facilitated PA [35,48,51].

Patients' beliefs, views, and perceptions on physical activity: Individuals with HNC acknowledged the benefits of PA and expressed the need for more information on how to become physically active. Study participants reported that PA contributed to their well-being, both physically and mentally [47,51], providing them with a sense of personal empowerment [35]. They were motivated to increase their PA levels to improve their physical and mental health, as well as their fitness levels [48]. They suggested that they would benefit from more education and information about recovering from the side effects of cancer treatment [47].

Exercising in a group was found to have the advantage of facilitating the exchange of information and discussion about experiences [42]. Patients did not associate their health behaviour with morbidity, and felt that the information they received to change their health behaviour was too focused on prevention rather than function [41].

Participants suggested that a tailored program to promote PA should consider personal preferences, address barriers, and enhance facilitators [47]. Additionally, they highlighted that PA promotion programmes should be supervised by experts to minimize risk of injury and to enhance adherence and enjoyment [37]. Participants also emphasized that surgeons should support and encourage PA [47,50].

Healthcare professionals' and researchers' views and recommendations on physical activity in people with head and neck cancer: with the exception of three studies [39,40,52] all of the included publications stated expert views and recommendations on PA promotion. From this data five overarching themes emerged (see Table 4). They included: addressing symptoms and barriers; providing information and education; addressing behaviour, attitude, and intention; provision of support within the healthcare system and suggestions about PA intervention delivery.

Many study teams recommended regular screening and adequate addressing of physical and psychological symptoms, and patients' perceived barriers [36,37,41,44,45,48,50,51,53]. Tailored and individualised approaches were suggested to help people with a HNC diagnosis to increase their PA levels [42,44,47,49,50]. To increase the self-efficacy and competence of people with HNC, standard care should include patient education about the benefits of PA and how to overcome barriers from the time of diagnosis onwards [45,47–50].

Healthcare professionals should also be educated to increase their awareness of the benefits of PA for patients. They should take an active role in motivating and facilitating PA to enhance patients' recovery [45,47,50]. Individuals diagnosed with HNC tend to overestimate their activity level and may require special guidance and referrals to exercise specialists to help them prioritize PA and change their behaviour [48,51]. PA interventions should be integrated into the HNC care pathway as usual care [44,47,53] and should be promoted by all members of the health care team [46,47,50].

The type and mode of delivery of PA interventions or programmes should be tailored to an individual's abilities, preferences, and goals [44,47,49,50,53]. Furthermore, PA programmes should be flexible and take place at locations convenient for the patient [42,53].

Table 3: Barriers to and facilitators for physical activity in patients with head and neck cancer

	PA Barriers	f/n*	PA Facilitators	f/n*
Personal factors	**Characteristics**			
	• Older age [50]	1/22		
	Feelings/Emotions			
	• Low emotional well-being/distress [44,49,53] • lack of confidence: fear of injury and making the condition worse [45,48] • not feeling comfortable: pressured by coaching approach [53]; intimidation by group format [42]	3/485 2/457 2/74	• Feeling mentally/physically better and more normal [47,48,51,53] • positive feelings (contentment, power and control, confidence, self-esteem) [35,51,53] • enjoyment of being outdoors [48]	4/63 3/31 1/20
	Attitude			
	• Lack of time [42,46,49,50,53] • lack of motivation/ interest/enjoyment [39,42,46] • not having a preference concerning the source of counselling and exercise variability [38] • overestimation of own PA levels [48] • lack of intention, no interest or aversion towards more PA [51]	5/142 3/173 1/90 1/20 1/9	• Returning to normal life and better function as motivators [40,48]; • not feeling anxious and having experienced the benefits (after intervention) [42] • making you feel better, improved attitude [50] • using terms "movement" or "physical activity" rather than "exercise" [47] • after exercise participation decreased barrier: "lack of interest" and "exercise is boring" [40]5/3/2024 9:18:57 AM	2/31 1/60 1/22 1/20 1/11
	Behaviour			
	• laziness [48,50] • missing structure and accountability after intervention [42] • lacking prior experiences/sporty attitude, loss of self-control [53] • being sedentary, but confident to have adequate PA level [51]	2/42 1/60 1/14 1/9	• Enjoyment by social environment and accountability to instructors and group [42] • structured program [42] • prior experiences/sporty attitude [53] • most important motivator to continue exercise: beneficial, motivated, controllability [52]	1/60 1/60 1/14 1/9
	Beliefs/Expectations			
	• No need to increase PA levels, PA was considered irrelevant or pre-existing PA habits were considered sufficient. [51]	1/9	• Outcome expectations: improvement of overall physical health, giving a higher energy level, increasing flexibility, improving overall health [39]	1/101
Social factors	• Lack of company [45]	1/437	• Emotional and practical support from social network, [35,48,50,51,53] • group setting and instructors created a positive atmosphere and a possibility to exchange and discuss experiences [42,46] • social aspect of PA [48,50] • hobbies [48] • commitment to study program, [53] • personal coaching and empowerment with clear instruction, personalized intervention [53]	5/73 2/72 2/42 1/20 1/14 1/14
Environmental factors	• Work and family responsibilities [38,42,46,48,51] • distance to training facility, lack of transportation or too time consuming [45,51,53] • weather condition [38,48,51] • no or little advice on PA [44,51] • a hostile exercise environment [38,48] • financial problems/constraints [48,51] • HCPs approach and focus on prevention rather than on resuming function [44] • content of exercise program unclear [53]	5/191 3/460 3/119 2/446 2/110 2/29 1/437 1/14	• External incentive, chemo dog [53] • structure of daily life activities, home-based, simplicity of the intervention [53]	1/14 1/14
Health- or treatment related factors	• Fatigue or loss of energy [42,44,45,48,50–53] • general pain [44,45,48,51,53], or pain specified to head, neck or shoulder [50,52] • other physical complaints [42,49,50,52,53] • problems with eating/feeding [38,42,45,50,53]	8/1008 7/948 5/762 5/623	• Experienced or perceived general health benefits [44,48,50,53] • building up strength and fitness [44,48,50] • reducing risk of disease [44] • increased energy levels, less fatigue [42]	4/493 3/479 1/437 1/60

	• dry mouth or throat [38,44,45,50] • general treatment toxicity [40,42,49,53] • pre-existing health problems, comorbidities [45,50,51] • general weakness [44,48] • shoulder weakness, [44,45] • difficulties with breathing [44,45]; experience of choking feeling during exercise [50] • weight loss [53] • hospital admittance [53]	4/1105 4/119 3/468 2/457 2/874 3/500 1/14 1/14	• psychological benefits [48]	1/20

(Abbreviations: HCPs: healthcare professionals, PA: physical activity; * frequency = number of publications in which this factor is stated)

Table 4: Expert views and recommendations on physical activity in people with head and neck cancer**

Addressing symptoms and barriers:	• Address PA barriers and give patients advice on how to overcome them [44,45,48,50] • Physical [36,41,51] and psychological [53] impairments (e.g. distress, anxiety, depression) need to be adequately addressed • Symptoms or risk factors associated with low PA levels need to be covered [36,37] • If necessary rehabilitation should be recommended [36], ongoing support should be offered by specialist rehabilitation teams [48] • Referrals to specialists should be made for individuals with more needs/worries about exercise [51]
Providing information and education:	• Give education and training for HCP and patients to be aware of benefits of exercise [44,47,50] • Patient education about symptom management should be offered to enhance self-efficacy and PA [37] and access to resources relevant for recovery should be provided [47] • Focus should be put on personal goals and knowledge gaps about benefits and perceived barriers. [49] • Information on exercise should ideally be given soon after time of diagnosis [44] • Blended care or e-health apps can be helpful in providing patient-tailored information on activity level, personal goals and monitoring individual progress. [53]
Addressing behaviour, attitude, and intention:	• Health behaviour change interventions and psychological strength building should be offered to increase patient's self-efficacy and engagement [41,48] • Assistance by medical professionals or exercise specialist should be given to find a suitable type of PA [38,41] • Supporting the empowerment process is important, [43] • Some patients will need professional guidance to help prioritize PA [51] • Patient education about exercise benefits to increase confidence, competence, uptake and adherence [50] • Attention should be put on dealing with the lack of perceived ability to participate, an expert should guide them [38] • HCPs should improve awareness about actual PA levels of individuals [51] • Provide access to HCPs at treatment-end to guide lifestyle decisions [48] • Potential intention-behaviour gap needs to be considered [43] • Intention might need to be targeted; pedometers or accelerometers might improve awareness of actual PA levels [51] • The health behaviour history needs to be included in the survivorship care plan [41]
Support provided within the healthcare system:	• Exercise and PA interventions should be integrated within the oncological care pathway as usual care [44,47,53] • There should be a culture shift towards more PA; and providing necessary prescriptions [47,48] • Surgeons should advise and encourage exercise [47,50] • all members of the health care team should motivate and facilitate exercise as part of recovery [50] • Exercise specialists should be involved in the care pathway. [47] • Exercise and PA interventions should start as early as possible [53]

Suggestions about PA intervention delivery:	*Type of intervention:* • Programs and interventions should be tailored to each patients abilities and preferences [44,47,49,50] • Collaborative, flexible, culturally sensitive, and individualized approaches are needed [50] • Exercise interventions should be tailored and personalized with regard to goal-setting, training type, intensity, setting and timing and should be incorporated in ADLs [53] • A flexible training programmes should be offered with check-in policy after several missed classes at the end stage of treatment [42] • Scheduling of exercise sessions need to be flexible around treatment appointments [53] *Location:* • When it is safe: home-based moderate intensity exercise should be included [38] • Training should be at a location to the patients' convenience [53] *Supervision:* • Supervision: supervision before treatment and remote supervision for home-based training during and shortly after chemo-radiotherapy [53] • It is assumed that attendance rate and effects are lower for unsupervised training interventions [46] • Patients should be monitored before and during exercise [49] • The physiotherapist can act as an important facilitator for motivation, mental support and increasing discipline to exercise [53] *Others:* • Exercise/PA should be combined with intensive nutritional support and monitoring [49] • Resources need to be built to support exercise into cancer survivorship and a in community-based settings [47] • Need for funding for exercise programmes (outside of study context) [47]

(Abbreviations: HCPs: healthcare professionals, PA: physical activity; ** all views and recommendations are extracted from the discussion section of the publications with the exception of Daun et al 2022[47] who used interviews with HCPs)

Discussion

The objective of our scoping review was to provide an overview of the known factors that influence PA in people diagnosed with HNC, such as barriers, facilitators, beliefs, views and perceptions experienced by people being affected, as well as to compile views and recommendations from experts in the field. A variety of personal, environmental, social, and health-related factors can influence PA. Patients and experts suggest that PA should be integrated into the HNC treatment pathway. This should include providing information and education on how to manage symptoms and overcome barriers. Furthermore, PA promotion should actively support individual behaviour change, facilitating motivation and intention to increase PA levels.

Factors associated with physical activity:

This review found an association between individual characteristics and PA levels. Personal and health-related factors were specifically linked to lower PA levels. This is consistent with a previous study which reported, that lower PA levels were associated with educational level, number of comorbidities, and tumour stage among newly diagnosed HNC patients [24].

Barriers to and facilitators for physical activity:

Most of the included publications cite health- and treatment related barriers as the most important barrier to PA. When comparing cancer types, individuals with HNC seem to be the most vulnerable group for having co-morbidities that hinder PA. Gildea et al. [54] showed that two thirds of patients with HNC stated comorbidities as a barrier to PA whereas this percentage was lower for all other examined cancer types including multiple myeloma (50%), prostate cancer (25%), colorectal cancer (12%) and breast cancer (4%).The most common health-related barrier to PA in our review is fatigue. Fatigue, a prevalent issue for individuals with cancer, which can be alleviated through exercise and PA [55]. Sharp et al. [56] demonstrated that almost one-third of HNC patients experienced clinically significant fatigue symptoms during the first year after diagnosis, with the peak occurring four months after diagnosis, affecting almost 45% of patients. International guidelines [57,58] recommend counselling for PA and exercise promotion. Further investigation into the potential of enhancing PA engagement through fatigue screening during and after the treatment phase is warranted. In our review pain and eating problems are also among the most reported health-related barrier. According to a systematic review by van den Beuken et al [59], patients with HNC had a higher prevalence of pain compared to those with other cancer types. Patients with oral cancer were found to be particularly susceptible to pain, with almost 70% affected [60]. Swallowing, eating, and feeding difficulties are also highly prevalent and specific to HNC, placing a significant burden on affected individuals [61], and feeding tubes may be required [62]. This area of

concern has also been underscored in our review. The prolonged times required for eating or being fed through an enteral tube can contribute to the most common personal reason people with HNC cite for being inactive: lack of time. The shortage of time was frequently identified as a primary barrier to PA in various cancer types [27] and seems to be most prominent in the phase after treatment [54].

Support from their social network is a major factor in facilitating PA for individuals affected by HNC as seen in our result. This is in line with research on other cancer types which also describe the importance of social support and guidance as a main facilitator for PA [54,63]. Therefore, interventions promoting PA should actively involve and encourage family members or other individuals from patients' networks to support PA. Osazuwa-Peters et al. 2019 [64] demonstrated that being married reduced mortality rates for people with HNC by one third, highlighting the significant positive impact of having a partner. Given that not every person with HNC has a close network or a significant other for support, these individuals may require additional support. Family and network involvement should be subject of further research, as it has the potential to improve the situation [65].

Patients' beliefs, views, and perceptions on physical activity:

This scoping review confirms that patients diagnosed with HNC are motivated to increase their PA to enhance their physical and mental health. Our findings align with studies indicating that PA is linked to an improved health status and an improved sense of control and satisfaction for patients with HNC but also with other cancer types [17,26,27].

Our results suggest that facilitating behaviour change should be further explored and targeted in tailored interventions for individuals with HNC. Some patients with HNC may not intend to change their PA behaviour because they believe that they are sufficiently active or overestimate their personal PA levels [48,51]. Low health literacy or lack of knowledge about the effects of health behaviours may hinder PA uptake; nearly 50% of patients with HNC were found to be insufficiently health literate in the sample analysed by Clarke et al. [66], which has also been associated with being less self-efficient. Educating patients with HNC about the benefits of PA and providing access to interventions to promote self-efficacy, a precursor for behaviour change, may increase PA levels in this population [41,48].

Healthcare professionals' and researchers' views and recommendations on physical activity in people with head and neck cancer:

Tailored interventions or PA programs align with patients' needs in reducing barriers to integrate PA into their lives, as demonstrated in the results of this review. Additionally,

healthcare professionals are aware of PA benefits and the importance of screening risk factors for low PA levels during the HNC treatment pathway. However, there are currently no corresponding recommendations on how this should be implemented in clinical practise; this should be explored in more detail in the future.

The findings of this review suggest that PA should be an integral part of the treatment pathway for patients with HNC. In contrast to this recommendation, the clinical practice guideline for HNC of the National Comprehensive Cancer Network (NCCN) [67] in the United States and the ESMO guidelines of the European Society of Medical Oncology [68] have not yet incorporated this recommendation. Conversely, the American Cancer Society's HNC survivor guidelines [69] proposes PA for a later period during the cancer care continuum, asserting that primary care clinicians should recommend PA. It should be considered to actively promote PA during the treatment phase, providing clinicians with the opportunity for 'teachable moments' to assist patients with HNC in integrating PA into their daily activities [70,71].

Our review confirms that patients with HNC require customized programmes, consistent with the recommendations for PA promotion for patients affected by various cancer types [17,18,27,54]. However, it remains still unclear which intervention components are essential and when they should be delivered during the cancer journey to best address patients' needs. This scoping review affirms that healthcare professionals and researchers are convinced that more information and education on PA benefits should be provided to patients and professionals. Haussmann et al. [72] confirm that in-depth PA counselling is necessary to enhance PA levels in patients with cancer, but is rarely delivered to them.

Implications for further research: There are several topics that require further investigation to advance the implementation of physical activity promotion within the care continuum of individuals with head and neck cancer.

1. Understanding how, when, and by whom screening for relevant symptoms and barriers related to physical activity should be conducted.
2. Developing tailored information and effective education for individuals affected by HNC and for healthcare professionals involved in their care.
3. Improving understanding of the motivation for, intention to, and behaviour change towards increased physical activity in individuals with HNC.

Strengths and limitation: A strength of this scoping review lies in its extensive examination of factors influencing PA in people with HNC. By incorporating views and recommendations

from healthcare professionals and researchers, valuable expert knowledge is compiled. The review consolidate evidence on PA in patients diagnosed with HNC, affirming findings on barriers and facilitators from previous research [26,27]. Moreover, the review suggests open questions for future research to advance PA promotion in people affected by HNC.

The results of this scoping review should be interpreted cautiously because the concept of PA was defined broadly, and the context of PA was heterogeneous. The included studies investigated everyday PA, analysed exercise interventions within a study setting during treatment, or analysed PA after treatment was completed. Our goal was to compile knowledge on influencing factors and recommendations from the literature and to suggest future exploration. Owing to the heterogeneous nature of the data sources and the different sample sizes of the studies, objective quantification of the various factors was not feasible. Instead, an approximation of the importance of a particular factor was only provided by indicating the frequency of citations. Results of this review are not generalizable since no quality assessment for the included studies was executed. Quality assessment is not usually part of the methodology of a scoping review, which rather seeks to provide a comprehensive overview of the diverse existing evidence on a particular topic [29].

Conclusion

Personal, social, environmental, and health-related factors have an influence on PA in patients with HNC. These factors encompass personal characteristics like age and co-morbidities, as well as factors such as attitude, interest, and motivation. Treatment side-effects and the overall health condition of individuals place the most important barriers to PA whereas perceived benefits and support from the persons' network act as facilitators to PA. Patients with HNC express a desire for personalized information and programmes tailored to their needs. Experts suggest that support and education should be provided within the healthcare system to overcome barriers and promote PA by addressing behaviour, attitude, and intention. Further research is necessary to understand how to best encourage patients' PA participation and how and when to provide the necessary information and support to overcome potential PA barriers.

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Contributors MS planned the study with the support of MW and MB. MS carried out the literature search; MS and NM did the screening of all titles and abstracts; MS, MB and RE did the screening of full texts and the literature review, MS drafted the manuscript. RE, MB, MW assisted with data interpretation and drafting the manuscript. All authors read and approved the final manuscript.

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Competing interests None declared.

Data sharing statement Additional materials with the detailed search strategy and more detailed overview of included studies are available as supplements S1 and S2. Furter material can be provided on request.

Figures: Figure 1: PRISMA flowchart on study inclusion

Supplements:

- S1: Search strategy for all databases
- S2: Details on included studies

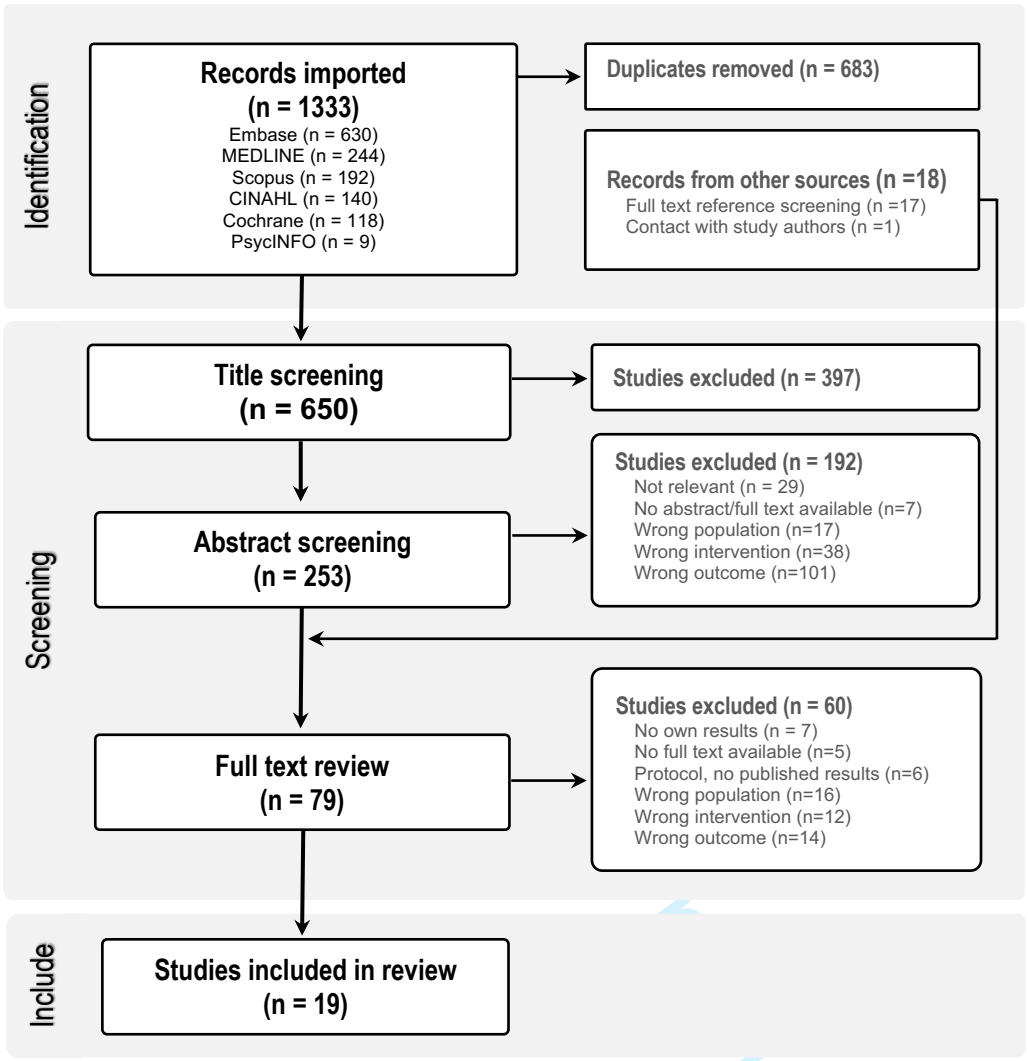
Ethical Approval Statement: not applicable

References:

1 Gormley M, Creaney G, Schache A, *et al.* Reviewing the epidemiology of head and neck cancer: definitions, trends and risk factors. *Br Dent J*. 2022;233:780–6. doi: 10.1038/s41415-022-5166-x
2 Johnson DE, Burtness B, Leemans CR, *et al.* Head and neck squamous cell carcinoma. *Nat Rev Dis Primer*. 2020;6:1–22. doi: 10.1038/s41572-020-00224-3
3 Warinner CB, Bergmark RW, Sethi R, *et al.* Cancer-Related Activity Limitations Among Head and Neck Cancer Survivors. *The Laryngoscope*. 2022;132:593–9.
4 Bras L, Driessen DAJJ, de Vries J, *et al.* Patients with head and neck cancer: Are they frailer than patients with other solid malignancies? *Eur J Cancer Care (Engl)*. 2020;29:e13170.
5 Parke SC, Langelier DM, Cheng JT, *et al.* State of Rehabilitation Research in the Head and Neck Cancer Population: Functional Impact vs. Impairment-Focused Outcomes. *Curr Oncol Rep*. 2022;24:517–32.
6 Hammermüller C, Hinz A, Dietz A, *et al.* Depression, anxiety, fatigue, and quality of life in a large sample of patients suffering from head and neck cancer in comparison with the general population. *BMC Cancer*. 2021;21:94.
7 Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep Wash DC 1974*. 1985;100:126–31.
8 World Health Organization. Physical activity. https://www.who.int/news-room/fact-sheets/detail/physical-activity (accessed 10 November 2022)
9 Cormie P, Zopf EM, Zhang X, *et al.* The Impact of Exercise on Cancer Mortality, Recurrence, and Treatment-Related Adverse Effects. *Epidemiol Rev*. 2017;39:71–92.
10 Schmitz KH, Campbell AM, Stuiver MM, *et al.* Exercise is medicine in oncology: Engaging clinicians to help patients move through cancer. *CA Cancer J Clin*. 2019;69:468–84.
11 McTiernan A, Friedenreich CM, Katzmarzyk PT, *et al.* Physical Activity in Cancer Prevention and Survival: A Systematic Review. *Med Sci Sports Exerc*. 2019;51:1252–61.
12 Campbell KL, Winters-Stone KM, Wiskemann J, *et al.* Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable. *Med Sci Sports Exerc*. 2019;51:2375–90.
13 Rock CL, Thomson CA, Sullivan KR, *et al.* American Cancer Society nutrition and physical activity guideline for cancer survivors. *CA Cancer J Clin*. 2022;72:230–62.
14 Cormie P, Atkinson M, Bucci L, *et al.* Clinical oncology society of australia position statement on exercise in cancer care. *Med J Aust*. 2018;209:184–7.
15 Hayes SC, Newton RU, Spence RR, *et al.* The Exercise and Sports Science Australia position statement: Exercise medicine in cancer management. *J Sci Med Sport*. 2019;22:1175–99.
16 Chan A, Ports K, Neo P, *et al.* Barriers and facilitators to exercise among adult cancer survivors in Singapore. *Support Care Cancer*. 2022;30:4867–78.
17 Clifford BK, Mizrahi D, Sandler CX, *et al.* Barriers and facilitators of exercise experienced by cancer survivors: a mixed methods systematic review. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2018;26:685–700.
18 Depenbusch J, Wiskemann J, Haussmann A, *et al.* Impact and Determinants of Structural Barriers on Physical Activity in People with Cancer. *Int J Behav Med*. 2022;29:308–20.
19 Bye A, Sandmael JA, Stene GB, *et al.* Exercise and Nutrition Interventions in Patients with Head and Neck Cancer during Curative Treatment: A Systematic Review and Meta-Analysis. *Nutrients*. 2020;12. doi: 10.3390/nu12113233
20 Samuel SR, Maiya AG, Fernandes DJ, *et al.* Effectiveness of exercise-based rehabilitation on functional capacity and quality of life in head and neck cancer patients receiving chemo-radiotherapy. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2019;27:3913–20.
21 Lynch PT, Horani S, Lee R, *et al.* Effectiveness of physical activity interventions in improving objective and patient-reported outcomes in head and neck cancer survivors: A systematic review. *Oral Oncol*. 2021;117:105253.
22 Samuel SR, Maiya AG, Fernandes DJ, *et al.* Effectiveness of exercise-based rehabilitation on functional capacity and quality of life in head and neck cancer patients receiving chemo-radiotherapy. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2019;27:3913–20.
23 Huang S, Zhan Y, Jeon S, *et al.* Longitudinal associations among physical activity, inflammatory markers, and quality of life in patients with head and neck cancer. *Head Neck*. 2023;45:1952–66.
24 Douma JAJ, Leeuw IMV, Leemans CR, *et al.* Demographic, clinical and lifestyle-related correlates of accelerometer assessed physical activity and fitness in newly diagnosed patients with head and neck cancer. *Acta Oncol*. 2020;59:342–50.
25 Fang Y-Y, Wang C-P, Chen Y-J, *et al.* Physical activity and fitness in survivors of head and neck cancer. *Support Care Cancer*. 2021;29:6807–17.
26 Ning Y, Wang Q, Ding Y, *et al.* Barriers and facilitators to physical activity participation in patients with head and neck cancer: a scoping review. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2022;30:4591–601.
27 Doughty HC, Hill RA, Riley A, *et al.* Barriers to and facilitators of physical activity in adults living with and beyond cancer, with special emphasis on head and neck cancer: a systematic review of qualitative and mixed methods studies. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2023;31:471.
28 Khalil H, Peters MDJ, Tricco AC, *et al.* Conducting high quality scoping reviews-challenges and solutions. *J Clin Epidemiol*. 2021;130:156–60.
29 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;19–32.
30 Peters MDJ, Godfrey C, McInerney P, *et al.* Best practice guidance and reporting items for the development of scoping review protocols. *JBI Evid Synth*. 2022;20:953–68.
31 Tricco AC, Lillie E, Zarin W, *et al.* PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;169:467–73.
32 Covidence - Better systematic review management. Covidence. https://www.covidence.org/ (accessed 24 May 2022)
33 Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs*. 2008;62:107–15.
34 Peters MDJ, Marnie C, Tricco AC, *et al.* Updated methodological guidance for the conduct of scoping reviews. *JBI Evid Implement*. 2021;19:3–10.
35 Björklund M, Sarvimäki A, Berg A. Health promotion and empowerment from the perspective of individuals living with head and neck cancer. *Eur J Oncol Nurs Off J Eur Oncol Nurs Soc*. 2008;12:26–34.
36 Duffy SA, Khan MJ, Ronis DL, *et al.* Health behaviors of head and neck cancer patients the first year after diagnosis. *Head Neck*. 2008;30:93–102.
37 Rogers LQ, Courneya KS, Robbins KT, *et al.* Physical activity correlates and barriers in head and neck cancer patients. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2008;16:19–27.

38 Rogers LQ, Malone J, Rao K, *et al.* Exercise preferences among patients with head and neck cancer: prevalence and associations with quality of life, symptom severity, depression, and rural residence. *Head Neck*. 2009;31:994–1005.
39 Rogers LQ, Fogleman A, Verhulst S, *et al.* Refining Measurement of Social Cognitive Theory Factors Associated with Exercise Adherence in Head and Neck Cancer Patients. *J Psychosoc Oncol*. 2015;33:467–87.
40 Zhao SG, Alexander NB, Djuric Z, *et al.* Maintaining physical activity during head and neck cancer treatment: Results of a pilot controlled trial. *Head Neck*. 2016;38 Suppl 1:E1086–96.
41 Henry M, Bdira A, Cherba M, *et al.* Recovering function and surviving treatments are primary motivators for health behavior change in patients with head and neck cancer: Qualitative focus group study. *Palliat Support Care*. 2016;14:364–75.
42 Jackson C, Dowd AJ, Capozzi LC, *et al.* A turning point: Head and neck cancer patients' exercise preferences and barriers before and after participation in an exercise intervention. *Eur J Cancer Care (Engl)*. 2018;27:1–13.
43 Buffart LM, de Bree R, Altena M, *et al.* Demographic, clinical, lifestyle-related, and social-cognitive correlates of physical activity in head and neck cancer survivors. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2018;26:1447–56.
44 Midgley AW, Lowe D, Levy AR, *et al.* Exercise program design considerations for head and neck cancer survivors. *Eur Arch Oto-Rhino-Laryngol Off J Eur Fed Oto-Rhino-Laryngol Soc EUFOS Affil Ger Soc Oto-Rhino-Laryngol - Head Neck Surg*. 2018;275:169–79.
45 Rogers SN, Travers A, Lowe D, *et al.* Importance of activity and recreation for the quality of life of patients treated for cancer of the head and neck. *Br J Oral Maxillofac Surg*. 2019;57:125–34.
46 Felser S, Behrens M, Liese J, *et al.* Feasibility and Effects of a Supervised Exercise Program Suitable for Independent Training at Home on Physical Function and Quality of Life in Head and Neck Cancer Patients: A Pilot Study. *Integr Cancer Ther*. 2020;19:1534735420918935.
47 Daun JT, Twomey R, Dort JC, *et al.* A Qualitative Study of Patient and Healthcare Provider Perspectives on Building Multiphasic Exercise Prehabilitation into the Surgical Care Pathway for Head and Neck Cancer. *Curr Oncol Tor Ont*. 2022;29:5942–54.
48 Hanika C, Porter N, Blick K, *et al.* Lifestyle choices following head and neck cancer treatment: A qualitative study. *Nutr Health*. 2022;2601060221106624.
49 Kok A, Passchier E, May AM, *et al.* Feasibility of a supervised and home-based tailored exercise intervention in head and neck cancer patients during chemoradiotherapy. *Eur J Cancer Care (Engl)*. 2022;31:e13662.
50 Rogers SN, Lowe D, Midgley AW. Patients' views of physical activity whilst living with and beyond head and neck cancer. *Int J Oral Maxillofac Surg*. 2022;51:323–31.
51 Sealy MJ, Stuiver MM, Midtgaard J, *et al.* Perception and Performance of Physical Activity Behavior after Head and Neck Cancer Treatment: Exploration and Integration of Qualitative and Quantitative Findings. *Int J Environ Res Public Health*. 2021;19. doi: 10.3390/ijerph19010287
52 Ntoukas SM, McNeely ML, Seikaly H, *et al.* Feasibility and safety of Heavy Lifting Strength Training in Head and Neck Cancer survivors post-surgical neck dissection (the LIFTING trial). *Support Care Cancer*. 2023;31. doi: 10.1007/s00520-023-07815-2
53 Kok A, Passchier E, May AM, *et al.* Expectations and experiences of participating in a supervised and home-based physical exercise intervention in patients with head and neck cancer during chemoradiotherapy: a qualitative study. *Submitt Publ*. 2023.
54 Gildea GC, Spence RR, Jones TL, *et al.* Barriers, facilitators, perceptions and preferences influencing physical activity participation, and the similarities and differences between cancer types and treatment stages - A systematic rapid review. *Prev Med Rep*. 2023;34:102255.
55 Cramp F, Byron-Daniel J. Exercise for the management of cancer-related fatigue in adults. *Cochrane Database Syst Rev*. Published Online First: 2012. doi: 10.1002/14651858.CD006145.pub3
56 Sharp L, Watson L-J, Lu L, *et al.* Cancer-Related Fatigue in Head and Neck Cancer Survivors: Longitudinal Findings from the Head and Neck 5000 Prospective Clinical Cohort. *Cancers*. 2023;15:4864.
57 Fabi A, Bhargava R, Fatigoni S, *et al.* Cancer-related fatigue: ESMO Clinical Practice Guidelines for diagnosis and treatment†. *Ann Oncol*. 2020;31:713–23.
58 National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology - Cancer-Related Fatigue. 2023. https://www.nccn.org/professionals/physician_gls/pdf/fatigue.pdf (accessed 22 November 2023)
59 van den Beuken-van Everdingen MHJ, de Rijke JM, Kessels AG, *et al.* Prevalence of pain in patients with cancer: a systematic review of the past 40 years. *Ann Oncol*. 2007;18:1437–49.
60 Khawaja SN, Jamshed A, Hussain RT. Prevalence of pain in oral cancer: A retrospective study. *Oral Dis*. 2021;27:1806–12.
61 Ringash J, Bernstein LJ, Devins G, *et al.* Head and Neck Cancer Survivorship: Learning the Needs, Meeting the Needs. *Semin Radiat Oncol*. 2018;28:64–74.
62 Vermaire J, Raaijmakers C, Monninkhof E, *et al.* The course of swallowing problems in the first 2 years after diagnosis of head and neck cancer. *Support Care Cancer*. Published Online First: 30 August 2022. doi: 10.1007/s00520-022-07322-w
63 Elshahat S, Treanor C, Donnelly M. Factors influencing physical activity participation among people living with or beyond cancer: a systematic scoping review. *Int J Behav Nutr Phys Act*. 2021;18:50.
64 Osazuwa-Peters N, Christopher KM, Cass LM, *et al.* What's Love Got to do with it? Marital status and survival of head and neck cancer. *Eur J Cancer Care (Engl)*. 2019;28:e13022.
65 Zeng Q, Ling D, Chen W, *et al.* Family Caregivers' Experiences of Caring for Patients With Head and Neck Cancer. *Cancer Nurs*. 2023;46:E41–61.
66 Clarke N, Dunne S, Coffey L, *et al.* Health literacy impacts self-management, quality of life and fear of recurrence in head and neck cancer survivors. *J Cancer Surviv*. 2021;15:855–65.
67 Pfister DG, Spencer S, Adelstein D, *et al.* Head and Neck Cancers, Version 2.2020, NCCN Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw*. 2020;18:873–98.
68 ESMO. Clinical Practice Guidelines-Squamous Cell Carcinoma of the Head and Neck. 2020. https://www.esmo.org/guidelines/guidelines-by-topic/head-and-neck-cancers/squamous-cell-carcinoma-of-the-head-and-neck (accessed 22 November 2023)
69 Cohen EEW, LaMonte SJ, Erb NL, *et al.* American Cancer Society Head and Neck Cancer Survivorship Care Guideline. *CA Cancer J Clin*. 2016;66:203–39.
70 Karvinen K, Bruner B, Truant T. The Teachable Moment After Cancer Diagnosis: Perceptions From Oncology Nurses. *Oncol Nurs Forum*. 2015;42:602–9.

71 Bluethmann SM, Basen-Engquist K, Vernon SW, *et al.* Grasping the 'teachable moment': time since diagnosis, symptom burden and health behaviors in breast, colorectal and prostate cancer survivors. *Psychooncology*. 2015;24:1250–7.
72 Haussmann A, Ungar N, Tsiouris A, *et al.* Physical activity counseling to cancer patients: How are patients addressed and who benefits most? *Patient Educ Couns*. 2021;S0738-3991(21)00284-6.



Supplement S1: Search strategies for all included databases

The overall search concepts:

Concept 1:	**Concept 2:**	**Concept 3:**
head and neck cancer	influencing factors	physical activity

- Medline, APA PsycINFO, CINHAL via EBSCOhost

Concept 1:	TI ((head OR neck) N3 (neoplasm* OR cancer* OR tumo#r*)) OR AB ((head OR neck) N3 (neoplasm* OR cancer* OR tumo#r*)) OR TI ((oral cavity OR pharyn* OR laryn* OR lip*) N3 (neoplasm* OR cancer* OR tumo#r*)) OR AB ((oral cavity OR pharyn* OR laryn* OR lip*) N3 (neoplasm* OR cancer* OR tumo#r*)) OR "head and neck cancer" or "oral cancer" or "oropharyngeal cancer" or hnc
	AND
Concept 2:	(DE "Sedentary Behavior") OR (DE "Health Behavior") OR (DE "Health Belief Model") OR view* or belief* or perspective* or attitude* OR facilitator* OR barrier*
	AND
Concept 3:	(DE "Physical Activity") OR (DE "Physical Fitness") OR (DE "Athletic Training") OR (DE "Exercise") OR "physical activity" or exercise or fitness or "physical exercise"

- Embase

Concept 1:	(('((head or neck) near/3 (neoplasm* or cancer or tumor* or tumour*)):ti,ab,kw' OR 'head and neck tumor'/exp OR '`oral cavity` or pharyn* or laryn* or lip* near/3 neoplasm* or cancer* or tumor* or tumour*:ti,ab,kw')
	AND
Concept 2:	('attitude to health'/exp OR 'health belief model'/exp OR belief*:ti,ab OR perspective*:ti,ab OR perception*:ti,ab OR attitude*:ti,ab OR view*:ti,ab OR barrier*:ti,ab OR facilitator*:ti,ab)
	AND
Concept 3:	('physical activity'/exp OR 'activity, physical':ti,ab OR 'physical activity':ti,ab OR 'exercise'/exp OR 'biometric exercise':ti,ab OR 'effort':ti,ab OR 'exercise':ti,ab OR 'exercise capacity':ti,ab OR 'exercise performance':ti,ab OR 'exercise training':ti,ab OR 'exertion':ti,ab OR 'fitness training':ti,ab OR 'fitness workout':ti,ab OR 'physical conditioning, human':ti,ab OR 'physical effort':ti,ab OR 'physical exercise':ti,ab OR 'physical exertion':ti,ab OR 'physical work-out':ti,ab OR 'physical workout':ti,ab OR 'sedentary lifestyle'/exp OR 'sedentary behavior':ti,ab OR 'sedentary behaviour':ti,ab OR 'sedentary life style':ti,ab OR 'sedentary lifestyle':ti,ab OR 'healthy lifestyle'/exp OR 'healthy life style':ti,ab OR 'healthy lifestyle':ti,ab OR 'sport'/exp OR 'sport':ti,ab OR 'sports':ti,ab)

- Scopus

Concept 1:	(TITLE-ABS-KEY ("head and neck cancer" OR hnc OR "oral cancer" OR "oropharyngeal cancer") OR TITLE-ABS-KEY ((head OR neck OR "oral cavity" OR pharyn* OR laryn* OR lip*) W/3 (neoplasm* OR cancer* OR tumor* OR tumour*))
	AND
Concept 2:	TITLE-ABS-KEY (belief* OR perspective* OR perception* OR attitude* OR view* OR barrier* OR facilitator*)
	AND
Concept 3:	TITLE-ABS-KEY ("physical activy" OR exersice OR "physical exercise" OR "physical fitness" OR "sedentary behavior" OR "sedentary behaviour" OR "health* behavior" OR "health* behaviour" OR "healthy lifestyle" OR "healthy lifestyle" OR "behavior change" OR "behaviour change"))

- The Cochrane Library

Concept 1:	#1	MeSH descriptor: [Head and Neck Neoplasms] this term only
	#2	(head OR neck) NEAR/3 (neoplasm* OR cancer* OR tumor* OR tumour*)
	#3	("oral cavity" OR pharyn* OR laryn* OR lip*) NEAR/3 (neoplasm* OR cancer* OR tumor* OR tumour*)
	#4	#1 OR #2 OR #3
Concept 2:	#5	belie* OR perspective* OR perception* OR attitude* OR view* OR barrier* OR facilitator*
	#6	MeSH descriptor: [Health Belief Model] this term only
	#7	MeSH descriptor: [Attitude to Health] this term only
	#8	MeSH descriptor: [Health Behavior] this term only
	#9	MeSH descriptor: [Healthy Lifestyle] this term only
	#10	MeSH descriptor: [Sedentary Behavior] this term only
	#11	#5 OR #6 OR #7 OR #8 OR #9 OR #10
Concept 3:	#12	MeSH descriptor: [Exercise] this term only
	#13	"physical activity"
	#14	MeSH descriptor: [Sports] this term only
	#15	MeSH descriptor: [Physical Fitness] this term only
	#16	MeSH descriptor: [Sedentary Behavior] this term only
	#17	MeSH descriptor: [Health Behavior] this term only
	#18	MeSH descriptor: [Healthy Lifestyle] this term only
	#19	"behavior change" OR "behaviour change"
	#20	#12 OR #13 OR #14 #15 OR #16 OR #17 OR #18 OR #19
Final search:	#21	#4 AND #11 AND #20

Supplement 2: Details of included studies

Year & first author	Study participants	Study type & design	Study aim	Quantitative outcome measures (relevant for scoping review)	Main findings (relevant for scoping review)
2008 Björklund	**n= 8** persons with HNC; 1-9 months post diagnosis male: 4, (age range: 52 to 83, mean: 63.3) female: 4 (age range: 61–69, mean: 65.8)	**Qualitative** study with semi-structured interviews	To shed light on health promotion from the perspective of individuals living with head and neck cancer	xxx	Main theme was regaining control and empower oneself: by dialogue with one's inner self by contact with social network and by means of contact with the environment.
2008 Duffy	**n= 283** newly diagnosed HNC patients male : 220 (77.7%), female: 63 (22.3%), mean age: 59,4 years (SD± 11.1)	**Quantitative**, prospective, cohort study, written survey, and medical record audit	To analyse 5 health behaviours (smoking, problem drinking, nutrition, physical activity, and sleep) of HNC patients in the first year after diagnosis	- Physical Activity scale for the Elderly (PASE) - demographics - clinical measures	*Factors significantly associated with lower PA levels at baseline and 1-year:* - lower sleep score - older age - not being married - having moderate or severe comorbidities - having cancer of the oral cavity *Factors associated with lower baseline PA scores:* - having stage III or IV cancer *Factors associated with lower 1-year PA scores:* - while having a feeding tube
2008 Rogers L.	**n= 59** HNC patients during and after treatment; mean age 58 (SD± 12.8); male: 83% female: 17%,	**Quantitative, cross-sectional** study utilizing chart review and self-administered questionnaires	To determine the most frequent and important PA barriers reported by head and neck cancer patients	- demographic and medical variables - Godin Leisure-Time Exercise Questionnaire - Social cognitive theory constructs: confidence, barrier (for coping) self-efficacy, Task self-efficacy - Perceived PA barriers, - PA enjoyment - social support - role model exposure - depression (Center for Epidemiologic Studies Depression Scale) - symptom index (FACT: functional assessment of cancer treatment questionnaire)	*The strongest correlates of PA:* - enjoyment (r_s = 0.41; p = 0.002) - symptom index (r = −0.36; p = 0.006) - alcohol use (r_s = 0.36; p = 0.007) - task self-efficacy (r_s = 0.33; p = 0.013) - perceived barriers (r = −0.27; p = 0.047) - comorbidity score (r = −0.27; p = 0.042) Enjoyment and symptom index had independent associations with PA.
2009 Rogers L.	**n= 90** HNC patients 33% <4 months since treatment, 67% >4	**Quantitative, cross-sectional** chart review and	To determine the prevalence of specific exercise counseling	- exercise counseling & program preferences, - QoL,	- lack of preference was the most frequent option for counseling source (66%), counseling delivery (47%), and exercise variability (52%)

	months since treatment male:70 (78%) female: 20 (22%); age groups: <65 n = 58 (65%), >65 n= 32(35%)	self-administered survey	and programming preferences and to determine differences in these preferences based on quality of life, symptom severity, depression, and rural residence	- symptom severity, - depression, - rural residence, - demographic, medical and lifestyle covariates, - PA (Godin leisure time activity questionnaire)	- popular specific preferences included outdoors (49%), morning (47%), and alone (5%) - significant adjusted associations occurred for patients' interest with lower functional well-being, alone with higher functional well-being, and morning with higher total quality of life and emotional, social, and functional well-being - no significant associations occurred with symptoms, depression, or rural residence
2015 Rogers L.	**n= 101** (67 returned the 2. survey= 66%) mean months since diagnosis 26.4 (SD± 43.9); mean age: 60 years (SD± 12); male: 73%	**Quantitative**, cross-sectional, self-administered survey	Determine psychometric properties of different scales and perform item reduction to shorten the scales and to examine cross-sectional and prospective associations between the tested constructs and self-reported leisure-time exercise.	- barriers self-efficacy - perceived barriers interference - outcome expectations enjoyment, and - goal setting - Godin Leisure-Time Exercise Questionnaire	reduces items for barrier interference: - lack of interest, motivation, time, enjoyment, stamina (tire easily), - weather, no equipment, facilities or space to exercise, - pain or discomfort, fatigue, dry mouth or throat - exercise is not a priority, - family or work responsibilities, reduced items for outcome expectations: - improvement of overall physical health, - improving overall health - giving a higher energy level - increasing flexibility. Barriers self-efficacy and goal setting were significantly associated with meeting recommendations at baseline.
2015 Zhao	**n= 18** (intervention: 11, controls: 7), HNC patients beginning first-line chemo-radio therapy without surgery; age 57 years (SD± 7)	**Quantitative**, pilot controlled trial	Primary aim: to assess the benefits of a resistance and walking exercise intervention on muscle strength, functional mobility, and self-reported quality of life. Secondary aim: to assess other key endpoints (e.g. self-reported and actual activity and barriers to exercise).	- muscle strength - functional mobility - QoL, - body mass index - Physical Activity scale for the Elderly (PASE) - Actigraph (objective measure for PA) - barriers to exercise (34 items) - smoking, alcohol, diet - chemotoxicity	Most barriers showed no differences in change between groups, except at 7 weeks: - "lack of interest in exercise" as a barrier tended to be unchanged in the intervention group but was significantly more of a barrier in the controls ($p < .05$) - "exercise being classified as boring" was also more of a barrier in the controls than in the intervention group ($p < .05$).
2016 Henry	**n= 29** patients with HNC diagnosis within the past 3 years with maximum variability sampling; male: n: 23 (79%), age 65 (SD± 10)	**Qualitative**, focus group interviews	To better understand the needs and experiences of HNC patients about five health behavioural change (HBC) topics (tobacco use, alcohol	xxx	Patient engagement was the main theme: - being proactive in rehabilitation - being informed by the medical team, in an optimistic & flexible way - seeking support when needed *Primary motivators for positive health behaviours:* - return to normal life and reclaim function.

			misuse, diet, exercise, and UV protection), as well as the barriers and facilitators to change. How to best tailor the intervention to meet the needs of HNC patients in terms of timing and content to be used in counselling.		*Barriers to patient engagement:* - emotional aspects (e.g., anxiety, depression, trauma, demoralisation) - symptoms (e.g., fatigue, pain) - lack of information about HBC - healthcare providers' authoritarian approach in counselling on HBC
2017 Jackson	**n= 22**, patients during or shortly after completion of radiation therapy 82% male, mean age: 58.2 years (SD±5.6)	**Mixed-method**, self-administered retrospective questionnaires and follow-up semi-structured interviews	To examine the exercise preferences and barriers of HNC survivors and explore how these factors changed with exercise exposure.	- demographics - exercise levels - QoL - depression - symptom severity - pre- and post-exercise preferences - barriers	**Quantitative results:** *after participation in exercise intervention:* - significant decrease in typical barriers including lack of interest (p = .008), exercise not a priority (p = .039) and exercise not in routine (p = .004) - number of barriers experienced was negatively correlated with age, quality of life and minutes of resistance exercise training per week - significant increases in preference for exercising at a cancer centre (p = .031) and with other cancer survivors (p = .016) **Qualitative results:** *before participation in exercise intervention:* - preference: to exercise alone - barriers: lack of motivation, enjoyment, time and feeling anxious, cancer-related factors (including fatigue, depression) *after participation in exercise intervention:* - return to usual PA routines - preference on mode of delivery: to participate in group exercise to get information (e.g., on recovery and managing side effects) and to form a social support network and to increase motivation for exercise including the social accountability to other group members - preference on location: the hospital was considered convenient during treatment, but not afterwards
2018 Buffart	**n= 416**, median time since diagnosis 54 months (IQR 33;120); mean age: 66.6 (SD± 9.4) male: 339 (82%) female: 77 (18%)	**Quantitative**, cross-sectional survey study with self- reports of PA and social-cognitive factors (merged results of 2 studies)	To identify social-cognitive correlates of PA using the theory of planned behavior (TPB) and demographic, clinical, and lifestyle-related correlates	- self-reported PA (PASE: PA scale for the elderly & IPAQ: International PA questionnaire) - demographic factors, - treatment related factors - alcohol consumption exercise history	- PA intention was significantly higher in HNC survivors with a history of exercising, who had a more positive attitude, subjective norm, and perceived behavioural control. - patients with higher PA intention, higher perceived behaviour control, a lower age, and without unintentional weight loss or comorbidities had higher PA behaviour. - the model explained 22.9% of the variance in PA intention and 16.1% of the variance in PA behaviour

2018 Midgley	**n= 437**, median time since diagnosis 43 months (IQR 30;58) median (IQR) age at survey 66 (IQR 60;73) years, male: 74% of respondents *> same sample as Rogers 2019*	**Quantitative**, postal questionnaire survey	To establish exercise preferences, barriers, and perceived benefits among HNC survivors and to investigate the level of interest in participating in an exercise program, as well as factors associated with between-subject differences in the level of interest.	- exercise preferences - perceived exercise benefits - exercise barriers - Godin leisure time exercise questionnaire - University of Washington quality of life questionnaire - interest in participating in an exercise program	- most common exercise preferences: frequency of three times per week; moderate intensity; 15–29 min per bout. - most popular exercise types: walking (68%), flexibility exercises (35%), water activities/swimming (33%), cycling (31%), and weight machines (19%). - most common preferences where to exercise: at home (55%), outdoors (46%) and health club/gym (33%). - perceived exercise benefits relating to improved physical attributes were commonly cited, whereas potential social and work-related benefits were less well- acknowledged. - most common exercise barriers: dry mouth or throat (40%), fatigue (37%), shortness of breath (30%), muscle weakness (28%) difficulty swallowing (25%), shoulder weakness and pain (24%).
2019 Rogers S.	**n= 437**, median time since diagnosis 43 months (IQR 30;58) median (IQR) age at survey 66 (IQR 60;73) years, male: 74% of respondents *> same sample as MIdgley 2018*	**Quantitative**, postal questionnaire survey	To analyse patients' responses to the activity and recreation domains of the University of Washington Quality of Life Questionnaire (UW-QoL), and to relate them to clinical characteristics, intensity of leisure-time exercise/week, perceived barriers that interfere with exercise, and feeling able to participate in an exercise programme.	- Godin leisure time exercise questionnaire - UW-QoL questionnaire - clinical characteristics	- the main impacting factors were site (oropharynx), advanced stage (stage (T3-4), N2-3 (loaded nodes), radiotherapy and chemotherapy, composite flap, gastrostomy tube, and coexisting conditions - low (worse) scores in the UW-QoL activity and recreation domains were associated with little time spent exercising, low-intensity exercise, more barriers to exercising, and a lack of preference. - scores for both activity and recreation were lower in those who had had radiotherapy or chemotherapy, and who currently had a feeding tube or other medical conditions
2020 Felser	**n= 12**, long time survivors, > 5 years (n:8) <5 yrs n: 4); age mean 68 (range: 52-81); female: 6, male: 6	**Quantitative**, feasibility study	To evaluate the feasibility and impact of a low- to medium-intensity exercise intervention on physical function and QoL	- feasibility outcomes: intervention completion - fatigue - active ROM - mouth opening - flexibility - fall risk (short physical performance battery) - 6 minute walk test - demographic parameters - QoL	- 10 out of 12 participants completed the intervention (83%) with an average attendance rate of 83% - participants showed significant improvements in selected physical functions (better head rotation and walking distance, Qo) - Reasons for non-participation: lack of interest and distance to training facility and others (e.g. overlap with work, care/supervision of relatives/children)
2022 Daun	**n= 20** (n= 10 surgical HNC patients; n= 10 HCPs)	**Qualitative** research, embedded in a	To understand patient and HCP perspectives on the role of	xxx	Four main themes: - assessments are acceptable and necessary

	HCP n=10 (4 male, 6 female) surgeon: 4 (40%), oncology nurse: 2 (20%), physio: 1 (10%), unit manager: 1 (10%), clinical nurse educator: 1 (10%), unit nurse/research assistant: 1 (10%)	feasibility study, semi-structured interviews	multiphasic exercise prehabilitation considering unique needs across the surgical timeline for HNC patients		- value of exercise and its importance in clinical care (perception of exercise for physical and psychosocial outcomes) - the components of an ideal multiphasic exercise prehab program (the need for individualization; considering frequency, intensity, time and type of exercise) - key factors support implementation (education for patients and HCPs, the role of HCP's, need for a culture shift in cancer care)
2022 Hanika	**n= 20**, post-treatment HNC patients male: 14 (70%) female: 6 (30%), age at interview: 45-50: n=1 (5%), 51-60: n=5 (25%), 61–70 n=7 (35%) , 71–80 n=6 (30%) 81+: n=1 (5%)	**Qualitative** study with interviews	To explore health-related behavioural changes (PA, smoking, alcohol consumption, diet) if any, adopted by HNC survivors, further identifying barriers and motivators to achieving health recommendations.	xxx	- most participants (80%) made lifestyle changes following HNC treatment. - most prevalent changes: diet and alcohol intake - motivators: feeling cancer risk and ill-health, treatment side-effects - barriers: lack of motivation, support and misinformation, treatment side-effects - knowledge of health behaviours: widespread recognition of the "5 a day" message and harm of smoking. Other public health recommendations were less well-known; most participants (98%) were unaware of current alcohol guidelines, PA was overestimated
2022 Kok	**n= 34**, HNC patients during chemo-radiotherapy; median age: 58 years (IQR 35;70) male: 27 (79.4%), female: 7 (20.6%),	**Quantitative**, feasability study	Primary aim: To assess the feasibility of a tailored exercise programme for HNC patients during chemo-radiotherapy. Secondary aim: To assess changes from pre- to post-intervention	- feasibility outcomes: adherence, recruitment, retention, compliance - Secondary: muscle strength, body composition, QoL, fatigue, 6MWT, hand grip strength, 30second chair stand test - Reasons for declined participation, reasons for drop out	- overall adherence: 54%, - recruitment rate: 36% - retention rate 65% - compliance to the supervised intervention protocol: 66% - attendance to supervised sessions declined after treatment completion - shortly after treatment a high number of sessions were missed

2022 Rogers S.	**n= 22**
	25 interviews held, data of 22 interview transcripts used: male: 13 female:9; age: <50= 3, 50–64= 13, >65= 6
	
	> stratified sample of Midgley 2018/Rogers 2019
		Qualitative, semi-structured telephone interviews that took place after the postal survey*	To get additional insight into how and why HNC patients would be interested in participating in an exercise programme.	xxx	Main themes:
					- perceived benefits:
					  - psychological: making you feel better;
					  - Health benefits: keeping fit
					  - social aspects
					- barriers to exercise:
					  - treatment side effects
					  - lack of time
					  - other health conditions
					- advice to others:
					  - exercise should be individualized to own capabilities
					  - do what geels good
					  - exercise in social groups or have someone accompany them during exercise

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2022 Sealy	**n= 9** patients before surgery with curative intent; female: 4 male: 5 median age: 65 (IQR 52;67)	**Mixed-method** study, interviews and questionnaires	to explore HNC survivors' views on PA, including their self-perceived PA level, and to compare these with objectively measured PA.	- the Exercise Self-Efficacy Scale (ESES) questionnaire - self-reported PA (part ESES) - objectively measured PA (senseWearPro3), - stage of change - exercise screening instrument - Exercise Self-Regulation Questionnaire (SRQ-E) - relative autonomy index (RAI)	**Quantitative findings:** - moderate to very high confidence in self-efficacy to exercise - low level of internalized regulation of PA - 6 out of 8 participants were considered mostly sedentary - 5 participants met the minimum of 21min of PA at 3 MET intensity - self-perceived PA level is higher than actually measured PA - only 1 participant met the recommended guideline for PA **Qualitative findings:** 5 main themes of PA perception: - barriers and problems prioritizing PA - PA is part of day-to-day life - no need to increase PA (lack of intention) - PA is associated with positive feelings or effects - limited social support and persuasion

2023
Ntoukas
	n= 9
	HNC patients, time since neck dissection surgery : <5 years: 3 (33%), ≥5 years: 6 (67%);
	mean age: 63 years (SD ±11),
	male :7 (78%),
	female: 2 (22%)
		Quantitative, single-arm feasibility study	To test the feasibility and safety of a heavy lifting strength training program and to examine the preliminary efficacy for improving muscular strength, physical functioning, and patient-reported outcomes	- Godin Leisure Time Exercise Questionnaire (GLTEQ)
				- perceived benefits, barriers, and motivation for the program
					- median attendance: 96%
					- no barriers interfered severely with training participation
					- perceived benefits included:
					  - physical fitness & muscular strength
					  - improvement of fatigue and overall QoL
					  - sense of control over their health
					- weight lifted increased for squat/leg press, bench press, deadlift
					- no adverse events were reported
					- participants were motivated to continue with the training after the study
					- motivation was high at baseline and remained high post-intervention

2024 Kok	**n= 14** (2 lost to follow up for post intervention interviews) male: 11 female: 3 mean age: 57 years (SD± 8.7) *> subsample of Kok 2022*	**Qualitative**, semi-structured interviews pre and post intervention of a feasability study (Kok 2022)	To gain insight into preferences and expectations of patients with HNC before and after participating in an exercise intervention during chemo-radiotherapy & to identify factors influencing adherence, retention and compliance from a patients' perspective	- xxx	Five main themes: - planning and time management - treatment toxicity - motivation to exercise - exercise intervention - supervision by a physiotherapist. Barriers: - intensity of treatment schedule - treatment toxicity Facilitators: - physical and emotional benefits, - social support, - simplicity of intervention - home-based setting of intervention

HCP: health care professionals; HBC: health behaviour change; HNC: head and neck cancer; IQR: interquartile range; PA: physical activity; QoL: quality of life; SD: standard deviation

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.